METHODOLOGICAL, THEORETICAL AND APPLIED ADVANCES IN BEHAVIOURAL SPILLOVER

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EDITORIAL
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Editorial: Methodological, Theoretical and Applied Advances in Behavioral Spillover

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Editorial on the Research Topic

Methodological, Theoretical and Applied Advances in Behavioral Spillover

BACKGROUND

Psychology and allied disciplines (e.g., behavioral economics, marketing, and management) have established a range of techniques for understanding and changing behavior. Historically, the interventions derived from these techniques have largely focused on individual behaviors, rarely considering dynamic relationships between behaviors (i.e., whether the performance of a target behavior influences non-target[1] behaviors). And yet work on response generalization (e.g., Ludwig, 2002), rebound effects (e.g., Greening et al., 2000), and moral licensing (e.g., Blanken et al., 2015) (to name but a few), has all variously described how changes in one behavior *can* have "knock-on" consequences for other actions.

Understanding secondary behavioral processes—including behavioral "spillover" effects—is a scientific and societal imperative. Scientifically, behavioral models and theories are improved by considering behavior beyond the narrow focus of a single action, offering a more comprehensive view of behavior change. Societally, interventions to address urgent problems, such as climate change or obesity, may be more effective and efficient if they are designed to change a suite of behaviors, rather than a single action.

The aim of this special issue is to unite contemporary psychological (and allied) research on the issue of behavioral spillover, to improve conceptual coherence in the field, and to advance knowledge in this area. In doing so, we hope to build upon the extant literature (for reviews see, Truelove et al., 2014; Dolan and Galizzi, 2015; Nash et al., 2017; Nilsson et al., 2017) to provide fresh insight into the underlying psychological mechanisms of the phenomenon, to explore cross-cultural similarities, and elucidate the principles underpinning effective intervention design.

This special issue comprises 14 conceptual, review, and empirical articles investigating a breadth of behavioral spillover research, both within behavioral domains and across socio-spatial, behavioral, and temporal contexts. The articles draw upon qualitative and quantitative methods to explore diverse theoretical and empirical aspects of spillover, including its measurement, the

[1]This could be the target behavior but in a non-targeted context, or non-targeted behaviors in the same or different contexts (e.g., Nilsson et al., 2017).

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conditions under which it does and does not occur, and examples of where and when it can "backfire" (e.g., where "spillunder" might occur, Krpan et al.).

While this special issue does provide some conceptual depth and clarity to our understandings of spillover (e.g., its relationships with self-identity, Verfuerth et al.); and does advance the state-of-the-art regarding its measurement (Galizzi and Whitmarsh), it also raises many questions. A running theme in the studies is the unpredictable nature of spillover, unpredictability which serves to highlight important avenues for future research. As editors of this special issue we hope that the articles contained within may act as a source of "academic spillover;" informing the development of this field, such that the potential of spillover in responding to both scientific and social imperatives can be realized.

SUMMARY OF THE ARTICLES

This special issue comprises 14 articles, written by 40 authors spread across 11 countries and 4 continents. This section synthesizes and summarizes the focus and key findings of each article.

Three papers focus principally on the development of theory relating to spillover. Drawing on various psychological and economic theories (e.g., executive functioning, moral licensing and emotion regulation), Krpan et al. build a novel conceptual model of "spillunder" effects—where a person's intentions to act in accordance with a target intervention in the future (e.g., to exercise more) lead to performance of unintended actions in the present (e.g., overconsumption of food). Drawing upon attitude theory, Brügger and Höchli investigate the role that attitude strength plays in moderating the likelihood of spillover: requiring participants to think about past environmental or health behaviors before an opportunity to carry out successive goal-consistent actions, they find only limited evidence of spillover but some evidence for the anticipated moderation effect. Verfuerth et al. build and test a novel conceptual model of contextual spillover based upon Breakwell's Identity Process Theory (e.g., Jaspal and Breakwell, 2014): using the principles of identity integration, compartmentalization and conflict, they explore the mechanisms underpinning positive and negative contextual spillover, detail a real-world workplace intervention (centered upon dietary-choice), and reflect upon the theoretical and applied relevance of the findings derived from an affiliated qualitative interview-based study (incorporating a new visualization task).

Two papers focus on methodological contributions to the assessment of spillover. In a cross-cultural study comprising large samples from seven countries (Brazil, China, Denmark, India, Poland, South Africa, and the UK), Capstick et al. investigate individuals' beliefs about spillover processes, and assess the psychometric and cross-cultural properties of a new measure of behavioral spillover and its relation to subjective beliefs. Galizzi and Whitmarsh critically review experimental and non-experimental methods used to measure behavioral spillover and propose a systematic checklist designed to help researchers and policy-makers to rigorously and transparently test for behavioral spillover effects.

Several papers apply quantitative methods to understanding various forms of spillover. In order to learn more about the factors underpinning behavioral inconsistency in inter-context environmental action, Whitmarsh et al. use the Theory of Planned Behavior (Ajzen, 1991) as a framework for predicting waste-related behaviors at home, at work and on holiday: using a mixed-methods design, they reveal new insight into the strength and nature of inter-relationships between recycling and other waste-reduction behaviors within and between contexts. Fanghella et al. experimentally investigate the interaction between priming environmental self-identity and environmental action in the context of two commonly-used policy tools designed to change behavior (i.e., provision of social information and encouraging goal commitment): they urge caution when seeking to leverage environmental and other self-identities to promote behavior change and provide advice for those pursuing this strategy. Drawing upon principles of nudging (e.g., Thaler and Sunstein, 2003), Ghesla et al. note that research has yet to rigorously investigate whether nudges exert an impact upon non-target behaviors: focusing on pro-social behavior and the use of choice defaults, their experiment finds no evidence that negative spillover results from choice default nudging, and little evidence of positive spillover. In four lab experiments focused on environmental behaviors, Van der Werff and Steg explore the implications of pro-environmental vs. pro-economic messaging in yielding positive spillover: they find some evidence that environmental framing strengthens environmental identity and fosters spillover, while economic messaging weakens environmental identity and inhibits spillover.

Three papers employ longitudinal designs to assess the effects of behavior change campaigns. Thomas et al. use mixed methods to investigate behavioral and attitudinal responses to the introduction of a plastic bag charge in England: their results point to the broad, positive impact that the charge had on bag-use among the public, and evidence "policy spillover" in the form of enhanced support for policies to reduce plastic waste. Elf et al. identify the importance of social support for spillover and examine the emergence of spillover effects in response to an intervention led by a commercial partner, finding evidence of significant and sustained behavior and identity change and some evidence of spillover from an experimentally delivered intervention. Höchli et al. use an experimental field study to test the hypothesis that subordinate goals generated by short-term behavior change interventions are a potential source of negative spillover: examining a 2-month cycle-to-work campaign, they report upon some evidence of positive spillover and find no evidence of subordinate goals triggering negative spillover nor of their goal-level manipulation affecting the maintenance of post-intervention cycling behavior.

Finally, two papers apply qualitative approaches to provide a more in-depth exploration of the roots of behavioral spillover. Nash et al. explore subjective self-reflections of pro-environmental behavioral spillover in Brazil, China, and Denmark and discuss the prevalence and nature of within- and between-domain spillover effects via semi-structured

interviews within a culturally-diverse sample: their findings not only point to commonalities in environmental spillover across countries, but also highlight the rarity of between-domain spillover and the link between pre-existing environmental values and the chance of "conscious" spillover occurring. Employing a series of life-history interviews with oil company workers, Uzzell and Räthzel, explore the processes by which practices are "carried over" between contexts: drawing on theories such as border crossing (Clark, 2000), they elucidate how myriad dispositional and situational influences govern and shape the transfer of environmental practices between places or contexts (in this case work and home).

AUTHOR CONTRIBUTIONS

All authors contributed to the writing of this editorial.

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Border Crossing and the Logics of Space: A Case Study in Pro-Environmental Practices

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We investigate whether and how workers in a transnational oil corporation carry practices, meanings, and identities between the places of work and home, focusing on environmental and health and safety practices, in order to understand the larger question, how can environmentally relevant practices be generalized in society at large? Our theoretical starting point is that societal institutions function according to different logics (Thornton et al., 2012) and the borders (Clark, 2000) between these institutions create affordances and constraints on the transfer of practices between these places. By connecting their theoretical ideas, we suggest that these provide an alternative critique and explanatory account of the transfer of environmental practices between home and work than a "spillover" approach. We employ life history interviews to explore the development and complexity of the causes, justifications, and legitimations of people's actions, social relationships, and the structural constraints which govern relationships between these spaces. While Clark's concepts of permeable, strong, or blended borders are useful heuristic tools, people may simultaneously strengthen, transgress, or blend the borders between work and home in terms of practices, meanings, identities, or institutional logics. Individuals have to be understood as creators of the border crossing process, which is why their life histories and the ways in which their identities and their attachments to places (i.e., institutions) are shaped by the logics of these places are important. For environmental practices to travel from work to home, they need to become embedded in a company culture that allows their integration into workers' identities.

Keywords: border crossing, spillover, environmental practices, health and safety, institutional logics, home and work, life histories, behavior change

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INTRODUCTION

Our interest in the ways in which individuals might take practices, identities, and meanings from one place to another is rooted in our concern for environmental change, which requires a transformation of the way we produce and consume. Thus, whether and how people might take practices from sites of production (work) to sites of consumption (home) is crucial for understanding how such a transformation might occur. This research might seem to fall under the heading of spillover, but most studies of spillover focus on transfer across domains [e.g., waste behaviors and energy conservation (Thøgersen and Ölander, 2003; Poortinga et al., 2013; Thomas et al., 2016]. Our focus is on place and the conditions for transfer may be very different. "Spillover,"

"catalyst," or "wedge" approaches are methodologically empathetic with neoliberal government market-led strategies (Defra, 2008) which require neither legislative levers nor structural transformation that challenge consumer sovereignty, and rely on individuals' own preferences and decisions in the context of influencing "choice architectures" (Thaler and Sunstein, 2008), social marketing (McKenzie-Mohr, 2000; Cialdini, 2003), or encouraging particular environmental identities (Stryker and Burke, 2000; Nigbur et al., 2010; Whitmarsh and O'Neill, 2010).

There is little doubt that environmental psychologists have been at the forefront of research seeking to understand the drivers and constraints on individuals' environmental behaviors, drawing particularly on theories from social psychology, e.g., attitudes, social norms, and behavior change (Clayton et al., 2015). But in recent years, it has been recognized that a more particular contribution that environmental psychology might make is to draw on research which has focused on the importance of place in people's lives through concepts such as place identity and place attachment, and explore how these are functional for people's environmental behaviors and practices (Uzzell et al., 2002; Clayton et al., 2016). Building upon this development, we sought to find an alternative approach to "spillover" that provides a more nuanced understanding of the transfer of meanings and practices across different places, and moves away from the kind of individualistic approaches described above. We thus posed the question, under what conditions are environmentally significant practices carried from home to the workplace and *vice versa*?

In order to answer our question, we recognized the need for a concept of place which incorporates the specificities of home and work. The first author is an environmental psychologist whose work over many years has explored how people develop place attachments and place identities and how such responses may be functional for pro-environmental behavior and the support of environmental practices. The second author comes from sociology where the interest is on the societal structure of a place: what is the societal goal of place, what are the societal rules governing the actions at this place, and how do these shape the ways in which people act and think about places? To bring together the approach of environmental psychology and sociology, we draw on two theoretical approaches to make sense of our material: Clark's (2000) theory of border crossing, which centers on individuals as conscious actors, and the theory of institutional logics (Friedland and Alford, 1991; Thornton et al., 2012) which analyses the societal structures of places. In this theoretical framework, the places of home and work are institutions, socially created places, with specific societal goals and specific rules and regulations (logics) governing what kind of practices can (and must) take place there and which ones are "out of place," need to be avoided. In the following, we will use the terms "place" and "institution" interchangeably.

The paper is organized as follows: first, we elaborate on our usage of Clark's border crossing and the institutional logic perspective; second, we describe our methodological approach. The third part comprises the analyses of our material: a diachronic, in-depth analysis of two case studies which exemplify the multidimensional and contradictory relationships our protagonists developed between home and work against the background of their life-histories, and a synchronic analysis which offers an investigation of the breadth of border crossing practices. Fourth, we conclude with a suggestion to combine border crossing with the institutional logic perspective, creating a perspective that includes process (border crossing), structure (institutional logics), and the individual as the actor.

THEORETICAL FRAMEWORK

The transfer of environmental practices between work and home has typically been examined through the concept of spillover, but this has been shown to have many shortcomings and mixed results (Grzywacz and Marks, 2000; Thøgersen and Crompton, 2009; Austin et al., 2011; Littleford et al., 2014; Truelove et al., 2014). One particular failing is the lack of the concept of actors, of individuals having emotions, making sense of their worlds and deciding to take practices from one space to another. These problems have been compounded by the use of measures of statistical association, and inadequate theoretical attention being paid to *how* it works when it does (Thøgersen and Crompton, 2009; Austin et al., 2011). Clark's (2000) concept of "border crossing" overcomes this shortcoming by formulating questions from the point of view of the individuals: "People are border-crossers who make daily transitions between two worlds – the world of work and the world of family. People shape these worlds, mold the borders between them, and determine the border-crosser's relationship to that world and its members. Though people shape their environments, they are, in turn, shaped by them" (ibid.: p. 748). Clark was concerned with issues of work–home balance, but we felt that the concept of border crossing had wider utility and might be used to explain how individuals take practices from work to home and *vice versa*. In this paper, we focus principally on three key characteristics of Clark's borders – permeability, blending, and strength. Permeability is the perviousness of a space and the degree to which practices and behaviors from one place/institution are able to enter another. Strength is the degree of resistance as one moves from one place to another. Spatial and temporal blending occurs when there is a high level of border permeability creating a "no-man's land," which is neither exclusively home nor work, for example, a "spare" bedroom converted into an office or when a dining room table is used in the evening for office work that has been brought home.

The origins of border crossing theory lie partly in the work of Kurt Lewin (Lewin and Cartwright, 1952) and his concept of "life space." Lewin believed a life space includes attitudes, memories, and motivations which are set within environmental and situational contexts or "regions" that have borders which are subject to different degrees of permeability. For Lewin (1948), the boundaries between life space regions have two important qualities, sharpness and rigidity. Clark (2000) took this idea and its later formulations and suggested there are four elements to the theory, (a) two spaces, in this case work and home, (b) the borders between the two, (c) the agent, i.e., the border-crosser, and (d) the border-keepers and other domain managers. She

explained the differences between home and work as follows: "Differences between work and home can be classified in two different ways: differences in valued ends and differences in valued means (. . .)" (ibid.: p. 753). Clark found that work is predominantly valued because it provides an income and gives "a sense of accomplishment", while home life satisfied the ends of attaining close relationships and personal happiness" (ibid.) What is lacking in this explanation is a sense of the affordances and constraints of the two places which could explain why people give different values to different places, for instance, by analyzing them as societal institutions. What is needed is a language that enables us to understand the institutional structures and settings in which individuals operate, and within which people value different places differently.

The theories of "institutional logics" provide such a language. Its first promoters were Friedland and Alford (1991), who drew on Mary Douglas's anthropological insights (Logue et al., 2016) as a means of examining the interrelationships between individuals, organizations, and society, in particular the idea that everyday practices are place-related such that actions are made meaningful in the context of social relations within different institutionalized structures. They contended that, ". . . institutions shape individual preferences and organizational interests as well as the repertoire of behaviors by which they may attain them. These institutions are potentially contradictory and hence make multiple logics available to individuals and organizations" (ibid.: p. 232). In their book on the "Institutional Logic Perspective," Thornton et al. (2012) developed the theory further and created an authoritative framework for research on the "culture, structure, and process of institutions." The theory aims to understand institutional logics from within their respective practices relating them to societal logics at large only in as far as they can be observed at specific conjunctures. One of their examples is the effect of the changing power of market logics on companies (ibid.: p. 77). While we find the idea of institutional logics useful we would like to suggest a different way of creating institutional categories. For instance, Thornton et al. describe some family logics with the same concepts used for the functioning of companies: "increasing," "capitalism," "status." (ibid.: p. 73). In our view, it is possible to differentiate between more or less powerful logics which may lead to the infiltration of dominant logics from one institution setting to another (a capitalist logic entering the family logic). However, such processes cannot be analyzed critically if their results are already taken for granted by the usage of the same categorical logics for different institutions. Therefore, we suggest to define the logics of an institution according to the role(s) it plays for the reproduction of society. These would be defined as the essential logics, while contingent logics would be those which help to realize this role but would differ according to place and political conjunctures.

The role of production consists in producing the means for life, while the role of families consists in producing life itself. These general and basic definitions offer a starting point from which to formulate the essential logics of an institution. More concretely, in capitalist market societies corporations need to produce a product that appears useful to their customers and that creates a profit to satisfy shareholders. The logic of profit and the logic of use-value are thus the essential logics of corporations. For families to fulfill their role of creating the next generation and providing a space where people can regenerate to continue to work productively the logic of care is essential. Interestingly, the logic of care does not figure at all in the definition of the institutional system that Thornton et al. (2012, p. 73) provide. Essential logics are those which an institution cannot disregard without endangering its existence, while contingent logics change according to place and time and can be realized or not.

Given the different logics under which life in the workplace and in the place of home are lived, it makes sense to talk about the transfer of behaviors and practices between work and home in terms of border-crossing. Actions that are functional in the workplace can be dysfunctional at home and *vice versa*. For example, most parents would not want to put their child to bed evaluating the process in terms of "time/effort input and output." If they have to, due to conflicting needs, they may feel guilty. This is not to say that the institutions of families and companies cannot share certain logics. We can find the contingent logic of care in a company devoted to environmental protection and the contingent logic of cost efficiency in families needing to make ends meet. Some workplaces are designed for the home/work border to become fuzzy (Enigma, 2016), e.g., break-out spaces where the provision of armchairs and coffee tables may encourage a relaxed environment, implying that work and life are indistinguishable (Michel, 2011). However, this serves to stress the difference between the two institutions, since the aim is to make employees feel more "at home" assuming this will make them feel happier and thus work better.

In addition to combining the theoretical approaches of border crossing and institutional logics, we decided that life-history interviews would be the most appropriate method to answer our questions (Denzin and Lincoln, 2003; Daiute and Lightfoot, 2004; Portelli, 2015). They capture the complexity of the family/work institutional context over time. Life-histories allowed us to explore the processes and conditions under which people engage in, or refrain from carrying practices across work-home borders. They help us to understand the contradictory attitudes that people can hold in the pursuit of socially desirable goals, as well as the causes, justifications and legitimations for their practices.

To summarize, if we are to understand more fully the processes which govern the transfer of actions across the work/home border, there are at least three issues which need to be addressed. First, we need a framework that articulates the transfer process, which we find in combining Clark's theory of border crossing and a revised version of the institutional logics perspective. Second, there is a need to understand the interactions between and the complexity of the psychological processes, social relationships, attachments, and identities which are shaped by structural constraints and affordances. This requires us to put the individual at the center of the process. Third, in order to do this, we need to use a methodology that captures the developmental dynamics of changed practices and their transference across institutional spaces, which we find in using life-history interviews.

CROSSING BORDERS: CONTEXT AND METHODS OF INVESTIGATION

The research reported here was part of a larger international study which examined the lifestyles, working practices, and home/work spaces of workers in seven countries and a variety of workplaces. This case study analyses the life of on- and offshore oil workers and managers in a major transnational corporation, GlobalOil[1] operating in the North Sea. The separation of home and work is more extreme in the oil industry than in many others and therefore it highlights some of the consequences of the growing economic and lifestyle trends of hypermobility that lead to physiological, psychological, emotional, and social costs (Cohen and Gössling, 2015). GlobalOil was interested in the research as they had put into place the environmental program "Sustainable HomeWorks" (name changed) to encourage employees to engage in environmentally sustainable behaviors in the office and at home.

Our interviews were introduced by an explanation of the project followed by the request for individuals to tell us their life history. We only asked questions for clarification related to what interviewees told us, because we wanted them to determine the content of their life-stories. If issues we were interested in were not mentioned we asked about them at the end of the interview. Some interviews (with senior managers at GlobalOil headquarters) were semi-structured informative interviews, focusing on the problems and possibilities of implementing environmental practices in the company. Our contract with GlobalOil required that the interviewees (except for HQ managers) were selected by the HR Manager of GlobalOil; the reason given was that it was necessary for logistical reasons (e.g., availability when flying out to oil platforms). Unavoidably, this gave HR some degree of control over selection. In addition, we used a snowballing method to recruit more oil workers employed by other companies but working under similar conditions. Interviews were conducted onshore either before or after deployment to a platform. On acceptance, all interviewees were provided with an information sheet explaining the purpose, procedure, and ethical aspects of the project and a consent form to confirm their willingness to participate. Twenty-five interviews were conducted between February and June 2012 in London and Aberdeen lasting between 1 and 2½ h, resulting in + 60 h of interviews (**Table 1**). In Aberdeen, 11 off-shore workers (one female) and seven on-shore staff (two female) holding management positions were interviewed. In London, four senior staff were interviewed (one female)[2]. All interviews were recorded and professionally transcribed. We consulted published GlobalOil reports on their environmental record, as well as documents of regulatory government bodies, in order to understand the company's public representation of their environmental practices. The research received a favorable ethical opinion by the University of Surrey Ethics Committee[3].

TABLE 1 | GlobalOil interviewees.

Scott Adams	Offshore technician; later onshore office	M	GlobalOil	Aberdeen and North Sea
Kia Alani	Offshore and onshore engineer	F	GlobalOil	Aberdeen and North Sea
Robin Banks	Offshore operator	M	GlobalOil	North Sea
Tony Sarkus	Wiring technician (offshore)	M	GlobalOil subcontractor	Aberdeen and North Sea
Will Brennan	Diver (offshore)	M	GlobalOil subcontractor	North Sea
Kevin Dale	Offshore operator	M	GlobalOil subcontractor	North Sea
Conor Davies	Mechanical engineer	M	GlobalOil subcontractor	Aberdeen and North Sea
Paul Evans	Mechanical engineer	M	GlobalOil	Aberdeen and North Sea
Andy Harper	Offshore operations supervisor	M	GlobalOil	North Sea
Gary Holmes	Trade union official	M	Oil Industry Trade Union	Aberdeen
Buck Jones	Project manager	M	GlobalOil	Aberdeen and North Sea
Frank McKeen	Operations supervisor	M	GlobalOil	North Sea
Rona Mills	Finance manager	F	GlobalOil	Aberdeen
Steve Morris	Technician	M	GlobalOil subcontractor	North Sea
Anne Pedersen	Senior manager	F	GlobalOil	Aberdeen
Jim Roberts	Senior manager	M	GlobalOil	London
Brian Smith	Senior manager	M	GlobalOil	London
Nick Stevens	Operations manager	M	GlobalOil	Aberdeen
Emily Stevenson	Senior manager	F	GlobalOil	London
Matt Thompson	Environmental manager	M	GlobalOil	Aberdeen and North Sea
Luc Vermeeren	Project manager	M	GlobalOil	Aberdeen
Mike Wellwood	HR manager	M	GlobalOil	Aberdeen
Chris Williams	Environmental manager	M	GlobalOil	Aberdeen
Philip Woods	Senior manager	M	GlobalOil	London
Dave Wright	Offshore installation manager	M	GlobalOil	North Sea

[1]We have changed the name of the oil and gas corporation, individuals, and oil fields to ensure anonymity obligations.

[2]These numbers reflect the gendered division of work. We do not have the space to conduct a gender specific analysis of the material.

[3]All subjects gave verbal and informed consent to interview and use the interviews for our analyses. The research team followed the British Psychological Society BPS Code of Ethics and Conduct (2009) which states that "*The way in which consent is sought from people to participate in or otherwise contribute data for research should be appropriate to the research topic and design, and to the ultimate outputs and uses of the analyses. It should recognise in particular the wide variety of data types, collection and analysis methods, and the range of people's possible responses and sensitivities. The principle of proportionality should apply, such that the procedures for consent are proportional to the nature of participation and the risks involved.*" None of the interviewees were children, vulnerable adults, or adults with severe physical or mental impairments, and thus given the subject of the research it was felt that verbal consent was proportional. All interviewees volunteered to be interviewed and were informed, *inter alia*, of the following: the

The names of interviewees are pseudonyms to avoid personal identification.

Analytical Strategy

Our aim was to undertake a nuanced analysis exploring what border crossing might mean in respect of the transfer of practices, meanings, and identities from one domain to another, rather than in relation to work/family balance which was the objective of many studies which draw on the concept (Geurts and Demerouti, 2003; Shumate and Fulk, 2004). Because life history interviews covered many aspects of the individuals' formation, career development, and domestic and working lives, we approached the coding and data analysis with specific questions in mind (Braun and Clarke, 2006). We were interested in (a) the rationale and legitimations interviewees provided for their decisions, (b) the institutional logics by which they were framed, and (c) what kind of practices, meanings, and identities were taken from one domain to another. Having identified these elements, we assessed whether Clark's categories of permeability, blending, and strength provided a suitable classificatory framework for the analysis. It was not, however, a question of fitting the material into Clark's framework as a form of confirmatory analysis. Quite the opposite, we were concerned to identify under what conditions border crossing occurred, and what conditions led to its resistance where there were contradictions with or divergences from the model that border crossing and the institutional logic perspective present. This will become clear in our diachronic analysis.

Thematic analysis was considered to be the most appropriate for the identification of "repeated patterns of meaning" regarding the transfer of practices between home/work (Braun and Clarke, 2006). The transcribed interviews were imported into MAXQDA11. They were coded taking several steps: first, we coded all instances where interviewees talked about a transfer of practices, meanings, or identities from home to work or *vice versa*. Second, we coded instances where we found that similar practices, meanings, or identities reported by interviewees appeared in descriptions of their work and their home practices. Third, we used Clark's generic concepts (e.g., permeability, strong borders) to create sub-codes. While our coding sought to draw on Clark's categorical concepts, we were open to different formulations of border-crossing than discussed by Clark as will become apparent in our analysis through the coding of the semantic and latent content. Finally, we created a further sub-group of coded instances by coding who supported or resisted border crossing (i.e., the worker, members of his/her family, and friends).

By setting the interviews in their situational context, we sought to explicate and give meaning to individual, institutional, and societal drivers. Our analysis not only seeks to describe cross-border movement of practices, meanings, and identities, but also the underlying assumptions and drivers of these movements. It is necessary to look at individual motivations to explain human behavior, but in common with the position we take in much of our work on behavior change, we are concerned not to ignore the affordances, constraints, and logics of the places in which people live out their everyday lives.

Because we considered Clark's concepts to be sufficiently general to allow a diversity of theoretical explanations, our approach was essentially theoretically inductive. In the synchronic analysis, themes and sub-themes were developed by collecting accounts which were related, and these were discussed in order to confirm their validity and to ensure that their interpretation was convincing and defensible. It was an important part of the analytical strategy that we were sensitive to themes which were identified inductively.

Life on an oil platform with its hostile working environment and crowded living conditions bears little comparison with the working experiences of most people. Thus, it might be thought of as an inappropriate case study for understanding the "everyday" experiences of workers and their relationships with their workplace, family and wider society. However, oil workers' lifestyles bring into sharp relief many of the issues affecting home/work relations and the barriers to change which exist in other contexts as well. As Flyvbjerg has argued, "extreme cases reveal(s) more information because they activate more actors and more basic mechanisms in the situation studied. In addition, from both an understanding oriented and an action-oriented perspective, it is often more important to clarify the deeper causes behind a given problem and its consequences than to describe the symptoms of the problem and how frequently they occur" (Flyvbjerg, 2006, p. 229). Because most workers live in a societal and family context (Morrice et al., 1985; Sutherland and Flin, 1989), these contrasting structures will always create different values and issues. A workplace is not only a place of work but also a place where social relations, friendships, and enmities are created. How this happens becomes more visible when the workplace becomes a "home from home" for a longer period of time as in the case of workers on an oil platform.

Qualitative data are sometimes criticized for not permitting generalizability. But as Tsang (2014) and Eisenhardt and Graebner (2007) have found, case studies are increasingly used for theory development, not only because they are sensitive to context and the conditions under which phenomena may occur (perhaps in one setting but not another as is the case in this study) but also because they "allow researchers to tease out ever-deepening layers of reality in the search for mechanisms and influential contingencies" (Tsang, 2014), and to gain insight into the factors linking cause and effect (Gerring, 2007), which may have policy lessons for home/work relations applicable across the economy.

To examine such layers, we undertook both a diachronic and a synchronic analysis of our material. In the diachronic analysis, we focus on two off-shore workers and how living, as one worker called it, "two lives," impacts on them, their friends, families, and their environmental and safety practices. The focus on two examples aims at an in-depth analysis of the complexity and contradictions of home–work relationships and introduces the individual and their life-story as a mediator of these relationships.

aim(s) of the project; the type of data to be collected; the method of collecting data; confidentiality and anonymity of both the interviewee and the company they worked for; the right to decline to offer any particular information requested; the opportunity to withdraw from the study at any time with no adverse consequences; and how the data will be used and planned outcomes.

The synchronic analysis in turn, presents a broader variety of home–work relationships to understand which kinds of practices make their way across the borders.

DIACHRONIC ANALYSIS: THE AMBIGUITIES OF BORDER CROSSINGS AND THE POWER OF COMPANY LOGICS

For the diachronic analysis, we have chosen two individuals who are both "extreme" when compared to the majority of "normal" working conditions and "paradigmatic" (Flyvbjerg, 2006). They are paradigmatic because all offshore workers – including Kevin Dale and Andy Harper who are the key protagonists in this diachronic analysis -talked about their offshore life becoming a home from home. But they differed in terms of the ways in which the border was managed between their two homes. This was due to their different life histories and stages of life.

After a short introduction to the workers' background, we present their relationship to and identification with their company. Identification is important for the ability of individuals to manage the work–home border successfully (Clark, 2000) and to comply with the role of an institution (Thornton et al., 2012). We then analyze the ways in which our protagonists describe and define their working places and their homes, manage borders, carry practices and identities from one place to another, and relate to the logics of company and home.

Kevin Dale – Strong and Permeable Borders

Kevin Dale, an offshore subcontractor aged 23, had trained with several oil companies from the age of 16 after leaving school. Dale is single and lives on his own. He is a Process Technician and responsible for quality and environmental protection:

> *And I'm shouted to control, maintain or modify anything that's happened on the plant, to meet the standards for export so that we're keeping everybody happy. Avoiding unnecessary shutdowns where possible, unnecessary flaring where possible, or any kind of discharge to the sea where possible.*

Meeting standards for export is necessary, while avoiding actions harmful to the environment are conditioned on their possibility. Dale identifies with the environmental record of his company, describing it as "*very good*" since they have a policy of zero discharge into the sea whereas 20 years before, "*it would just be a ring of a slick every way*." When he describes his work offshore its contradictions become evident:

> *. . . my work is quite interesting. (. . .) I'm used to it now. I've done it for so long, I wouldn't really know how to do a nine-till-five office job. (. . .). But yeah, you just tend to work. Work, gym, sleep. Work, gym, sleep. And then that's you ready for home! And you try not to count down the days and, you know, count your life away a wee bit. But that tends to be what everybody does. You're looking forward to that day you're going home. Then you come home and it's the best job in the world! You think it was the worst job when you went out there; when you come home it's the best job in the world!*

The change between an intense time at work and an intense time at home creates a solid barrier between the two. Work itself is rewarding, but the employment conditions of having to work 12 h a day 2 weeks in a row on what appears like a monotonous routine makes his job appear as "the worst." The best part of the job is being able not to do it, to enjoy 3 weeks onshore without any work commitments. At the platform itself, the social relations, the familiarity with co-workers bring a comfort and a compensation for the hard work routine:

> *And I've worked with the same group of about a dozen guys now for the last couple of years, so we're very friendly. (. . .) we're all very close and we get on well together. (. . .) it's nice to go out there and know what you're getting, knowing the people, having your own same cabin. (. . .)You know the gym, you know what the food's like, and it's just easier. (. . .) It's like a home from home.*

It is his relations with friends, which permeate the borders between work and home:

> *And in my spare time I like to – I've got a very close, good group of friends. We like to go on weekends abroad. Quite often we – well, we go to Barcelona nearly every year. I'm going this weekend to watch the MotoGP motorbikes. And we often take trips down south . . . by plane – or by train at times.*

While it does not seem that his friends at work and his friends outside work are the same, the culture of male bonding is described similarly for both spaces. However, talking about the masculine culture at the workplace which he describes as rough, he constructs a contrast between the two domains: "*I think you tend to mould yourself into that* [masculine culture at work]*, and then you come home and you're a gentleman again for three weeks. And then you go back [laughs] to the regular way!*"

It is noteworthy that Kevin Dale sees what many would consider to be abnormal (i.e., living on an oil platform) as being "regular," while being at home requires being different – indeed he talks about it like an actor playing a role – he is "a gentleman" for 3 weeks only. Given his description of practices outside work racing and watching motorbike races, it is not easily understandable why Dale uses the term "gentleman" to portray his behavior away from the rig. But it may be that home has a symbolic function for him – it is a place where you are well behaved because this is where you meet the opposite sex and you should not behave in a "blokey" way. It is also possible that being a gentleman is associated with freedom, freedom from work:

> *A lot of the offshore guys tend to like their motorbikes because there's that freedom to go wherever they want when they're home. . . .. I'm very passionate about cars. I've had quite a few nice cars since I started working. I've also got heavily into motorbikes (. . .) with a lot of road-riding.*

On the one hand, there is a strong border between on- and off-shore, as one can read the freedom experienced with the bike as a compensation for the restriction of space and time, which rules life on the oil platform. On the other hand, there is permeability too. A masculine culture is lived in both places. While offshore and onshore life are contrasted in terms of constraining, exhausting and repetitive practices at work and the freedom to roam at home, Dale also recreates logics of home,

close friendships, and a "place of his own" at the workplace. Equally, a masculine culture of enjoying machines and dangerous practices are taken from home to work and *vice versa*. It is impossible to say, which is the source and which is the effect. Space restrictions and routine at work are not of Dale's making, but he makes the most of overcoming these conditions by fully realizing the freedom of space and time outside work. So far, the borders between work and home are simultaneously strong and permeable, but what about environmental awareness?

> *I'm very passionate about cars. So, carbon footprint-wise, I have a car, I have a van and I have a motorbike! So that's me doing my bit!*

When Dale talked about his environmental responsibilities at work, he seemed fully integrated into a logic of care for the environment. Avoiding discharges into the sea, flaring, and other environmental damages is part of his responsibilities. This stands in stark contrast to this sarcastic self-description of "doing his bit." But one could argue that while Dale does not take his environmental concerns onto the helicopter when he goes onshore, he does identify with the tacit contradictory logic which guides his company, contributing to environmental destruction while simultaneously engaging in some practices of environmental protection. His identification with the environmental values he sees GlobalOil developing works as a kind of permission to take environmentally damaging practices (creating carbon emissions) from the workplace into his places of leisure. Dale was fond of motorbikes and cars before he started work at GlobalOil. Thus his life-history shows that the dimensions of the workplace with which people identify depends also on the priorities they set in their life outside work.

Andy Harper: Dual Loyalties – One Identity

Andy Harper is an offshore supervisor in his mid 50s. He has been working at GlobalOil for over 10 years and in the oil and petrochemical industry prior to that. When we interviewed him, he was working on an assignment in Northeast England while his family home was in Scotland. He regretted the carbon footprint that his traveling between both places entailed. We do not know much about his life history because while we kept asking questions about his life, he wanted to talk predominantly about how environmental issues have accompanied him all his life, at home and at work. He talked about how his grandparents recycled everything and how his son has now come "*full circle*" growing his own vegetables and buying his clothes in second-hand shops. In this context, he explains how GlobalOil is today more environmentally aware than in the past:

> *I do see that people from the top, (. . .) seem to be doing the right thing. There's environmental focal points and environmental reps – that's their full-time job. (. . .) I personally think GlobalOil (. . .) are more environmentally friendly than some other companies.*

However, 40 min later, Harper tells a story which contradicts this judgement:

> *You walk round the office there's £100,000 cars in the carpark! (. . .) So as a boss, as a head of the company, a head of department, they will stand up in front of all the workforce and tell them, 'You must put your cup in that bin, and you must put your paper towel in that bin,' and then they walk outside and they get in a big four-by-four and they drive forty miles to home every day! So it's this thing where we all like to think that we do a little bit for the environment, but how much do we really do? Because we like our lifestyle.*

From talking about the contradictory behaviors of managers, Harper switches to seeing these as examples of general human weaknesses, ending his story with a statement about "us" and "our lifestyle." A few minutes later however, big cars are explained, not just as a human weakness but as part of the company policy:

> *I think as a company it's kind of encouraged. Because once you get to a certain level within the company, you get a company car allowance. (. . .) If somebody says to you, "You can have £500 a month allowance to spend on a car," you're not going to spend £200 a month – you're going to spend £500.*

In these stories, we can detect shifts between practices at work and practices at home. While GlobalOil has policies to reduce its environmental impact, the behavior of managers and staff outside work contradicts their environmental efforts at work. While car ownership can be defined as a practice outside work, the company crosses the borders between work and home by rewarding employment positions with the provision of company cars and car allowances. This border crossing follows the profit logic as higher positions are rewarded with higher allowances, enabling higher status at work to be reproduced at home. Thus, the company's logic of "care for the environment" (in terms of protecting the immediate environment from the damaging consequences of oil and gas extraction, as well as encouraging an environmental ethic with their "Sustainable HomeWorks" program) is contradicted by encouraging higher GHG emissions as a symbol of higher status.

Giving activity spaces the labels "home" and "work" may hide deeper and more ambivalent understandings of the meanings of these places. When Harper is asked by the interviewer how he sees the relationship between his life offshore and onshore, he answers by simultaneously describing strong and permeable borders between his "separate lives."

> *But in terms of lives, (. . .) it might sound daft, but you've got a family at home and you've got a family offshore. Because these are the people that you're living with 24 hours of the day, seven days a week, for two weeks! And you become pretty attached, quite emotional. You hear about their families. (. . .) – there's similarities, and you establish close bonds. (...) While they are totally separate lives, because what happens at work stays at work, (. . ..) I keep a lot of my emotions from work separate to emotions from home. Equally, there may be something going on in my home life and I try and keep it separate from my work life. But there's times that there is an overlap. And over the years I've got very close to maybe just twelve colleagues and their families. And we meet up every year (. . .) And it's really nice to pull it all together.*

Harper describes how, in spite of trying to keep both lives separate, practices, and meanings connected with family life at home are replicated at the workplace, while actual events together with the emotions they trigger are not transferred from one place to the other. The combination of spatial closeness,

the sharing of tasks and daily life from dawn to dusk, create more intense experiences than those normally found at work and are therefore conducive to the reproduction of domestic practices at work and *vice versa*. That both lives are not as separate as Harper describes them, becomes clear in comparison to Dale's description of "home from home." While the latter talked about male bonding, Harper emphasizes the existence of "two families." This reflects how the logics of home (in its broad sense) guide the perceptions of life at work. Other workers recounted how attempts are made to make the workplace more homely, especially at poignant moments in the year (e.g., Christmas): "*I've seen some fantastic creations. There was one year, (. . .) a fireplace appeared in the Control Room. So we had candles, carriage clock, and the flames in the grate and the stockings hanging off it – it was absolutely incredible!*" (Frank McKeen). For Robin Banks, such actions only served to highlight what they were missing: for " . . . *other guys it was just winding them up. Because like at the end of the day you're on an oilrig.*" "Home from home" in the workplace might be seen, in Clark's theory, as "blending," where an effort is made to re-create the practices usually associated with the domain of home into the living quarters of the off-shore platform. The different reactions to these practices show the ambivalence of such blending as different ways of dealing with the absence of home. Despite his best efforts to keep his worlds apart, Harper cannot shed GlobalOil's safety culture as he boards the helicopter back to the mainland:

> *. . .my family, (. . .) they have a life without me, and (. . .) a different life when I am home, because I have different standards. While it's nice to see each other, there can be a clash at times! It's "Oh, you're back again . . . We don't bother with that when you're away!" Like if I (. . .) do some gardening, I'll wear safety boots, and I'll put goggles on, and (. . .) ear-defenders. And my wife will go in the garden . . . in her stockinged feet and no gloves! And she's doing the gardening, and [I will say] "Whoa, whoa, whoa! No, no, you need to!" "Oh, I'm okay! You get back offshore!"*

Harper's actions are understandable in that he is concerned for his wife's safety. But from the point of view of his wife, she is behaving appropriately. For her, Harper's intervention constitutes what Mary Douglas refers to as a breach of the moral order as the ". . . moral component of assigning reality to different categories becomes particularly apparent when things get out of place" (Wuthnow et al., 2009, p. 87). Not only objects can be out of place but also behaviors and the logics guiding them. Given the essential logics we have laid out for corporations and families, the clash of practices here is a reversal of what we have claimed: the workplace practices signify care, while the home practices signify an ordered routine and efficiency put in place by Harper's spouse. Harper's wife does not experience his behavior as care but as an intrusion into her way of life, undermining her sense of control, her identification with her home, by rendering her practices as inferior. Harper's descriptions of work and home demonstrate loyalty to both his workplace and his home, while his identity is shaped predominantly by his long work experiences and thus tends to create tensions at home rather than at work. While in Dale's case, his shorter experiences at the workplace led him to use company logics as a legitimation to continue his environmentally damaging practices outside work, in Harper's case, his long work experience led him to identify with environmental and safety practices at work to the point that he aimed to transform his home according to the safety rules guiding his workplace.

Taking safety practices from work to home was a story told by many of our informants as well as the resistance their partners posed to such a transference. Kia Alani, an offshore worker, relates.

> *...when I first joined, I saw the strict rules about holding the handrail. You're thinking, "Holding the handrail! Do you know how many people have touched the handrail? (. . .) And then just three days ago the lady sitting next to me, said, she always tells her husband (. . .): 'Hold the handrail.' and he always laughs and says, 'Oh, please, it's a GlobalOil rule!' (. . .). And two days ago, he fell down from a flight of stairs in their house, all the way down, because he wasn't holding the handrail!."*

Kia Alani regarded this story as reflecting well on GlobalOil safety culture, as "*a lot of company policies and procedures to try and keep you safe*," even when she had had another concept of safety concerning handrails.

Nick Stevens, at the time of the interviews had worked for GlobalOil for 37 years. He identifies with the company, which comes across as he talks about the safety record of GlobalOil, "*this is not just rhetoric; this is what I believe to be true – the safety of our employees, [the] health of our employees and also on environmental issues*." In 2008, he "*. . . decided to change completely, to become . . . the Regional Discipline Advisor for Competence and also for the Skill Pool [Manager] and making sure that that was robust.*" Given this background, it is not surprising that he tended to treat the home like the oil platform – and *vice versa*: "*We had a great book [at GlobalOil], the A-Z of Safety it was called (. . .) So a bit like being offshore when I had my exercises, I used to – this is terrible, really! – I used to practise with my children, and press the alarm at maybe nine o'clock in the morning on Saturday; not too early – and they knew that they had to get up, get dressed, shout 'Fire!' and then go outside.*" Stevens was not blind to the incongruity of his actions in different settings. We can conclude that it is the "exercise" element of his practice, which in hindsight strikes him as "terrible." Logics of discipline and compliance and the logics of care crash in this translation of work into home practices.

How can we explain that specifically safety practices were transferred from work to home? Shove (2010) argues, ". . . we need to understand how institutions, infrastructures, and daily life interact" (p. 1278). One management strategy which recognizes this is the concept of organizational culture (Schein, 2010; Schneider et al., 2011). Corporate culture can be defined as a contingent logic attributed to the organization. Safety was often discussed by our interviewees not as a set of rules and regulations, but rather as a habitual cultural driver. The Deepwater Horizon disaster (in 2010) featured in the narratives of only two workers, both explaining it as the management "cutting corners" and thus distancing their own company from it. Some of the most persuasive evidence for the effectiveness

of organizational culture approaches comes from multi-national oil and gas corporations (Hudson, 2007). Building safety into everyday practices has been seen as essential to address high accident rates in an extremely hazardous working environment. To the degree that such practices become habitual, they are internalized and form part of people's identities. Mike Wellwood provided an example of the processes through which this happens: "*And people will start meetings with a safety message, which will include examples from home. And you will see sometimes articles online about safety in the home as well as the workplace. . .*" For Stevens, the benefits of this led to GlobalOil playing a critical role in social change through the encouragement of border crossing: "*GlobalOil actually contributes to social change as well. Because what people learn at work they do take home with them and become more aware*." The conflict he described when he "exercised" safety practices at home has disappeared in this statement. While practices are taken from work to home because they have become a part of people's identities, there is simultaneously the need to strengthen the borders between both places by "forgetting" the conflicts these transferences can elicit.

A psychological interpretation of the desire to adopt or maintain similar practices on either side of the work/home border might be cognitive consistency (Thøgersen, 2004). A more persuasive driver for the adoption or maintenance of consistency means that similar types of practices may be pursued or avoided in each space. While taking behaviors home may result in cognitive and emotional consistency for the person who straddles the border, it simultaneously creates cognitive and emotional dissonance for the person remaining at home, since that behavior is not part of the accepted logic and assumptive world of *their* context.

The study of our two protagonists shows that it would be short sighted to talk about individuals either drawing borders strongly or permeating them. Kevin Dale and Andy Harper did both: they emphasized the differences between home and work but at the same time described their workplaces as another home into which they invested emotional attachment, thus carrying meanings, emotions, and identities from one place to the other. In terms of carrying practices across borders, though, both men were quite different. Dale engaged in similar (male culture) and contrasting behaviors at work and at home: being responsible for environmental protection at work, he was quite conscious of the significant carbon footprint he created in his leisure time without expressing any regrets. Dale reproduced his company's double standard of environmental care and environmental destruction in his everyday life outside work subconsciously. What he took with him from work to home was not a specific practice but a tacit institutional logic.

Harper's border crossings were in line with the logic of care at the workplace: care for his family's safety when he urged his wife to wear protection gear in the garden. But these practices were seen by family members as "matter out of place," as the intrusion of a work logic into the logic of the home. The institutional logic of care for safety had become a logic according to which Harper organized his personal life, but he could not carry this logic and the respective practices into his home where his family lived according to a different logic, which required other priorities of care.

In the following sections, we shift the focus of our analysis from a diachronic analysis of individuals' home–work relationships to a synchronic analysis of border crossing practices.

SYNCHRONIC ANALYSIS: INSTANCES OF BORDER CROSSING – PERMEABILITY, STRONG BORDERS, AND BLENDING

Permeability

Paradoxically, when talking about sustainable environmental practices, the activity mentioned most frequently (as it would be by the population at large) was waste reduction, not energy conservation or carbon reduction. Robin Banks, a subcontractor whose father worked for another multinational oil corporation, was in his late 20s but had experience of working on numerous offshore platforms for a variety of companies. Separating and recycling waste is standard practice in most "good" companies which has served to reinforce the habit: "*I do a lot of recycling at home. I used to do it a bit before, but now, seeing all the segregation bins offshore, it's encouraged me to do a lot more at home as well.*"

Jim Roberts worked at HQ in London. His role had been to promote sustainability in respect of GlobalOil's real estate: "*. . .my main project has been on the carbon reduction commitment in the United States*." He was skeptical about carbon reduction actions at home. If it did occur it was in his view, "*Because we're in the CO_2 business . . .people tend to know, therefore they tend to do things just because of their knowledge.*" Frank McKean commented: "*Do I take what I do at work home with me? I think so..., even the type of car that you drive. Looking at the CO_2 emissions aspect of your car, (. . .).– (. . .). 'Oh, how much carbon is it?.*"

All the information, persuasion, and education to encourage the generalization of actions is in vain if the conditions in which people live and work do not allow them to change. Enabling actions of government in providing an infrastructure that encourages change are critical: "*I am quite frustrated with my own home life (. . .) we could waste-segregate more and we could recycle more.*" This lack of recycling, McKeen reveals, is due to the Highland Regional Council not taking a larger range of recyclables.

The Power of the Economy

Andy Harper was one of the two workers we interviewed who had made an effort to install solar panels on his house. The other was Steve Morris, Aberdeen born and bred, who had always engaged in energy-saving activities such as salvaging remnant insulation panels from his previous company and using them to insulate his ceilings and under-floor cavities. He bemoaned the reduction of the government's feed-in tariff incentive (a subsidy for domestic

renewable energy production which goes into the national grid and for which the householder is paid), and the absence of any financial support for the initial capital cost: "*If the government even gave you a grant to get it, or met you halfway or something, I'd probably jump at it.*"

Arguably, economic reasoning is as much a logic of home as it is part of the logic of profit at work. The question is one of priorities. One can imagine decisions at home, where quality or well-being take priority over economic reasoning. Thus, prioritizing saving money over environmental protection can be seen as a way in which the corporate logic of cost efficiency seeps into the home domain and prevents significant environmental practices.

At the time of this research, GlobalOil launched an "in-house" campaign "Sustainable HomeWorks" to encourage the workforce to act more environmentally sustainably including reducing their carbon emissions at work and home. There is, of course, an irony about one of the world's largest oil and gas producers and carbon emitters encouraging its staff to act more sustainably. What these practices taken from home to work show is that there is a need for "interinstitutional relationships" (Thornton et al., 2012), e.g., for a government infrastructure which allows people to transfer practices from one place to another.

Strengthening the Border: Resistance and Compensation

When asked about a poster in the offices which warned about accidents in the home, Luc Vermeeren, an Onshore Project Manager in his early 40s, said, "*I mean, you don't want the company to fully start determining your home life as well.*" One can trace Luc Vermeeren's rejection of border crossing to his experiences as a young man. From the age of 17 or 18, he was a member of *Loesje*,[4] a Dutch political organization which raises public awareness by putting up posters on issues such as the environment and racism. He took a year of unpaid leave at one point and traveled to Latin America and South-East Asia with a friend. His friend intended to go into Aid work, but Luc became frustrated by seeing how people lived, arguing that "*. . .they didn't have this drive to try to make the best out of things they could. I think we said, "Well, forget it, (..). I'll just leave it as it is, because there's no use trying to push people into a direction they don't want to be pushed.*" His resistance to the company's intervention into life at home can be regarded as a principle acquired through life experiences before he entered his present workplace. He is an example of how identities acquired outside work can constitute a resistance to the logics of the workplace.

Kia Alani, a chemical engineer in her late 20s has worked for GlobalOil both off- and onshore. Thinking back to her time offshore, Alani described the practice of recycling: "*So you have like the cans, the bottles, you have like paper. . .. . . and people are encouraged to do that as well.*" But then, guilty, she said "*Phhh! Don't know if I should be saying this, though, . . . I do, at work. But when I go home, I just put everything in one, and that's it! [laughs] Yeah, sorry, I know!*' But there are other practices, she does take home: '*...what they try and encourage us to do is switch off your monitors, (. . .). . . . which I now apply at home, be it my laptop, light bulbs in my room, (. . .) – with the TV as well. So that I do take home!*"

This sheds some light on the conditions under which people carry practices from work to home. Switching off electrical appliances carries more weight than recycling probably because it implies saving energy, and thus money. By contrast, recycling as at work is a lot of effort. It might be an act of quiet resistance or simply of compensation to "*put everything in one*."

Blending – Home as a Transitional Border

Our last example demonstrates that the relationships we are dealing with enable individuals to act as carriers of practices between institutions where these meet in the home. Frank McKeen introduced his partner to Six Sigma (Pande et al., 2000), a set of techniques developed for improving industrial processes and reducing defects. It had been adopted by GlobalOil in order to reduce waste and improve efficiencies with, he claimed, "huge effect." He took the ideas home to his partner who took them to her boss, who then applied them to his business. In the reverse direction, having learnt from his spouse about the "Kaizen" management technique (Recht and Wilderom, 1998), he realized how GlobalOil could make its waste processes more efficient: "*So they had a recycle route for high-density plastics, and I knew that on the Kittywake we were using these drums and they were just going to landfill. But here was this readymade disposable route, so we joined up that two aspects of it...*" Company-to-company border crossing is not new, but this example is significant because the transfer is mediated through domestic conversations. Frank McKeen was one of the workers who enjoyed the workplace as a "home from home." In turn, he did not shy away from converting the kitchen table into a workplace, where he and his partner assumed the role of managers thinking about how to improve their company's effectiveness, blending work and home. Workplace logics materialize at home, the kitchen table becomes a space of creative innovation where two workers internalize the essential logics of their respective employers and help their production processes.

CONCLUDING COMMENTS

In our initial research, industrial workers told us stories about how they took practices related to a "safety culture" at work home and the effect this had on their families and friends. Safety practices are more significant at work, because individuals and corporations receive more immediate feedback from health and safety incidents than from climate change (Gifford, 2011). In the case of industrial accidents, the reputational costs as well as financial penalties[5] tend to fall on the company, while climate change is still regarded as a negative externality. Consequently, we realized that if we explored the relationship between the two domains and the ways in which individuals transition from one place to the other more generally we could also get a better

[4]http://www.loesje.org

[5]The Piper Alpha explosion (1988) in the North Sea resulted in 167 dead, and an insured loss of £1.7bn (Woolfson et al., 1996). BP has estimated the final cost of the Deepwater Horizon blowout in the Gulf of Mexico to be $62bn (BP, 2016).

understanding of how *environmental* practices, meanings, and identities might become generalized through transitions from work to home and *vice versa*. We therefore decided not to reduce our analysis to the few instances where people talked about environmentally relevant practices, but to include other practices that were transferred from one domain to the other. Theoretically, this was important as it set workers' practices in the context of how they made sense of their relationship between the places of working life and the places of home life.

If practices were taken from one place to another, it was usually from work to the home. This indicates the power that company logics have in relation to the more malleable family logics. Borders were especially *permeable* between work and home when practices at work were homologous to those at home. The emphasis of the company on such environmental practices is ironic given the fact that the oil industry is a key producer and driver of GHG emissions. Knowledge about the dangers of GHG that comes with working in the oil industry also led to more significant pro-environmental practices like installing solar panels on the house by a few workers. But the internalized logics of the company served to reinforce practices only if they were seen to be economically efficient. When practices learned at the workplace are carried home, family members may *strengthen* border controls, because they experience these practices as an intrusion into a place they value and control. Some workers' resistance to company demands of taking work practices home were a result of bringing logics acquired in their life course to bear on their relations to the company.

Another phenomenon was *blending* when subjective values individuals give to their home were taken into the workplace making it a "home from home." Blending also occurs when family relationships at home draw on the logic of the corporation such that beneficial production practices are communicated between companies through the home.

Clark's theory of border crossing places the individual as a purposeful agent at the center of managing the relations between workplace and home. We argue that the theory gains strength by combining it with a revised version of an institutional logics perspective. Recognizing that subjective values given to different places are connected to the structural, societal logics of those places, provides a framework of opportunities, constraints, and priorities for action. This enables us to understand better why some people under specific conditions draw strong borders between places, while under other conditions the same people experience borders as permeable, allowing the flow of practices, which may then operate "out of place." We found Douglas's (1966) ideas of moral ordering within a social setting also to be useful in understanding the meanings of home and work and how they may collide. We found that if we are to understand whether and how practices, meanings and identities are taken from one place to another then we need to analyze the process of border crossing on a number of levels while differentiating between different kinds of institutional logics.

Differentiating between essential and contingent logics has enabled us to show how the former dominate the latter. In our case, the contingent logic of care for the environment stood in contrast to the logic of producing a profitable product and played therefore a subordinate role in the everyday working life, mirrored by the marginal role it played in the accounts of workers. By contrast, the contingent logic of care for the safety of employees was connected to the essential logic of the company (since the costs for injuries and accidents are its responsibility) and could therefore become part of the company culture. As a result, safety considerations became part of workers' identities, creating an attachment to their workplace and motivating them to carry the respective practices from work to home.

How individuals manage the borders between work and home depends not only on their position in the different domains as Clark argues, but also on the ways in which they make sense of their life trajectories and develop their identities. Kevin Dale a young worker with a love for motorbikes, cars, and frequent traveling is aware of his carbon footprint but does not present this as a problem, subconsciously reproducing the tacit logic of his company which fosters a logic of environmental care, but needs to follow the logic of profit thus contributing to environmental destruction through its production process and its product.

By contrast, Andy Harper, whose account centered around experiences of environmental protection in his family history and who has witnessed the development of a safety culture during his long years in the oil industry has developed an identity that leads him to carry work practices home, even if this produces conflicts: simultaneously he consciously aims to keep his "two families" at work and at home apart. Not only logics and practices travel but also emotions. One can argue that the essential logics of home – care, support, and emotional closeness need to cross the borders into the workplace. We found that this becomes especially clear when analyzing an extreme case like work on an oil platform, where the two domains differ decisively and there are larger time lapses between a presence at home. This is compounded when individuals may feel vulnerable since they are working in a dangerous environment where mutual support is essential.

Our analysis leads us to four key conclusions concerning border crossing between the place of home and the place of work. First, the institutional logics of home and work will influence the individuals acting in these places. Second, the way in which this happens has to be analyzed in each of the different domains. On the side of the subject the domains of practices, meanings, and identities can differ in terms of how institutional logics are carried across borders or not. Third, the transfer (or not) of practices, meanings, identities and logics needs to be analyzed as a process which happens consciously as well as subconsciously. Fourth, in order to understand this process and its complexity in its different domains, we need to analyze the respective institutional logics of the places between which the process of border crossing takes place as well as the life-trajectories of individuals as purposeful actors of this process. As we found, for example, in the case of Kevin Dale, an individual may regard the same border as both strong and permeable depending on whether they perceive the border rationally or emotionally, for instance. Our case studies showed that carrying practices across the work-home divide involves contextual meaning-making, deliberation, conflict, negotiation, and decision-making. As noted (Kossek and Lautsch, 2012), many organizational studies tend to privilege either individual

or organizational factors in boundary management. As with their study, we argue for an understanding of individuals' work/home relationship as being "nested" within organizational logics. However, our study does not take a role-based approach or center on boundary management but sees the logics of institutions as being a critical factor in understanding the creation and management of boundaries.

If it is deemed desirable that safety and environmental practices should cross the home/work divide, then it has to be appreciated that the process will not happen by osmosis but has to be planned and facilitated. This requires companies to recognize the elements occurring in the process: deliberation, conflict, negotiation, decision-making, and power relations. What are the conditions under which people make decisions that increase or decrease the probability of the transfer of pro-environmental or other behaviors across different institutions with different logics? The logic of care can be present in the workplace through "family-friendly" policies and facilities (e.g., crèche facilities), but also through safety regulations and a "health and safety culture." The latter tend to be limited to reducing the immediate threat of the production process to the health and safety of workers and the surrounding environment (or as one interviewee said they often referred to the sea as – "the big blue skip"). Health and safety is not regarded as a negative externality in the way that the environment is. Treating environmental impacts as internalities might lead to both the development of an environmental culture akin to the safety culture, and a longer term appreciation of the cost of oil production. We would suggest that future research into the relationship between work and home could benefit from analyzing not only the process of carrying practices across the work/home border but also the multiple levels of essential and contingent logics that guide practices, meanings, and identities in each domain as well as the life trajectories of individuals as the actors of border crossing.

We have seen an opportunity in this paper to provide a permeable border between environmental psychology writings on place-related environmental behaviors and sociological writings on societal and institutional factors influencing decision-making. While we would agree that place-meaning can be an important condition influencing people's pro-environmental attitudes and behaviors, we would also argue that those places where place is salient such as the home and the workplace are also institutional settings which are subject to particular logics. When we, as environmental psychologists, talk of the importance of context we have not always been particularly specific in articulating precisely what this context is. We would have little difficulty in agreeing that it includes social relations and the physical environment. But it also includes society's institutional structures with their attendant logics. We suggest that the contribution of this paper to the research literature on the transfer of pro-environmental behaviors and practices across places is that it argues for the need for researchers to attend to the institutional logics which are no less part of the context which drives our environmental attitudes and behaviors than other structural or processual considerations.

AUTHOR CONTRIBUTIONS

DU and NR undertook the analysis and interpretation of the interviews in equal measure. DU and NR co-wrote the final text.

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ORIGINAL RESEARCH
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Waste Reduction Behaviors at Home, at Work, and on Holiday: What Influences Behavioral Consistency Across Contexts?

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Demand for materials is increasing, along with the environmental damage associated with material extraction, processing transport and waste management. While many people state they recycle at home, adoption of sustainable waste practices in the workplace and other contexts (particularly, on holiday) is often lower. Understanding how to promote more sustainable behaviors (including, but also going beyond, recycling) across a range of contexts remains a key challenge for policy-makers and researchers. The Theory of Planned Behavior (TPB) has been applied to a range of environmentally-friendly behaviors but the relative importance of the model's predictors has not yet been explored across a range of contexts. Here, we test the TPB across workplace (laboratory and office), home and holiday contexts, and examine whether consistency across contexts is a function of pro-environmental identity. Following ten semi-structured interviews, we undertook an online survey with laboratory workers (primarily in the UK; N = 213) to examine the predictors of recycling and waste reduction habits across these contexts. Interview findings indicate a range of motivations and barriers to recycling in the workplace, and inconsistency across home and work behaviors. Expanding the focus to include holiday as well as workplace and home contexts, our survey analysis shows that the proportion of waste recycled in the home is higher (67%) than in the workplace (39%) and on holiday (38%). Further, the TPB explained around twice as much variance in home recycling compared to work or holiday recycling; but overall did not provide a good explanation for recycling. The study highlights the importance of both contextual (e.g., facilities) and individual (e.g., identity) factors in shaping waste behaviors. We find significant correlations amongst different waste reduction behaviors within and between contexts, though within-context (e.g., home) behaviors are generally more strongly related. Future research should move beyond the TPB to expand the range of contextual (e.g., organizational) factors explored in contexts beyond the home, including workplace and holiday contexts. Given the different drivers-of and barriers-to waste reduction within and between contexts, a range of interventions will be required to promote recycling, reduction and reuse behaviors across these contexts.

Keywords: recycling, theory of planned behavior, habits, spillover, waste reduction

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INTRODUCTION

Waste Reduction Behaviors

Demand for materials is increasing, along with the environmental damage associated with material extraction, processing transport and waste management (Allwood et al., 2011). According to the "waste hierarchy" (reduce, reuse, recycle), which is the product lifecycle approach underpinning European legislation on waste (European Commission, 2014), the most effective means of reducing waste is to prevent waste in the first place (e.g., avoiding products with excessive packaging; consuming fewer products), followed by reusing or finding new uses for items, while recycling is the least effective strategy for reducing waste. While public awareness of waste-related problems (e.g., marine pollution) is growing (e.g., Hartley et al., 2018) and recycling rates are increasing in many countries (Eurostat, 2018), there has been less progress in reduce and reuse behaviors (Whitmarsh et al., 2011). For example, while only 3% of the UK public say they never recycle, this rises to 15% who never buy products with less packaging, and 30% who never avoid buying new things (Whitmarsh et al., 2017). Consequently, much waste continues to be generated and is often sent to landfill or for incineration (e.g., DEFRA, 2016).

While businesses and governments need to play a part in reducing waste, a significant role can also be played by individuals across the various contexts in which they consume and use materials. Little is known, however, about the predictors of waste reduction behaviors in different settings (e.g., home, workplace) or indeed how consistent individuals are across settings in this respect. Recycling research, though, suggests there is likely to be significant variation across contexts; for example, between the workplace and home (Tudor et al., 2008). Understanding how to promote more sustainable behaviors (including, but also going beyond, recycling) across a range of contexts remains a key challenge for policy-makers and researchers.

This paper aims to expand the behavioral and situational scope of waste reduction behavior research, which has largely focussed on recycling in the domestic context. We explore behavior at all levels of the waste hierarchy, including reduction, reuse and recycling behaviors; and we also examine these behaviors across three different contexts: home, workplace, and holiday.

Influences on Waste-Reduction Behaviors

Recycling at home has been well-studied, and is influenced by both individual and contextual factors (Oskamp et al., 1991; Varotto and Spagnolli, 2017). Specifically, attitudes, knowledge, norms, demographics, habits and situational factors (e.g., collection frequency, recycling bin provision) have been shown to predict recycling behavior (e.g., Barr et al., 2003). Older, wealthier, more educated people and women have been shown to recycle more, while knowledge about environmental issues also predicts recycling behavior - particularly knowledge about recyclable materials, programmes and the location of recycling facilities (Geller et al., 1982; Vining and Ebreo, 1990; Schultz et al., 1995; Barr et al., 2003; Thomas and Sharp, 2013). Similarly, pro-environmental values or identity have also been shown to predict recycling behavior (Schultz et al., 1995; Whitmarsh, 2009; Huffman et al., 2014), particularly in the presence of recycling facilities (Derksen and Gartrell, 1993); indeed, having a kerbside recycling collection and other contextual factors (e.g., having space at home to store recycling) are typically the strongest predictors of recycling behavior (De Young, 1989; Barr et al., 2003; Varotto and Spagnolli, 2017). As recycling facilities have been expanded over recent decades, recycling has become easier and more normative. Both descriptive and injunctive social norms (i.e., perceptions of what most people are doing and what one ought to do, respectively) have increased amongst many societies, and in turn positively influenced recycling uptake (Thomas and Sharp, 2013). Consistent with this, interventions using social norms (coupled with psychological dissonance processes) have been found to encourage recycling behavior, with those making public commitments to recycle more likely to do so than those given information (Pardini and Katzev, 1984; cf. Bratt, 1999). Similarly, being asked to recycle by a local resident ("block leader") has been shown to increase perceived social norms as well as personal norms (personal obligation) to recycle (Hopper and Nielsen, 1991). Habit has also been shown to predict recycling behavior (Carrus et al., 2008) as recycling has increasingly become part of domestic routines (Thomas and Sharp, 2013).

Somewhat less is known about what predicts other waste reduction behaviors, including prevention and reuse, although studies exploring these practices similarly suggest both psychological and contextual (e.g., socio-demographic) factors are relevant. For example, UK research found that those with higher education, altruistic values, and pro-environmental identity are more likely to buy products with less packaging; while younger, more educated and lower income people, and those with altruistic values and pro-environmental identity were more likely to avoid buying new things (Whitmarsh et al., 2017). Interventions to encourage waste reduction (beyond recycling) include financial measures, such as carrier bag charging and "pay-per-bin" schemes (i.e., local councils charge residents for each refuse bin filled), which have been found to be effective (Gardner and Stern, 1996; Poortinga et al., 2013). This indicates a lack of motivation to reduce waste rather than primarily structural impediments to waste reduction.

Similarly, relatively little work has explored waste reduction behaviors beyond the domestic context. Tudor et al.'s (2007) study of UK hospital employees' waste behaviors found personal beliefs about the benefits of recycling were the main predictor of recycling behavior, and concluded that the Theory of Planned Behavior is applicable in a workplace context. By contrast, Holland et al. (2006) conducted a workplace intervention (in offices of a Dutch telecoms company) to encourage recycling, and found that behavioral intentions were a poor predictor of recycling behaviors, whereas habits and recycling facilities were key predictors. These divergent findings from very different organizational contexts highlight the need for further research into the predictors of recycling and other waste behaviors in a workplace context, including exploring variation across workplace environments (offices, labs, factories, schools, etc.) with associated diverse forms of waste and waste management.

Similarly, little research exists on waste reduction behaviors on holiday. In general, waste reduction initiatives in tourist and hospitality industries tend to focus on change in organizational processes and staff behavior, while attempts to change visitors' behaviors are less common (Pirani and Arafat, 2014). The very limited work that has been done on the links between sustainable tourism and other contexts suggests that individuals are likely to do significantly less for the environment while on holiday than at home, at least partly due to reduced motivation (i.e., they want a break from all obligations, including pro-environmental ones; Barr et al., 2010; Cohen et al., 2013) but also due to social and structural impediments (e.g., social norms, cost of different travel modes; Randles and Mander, 2009). The exception to this may be eco-tourist resorts which actively encourage pro-environmental actions; one study found recycling levels were similar (around 40%) between home and resort, although this sample is likely have been more environmentally-committed than the general public (Lee and Moscardo, 2005). Amongst more diverse samples, where efforts are made by individuals to take their pro-environmental habits on holiday, these seem more often to be in respect of energy and water saving behaviors than other pro-environmental actions (Goldstein et al., 2008; Barr et al., 2010).

Theory of Planned Behavior and Contextual Consistency

The Theory of Planned Behavior (TPB; Ajzen, 1991) has been applied to a range of environmentally-friendly behaviors, including waste reduction (Cheung et al., 1999; Kaiser et al., 2005). The TPB states that intentions predict behavior and that intentions are a function of social norms, attitudes, and perceived behavioral control. A study comparing the TPB with the Value-Belief-Norm (VBN) model of pro-environmental behavior found that the TPB predicted conservation behavior, including recycling, better than the VBN model (Kaiser et al., 2005). (The VBN model differs from the TPB in predicting behavior from personal moral norms rather than from behavioral intentions; personal norms, in turn, are predicted by beliefs about responsibility and environmental impact of behavior, and ultimately values). Indeed, many of the key influences on recycling behavior found in the studies described above map onto the TPB (e.g., perceived behavioral control reflects situational factors, such as availability of facilities), although other factors like identity, personal norm (sense of obligation) and knowledge, are also relevant for waste reduction behaviors but not explicitly part of the TPB. Similarly, given that waste-reduction behaviors can occur regularly and under similar circumstances (e.g., Holland et al., 2006) waste reduction could become a matter of habit, in which case this should also be taken into account, in addition to the TPB and other variables (Gardner, 2015).

However, the relative importance of the TPB variables and other predictors of waste reduction has not yet been explored across a range of contexts. We know from habit research (Verplanken, 2018) that context cues much of our behavior, meaning that many of our actions are inconsistent across different times and places (Nash et al., 2017). Similarly, there may be different motivations and barriers operating in different contexts, such as home and the workplace. For example, financial benefits of domestic energy saving may not exist at work, and control over equipment may be lower at work (Leygue et al., 2017). Indeed, previous research has found that workplace pro-environmental behaviors (e.g., setting up a recycling scheme at work) did not tend to co-occur with domestic or consumer behaviors, like recycling, turning off lights and buying green products (Whitmarsh et al., 2017). Even when comparing the same behavior across different contexts, there may be little or no relationship: Littleford et al. (2014) compared two Council workplaces and found notable differences between them in adoption of energy-saving behaviors, due primarily to control factors (e.g., automated lighting). They also found limited relationships between workplace and home energy-saving behaviors, although these relationships were stronger in one of the workplaces, where there was more control over behavior. They concluded that "people behave more consistently across settings when they have greater control over their own behavior," including physical and social control (p. 165).

The relationship between work and home behaviors may indicate "situational" spillover—i.e., adopting a behavior in one context leads to adoption of the same behavior in another (Nash et al., 2017); this is contrasted with "behavioral spillover" which is where one behavior leads to adoption of another behavior in the same context (Thøgersen, 1999). Littleford et al.'s (2014) work suggests that control may mediate situational spillover, and that material factors (i.e., using the same equipment at home and work) may also be a facilitator. Other work also suggests home-work spillover may be possible if there is organizational or social support in both environments (Rashid and Mohammad, 2011); or if one has a strong pro-environmental identity (Frezza et al., in press). Identity-mediated spillover appears to have been greatest attention in previous literature; based on identity theories (e.g., Breakwell, 2014), the assumption here is that individuals' psychological drive for self-consistency and self-continuity underpins the transfer of behavior across contexts. Previous work appears to assume that any situational spillover is more likely to originate from a home behavior and be carried—via identity, attitudes or some other psychological construct—to the workplace (Tudor et al., 2008; Young et al., 2015). However, workplace interventions may trigger spillover to the home context (Frezza et al., in press). For example, Andersson et al. (2012) found spillover to home waste behaviors from a workplace recycling scheme. To date, little work has explored spillover across contexts—such as home and workplace—and to our knowledge, no studies have examined spillover across multiple contexts (e.g., home-work-holiday). The current study is therefore the first to explore multiple waste behaviors across home, workplace, and holiday contexts in order to examine both behavioral and situational spillover.

Aims and Hypotheses

The present study examines waste behaviors across three main contexts—workplace (including lab and office), home and holiday. The research has two aims. Firstly, we compare the influence on recycling of TPB variables, pro-environmental

identity and relevant situational variables (e.g., recycling facilities, organizational waste policy) in each of these contexts. Second, we explore the extent to which individuals are consistent in their waste reduction behaviors (recycling, reduction and reuse) within and across contexts, and whether identity predicts cross-context consistency.

In relation to the first aim, we expected that TPB variables (attitudes, social norm, PBC), identity, habits, personal norms and contextual variables (e.g., recycling information, location of bins) will predict recycling behavior across contexts; based on previous literature (e.g., Varotto and Spagnolli, 2017), PBC and contextual factors are hypothesized to exert the strongest influence. In relation to the second aim, we hypothesized that relationships between behaviors would be stronger within contexts than between contexts, because of the importance of contextual factors in predicting waste reduction actions. Further, consistent with dominant spillover models (Truelove et al., 2014; Nash et al., 2017), we hypothesized that pro-environmental identity would explain consistency in behaviors across contexts.

METHODS

Since waste reduction behaviors have been little studied outside of the domestic context, we undertook initial qualitative research to explore the range of influences on recycling, reducing and reuse behaviors in order to inform a subsequent quantitative survey. This sequential mixed-methods approach offers the advantage that quantitative measures are relevant and contextually-grounded (Creswell, 1999). Furthermore, as well as informing survey content (e.g., wording of TPB items), the interviews provided valuable insights in their own right on waste reduction behaviors. This rich and detailed qualitative data source has been used to triangulate and elaborate on findings from the survey stage, for example shedding light on salient motivations for and barriers to recycling (first aim) and when/why waste reduction behavior across contexts is (in)consistent (second aim). Conversely, the survey enabled quantitative analysis of the prevalence and predictors of waste reduction behaviors suggested by the interviews in a larger and more diverse sample.

The study was approved by Cardiff University's School of Psychology research ethics committee. Written informed consent was obtained from interviewees; and survey participants clicked on the initial information and consent page of the survey to confirm their informed consent (the survey only started if they clicked consent).

We selected a laboratory setting to conduct the workplace component of the research. Laboratories generate considerable waste, much of which is not recycled or reused due to contamination or infection risks (Hossain et al., 2011). In addition, researchers working in laboratories often spend time in other workplace settings, such as offices. This makes laboratory workers interesting to study from a multi-context perspective: we can study their behavioral consistency between laboratory and office settings within the workplace, as well as across the three broader settings of workplace, home and holiday.

Interviews

We conducted interviews with laboratory workers ($N = 10$) working at a UK university. They were at different career-stages in several disciplines (biosciences, engineering, earth sciences, medicine). A convenience sample was recruited from amongst the authors' contacts, ensuring a balance of gender, seniority and discipline. Interviews lasted for around 30 min, were audio recorded and thematically coded using an inductive approach (Braun and Clarke, 2006). Interviews were semi-structured and intended to elicit prevalence, drivers and barriers in respect of waste reduction behaviors at work, with a particular focus on labs. The interview schedule covered the following topics: types of waste generated and how they are dealt with; which items are (not) recycled/reused, and why (not); awareness of waste facilities and policies; colleagues' waste behaviors; responsibility and reasons for reducing waste; and what measures would encourage more recycling and reuse.

Survey

Participants

Following this, an online survey was undertaken with laboratory workers ($N = 213$) to examine the predictors of recycling and waste reduction habits across the three contexts. Participants were recruited through academic email lists and snowballing (asking colleagues working in laboratories to send on to others). **Table 1** shows the sample composition. Most participants were from the UK and were early-career researchers working in universities. **Table 1** shows the sample composition. Participants were also asked 'what proportion of your time at work do you spend in your lab (as opposed to an office or elsewhere)?': a mean of 44% was recorded.

Measures

Dependent variables were measured as follows.

- Proportion of waste recycled: "Roughly what proportion of your waste at work (including in your office, lab, public work areas, etc.) do you recycle?" with response indicated on a percentage slider. The question was repeated for "at home" and "on your last holiday."
- Materials recycled: "Now thinking specifically about your laboratory, which (if any) of the following items do you recycle?" Items listed were those shown in **Figure 3**; respondents checked any of these they recycled. The question was repeated for "other areas at work, besides your laboratory (e.g., your office, kitchen, corridors)?"; "at home;" and "on your last holiday."
- Proportion of materials reused: "Roughly, what proportion of the things you use in your laboratory (e.g., gloves, petri dishes) do you reuse or repair (instead of throwing away)?" with response indicated on a percentage slider. The question was repeated for things used "at home."
- Other reuse and reduce behaviors included (a) carrier bag reuse: "How often do you take your own bag(s) when you go shopping?;" and (b) "How often do you choose products without too much packaging?" both with a five-point response scale from "Always" (5) to "Never" (0).

TABLE 1 | Survey sample characteristics.

Gender	%	Job role	%
Female	54	Student/PhD, Postdoc or Researcher	59
Male	44	Academic Staff	24
Prefer not to say	2	Manager	6
		Other (e.g., technicians)	11
Age			
16–25	13	**Subject**	
26–35	43	Biological	38
36–45	26	Medical	24
46–55	13	Earth/Environmental	23
56–65	4	Chemical	11
Over 65	0	Engineering/Maths/Computing	5
Prefer not to say	1		
		Organization	
Location		University/HEI	83
Wales	62	Private-sector organization	7
England	19	Other public-funded research organization	4
Scotland	2	NGO/charity	2
N. Ireland	0	Other	4
Other	17		
		Member of environmental organization	
		Yes	23
		No	77

TPB variables were measured as follows. All responses were made using a seven-point scale from Strongly disagree (1) to Strongly agree (7).

- Attitude ($\alpha_{home} = 0.80$, $\alpha_{lab} = 0.71$, $\alpha_{holiday} = 0.81$) comprised five items (adapted for the three primary contexts of interest: home, lab and last holiday). Three items began "I believe that recycling *at home [lab waste, on my last holiday]* benefits [benefited]" and ended with: (1) "me," (2) "my local area" and (3) "then environment," respectively. The other two items were: (4) "Recycling *at home [lab waste, on holiday]* poses risks to me and my family [colleagues]" (reverse-scored); and (5) "I think recycling *at home [lab waste, on holiday]* is a good idea."
- PBC ($\alpha_{home} = 0.83$, $\alpha_{lab} = 0.69$, $\alpha_{holiday} = 0.67$) was measured with two or three items, depending on context, with wording adapted to context: Recycling *at home [lab waste, on my last holiday]* is [was] too much of a hassle to bother with (reverse-scored); I avoid [avoided] recycling *at home [in my lab, on my last holiday]* due to lack of time (reverse-scored); I recycle *at home* because there are facilities available that make this easy (home only).
- Social Norms ($\alpha_{home} = 0.68$, $\alpha_{lab} = 0.87$, $\alpha_{holiday} = 0.79$) comprised two items again with context-relevant wording: Most of *my friends and family [colleagues]* recycle *at home [their lab waste, on holiday]; My friends and family [colleagues]* encourage me to recycle *at home [in the lab, on holiday]*.

Additional predictors included the following.

- Personal Norm was measured with one item: I feel a moral obligation to recycle *at home [my lab waste, on holiday],* again with responses on a seven-point agreement scale.
- Knowledge ($\alpha_{home} = 0.61$, $\alpha_{lab} = 0.54$, $\alpha_{holiday} = 0.72$) was measured with two items: I know a lot about which materials can [could] be recycled *at home [in my lab; on my last holiday];* I know [knew] where to deposit items for recycling *where I live [where I went on my last holiday, in my lab],* again using a seven-point agreement scale.
- Habit was measured with the four-item Self-report behavioral automaticity index (SRBAI; $\alpha_{home} = 0.95$, $\alpha_{lab} = 0.95$, $\alpha_{holiday} = 0.98$) across the three contexts: Recycling *in my laboratory [at home, on my last holiday]* … is something I do [did] automatically; is something I do [did] without thinking; I do [did] without having to consciously remember; I start [started] doing before I realize [realized] I was doing it. Responses were on a seven-point scale from Strongly disagree (1) to Strongly agree (7).
- Pro-Environmental Identity ($\alpha = 0.83$) was measured with six items that include general pro-environmental and more specific waste-conscious identity statements (adapted from Whitmarsh et al., 2017): I consider myself to be environmentally-conscious; Being environmentally-friendly is an important part of who I am; I think of myself as someone who is very concerned about environmental issues; I would be embarrassed to be seen as having an environmentally-friendly lifestyle (reverse-scored); To engage in recycling is an important part of who I am; I think of myself as a waste-conscious person. Responses were on a seven-point scale from Strongly disagree (1) to Strongly agree (7).

Contextual variables included demographic variables (**Table 1**) and the following.

- Recycling facilities: Do you have a recycling bin (or bins) in your laboratory? Yes (1), No (0), or Don't know (omitted from analysis). If yes, respondents were asked "Where is the nearest recycling bin positioned (in meters)?" Respondents were also asked: Do you have a doorstep recycling collection (e.g., green bin) where you live? and Did you have recycling facilities (e.g., green bins) where you went on your last holiday? with Yes (1), No (0), or Don't know (omitted from analysis) as response options.
- Waste policies and information: Two items measured workplace policies. These were: Does your organization have a policy to encourage recycling? Does your organization have a policy to encourage reuse of materials/equipment? Yes (1), No (0), or Don't know (omitted from analysis). A final question asked about information provision: Does your organization provide information on/near recycling bins about which materials can be recycled? Yes (1), No (0), or Don't know (omitted from analysis).

All means, standard deviations (SDs) and correlations are shown in **Appendix 1** in Supplementary Material.

RESULTS

Interviews

We outline here the main findings from the interviews, with exemplar quotes. All names reported are *pseudonyms* to protect interviewee confidentiality. Interview findings indicated (a)

inconsistency between workplace contexts and between home and work; and (b) a range of barriers to and drivers of recycling in the workplace. In relation to the former, interviewees indicated that recycling is less common in labs than in offices, due for example to fewer recycling facilities in labs than in offices and more concern about contamination risks (see below). Furthermore, waste reduction at work more generally was less common than at home for various reasons, including not feeling responsible at work for dealing with waste:

> "*At home I'm much more aware of it; I'll recycle everything I can. But here I shouldn't really say it, but there's just so much waste anyway, you don't feel as responsible for it I suppose. If I'm completely honest*" – Clara, Biosciences

Several others also noted a lack of responsibility for reducing waste. For example, Roger (Engineering) stressed that it is not something that can just be tacked onto somebody's workload; it would probably take up much of their time so would have to be a set role with sufficient time allocated. Likewise, Robin (Earth Sciences) concluded, "There's no accountability, that's the problem."

Others admitted they (and colleagues) did not always recycle or reuse items because of the effort involved and availability of single-use items:

> *"It's more convenient just to chuck it in the [general waste]. I must admit that we don't always put them through the recycling. It just becomes a matter of convenience"*—Roger, Engineering

> *"Because there's always cups available, why would they do that [soak, rinse and dry them to reuse them]"*—Louise, Medicine

Indeed, this interviewee (Louise, Medicine) concluded that because of the effort involved in reducing waste, "I think you've really got to want to do it," suggesting attitudinal factors (e.g., environmental values) might be important in the absence of a supportive context for waste reduction (see also "drivers," discussed below).

Consistent with this, a variety of contextual (physical, organizational, informational) barriers to waste reduction were mentioned by interviewees. These included: unclear rules, lack of bin labeling, collection infrequency, limited storage space, limited awareness of facilities, health and safety regulations, actions by cleaners, and sterilization cost. In relation to health and safety rules, for example, Wendy (Earth Sciences) noted that she was limited in how many boxes she could keep for re-use as they posed a fire hazard. A common theme was a lack of recycling facilities; this included infrequent collection where facilities did exist:

> *"[the sharps bins are] usually full, as you can see because all the broken glass is sort of propped on the top, which isn't very good*"—Johnny, Engineering

Concern was raised by three respondents (in two departments: Earth Sciences and Engineering) regarding rumors that cleaners tip recycling bins in with general waste, undermining individual efforts to sort waste:

> *"There's always rumors that these things get chucked into the normal waste at the end of the day"*—Johnny, Engineering

> *"Many people think they are recycling when in reality they're not. And it's not their fault … The fact that it's a blue bin doesn't mean anything to [the cleaners] […] I get it; the cleaning staff are busy, they're late, they've got tons of rooms to deal with. Having to deal with recycling and rubbish can be a bit of a burden"*—Robin, Earth Sciences

Lack of information about what can be recycled and where was also noted:

> *"I'd be surprised if everyone in the building knows there's a recycling bin for these particular products down in the basement"*—Jared, Medicine

> *"I think there's general confusion about how to recycle"*—Robin, Earth Sciences

The most commonly cited reason for not reusing or recycling items was risk of contamination (of both experiments and waste streams), mentioned by nine of the ten interviewees. In some cases, this led to a "blanket rule" that recycling bins were not permitted in labs (noted by Wendy, Earth Sciences) ostensibly to reduce contamination risk. In other cases, contamination risk was left to individual judgment and most adopted a precautionary approach:

> "[The] *sterilization issue is the only reason why we wouldn't recycle."*—Eileen, Biosciences

> *"Unless you're absolutely certain that that vial is completely clean, it's very difficult to know whether you'd have contamination"*—Roger, Engineering.

> *"The experiment has to come first, otherwise the results are meaningless"*—Johnny, Engineering.

Conversely, interviewees also mentioned some *drivers* of waste reduction. These included pragmatic factors, such as availability of supporting facilities or cost reduction. For example, several participants noted that some items could be reused at work by pooling equipment, where relevant schemes had been implemented. Others noted that "money is tight" (Robin, Earth Sciences), or the cost of buying new equipment instead of reusing items:

> *"That's the big issue. People have no idea how much their tubes cost or how much the little cups cost… There's always a supply, but they have no idea how much these things cost."*—Louise, Medicine

Other drivers of waste reduction were more normative or cultural, including personal values, habits (from home), social norms, and organizational policy or colleague encouragement.

As the following quotes illustrate, waste reduction was viewed positively and normatively:

> *"It's the right thing to do. There are moral issues with it—being wasteful when you don't have to be is wrong."*—Robin, Earth Sciences

> *"I just go on what you can recycle at home"*—Clara, Biosciences

> *"If we're all doing it and we're encouraged to do it, it makes it happen"*—Louise, Medicine

> *"We are an environmental lab so if we don't recycle who is going to recycle?"*—Eileen, Biosciences

The combination of these pragmatic and normative factors was identified by one interviewee:

> *"It just makes sense, doesn't it? It's what we're supposed to do. It's the social thing isn't it. Partially I think. The thing to do now. Facilities are there, you're encouraged to take advantage of them, if you like"*—Jared, Medicine

Survey

As **Figure 1** shows, the percentage of waste recycled at home, as estimated by participants ($M = 67.3$; $SD = 19.1$) is greater than in the workplace (Lab $M = 32.4$; $SD = 26.3$; Other work areas $M = 38.4$; $SD = 25.1$) and on their last holiday ($M = 38.3$; $SD = 27.7$). Consistent with this, the strength of recycling habits is higher at home than at work or on holiday (**Figure 2A**) and participants reuse a larger proportion of items at home than in the lab (**Figure 2B**). Furthermore, different materials are recycled in different locations, including within the workplace (laboratory vs. office; **Figure 3**).

Figure 4 shows the significant correlations between the behaviors measured within and across settings (see also **Appendix 1** in Supplementary Material for non-significant correlations). Almost all waste behaviors are significantly correlated, although the strength of relationships varies considerably. Home recycling is significantly correlated with all other waste behaviors, both in the home and beyond it (apart from lab repair/reuse). Similarly, holiday recycling is related not only to domestic recycling but to all domestic waste behaviors. Conversely, workplace behaviors appear to be less related to behaviors in other contexts: workplace recycling is significantly co-related with domestic recycling, but not to any other behaviors; and lab reuse/repair is unrelated to behaviors outside the workplace (even to domestic repair/reuse).

We conducted step-wise regression analyses of recycling behavior across three contexts (lab, home, holiday), which enabled us to observe how much additional variance is explained over and above the TPB (model 1) when adding knowledge and contextual variables (model 2), and also identity and personal norm (model 3). As shown in **Tables 2**, **3**, different, but overlapping, predictors are relevant in each setting. In laboratories, recycling is marginally predicted by attitude (model 1) and pro-environmental identity (model 3), while other predictors are non-significant. In the home, perceived behavioral control and knowledge are positive predictors, while attitude is a negative predictor in the full model. For holidays, perceived behavioral control, facilities, and personal norm are positive predictors. The results suggest that both contextual factors (e.g., facilities, PBC) and psychological factors (e.g., personal norm) are drivers of recycling behavior in different contexts, but also that different factors are important within each context. Our model of household recycling appeared to provide the best explanation of context-specific recycling of the three models, despite the additional explanatory variables included in our model of workplace recycling to anticipate differences between behavioral control in the workplace and other contexts.

Finally, consistency across contexts was explored by calculating an absolute difference score between the percentage of waste recycled at home and in the workplace (lab), and between home and their last holiday. This score was then

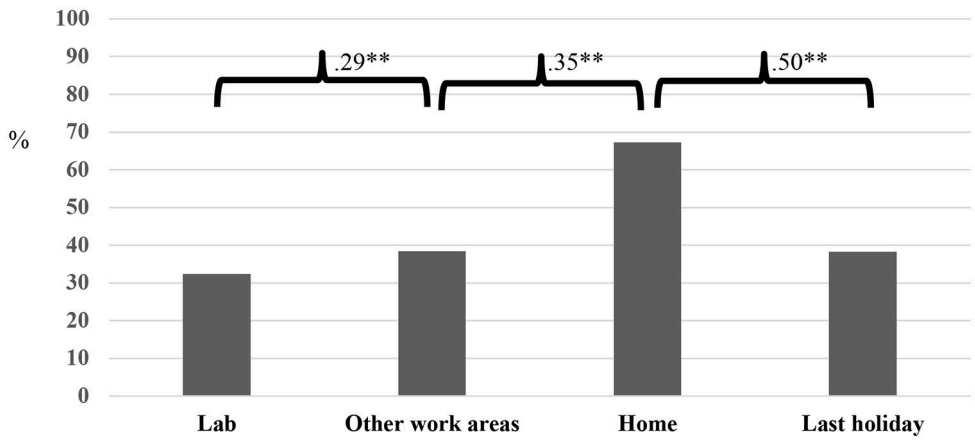

FIGURE 1 | Proportion of waste recycled (% of total waste) across settings. **Correlation is significant at 0.01 level (2-tailed).

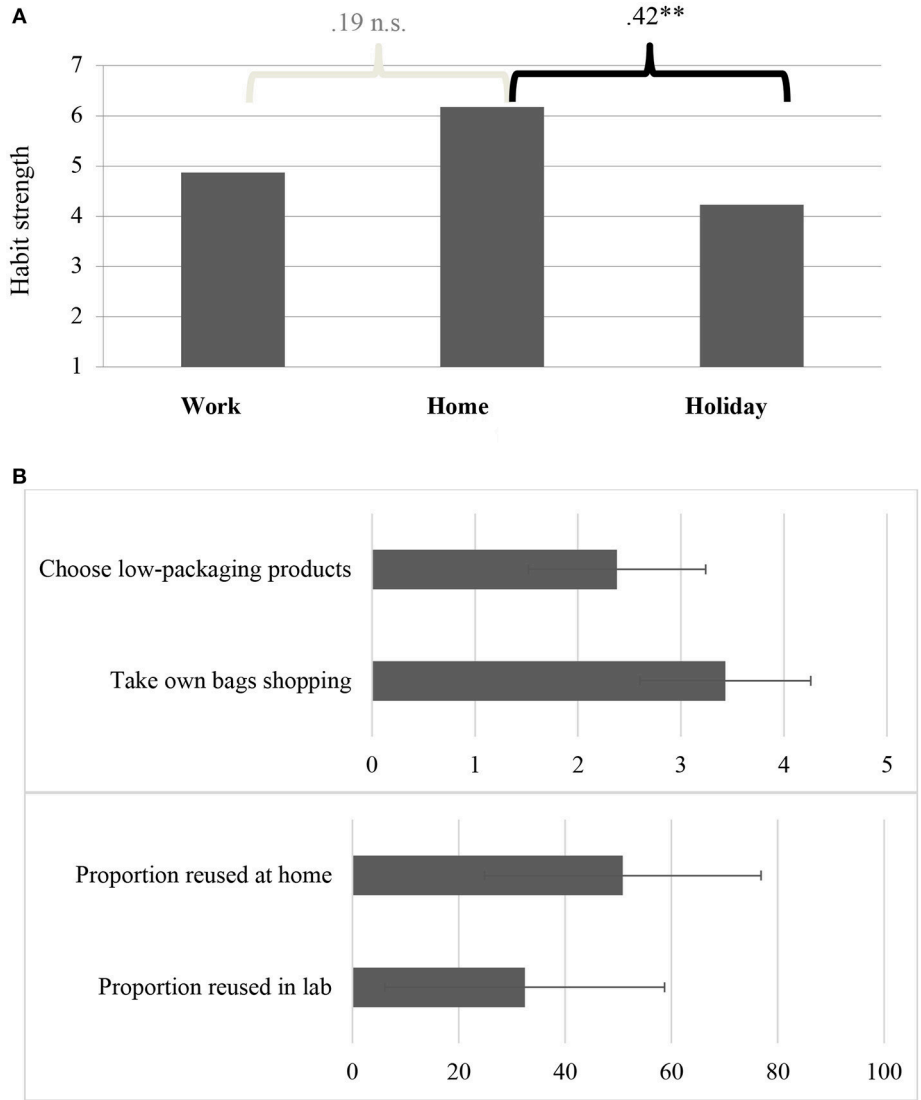

FIGURE 2 | (A) Strength of recycling habit across settings (7-point scale). **Correlation is significant at 0.01 level (2-tailed). **(B)** Reuse and reduction behaviors (domestic and workplace settings; top scale 0 = Never to 5 = Always, bottom scale %).

used as a dependent variable in a linear regression with pro-environmental identity as predictor to determine to what extent pro-environmental identity explains cross-context consistency. This analysis found that consistency was not predicted by identity: (a) difference home-lab % recycled - identity $B = 0.01$, $p = 0.96$; (b) difference home-holiday % recycled - identity $B = -0.18$, $p = 0.17$.

DISCUSSION

What Predicts Waste Behaviors in Different Contexts?

Our qualitative interviews showed that attitudes to recycling are largely positive, though there are barriers (e.g., lack of facilities/information, contamination risk) to translating intentions into action, as others have previously noted (e.g., Tudor et al., 2007). Indeed, the survey reinforces this finding, with contextual and control factors (recycling facilities, PBC) at least as important for predicting recycling as individual motivational or normative factors (e.g., identity, social norms). However, there were different predictors across contexts: Home recycling was predicted negatively by attitude, and positively by PBC and knowledge; Holiday recycling was predicted positively by PBC, recycling facilities, and personal norm; and work recycling was (marginally) positively predicted by pro-environmental identity. Overall, the TPB did not provide a sufficient explanation for recycling behavior in any location: social norms were not significant in any context, perhaps because recycling is now relatively normative, particularly amongst highly educated groups, such as the population we studied here (cf. Schultz et al., 1995; Thomas and Sharp, 2013). On the other hand,

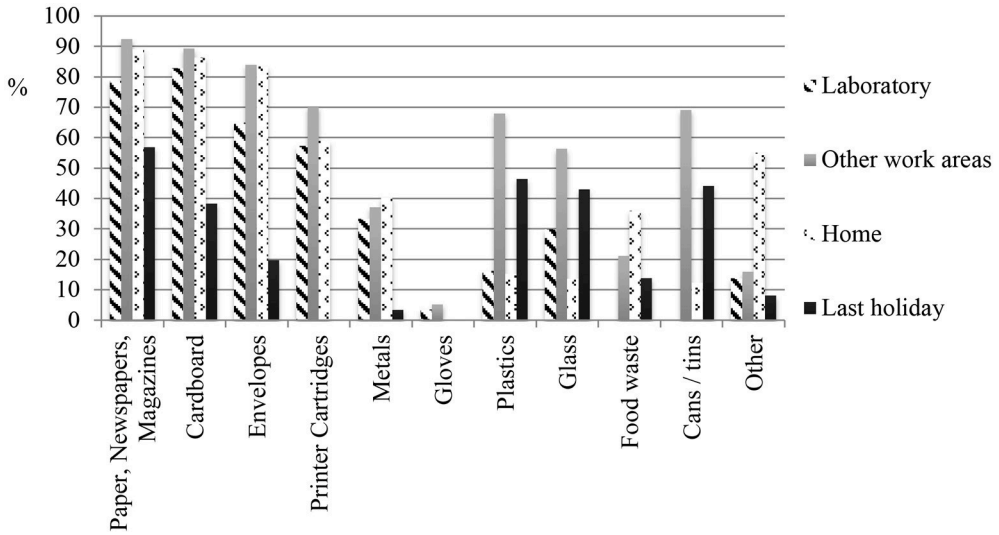

FIGURE 3 | Percentage of different materials recycled across settings (there was no option to indicate that materials were not used at all).

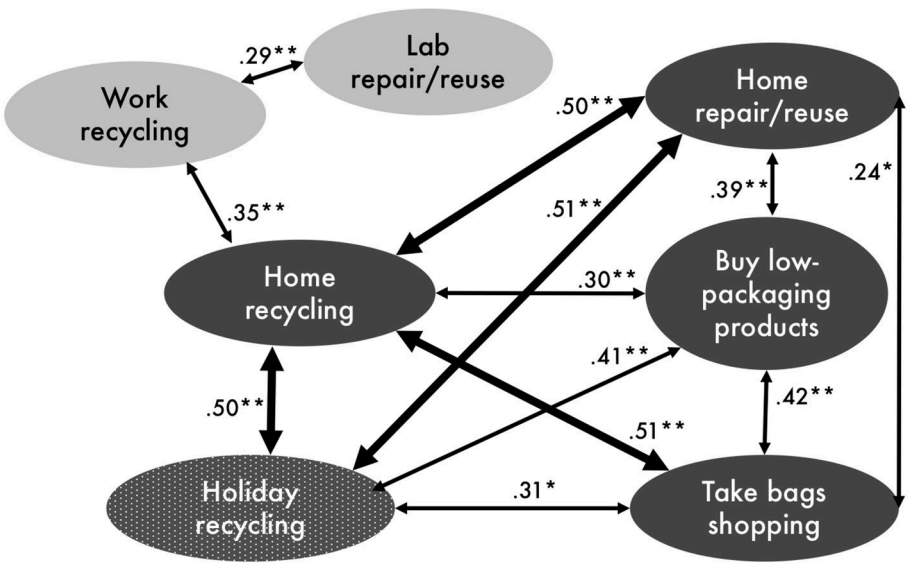

FIGURE 4 | Correlations between waste reduction behaviors across contexts (thicker arrows indicate stronger correlations; dark balloons = domestic context; light balloons = work context; patterned balloon = holiday context). *Correlation is significant at 0.05 level (2-tailed). **Correlation is significant at 0.01 level (2-tailed).

other non-TPB factors, such as recycling knowledge and personal norm, *were* found to be significant. The regression analysis shows attitude becomes a negative predictor when knowledge, PBC and recycling facilities were added to the equation. This negative role of attitude in home recycling is unexpected and difficult to explain. However, one possible explanation is that the inclusion of both knowledge and attitude creates an over-controlled model (Wooldridge, 2008). A prerequisite for such an explanation is met: that there is a moderate bivariate correlation between attitudes for home recycling and knowledge, $r = 0.35$, $p < 0.01$ (also PBC, $r = 0.24$, $p < 0.05$). Therefore, it is possible that the negative effect of attitude is a way in which, when controlling for the practical aspects—what, where and how to recycle—more abstract views about recycling do not always translate into recycling but the opposite (cf. De Young, 1989). Once variation in recycling due to recycling-knowledge is accounted for in the model, the remaining variation due to attitudes alone may represent only an abstract positivity toward the idea of recycling, and this abstract positivity may tend to increase to the extent that a participant does not actually engage with the reality of daily recycling. In addition, we found TPB variables account for much more variance at home (42%) than

TABLE 2 | Predictors of recycling in the laboratory (% of waste recycled).

	Beta	*t*	*Model and R^2* (R^2 change)
(Constant)		−0.82	*1*
Attitude	**0.40**	**2.06(*)**	*0.20 (0.20)*
Social norm	0.17	0.90	
PBC	−0.05	−0.25	
(Constant)		−0.61	*2*
Attitude	0.28	1.23	*0.32 (0.12)*
Social norm	0.44	1.74	
PBC	0.06	0.26	
Knowledge	−0.38	−1.55	
Proximity of recycling bin	0.32	1.36	
Organizational recycling policy	−0.08	−0.31	
Info on recycling bin	0.24	0.93	
(Constant)		−1.52	*3*
Attitude	0.20	0.90	*0.46 (0.14*)*
Social norm	0.36	1.51	
PBC	−0.16	−0.65	
Knowledge	−0.23	−0.90	
Proximity of recycling bin	0.15	0.62	
Organizational recycling policy	0.07	0.28	
Info on recycling bin	−0.11	−0.38	
Pro-environmental identity	**0.49**	**1.96(*)**	
Personal norm	0.11	0.39	

*$p < 0.1$, *$p < 0.05$.
Significant values shown in bold.

holiday (24%) or work (20%), perhaps because this context is more amenable to psychological factors such as those present in the TPB and other measured predictors (as suggested by the higher means for recycling attitudes, norms, PBC knowledge and recycling facilities at home than elsewhere; **Appendix 1** in Supplementary Material). Indeed, we found few significant predictors of recycling at work, perhaps because there are strong institutional factors that impede the translation of TPB factors or other measured predictors into individual action by laboratory workers: such institutional factors are indicated by the interviews (e.g., health and safety regulations, cleaners' actions) but not all of these could be included in the survey due to space restrictions. Future research should therefore not assume TPB is equally valid across contexts and in particular should employ more organizational models (cf. Tudor et al., 2007) to explore workplace PEBs.

Our regression analyses also included variables not found in the TPB, which previous research indicated could improve upon a TPB explanation of waste-reduction behavior. Notably, we found personal norm to be a significant predictor of recycling on holiday, perhaps because motivation and ability to be pro-environmental on holiday tend to be lower than in everyday contexts (Barr et al., 2010; also **Figure A1** in Supplementary Material) so for those people who do go to the effort of recycling on holiday they represent the most environmentally committed individuals. This is also consistent with the significant correlations observed between holiday recycling and all domestic waste reduction behaviors, suggesting those doing more waste reduction at home are the ones that take these habits on holiday. It would be interesting for future research to explore whether other models, such as the Value-Belief-Norm (VBN) model—which posits that personal norm is the proximal driver of pro-environmental action—would work better than TPB in certain contexts, such as on holiday.

How Consistent Are People Across Waste Behaviors and Contexts?

Comparing prevalence of the same behaviors across contexts, we found that recycling at home is more common than in the workplace or on holiday; and similarly that repair/reuse at home is more common than workplace repair/reuse behaviors. This is consistent with the literature which indicates individuals tend to experience more barriers and/or less motivation to act pro-environmentally on holiday and at work than at home (e.g., Randles and Mander, 2009; Barr et al., 2010).

Consistent with expectations and the prior literature (e.g., Nash et al., 2017), we found more consistency (represented by significant, positive correlations) within contexts than between them. All domestic waste behaviors (recycling, reuse, reduce) were related; and both workplace behaviors (recycling, reuse) were related. Across contexts, the picture is more mixed: while recycling across the three contexts was significantly correlated, home and lab reuse behaviors were not. Holiday recycling, however, was significantly related to all domestic waste behaviors (not only recycling).

Together, these findings suggest there are more barriers to waste reduction (recycling and reuse) outside the domestic context than within it; and that contextual factors (e.g., facilities) are at least as predictive of waste reduction as individual factors, as indicated previously (Varotto and Spagnolli, 2017). At the same time as there being considerable variation across contexts, though, we also see heterogeneity across behaviors: recycling is more common than other waste reduction behaviors (consistent with other UK-based research, e.g., Whitmarsh et al., 2017) and apparently more transferable across contexts than repair/reuse behaviors. This may be because repair/reuse behaviors are potentially more diverse and dependent on context-specific requirements, skills and equipment (e.g., sterilization facilities in labs vs. kitchen sink at home; higher requirement for precision and cleanliness in lab than at home) than recycling behaviors, which require only a relevant receptacle (and information on what to put in it).

Given the relatively strong relationships between domestic recycling and most other waste behaviors, it is also interesting to speculate about whether recycling at home may be a "catalyst" behavior (Austin et al., 2011) to trigger subsequent waste reduction actions at home or elsewhere. Domestic recycling has been the focus of much environmental campaigning and

TABLE 3 | Predictors of recycling at home and on last holiday.

	Home—% recycled			Last holiday—% recycled		
	Beta	***t***	***Model and R^2 (R^2 change)***	**Beta**	***t***	***Model and R^2 (R^2 change)***
(Constant)		0.40	*1*		−1.16	*1*
Attitude	−0.15	−1.61	0.42 *(0.42***)*	0.06	0.40	*0.24 (0.24**)*
Social norm	0.04	0.37		0.14	1.03	
PBC	**0.65**	**6.49*****		**0.42**	**2.91****	
(Constant)		−0.02	*2*		−0.97	*2*
Attitude	**−0.23**	**−2.57***	*0.53 (0.11***)*	−0.02	−0.14	*0.35 (0.11*)*
Social norm	−0.08	−0.82		0.11	0.84	
PBC	**0.45**	**3.65*****		**0.39**	**2.67***	
Knowledge	**0.41**	**3.95*****		0.02	0.15	
Recycling facilities	0.09	0.79		**0.34**	**2.50***	
(Constant)		0.35	*3*		−0.66	*3*
Attitude	**−0.28**	**−2.74****	*0.55 (0.02)*	−0.07	−0.40	*0.41 (0.06*)*
Social norm	−0.09	−0.92		0.11	0.81	
PBC	**0.46**	**3.74*****		**0.30**	**2.04***	
Knowledge	**0.34**	**3.13****		0.05	0.35	
Recycling facilities	0.07	0.64		**0.30**	**2.28***	
Pro-environmental identity	−0.08	−0.87		−0.13	−0.67	
Personal norm	0.20	1.70		**0.35**	**2.08***	

$^*p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.
Significant values shown in bold.

of environmental psychological research for many years, and it is now widely practiced (Whitmarsh, 2009), but other waste reduction behaviors are less well-known and may be more difficult for individuals, due to structural constraints (e.g., use of excessive packaging by suppliers; Whitmarsh et al., 2017). Where policy measures have promoted these other behaviors, their adoption has increased, notably in the case of carrier bag reuse (Poortinga et al., 2013).

We tested whether pro-environmental identity was a significant predictor of cross-contextual consistency in recycling, and found that it was *not*. This is in contrast to most spillover models (e.g., Nash et al., 2017) and may indicate that contextual or other variables that prevent even the most motivated from acting on their identity are too strong an impediment in this case. Future work should explore other possible mediators for situational spillover, such as self-efficacy (Nash et al., 2017), behavioral control or use of similar materials/equipment which are indicated as being relevant in previous situational spillover research (Littleford et al., 2014).

Implications and Limitations

The study highlights that both individual factors (e.g., pro-environmental identity) and contextual factors (e.g., facilities) are important in shaping individuals' waste behaviors; although different factors are more or less important in different contexts. Consistent with sociological perspectives on action (Schatzki, 2010), our results paint a picture of different drivers, constraints and "mindsets" (or social practices) occurring in different contexts. It may be that no single model (e.g., TPB) is able to adequately reflect this diversity. Similarly, the practical implication of these findings is that no single solution exists to improve waste reduction across diverse contexts, such as home, workplace and holiday settings. Indeed, there are also likely to be different measures required *within* each context to address different forms of waste reduction, including recycling, reuse and reduction behaviors. Recycling requires different forms of intervention or support (e.g., recycling bin, regular collection, information) than reuse or reduction behaviors (e.g., repair skills, storage space, product availability, changing norms around consumption; Whitmarsh et al., 2017).

This study adopted a mixed-method design, but did not undertake longitudinal or experimental analyses to ascertain causal pathways between behaviors. Similar to much previous "spillover" research (Nash et al., 2017), our correlational survey design only indicates relationships and consistencies across behaviors and contexts. Further work is needed to explore whether one behavior (e.g., home recycling) actually leads to adoption of further behaviors, and what factors mediate these behavioral or situational spillover processes. Our research also relied on self-reported recycling behavior, rather than observed recycling. Previous research shows these are positively correlated (Huffman et al., 2014) but there is generally a tendency to over-report pro-environmental behaviors due to social desirability (Kormos and Gifford, 2014), highlighting a need for future research in this area to include observational

measures in addition to (or instead of) self-reports of recycling. Our measures could also be improved and expanded. For example, we asked about reuse of items in the home but there may be wide interpretations of what this applies to (e.g., crockery vs. packaging). More generally, there is a need for a greater range of reuse and reduction behaviors in future studies than we were able to include here, and to explore the range of determinants of these behaviors (as well as of recycling). We also note that our knowledge measure (particularly relating to the lab) had rather low reliability and could be improved in future work. Finally, our research focussed on one type of workplace (i.e., scientific research organizations), albeit including two very different contexts within that (laboratories and offices), with a UK-dominated sample. Future research should consider expanding cross-contextual spillover studies to other kinds of work environment (e.g., factories, shops, schools) and a wider range of cultures.

ETHICS STATEMENT

This study was carried out in accordance with the recommendations of the British Psychological Society with written informed consent from all subjects. All subjects gave written informed consent in accordance with the Declaration of Helsinki. The protocol was approved by the School of Psychology Research Ethics Committee, Cardiff University.

AUTHOR CONTRIBUTIONS

LW designed the research, conducted the statistical analysis, and led the writing. PH assisted with statistical analysis and contributed to writing. MT undertook and analyzed the interviews, and contributed to writing.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyg.2018.02447/full#supplementary-material

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Spillover Benefits: Emphasizing Different Benefits of Environmental Behavior and Its Effects on Spillover

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To reduce environmental problems, people need to consistently engage in pro-environmental behaviors. Many environmentally friendly actions not only benefit the environment, but can also save money. Research suggests that emphasizing monetary benefits of pro-environmental behavior may hinder positive spillover to other pro-environmental behaviors. Yet, it is unclear why and under which circumstances this is the case. We propose that spillover effects depend on how emphasizing different types of benefits affects environmental self-identity, as a stronger environmental self-identity is more likely to lead to other pro-environmental actions. We hypothesize that emphasizing monetary benefits of pro-environmental behavior is less likely to strengthen environmental self-identity than emphasizing environmental benefits, and therefore not likely to lead to positive spillover. We tested our hypotheses in four experiments. In Study 1, we found that emphasizing the environmental benefits of pro-environmental behavior strengthened environmental self-identity, and resulted in positive spillover compared to not emphasizing any benefits or emphasizing monetary benefits. However, these results were not replicated in Study 2 that included a larger student sample. Yet, Study 3, including a large sample of the general population, showed that emphasizing monetary benefits weakens environmental self-identity and thereby leads to less spillover than emphasizing environmental benefits or not emphasizing any benefits. Similarly, Study 4 suggests that emphasizing monetary benefits may weaken environmental self-identity and decrease positive spillover compared to emphasizing environmental benefits or no benefits. Our findings suggest that environmental self-identity is not easily influenced by emphasizing different types of benefits of behavior, and consequently, spillover behavior is not easily promoted or inhibited. Yet, emphasizing monetary benefits may be a risk in some cases, as it may inhibit positive spillover.

Keywords: environmental benefits, monetary benefits, environmental behavior, environmental self-identity, spillover

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INTRODUCTION

To reduce environmental problems, people need to consistently engage in pro-environmental behavior (Intergovernmental Panel on Climate Change [IPCC], 2018). Policy makers aiming to promote pro-environmental behavior often do so by emphasizing the individual benefits of the behavior. For example, it is emphasized that saving energy also saves you money. Yet, emphasizing

the monetary benefits of environmental behavior may be less effective in promoting the target behavior than emphasizing the environmental benefits (Bolderdijk et al., 2013; Schwartz et al., 2015). Monetary benefits of environmental behavior are often small, and may therefore not be perceived as worth the effort (Dogan et al., 2014). Importantly, emphasizing monetary benefits of pro-environmental behavior may not only hinder the adoption of the target behavior, but may also reduce the likelihood of spillover to other pro-environmental behaviors (Evans et al., 2013; Steinhorst et al., 2015; Steinhorst and Matthies, 2016). Spillover effects entail that the engagement in an initial pro-environmental behavior influences the likelihood of subsequent environmental actions (Thøgersen, 1999; Thøgersen and Ölander, 2003; Thøgersen and Crompton, 2009). An initial pro-environmental behavior can increase the likelihood of subsequent environmental behavior (i.e., positive spillover) or decrease the likelihood of following environmental behavior (i.e., negative spillover; Thøgersen and Crompton, 2009). To prevent negative spillover, and to promote positive spillover from initial pro-environmental behavior to subsequent pro-environmental actions, it is crucial to understand why and under which circumstances an initial behavior may lead to spillover when emphasizing different benefits.

A few studies suggest that emphasizing the monetary benefits of pro-environmental behavior hampers positive spillover to other pro-environmental actions. For example, when environmental benefits of car sharing were emphasized, people are afterward more likely to recycle compared to a control group, while there was no significant difference with the control group in recycling when monetary benefits of car sharing were emphasized (Evans et al., 2013). However, in this study people were presented with a scenario on car sharing, but it is not clear if they engaged in that behavior. Therefore, it is not yet clear how emphasizing benefits of behavior that people engaged in influences spillover effects. Similarly, emphasizing environmental benefits when providing electricity saving tips did promote other environmental behaviors compared to a control group, while emphasizing monetary benefits when providing those tips did not promote other environmental behaviors compared to a control group (Steinhorst et al., 2015; Steinhorst and Matthies, 2016). In this case, electricity saving tips were provided, and hence, no reference was made to whether people engaged in initial pro-environmental behavior. Furthermore, another study asked people to report their energy use and indicate how they would reduce their energy use by 5% (Spence et al., 2014). Next, participants received feedback that either emphasized environmental benefits of energy use or monetary benefits. The results showed that emphasizing environmental benefits of energy savings led to positive spillover compared to presenting financial benefits of energy savings; yet, in this study both experimental groups did not differ from the control condition in the extent to which spillover occurred. Again, it is not clear whether people actually engaged in the initial behavior, in this case energy saving behavior. Overall, these studies suggest that emphasizing the monetary benefits of pro-environmental behavior is less likely to result in positive spillover than emphasizing environmental benefits. However, the experimental conditions did not always significantly differ from the control condition. Therefore, it is important to study under which conditions spillover effects are most likely to occur. Furthermore, to provide more insight into how emphasizing benefits of pro-environmental behavior influences spillover, it is crucial to study the underlying process. We propose that spillover effects depend on the extent to which emphasizing different benefits strengthens the extent to which people realize they engaged in pro-environmental behavior and therefore see themselves as a person who engages in environmentally friendly behavior (i.e., when their environmental self-identity is strengthened) which in turn influences spillover effects. We propose that people are more likely to realize they engaged in pro-environmental behavior when environmental benefits of behavior are emphasized compared to when monetary benefits are emphasized.

Specifically, we reason that engagement in a pro-environmental behavior may particularly promote positive spillover to other environmental actions when the initial behaviors strengthen one's environmental self-identity (Van der Werff et al., 2014b). Environmental self-identity is the extent to which people see themselves as a pro-environmental person (Van der Werff et al., 2013). Environmental self-identity reflects a person identity as defined by Stets and Burke (2000), and refers to how people see themselves. Environmental self-identity is partly stable, as it is influenced by someone's values (Van der Werff et al., 2013; Gatersleben et al., 2014). However, how people see themselves is also malleable to some extent (Stets and Burke, 2000). For example, when initial environmentally friendly behavior signals that one is a pro-environmental person, environmental self-identity is likely to be strengthened. As people are motivated to be consistent and act in line with how they see themselves, a strong environmental self-identity in turn is likely to increase the likelihood of engagement in other pro-environmental behaviors (Stets and Burke, 2014). Indeed, a stronger environmental self-identity was associated with a range of pro-environmental actions, including self-reported behaviors such as energy conservation, reduction of waste, eco-shopping (Whitmarsh and O'Neill, 2010), recycling, refraining from flying to a holiday destination (Gatersleben et al., 2014), and with the likelihood of using green energy in the coming year, a stronger preference for sustainable products and actual use of paper in a more economical way (Van der Werff et al., 2013, 2014b). Hence, when people realize they engaged in environmentally friendly behavior, their environmental self-identity is likely to be strengthened, increasing the likelihood of positive spillover to other pro-environmental actions.

We propose that engagement in pro-environmental behavior for which monetary benefits have been emphasized reduces the extent to which the behavior signals that one is a pro-environmental person, thereby not strengthening environmental self-identity and not promoting spillover to other environmental behaviors. Specifically, people may be less likely to realize they engaged in pro-environmental behavior when the behavior is presented as having monetary benefits. Indeed, research suggests that when people engage in pro-environmental behavior for environmental reasons, environmental self-identity

is strengthened and spillover to other pro-environmental behaviors is likely to occur (Peters et al., 2018). However, when people engage in pro-environmental behavior for other reasons, such as monetary reasons, their environmental self-identity is not strengthened and spillover to other pro-environmental behaviors is not likely (Peters et al., 2018), probably because in such cases, people are less likely to realize they engaged in pro-environmental behavior. Hence, we propose that for positive spillover to occur, it is critical that people realize they engaged in pro-environmental behavior, which is less likely to be the case when the monetary benefits of the particular behavior are emphasized.

In some cases, people may realize they engaged in environmentally friendly behavior even when the environmental benefits are not emphasized, for example when people believe the behavior has clear environmental benefits. For example, adopting solar panels or an electric vehicle may both be clearly seen as pro-environmental behaviors, even when environmental benefits are not emphasized. In such cases, emphasizing the environmental benefits of the behavior may have no or little added value above not stressing any benefit of the behavior, as people are likely to already realize they engaged in a pro-environmental behavior. When environmental benefits of behavior are very clear, engagement in such behavior is likely to strengthen environmental self-identity even when environmental benefits are not emphasized, making positive spillover to other pro-environmental behavior likely anyway. However, when the monetary benefits of such behaviors are emphasized, engagement in these behaviors may reduce the likelihood that people realize they engaged in pro-environmental behavior compared to not emphasizing any benefits, as they may instead see the behavior primarily as financially beneficial. Therefore, emphasizing the monetary benefits of a behavior that is clearly pro-environmental may weaken environmental self-identity and lead to less positive spillover compared to not emphasizing any benefits.

The current paper will test spillover effects following initial pro-environmental behavior for which monetary, environmental or no benefits are emphasized. Importantly, we will examine the underlying process through which emphasizing different benefits of behavior can influence spillover behavior. We expect that when people realize they engaged in a pro-environmental behavior, their environmental self-identity is more likely to be strengthened, making positive spillover to other environmental behavior more likely. Specifically, we expect environmental self-identity to be increased (rather than merely made salient) by reminding people of their past pro-environmental behavior. Research has shown that past environmental behavior is more likely to influence environmental self-identity when it concerns environmental behavior that they typically conduct, and not when it concerns environmental behavior which they hardly engage in (Van der Werff et al., 2014b). This suggests that environmental self-identity is not merely made salient by a reminder of environmental behavior, but that environmental self-identity increases when you realize you often engage in environmental behavior. In Study 1, we will focus on behavior that may not clearly be associated with environmental benefits, making it less likely that people realize they engaged in pro-environmental behavior. We expect that emphasizing the environmental benefits of these actions will strengthen environmental self-identity and spillover to other pro-environmental behavior compared to emphasizing monetary benefits or not emphasizing any benefits. To validate our findings, we will replicate Study 1 among a larger student sample in Study 2, and among a larger general population sample in Study 3. In Study 4, we focus on behavior that is clearly pro-environmental. When people anticipate engaging in such behavior, environmental self-identity may be strengthened and positive spillover may increase even when environmental benefits are not emphasized. We expect that emphasizing the monetary benefits of such behaviors may weaken environmental self-identity and reduce positive spillover compared to emphasizing environmental benefits or not emphasizing any benefits because emphasizing monetary benefits may make it less likely that people realize they engaged in a pro-environmental behavior.

STUDY 1

Methods

Data were collected via an online questionnaire. Participants were students of a university in the Netherlands participating in a course. Participants were invited via email to fill out the online study; they did not receive any compensation for it. In total, 39 participants filled out the questionnaire (N = 17 in the monetary condition, N = 9 for in environmental condition, N = 13 in the control condition). Age ranged from 18 to 29 (M = 21.3), 5 participants were male, 34 female.

Materials

We included a control question to check if participants carefully filled out the questionnaire. In the title of the question, we asked participants what their favorite sport is. However, in the explanation below the title we explained that this was a quality check and people should indicate what their favorite pet is, not their favorite sport. When participants mentioned a pet in their answer to this question they were included in the data analyses. Out of 39 participants, 35 answered this question by mentioning a pet (N = 15 in the monetary condition, N = 9 for in environmental condition, N = 11 in the control condition). We report the results based on all participants in the main text and the results based on the participants who answered the control question correct in a footnote.

We manipulated the type of benefit of respondents' past pro-environmental behavior (following Cornelissen et al., 2008)[1]. Participants were presented with a list of eight behaviors that many people frequently engage in (switching off appliances; lowering the heating; going by bike instead of by car; returning returnable bottles; switching off lights when no-one is in the room; using

[1]The study also included a fourth condition in which participants were presented with a list of eight behaviors that have no clear monetary or environmental implications (e.g., playing games studying). However, as these were not environmental behaviors this condition is not relevant for the current study.

energy efficient light bulbs; not eat meat every day; washing with a full load). Participants were asked to indicate to what extent each behavior applies to them (e.g., 'I switch off electric appliances') on a scale from 1 (totally disagree) to 7 (totally agree). As the behaviors are behaviors most people frequently engage in, the idea is that participants realize that they regularly engage in these behaviors. To emphasize the different benefits of the behaviors, the behaviors were either presented as environmental, monetary or neutral behaviors (e.g., 'Please indicate to what extent the following statements on *environmental behavior/financial behavior/behavior* apply to you'). As expected, overall, participants frequently engaged in these behaviors (M = 5.51, SD = 0.74). There were no significant differences between the three conditions in the extent to which they agree with the statements [$F(2,36) = 1.35$, $p = 0.27$]; simple contrast further revealed that the environmental (M = 5.86, SD = 0.58), monetary (M = 5.43, SD = 0.50) and control condition (M = 5.38, SD = 1.01) all did not significantly differ (all p-values > 0.10).

Measures

The following three items were used to measure environmental self-identity: Acting environmentally friendly is an important part of who I am; I am the type of person who acts environmentally friendly; I see myself as an environmentally friendly person (Van der Werff et al., 2013). Respondents rated each item on a seven-point scale, ranging from totally disagree to totally agree. Cronbach's alpha for this scale was 0.93 (M = 3.96, SD = 1.31).

To measure spillover, participants were asked to choose one out of two options of a product. One of the options was always the environmentally friendly and more expensive option, the other was the environmentally unfriendly and cheaper option. Participants indicated for five products: cookies, paper towel, deodorant, light bulbs, and cleaning products if they preferred the cheaper environmentally unfriendly option or the 10% more expensive environmentally friendly option. We counted the number of pro-environmental options participants chose out of the five options (M = 3.23, SD = 1.39).

Results

We conducted analysis of variance (ANOVA) to test our hypotheses. The manipulation had a significant influence on environmental self-identity [$F(2,36) = 4.27$, $p = 0.02$, $\eta_p^2 = 0.19$[2]]. Contrast analyses revealed that participants in the environmental condition (M = 4.89, SD = 0.97) had a stronger environmental self-identity than those in the control condition [M = 3.36, SD = 1.52; $t(36) = 2.92$, $p < 0.01$, $d = 1.20$, see **Figure 1**]. Besides, participants in the environmental condition had a marginally significantly stronger environmental self-identity than those in the monetary condition [M = 3.96, SD = 1.10; $t(36) = 1.94$, $p = 0.06$, $d = 0.90$]. No differences in environmental self-identity were found between the monetary condition and the control condition [$t(36) = 1.26$, $p = 0.22$].

The manipulation had a marginally significantly effect on product choice [$F(2,36) = 2.57$, $p = 0.09$, $\eta_p^2 = 0.13$[2]]. Contrast analyses revealed that participants in the environmental condition (M = 4.00, SD = 0.87) chose more pro-environmental products than those in the control condition [M = 2.69, SD = 1.38; $t(36) = 2.27$, $p = 0.03$, $d = 1.14$; see **Figure 2**]. Participants in the monetary condition (M = 3.24, SD = 1.48) chose less sustainable products than participants in the environmental condition, however, this difference was not statistically significant [$t(36) = 1.39$, $p = 0.17$]. The monetary and control condition did not differ significantly either [$t(36) = 1.11$, $p = 0.28$].

Discussion

In Study 1, we found that emphasizing the environmental benefits of past behavior that are commonly adopted strengthens

[2]We ran the same analysis including only the participants who answered the control question correctly. The results are similar.

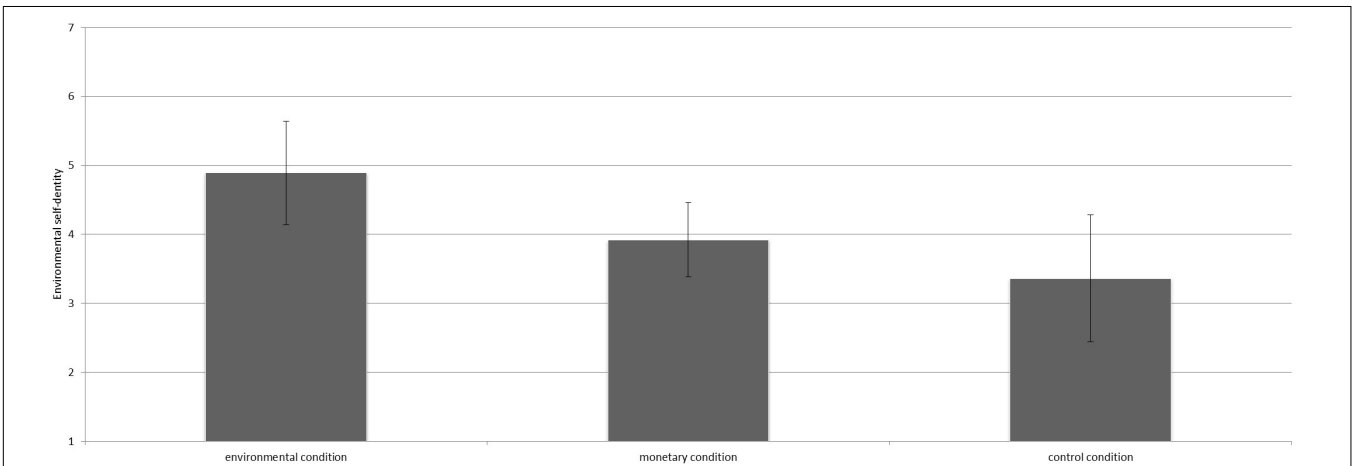

FIGURE 1 | Mean scores on environmental self-identity for the three conditions including the 95% confidence interval.

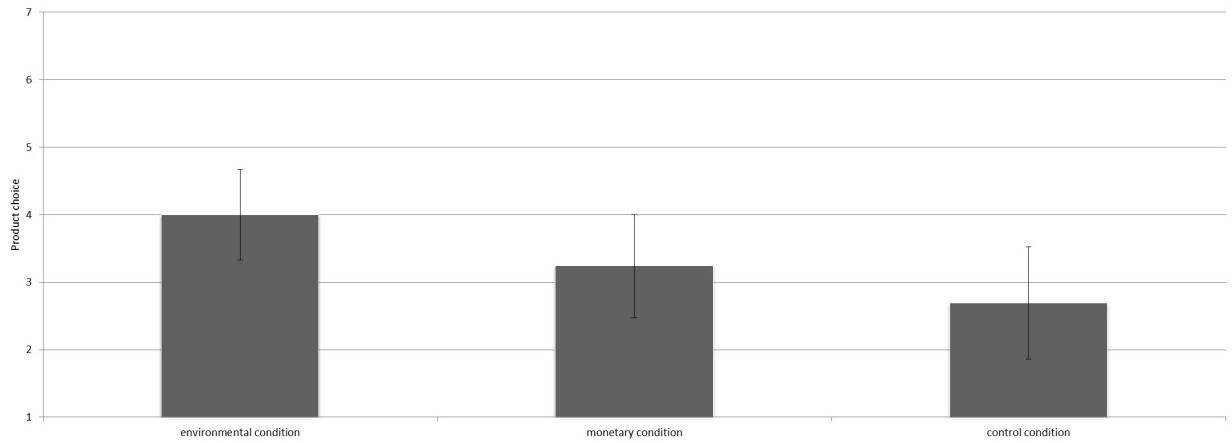

FIGURE 2 | Mean number of environmentally friendly products chosen per condition including the 95% confidence interval.

environmental self-identity and results in choosing more pro-environmental products compared to not emphasizing any benefits. Emphasizing monetary benefits of the same behaviors resulted in a marginally significantly weaker environmental self-identity compared to emphasizing environmental benefits. Environmental self-identity did not differ depending on whether monetary benefits or no benefits were emphasized. Emphasizing monetary benefits of past environmental behavior did not result in significantly less spillover behavior compared to emphasizing environmental benefits or no benefits. Our findings suggest that for pro-environmental behavior that is commonly adopted, emphasizing the environmental benefits does strengthen environmental self-identity and does lead to spillover behavior compared to a control group, while emphasizing monetary benefits does not strengthen environmental self-identity and does not promote positive spillover compared to a control group. One reason for not finding significant differences in spillover behavior between the environmental and monetary condition may be that the effects are too weak to detect in our sample. Therefore, Study 2 will include a larger student sample. Furthermore, in Study 1 the dependent variable was a choice between an environmentally friendly product that was more expensive and a cheaper environmentally unfriendly product. We argued that when people realize they engaged in pro-environmental behavior their environmental self-identity is strengthened and therefore they are more likely to choose the environmentally friendly products. However, it may be that when people realize they engaged in money saving behavior they may see themselves more as a person who saves money. Therefore, they may be more likely to choose the cheap products. This reasoning suggests that comparing people who realized they engaged in pro-environmental behavior to people who realized they engaged in money saving behavior may particularly lead to differences in environmental behavior that reflects a conflict between money and the environment. Therefore, in Study 2 we will also include a dependent variable that does not reflect a conflict between the environment and money.

STUDY 2

Methods

Data were collected via an online questionnaire. Participants were students of a university in the Netherlands participating in the study for credits. Power analysis showed that we needed 252 participants. In total, 366 participants filled out the questionnaire (N = 120 in the monetary condition, N = 125 for in environmental condition, N = 121 in the control condition). Age ranged from 17 to 38 (M = 19.9), 102 participants were male, 263 female, and 1 person indicated 'other' or preferred not to say.

Materials

We included the same control question as in Study 1 to check if participants carefully filled out the questionnaire. Out of 364 participants, 316 answered the question correct (N = 106 in the monetary condition, N = 106 for in environmental condition, N = 104 in the control condition). We report the results based on all participants in the main text and the results based on the participants who answered the control question correct in a footnote.

We manipulated the type of benefit of respondents' past pro-environmental behavior in the same way as in Study 1. As expected, overall, participants regularly engaged in these behaviors (M = 5.45, SD = 0.81). There were no significant differences between the three conditions in the extent to which they engage in the behaviors [$F(2,363)$ = 0.09, p = 0.92]. The control condition (M = 5.46, SD = 0.81), the environmental condition (M = 5.43, SD = 0.77), and the monetary condition (M = 5.47, SD = 0.87) did not significantly differ (all p-values > 0.10).

Measures

We used the same items as in Study 1 to measure environmental self-identity. Cronbach's alpha for the scale was 0.89 (M = 4.77, SD = 1.29).

We used the same product choice task to measure spillover as in Study 1. On average participants chose 3.63 pro-environmental products out of five (SD = 1.24).

We measured the intention to engage in pro-environmental behaviors that are not associated with higher financial costs, with four items (I would sign a petition to protest against environmentally unfriendly policies; I support pro-environmental policies; I intend to recycle my waste; I intend to reduce my waste). Respondents rated each item on a seven-point scale, ranging from totally disagree to totally agree. Cronbach's alpha for this scale was 0.79 (M = 5.54, SD = 1.15).

Results

We conducted analysis of variance (ANOVA) to test our hypotheses. The manipulation did not significantly influence environmental self-identity [$F(2,363) = 1.23$, $p = 0.29$[3]]. Contrast analyses revealed that environmental self-identity did not differ for participants in the environmental condition (M = 4.66, SD = 1.19), the control condition (M = 4.76, SD = 1.33) and the monetary condition (M = 4.91, SD = 1.35; all p's > 0.10, see **Figure 3**).

The manipulation did not influence product choice [$F(2,363) = 0.73$, $p = 0.48$[3]]. Contrast analyses revealed that participants in the environmental condition (M = 3.59, SD = 1.26), the control condition (M = 3.56, SD = 1.28), and the monetary condition (M = 3.74, SD = 1.17) did not significantly differ in the number of pro-environmental products chosen (all p's > 0.10, see **Figure 4**).

The manipulation did not influence intention [$F(2,363) = 0.84$, $p = 0.43$[3]]. Contrast analyses revealed that participants in the environmental condition (M = 5.43, SD = 1.18), the control condition (M = 5.60, SD = 1.11), and the monetary condition (M = 5.59, SD = 1.14) did not significantly differ in intention to engage in pro-environmental actions (all p's > 0.10, see **Figure 5**).

Discussion

Study 2 aimed to replicate Study 1 among a larger student sample with sufficient power. Study 2 showed that emphasizing the environmental benefits of past pro-environmental behavior did not increase environmental self-identity compared to not emphasizing any benefits or compared to emphasizing

[3]We ran the same analysis only including the participants who answered the control question correctly. The results are similar.

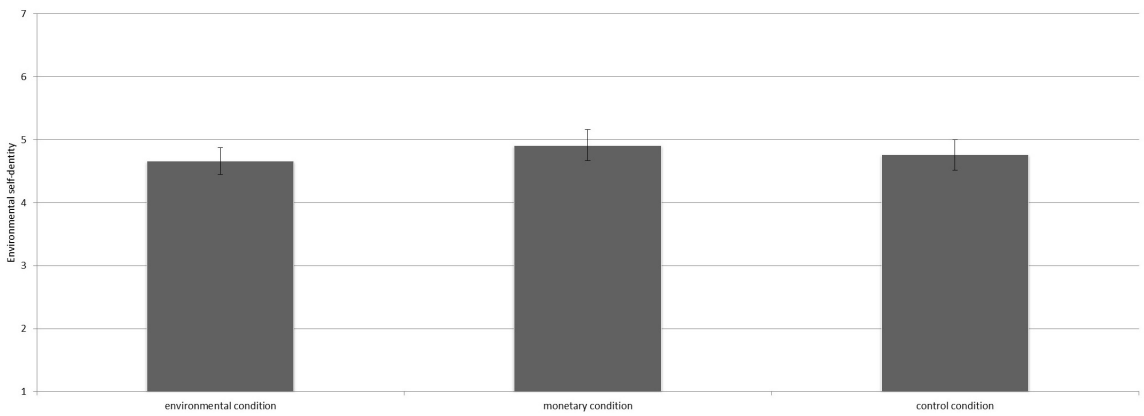

FIGURE 3 | Means scores on environmental self-identity for the three conditions including the 95% confidence interval.

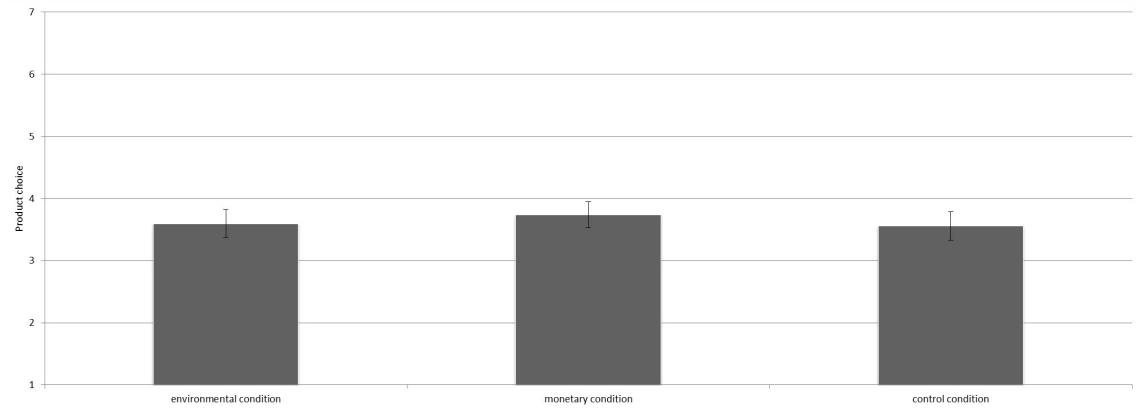

FIGURE 4 | Mean number of environmentally friendly products chosen per condition including the 95% confidence interval.

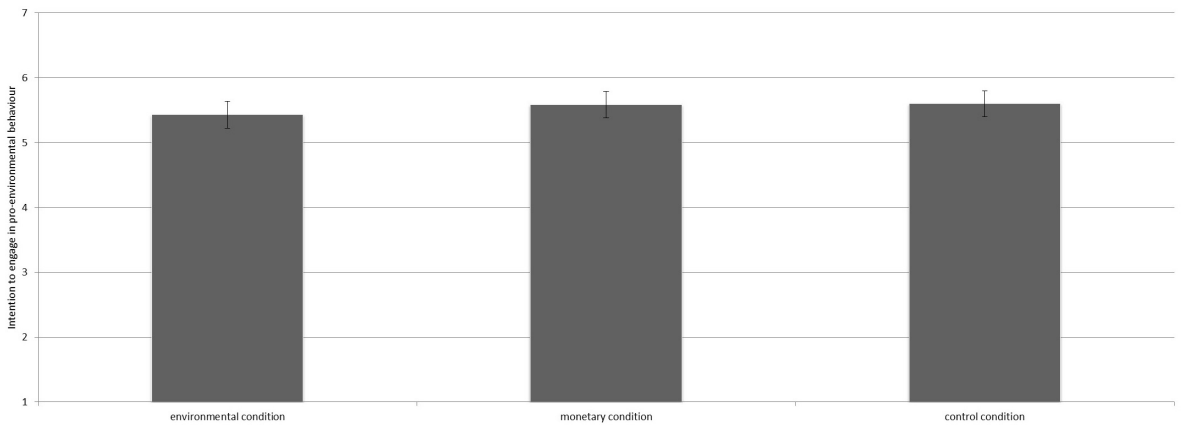

FIGURE 5 | Mean intention to engage in pro-environmental behavior per condition including the 95% confidence interval.

the monetary benefits. Emphasizing the monetary benefits also did not reduce environmental self-identity compared to not emphasizing any benefits. Furthermore, emphasizing the environmental benefits of past environmental behavior did not increase the number of pro-environmental products chosen or the intention to engage in pro-environmental behavior compared to not emphasizing any benefits or compared to emphasizing the monetary benefits. Emphasizing the monetary benefits also did not influence product choice or intention compared to not emphasizing any benefits. Our hypotheses that emphasizing the environmental benefits of past behavior strengthens environmental self-identity and leads to spillover behavior are thus not confirmed. The findings suggest that environmental self-identity may be quite robust, and not easily changed by emphasizing different benefits of past pro-environmental actions. This is in line with research showing that environmental self-identity is partly stable because it is rooted in one's values (Van der Werff et al., 2013; Gatersleben et al., 2014). Emphasizing the environmental or monetary benefits of the behavior may not easily influence environmental self-identity and spillover to other environmental actions. However, we tested our hypotheses among a rather specific sample, namely university students, mostly female. To test the validity of our findings further, we replicated the study again among a more general population sample.

STUDY 3

Methods

Data were collected via an online questionnaire. Participants were members of a Qualtrics panel in the Netherlands who received a small financial compensation for their participation. Power analysis showed that we needed 252 participants. In total, 307 participants filled out the questionnaire (N = 102 in the monetary condition, N = 102 for in environmental condition, N = 103 in the control condition). Age ranged from 18 to 81 (M = 50.6), 163 participants were male, 143 female, and 1 person indicated 'other' or preferred not to say.

Materials

We included two control questions to check if participants carefully filled out the questionnaire. The strict control question was the same question as in Studies 1 and 2. Out of 307 participants, 168 answered this control question correctly, namely by mentioning a pet (N = 56 in the monetary condition, N = 56 for in environmental condition, N = 56 in the control condition). We included a second control question as well, namely an item stating 'I have paid attention so I will select "seven" on the scale.' All participants selected seven for this scale. We report the results based on all participants in the main text and the results based on the participants who answered the control question correct in a footnote.

We manipulated the type of benefit of respondents' past pro-environmental behavior in the same way as in Studies 1 and 2. As expected, overall, participants regularly engaged in these behaviors (M = 5.68, SD = 0.91). There were no significant differences between the three conditions in the extent to which they engaged in the behaviors [$F(2,304) = 2.09$, p = 0.13]. However, in the control condition (M = 5.77, SD = 0.92) participants indicated to engage in the behavior marginally significantly more than in the monetary condition [M = 5.54, SD = 1.01; $t(304) = 1.89$, p = 0.06]. Furthermore, in the environmental condition (M = 5.74, SD = 0.78) participants indicated to marginally significantly engage in the behavior more than in the monetary condition [$t(304) = 1.63$, p = 0.10]. The environmental and control condition did not significantly differ (p = 0.80). Importantly, in all conditions participants engaged in the behaviors frequently.

Measures

We used the same items as in Study 1 to measure environmental self-identity. Cronbach's alpha for the scale was 0.92 (M = 5.16, SD = 1.29).

We used the same product choice task to measure spillover as in Study 1. On average participants chose 3.87 pro-environmental products out of five (SD = 1.28).

We used the same items to measure the intention to engage in pro-environmental behaviors as in Study 2. Cronbach's alpha for this scale was 0.85 (M = 5.53, SD = 1.19).

Results

We conducted analysis of variance (ANOVA) to test our hypotheses. The manipulation did not significantly influence environmental self-identity [$F(2,304) = 2.13$, $p = 0.12$[4]]. Contrast analyses revealed that environmental self-identity of participants in the environmental condition (M = 5.25, SD = 1.31) did not differ from the control condition (M = 5.28, SD = 1.26; $p = 0.84$). However, the monetary condition (M = 4.94, SD = 1.28) scored marginally significantly weaker on environmental self-identity than the control condition [$t(304) = 1.88$, $p = 0.06$, see **Figure 6**]. Furthermore, participants in the monetary condition reported a marginally significantly weaker environmental self-identity than participants in the environmental condition [$t(304) = 1.67$, $p = 0.10$].

The manipulation did not influence product choice [$F(2,304) = 0.25$, $p = 0.78$[5]]. Contrast analyses revealed that participants in the environmental condition (M = 3.94, SD = 1.17), the control condition (M = 3.86, SD = 1.32), and the monetary condition (M = 3.81, SD = 1.36) did not significantly differ in the number of products they chose (all p's > 0.10, see **Figure 7**).

The manipulation did not influence intention to engage in pro-environmental behavior [$F(2,304) = 0.89$, $p = 0.41$[5]]. Contrast analyses revealed that intentions did not significantly differ across participants in the environmental condition (M = 5.59, SD = 1.10), the control condition (M = 5.60, SD = 1.11), and the monetary condition (M = 5.40, SD = 1.34; all p's > 0.10, see **Figure 8**).

As the sample size in this study was relatively large and the effects of the manipulation on environmental self-identity are marginally significant, we additionally tested if environmental self-identity mediates the relationship between the manipulation and product choice and intention to act pro-environmentally, respectively. As reported above, environmental self-identity only marginally differed between the monetary condition versus the control condition as well as the environmental condition. Therefore, we computed a dummy variable comparing the monetary condition to both other conditions. We used Hayes' macro to test if the dummy variable influenced product choice and intention via environmental self-identity (Hayes et al., 2010).

The results showed that the dummy variable influenced product choice via environmental self-identity ($a \times b = -0.14$). The 95% confidence interval ranged from -0.30 to -0.01[5]. As the confidence interval did not include 0, the mediation effect was significant. Emphasizing the monetary benefits weakened environmental self-identity compared to not emphasizing benefits or emphasizing environmental benefits ($a = -0.32$, $p = 0.04$). Next, environmental self-identity was positively related to pro-environmental product choice ($b = 0.44$, $p < 0.001$). The direct effect of the dummy variables on product choice remained not significant when environmental self-identity was also included in the analysis ($c' = 0.05$, $p = 0.72$). Therefore, we found indirect-only mediation (Zhao et al., 2010).

The dummy variable influenced intention to act pro-environmentally via environmental self-identity as well ($a \times b = -0.22$). The 95% confidence interval ranged from -0.45 to -0.01[5]. As the confidence interval did not include 0, the mediation effect was significant. Environmental self-identity was positively related to the intention to engage in pro-environmental behavior ($b = 0.70$, $p < 0.001$). The direct effect of the dummy variable on intention remained not significant when environmental self-identity was included as well

[4]We ran the same analysis including the participants who answered the strict control question correctly. The results are similar. The control and monetary condition still differed [$t(165) = 2.01$, $p = 0.05$]. However, the monetary condition no longer differed significantly from the environmental condition [$t(165) = 1.18$, $p = 0.24$].

[5]When only the participants who answered the strict control question correctly were included the results are similar.

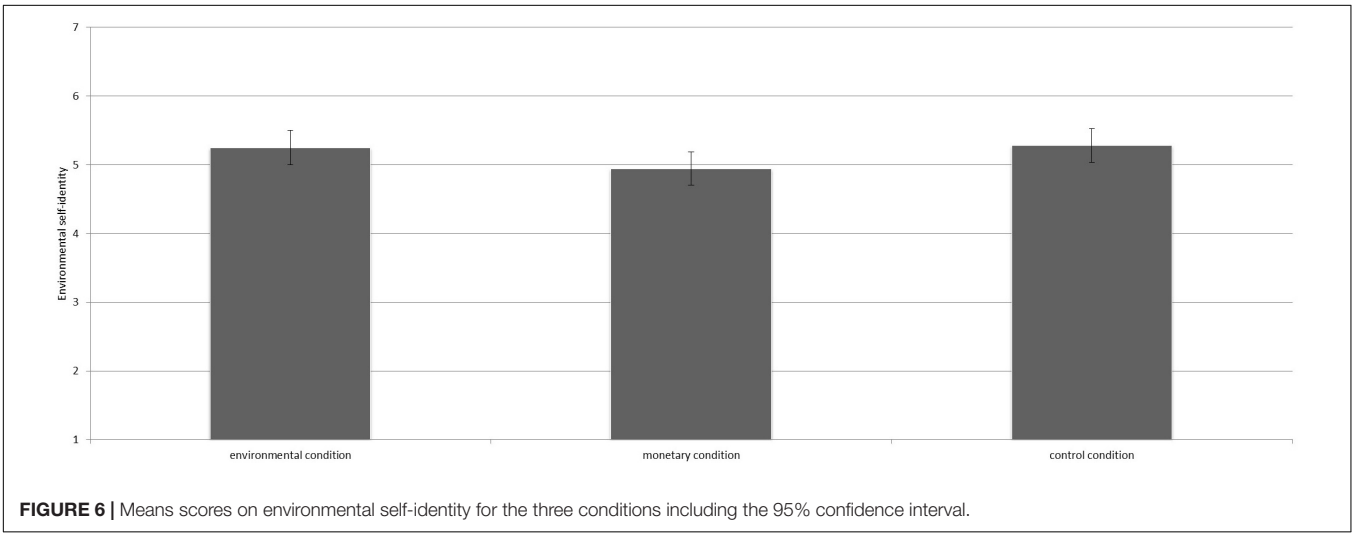

FIGURE 6 | Means scores on environmental self-identity for the three conditions including the 95% confidence interval.

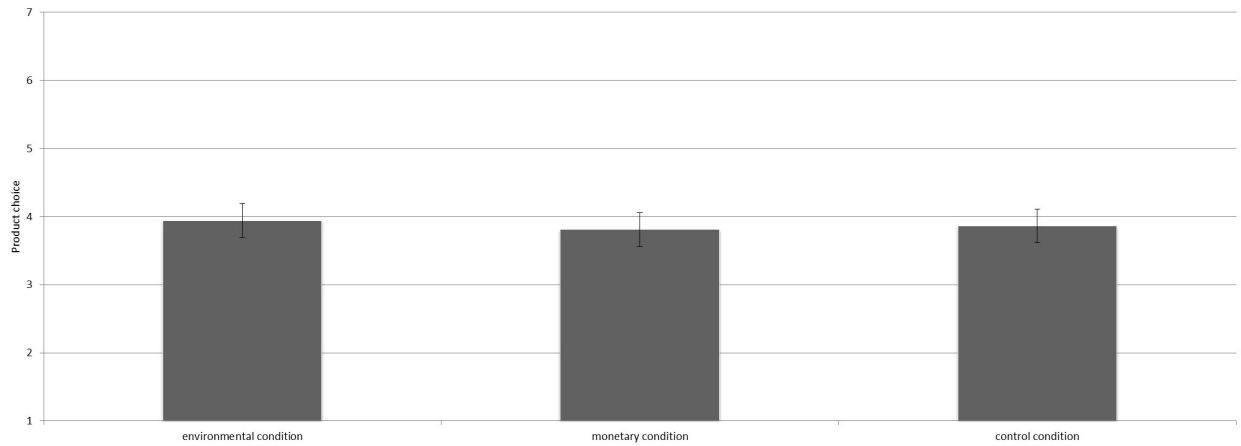

FIGURE 7 | Mean number of environmentally friendly products chosen per condition including the 95% confidence interval.

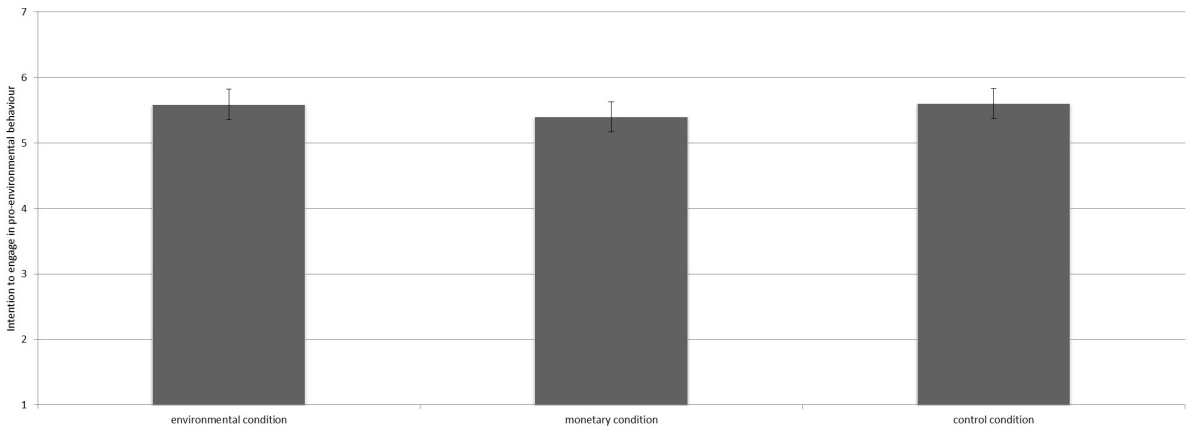

FIGURE 8 | Mean intention to engage in pro-environmental behavior per condition including the 95% confidence interval.

(c' = 0.05, p = 0.75). Therefore, again, we found indirect-only mediation (Zhao et al., 2010).

Discussion

Study 3 aimed to replicate Studies 1 and 2, again with sufficient power, but this time we tested our hypotheses among a more general population sample. The results show that emphasizing environmental benefits of past environmental behavior does not strengthen environmental self-identity compared to the control group. However, emphasizing the monetary benefits of past behavior marginally significantly weakens environmental self-identity compared to the not emphasizing any benefits and compared to emphasizing the environmental benefits. We did not find any direct effects of the manipulation on spillover to pro-environmental product choice or intention to engage in pro-environmental behavior. However, the results of the mediation analyses show that emphasizing the monetary benefits of behavior weakens environmental self-identity and thereby reduces both types of positive spillover behavior. We found that a weakened environmental self-identity resulted in less pro-environmental behavior that reflects a conflict between money and the environment. However, importantly, a weakened environmental self-identity also resulted in a weaker intention to engage in pro-environmental behavior that does not cost money. These findings suggest that our results are not only explained because emphasizing the monetary benefits makes people focus more on the financial benefits and therefore makes financially beneficial behavior more likely. It suggests that when monetary benefits are emphasized, environmental self-identity is weaker, making it less likely that people engage in other pro-environmental behaviors, also when these behaviors are not financially costly.

However, again, our findings suggest that people's environmental self-identity rather robust as it is not easily changed by emphasizing different types of benefits of past behavior. This is in line with research showing that environmental self-identity is partly stable because it is rooted in one's values. Therefore, emphasizing the environmental or financial benefits of the behavior is not likely to easily promote positive spillover to other pro-environmental

behaviors. Interestingly, it seems that if any effect occurs emphasizing monetary benefits may be risky, as this may weaken environmental self-identity to some extent.

STUDY 4

We reasoned in the introduction that emphasizing the monetary benefits may particularly weaken environmental self-identity and lead to less positive spillover to other pro-environmental behavior when a behavior is clearly pro-environmental. When behavior is clearly pro-environmental, people are likely to be well aware of the environmental benefits. Emphasizing monetary benefits of such behavior may merely weaken the extent to which people perceive its environmental benefits and therefore weaken environmental self-identity and positive spillover to other pro-environmental behaviors. Therefore, Study 4 aimed to test if emphasizing the monetary benefits of a clearly pro-environmental behavior results in a weaker environmental self-identity and reduces positive spillover to other pro-environmental actions compared to not emphasizing any benefits of the initial behavior or emphasizing the environmental benefits of the behavior.

Methods

Data were collected via an online questionnaire study. Participants were students in a course who could participate on a voluntary basis and did not receive any compensation for it. Participants were invited to participate in the study via email. In total, 91 participants filled out the questionnaire (N = 30 in the monetary condition, N = 30 for in environmental condition, N = 31 in the control condition). Age ranged from 19 to 28 (M = 21.9), 32 participants were male, and 59 female.

Materials

We included the same strict control question as in Studies 1, 2, and 3 to check if participants carefully filled out the questionnaire. Out of 91 participants, 71 answered this question by mentioning a pet (N = 21 in the monetary condition, N = 26 for in environmental condition, N = 24 in the control condition). We report the results based on all participants in the main text and the results based on the participants who answered the control question correct in a footnote.

We manipulated past pro-environmental behavior via a scenario. Participants were randomly assigned to one of three scenarios: the monetary condition, environmental condition and control condition[6]. Participants were asked to imagine that they just bought an electric vehicle. We asked participants to imagine they spent a lot of time figuring out which car to buy and that few others would buy an electric vehicle, thereby strengthening the extent to which purchasing an electric vehicle says something about a person and thereby strengthening its influence on environmental self-identity (see Van der Werff et al., 2014a). The adoption of an electric vehicle in the scenario was either presented as a pro-environmental behavior, a financially beneficial behavior or no emphasis was included:

'Imagine that you work at a company and need a car to get to work every day. You bought an electric car. You spent a lot of time figuring out which electric car *was most environmentally friendly to buy/was financially most attractive to buy/to buy*. You chose a car that was *very environmentally friendly/the best financial investment*. Only few people buy an electric car.'

Measures

The same items as in the previous studies were used to measure environmental self-identity. Cronbach's alpha for this scale was 0.90 (M = 4.59, SD = 1.11).

Similarly to the product choice task in Studies 1, 2, and 3 participants, were asked to choose one out of two options of a product to measure spillover effects. One of the options was always an environmentally friendly option that was 10% more expensive, while the other was an environmentally unfriendly but cheaper option. For example, participants were asked to choose between a pair of socks of 3 Euros that was produced unsustainably or a pair of socks of 3.30 Euros that was produced sustainably. In this study, participants indicated for eight products, namely jeans, milk, a laptop, a pen, a writing pad, a bike, a pair of socks and a mobile phone which option they preferred. We counted the number of pro-environmental options participants chose out of eight options (M = 4.40, SD = 2.21).

Results

We conducted analysis of variance (ANOVA) to test our hypotheses. The manipulation did not have a significant effect on environmental self-identity [$F(2,85) = 1.61$, $p = 0.21$, $\eta_p^2 = 0.04$[7]]. However, contrast analyses revealed that participants in the monetary condition (M = 4.31, SD = 0.82) reported a marginally significantly weaker environmental self-identity than participants in the environmental condition [M = 4.82, SD = 1.21; $t(85) = 1.75$, $p = 0.08$, $d = 0.49$]. Environmental self-identity did not significantly differ between the monetary condition and the control condition [M = 4.66, SD = 1.21; $t(85) = -1.21$, $p = 0.23$, see **Figure 9**]. As expected, no differences in environmental self-identity were found between participants in the environmental condition and participants in the control condition [$t(85) = 0.56$, $p = 0.58$].

The manipulation did not have a significant effect on product choice [$F(2,85) = 0.35$, $p = 0.71$, $\eta_p^2 = 0.01$[8]]. Contrast analyses revealed that participants in the environmental condition

[6]Similar to Study 1, this study also included a fourth condition in which participants were not presented with a scenario. In this condition, an initial pro-environmental behavior was not manipulated therefore spillover cannot be tested. Therefore, this condition is not included in the current study.

[7]When only the participants who answered the control question correct were included in the analyses the overall effect was significant [$F(2,68) = 3.30$, $p = 0.04$, $\eta_p^2 = 0.09$]. Those in the monetary condition (M = 4.03, SD = 0.77) reported a significantly weaker environmental self-identity than participants in the environmental condition [M = 4.64, SD = 1.15; $t(68) = 1.97$, $p = 0.05$, $d = 0.62$] and the control condition [M = 4.81, SD = 1.16; $t(68) = -2.45$, $p < 0.05$, $d = 0.79$]. The environmental and control condition remained not significantly different.

[8]When only the participants who answered the control question correct were included in the analyses the overall effect was significant [$F(2,68) = 2.82$, $p = 0.07$,

(M = 4.21, SD = 1.99), the control condition (M = 4.67, SD = 2.51), and the monetary condition (M = 4.31, SD = 2.14) did not significantly differ in the number of pro-environmental products chosen (all p's > 0.10, see **Figure 10**).

We again tested if environmental self-identity mediated the relationship between the manipulation and spillover behavior. As reported above, environmental self-identity only marginally differed between the monetary condition versus the environmental condition. Therefore, we computed a dummy variable comparing the monetary condition to the other conditions. We again used Hayes' macro to test if the dummy variable influenced product choice via environmental self-identity.

The results showed that the dummy variable influenced product choice via environmental self-identity ($a \times b = -0.48$). The 95% confidence interval ranged from −1.06 to −0.01[9]. As the confidence interval did not include 0, the mediation effect was significant. Emphasizing the monetary benefits marginally significantly weakened environmental self-identity compared to not emphasizing benefits or emphasizing environmental benefits ($a = -0.42$, $p = 0.09$). Next, environmental self-identity was positively related to pro-environmental product choice (b = 1.13, $p < 0.001$). The direct effect of the dummy variables on product choice remained not significant when environmental self-identity was also included in the analysis (c' = 0.35, p = 0.42). Therefore, we found indirect-only mediation (Zhao et al., 2010).

Discussion

In Study 4, we tested in a scenario study the influence of emphasizing monetary benefits of buying an electric car,

η_p^2 = 0.08]. Participants in the monetary condition (M = 3.67, SD = 2.03) chose significantly less sustainable products than participants in the control condition [M = 5.04, SD = 2.20; $t(68) = -2.24$, $p < 0.05$, d = 0.65]. Participants in the monetary condition did not differ from participants in the environmental condition [M = 4.00, SD = 1.94; $t(68)$ = 0.55, p = 0.58]. Participants in the environmental condition chose marginally significantly less sustainable products than participants in the control condition [$t(68) = -1.79$, p = 0.08, d = 2.41].

[9]When only the participants who answered the strict control question correctly were included the results are similar.

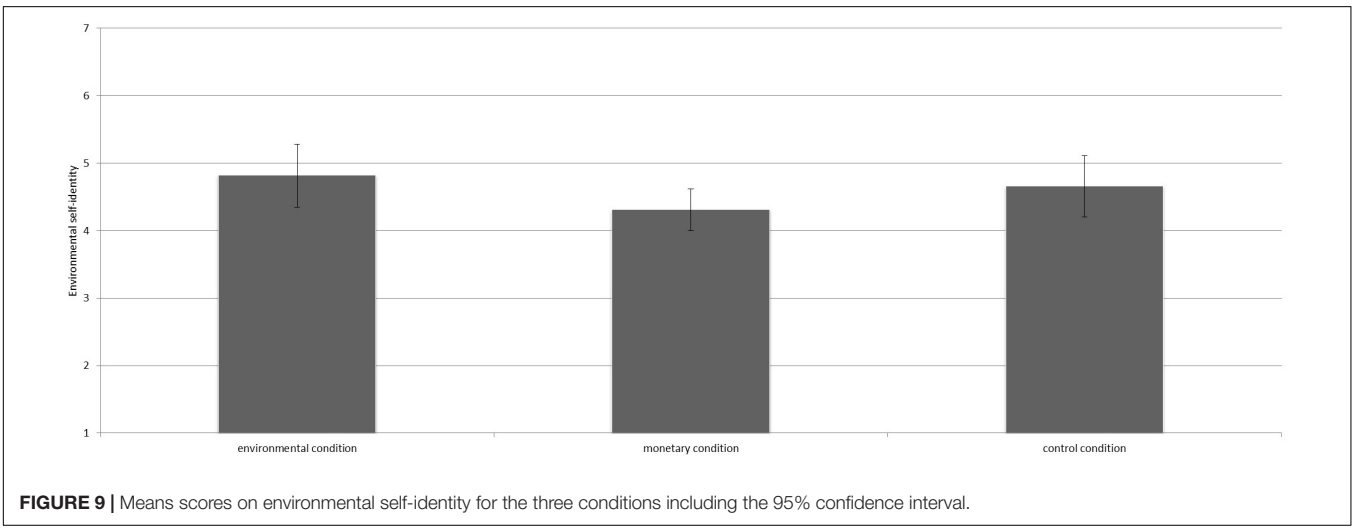

FIGURE 9 | Means scores on environmental self-identity for the three conditions including the 95% confidence interval.

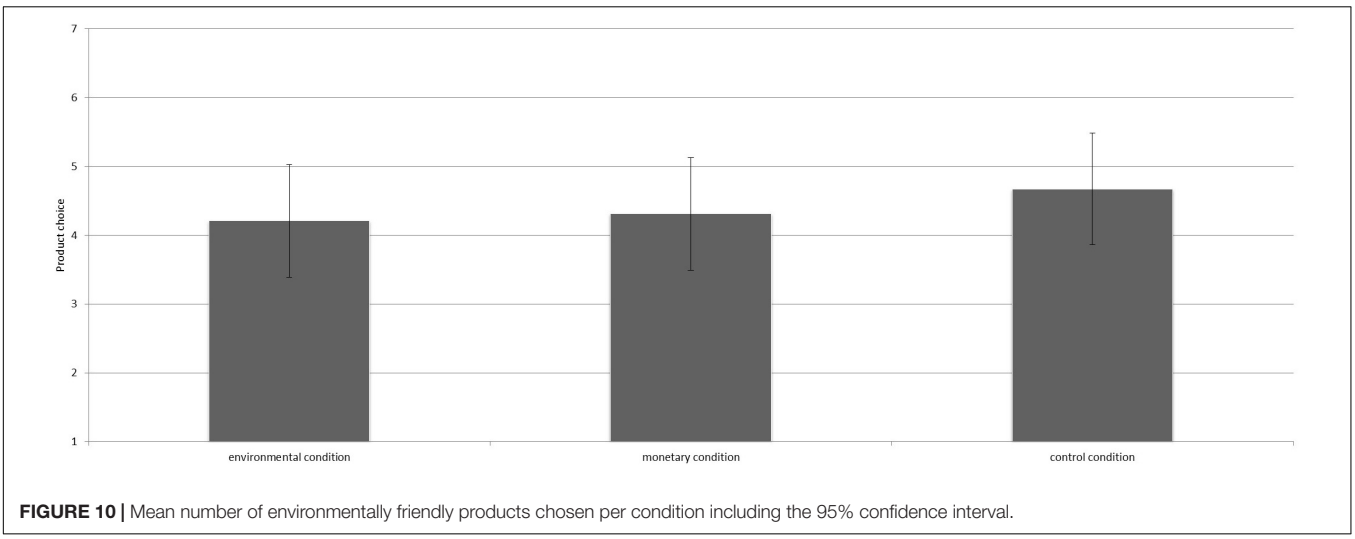

FIGURE 10 | Mean number of environmentally friendly products chosen per condition including the 95% confidence interval.

which is likely to be a clearly pro-environmental behavior, on environmental self-identity and spillover behavior. Our findings again suggest that environmental self-identity is quite robust and not easily changed by emphasizing different benefits of the behavior. However, we found that emphasizing the monetary benefits of buying an electric vehicle marginally significantly weakens environmental self-identity compared to emphasizing the environmental benefits. We did not find effects of emphasizing different benefits on pro-environmental product choice. However, we did find that emphasizing the monetary benefits marginally significantly weakens environmental self-identity and thereby weakens spillover behavior as environmental self-identity mediated the relationship between the manipulation and spillover behavior. When we only included the participants who answered the control question correct emphasizing monetary benefits lead to a weaker environmental self-identity compared to not emphasizing any benefits and compared to emphasizing environmental benefits. Among the participants who answered the control question correct, emphasizing monetary benefits also reduced the number of pro-environmental products chosen compared to not emphasizing any benefits. However, emphasizing the environmental benefits also reduced the number of pro-environmental products chosen compared to not emphasizing any benefits. Overall, these findings particularly suggest that emphasizing the monetary benefits of clearly pro-environmental behavior is risky, because environmental self-identity is weakened compared to emphasizing environmental benefits thereby reducing spillover effects.

GENERAL DISCUSSION

We aimed to test the influence of emphasizing different types of benefits of pro-environmental behavior on spillover to other pro-environmental behaviors. Research has shown that past pro-environmental actions can promote spillover to other pro-environmental behaviors by strengthening one's environmental self-identity. We proposed that emphasizing the monetary benefits of behavior may hamper the extent to which initial pro-environmental behavior strengthens environmental self-identity and promotes spillover to other pro-environmental behaviors, as doing so may decrease the likelihood that people realize they engaged in pro-environmental behavior.

Our results partly support our reasoning. Notably, results of Study 1 show that emphasizing the environmental benefits of environmental behavior that people commonly engage in does strengthen environmental self-identity and promotes spillover to other pro-environmental behaviors compared to not emphasizing any benefits. In contrast, emphasizing the monetary benefits of common pro-environmental actions does not strengthen environmental self-identity and does not result in stronger positive spillover effects compared to not emphasizing any benefits. Yet, in Study 2 we found that emphasizing environmental benefits does not increase environmental self-identity and spillover to other pro-environmental behavior. Furthermore, emphasizing monetary benefits did not weaken environmental self-identity and did not lead to less spillover to other pro-environmental behavior. In Study 3, we found that emphasizing monetary benefits somewhat weakens environmental self-identity compared to not emphasizing any benefits or emphasizing environmental benefits and thereby reduces spillover to other pro-environmental behaviors. However, we did not find direct effects of emphasizing different types of benefits on spillover behavior. Additionally, Study 4 shows that emphasizing monetary benefits of behavior with clear environmental benefits may somewhat weaken environmental self-identity and thereby reduce positive spillover to other pro-environmental behavior compared to emphasizing environmental benefits. However, we again did not find direct effects on spillover behavior. When we only included those who answered the control question correctly, Study 4 showed that emphasizing monetary benefits of behavior with clear environmental benefits weakens environmental self-identity compared to not emphasizing any benefits and compared to emphasizing environmental benefits. Furthermore, emphasizing monetary benefits reduced spillover compared to not emphasizing any benefits. However, emphasizing environmental benefits also reduced spillover behavior compared to not emphasizing any benefits for those participants.

Our research extends previous research in three ways. First, we tested the effects of an initial pro-environmental action on other pro-environmental behavior. We either reminded people of their past environmental behavior or presented them with a scenario in which they were asked to imagine they adopted a pro-environmental behavior. In earlier studies people did not actually engage in the initial pro-environmental action (Evans et al., 2013; Spence et al., 2014; Steinhorst et al., 2015; Steinhorst and Matthies, 2016). We sometimes found spillover effects. Yet, often we did not find direct spillover effects. To better understand under which circumstances spillover effects occur it is important that future research on spillover includes an initial environmental behavior. Initial environmental behavior can be included through a reminder of past behavior or a scenario. However, importantly, future research is also needed to test spillover behavior following actual environmental behavior.

Second, we studied the process underlying possible spillover effects. Our findings suggest that spillover effects depend on the extent to which environmental self-identity is strengthened. Notably, initial behaviors are more likely to encourage engagement in other types of pro-environmental behavior when the initial behavior strengthens individuals' environmental self-identity.

Third, we studied the conditions under which spillover effects occur. Importantly, our findings suggest that environmental self-identity is quite robust, and not easily changed by emphasizing the monetary or environmental benefits of behavior. Therefore, spillover behavior is not likely to be easily promoted. This may be explained by the finding the environmental self-identity also has a stable component, as it is influenced by and rooted in the values that people endorse, particularly biospheric values. As a consequence, environmental self-identity is likely to be somewhat robust (Van der Werff et al., 2013; Gatersleben et al.,

2014), and may only be changed when behavior clearly signals that you are a pro-environmental person (Van der Werff et al., 2014a). This is more likely when people realize they engaged in many pro-environmental behaviors or when the behavior is difficult and unique (Van der Werff et al., 2014a). Future research is needed to test under which circumstances emphasizing benefits of behavior is likely to influence environmental self-identity and thereby spillover behavior.

However, when people's environmental self-identity can be changed our results particularly suggest that emphasizing monetary benefits can be risky. Notably, our findings indicate that initial pro-environmental behavior may weaken environmental self-identity and thereby not lead to positive spillover when monetary benefits of pro-environmental behavior were emphasized compared to environmental benefits. This was the case for behavior that people frequently engage in as well as behavior that is clearly pro-environmental. Environmental self-identity was in some cases also somewhat weakened when monetary benefits were emphasized compared to not emphasizing any benefits. Our findings suggest that it may easier to weaken environmental self-identity by emphasizing monetary benefits than to strengthen environmental self-identity by emphasizing environmental benefits. Future research could test whether it is indeed easier to weaken environmental self-identity than to strengthen environmental self-identity and why this may be the case.

Future research is needed to examine if spillover effects indeed depend on the extent to which people realize they engaged in pro-environmental behavior. Furthermore, it could be tested if similar processes play a role when it concerns other benefits of pro-environmental behavior, as well as when it concerns other samples. For example, research suggests that emphasizing health benefits of pro-environmental behavior may also prevent positive spillover to other environmental actions (Carrico et al., 2017). Furthermore, people may engage in pro-environmental behavior for status reasons (Griskevicius et al., 2010). Emphasizing status benefits may also weaken the extent to which people realize they engaged in pro-environmental behavior. Future research is needed to test if emphasizing other benefits such as health or status benefits also hampers the extent to which pro-environmental behavior strengthens environmental self-identity as people may not realize they engaged in pro-environmental behavior. Furthermore, future research could test if our findings can be replicated among different samples as well. In Study 3, we included a general population sample to validate our findings. However, our participants were still all Western participants. Future research is needed to test if our findings also apply to other samples in other cultures.

Future research could examine the role of other potential mediators that can explain why spillover effects occur, such as self-efficacy. Indeed, research suggests that environmental behavior may lead to spillover to other environmental actions by strengthening self-efficacy (Lauren et al., 2016). When people engage in a pro-environmental action this may strengthen the extent to which they think they can engage in pro-environmental behavior thereby increasing the likelihood of other pro-environmental behaviors. Future research could also test the mediating role of environmental self-identity and self-efficacy, as identity and self-efficacy may be related (Brenner et al., 2018). That is, the more one sees oneself as a pro-environmental person the more one may think that one is capable of engaging in pro-environmental behavior. Future research should study the relationships between identity and self-efficacy.

Our results suggest that environmental self-identity is rather robust and spillover behavior is not easily changed by emphasizing different types benefits of behavior. However, in some cases emphasizing the environmental or monetary benefits of past pro-environmental behavior may influence environmental self-identity and subsequently the likelihood of positive spillover. Interestingly, we did not only find some support for spillover to behavior that implied a choice between saving money and the environment we also found some support for spillover to pro-environmental behavior that does not cost money. This suggests that our findings are not explained because emphasizing monetary benefits makes people see themselves more as a person who saves money and therefore engage in behavior that saves money. Our findings suggest that when people realize they engaged in pro-environmental behavior, their environmental self-identity is strengthened and therefore they are more likely to choose the environmentally friendly product. However, more research is needed to test if emphasizing the environmental or monetary benefits of behavior influences pro-environmental behavior that does not reflect a conflict between the environment and money. Furthermore, future research could test the influence on behavior that benefits the environment and saves money such as saving energy.

Future research could test to which behaviors environmental self-identity is most strongly related, and thereby to which environmental behaviors spillover effects are most likely. Additionally, future research is needed to test spillover effects to actual pro-environmental behavior. We tested spillover effects on intention to engage in pro-environmental behavior and on hypothetical choices, namely the preference for pro-environmental but more expensive products. The question remains whether similar results are found when the behavior is more difficult, and when people actually need to pay the additional costs. In line with the ABC-theory, environmental self-identity may be most strongly related to behavior that is somewhat difficult (Stern, 2000). When environmental behavior is very easy, almost everyone may engage in the behavior, therefore individual factors such as environmental self-identity are not or hardly related to the behavior. When the behavior is very difficult, hardly anyone engages in the behavior, therefore individual factors such as environmental self-identity may also hardly or not be related to the behavior. Future research could test the extent to which actual behaviors and environmental self-identity are related, and the extent to which an initial pro-environmental behavior is likely to spillover to actual pro-environmental actions via one's environmental self-identity. Future research could also examine whether effects depend on the extent to which the spillover behaviors are visible. There is some initial evidence to suggest that environmental

identity is more strongly related to behaviors that can be observed by others than to behaviors that are not visible for others (Brick et al., 2017). However, this study focused on an environmental social identity, not environmental self-identity. Visibility may be particularly relevant for social identity, when people are motivated to act in line with what their group values. Visibility of the behavior may be less relevant for environmental *self*-identity, as people with a strong environmental self-identity are motivated to act in line with how they see themselves, not how others see them. Future research is needed to test if the visibility of the environmental behavior influences the relationship between environmental self-identity and visible behavior and thereby whether an initial pro-environmental behavior is more likely to spillover to visible environmental behaviors than to less visible behaviors.

We included control questions in the questionnaire to test if participants carefully read the questions. In Studies 1 and 2, only few participants answered the question incorrectly, and the results did not differ depending on whether we included those who answered the control question incorrectly or not. However, in Studies 3 and 4, many participants answered the control question incorrectly. In Study 3, the results remained similar when only those who answered the control question correctly were included. However, this time environmental self-identity only differed between the monetary and the control condition, no longer between the monetary and the environmental condition. In Study 4, those in the environmental condition still reported a stronger environmental self-identity than those in the monetary condition, but the monetary condition also differed significantly from the control condition. Moreover, the direct effect of the manipulation on product choice became significant. Participants in the monetary condition chose less pro-environmental products than those in the control condition. However, those in the environmental condition also chose less products than those in the control condition. Our findings suggest that in some cases it may be useful to include a control question. When the sample consists of students who participate in the study to receive credits or consists of a panel that receives a financial compensation for participating the participants may be less likely to read the questions carefully. In such cases it may be useful to include a control question to ensure that participants read the questions and answered the questions seriously.

In contrast to our expectations, we found that emphasizing environmental benefits of behavior that has clear environmental benefits may reduce positive spillover slightly compared to not emphasizing any benefits. However, we only found this in Study 4, when only those participants were included who answered the control question correct and the difference was only marginally significant. However, these findings may hint to a reactance effect. For an environmental behavior with clear environmental benefits, people may realize that they engaged in a pro-environmental behavior without emphasizing the environmental benefits. When it is emphasized that the behavior is environmentally friendly reactance may occur as people may feel manipulated by this emphasis. As a consequence, environmental self-identity may not be strengthened and people may not be willing to engage in other pro-environmental behaviors as well. Future research is needed to test if this finding can be replicated. If this is indeed the case, it should be tested if reactance can indeed explain our findings in Study 4. Furthermore, it could be that particularly people who do not care about the environment show this reactance effect. When you do not care about the environment, but the environmental benefits of a clearly environmental behavior are emphasized, this may particularly lead to reactance. Therefore, future research could measure other variables such as biospheric values to test if the influence of reminding people of environmental behavior on environmental self-identity and spillover behavior depends on factors such as the strength of one's values.

Our findings may have important implications for studies testing incentives to promote environmental behavior, in which monetary benefits are not merely emphasized but actually provided in order to promote pro-environmental behavior. Research on spillover following incentives for pro-environmental behavior is mixed. Some studies suggest that incentivized environmental behavior may lead to positive spillover to other behaviors. For example, a monetary compensation for the purchase of sustainable products increased the purchase of these products compared to not receiving monetary compensation. Subsequently, the group purchasing more sustainable products was also more likely to engage in other pro-environmental behaviors (Lanzini and Thøgersen, 2014). Other studies suggest that incentivized pro-environmental behavior is less likely to lead to positive spillover compared to pro-environmental behavior that was not incentivized (Poortinga et al., 2013; Thomas et al., 2016). More specifically, providing people with a financial incentive to reduce the use of plastic bags seemed to effectively reduce the targeted behavior. Yet, in countries where people did not receive the monetary incentive for the initial behavior, positive spillover effects were stronger compared to countries where they did receive a monetary incentive. Also, emphasizing environmental benefits of electricity savings did lead to positive spillover to reducing waste in China. However, waste was not reduced when people received monetary incentives to reduce their energy, suggesting that incentives may reduce positive spillover effects (Xu et al., 2018). Our findings may provide insight into these mixed findings. Based on our findings, we propose that whether or not incentivized behavior promotes positive spillover to other environmental behaviors depends on the extent to which the incentivized behavior strengthens one's environmental self-identity. More specifically, we propose that when people realize they engaged in a pro-environmental action, their environmental self-identity is strengthened and positive spillover is likely to occur. People may still realize they engaged in a pro-environmental action after engaging in incentivized environmental behavior. For example, compensating people for pro-environmental behavior as was done in the study by Lanzini and Thøgersen (2014) may still have increased the extent to which people realize they engaged in a behavior with environmental benefits, and see themselves as a pro-environmental person. After all, people did purchase pro-environmental products while they

overall did not receive money as it was merely a compensation for the extra costs of the environmentally friendly products. However, when people receive strong financial incentives for pro-environmental behavior or when the emphasis is on the financial incentive, they may be less likely to realize they engaged in a behavior with environmental benefits. In that case, they may mainly see the behavior as providing monetary benefits not environmental benefits making positive spillover to other pro-environmental behaviors less likely. Future research is needed to test if spillover effects following financial incentives depends on the extent to which the incentivized behavior makes people realize they engaged in a pro-environmental action. Furthermore, future research is needed to test how incentives can be designed to ensure that the behavior increases environmental self-identity thereby promoting spillover to other environmental behaviors.

Our findings have important practical implications for policy aimed to promote spillover effects. To promote positive spillover to many environmental behaviors it is crucial that people realize they engaged in environmentally friendly behavior. Yet, at least in some cases, emphasizing the monetary benefits of environmental behaviors may be risky as it can weaken the extent to which people realize they engaged in pro-environmental action, making it less likely that environmental self-identity will be strengthened and weakening positive spillover. To promote positive spillover, it seems important that policy makers and practitioners instead emphasize the environmental benefits, as this makes it more likely that engaging in such behavior strengthens environmental self-identity and promotes positive spillover. For example, on recycling bins or cycling lanes messages could be added that emphasize the environmental benefits of this behavior. That way, people are more likely to realize they engage in pro-environmental actions thereby strengthening environmental self-identity making spillover to a range of pro-environmental behaviors more likely. However, as explained above, environmental self-identity is rather robust, so the appeals need to be sufficiently strong. Yet, being rather robust suggests that once environmental self-identity is strengthened it is likely to lead to long term pro-environmental behavior as it is not easily weakened.

ETHICS STATEMENT

This study was carried out in accordance with the recommendations of "the National Code of Ethics for Research in the Social and Behavioural Sciences involving Human Participants as formulated by the National Ethics Council for Social and Behavioural Sciences, Ethical Committee Psychology of the University of Groningen" with informed consent from all subjects. All subjects gave informed consent in accordance with the Declaration of Helsinki. The protocol was approved by the "Ethical Committee Psychology of the University of Groningen."

AUTHOR CONTRIBUTIONS

EVDW and LS designed the studies. EVDW collected and analyzed the data and drafted the article. LS engaged in several rounds of critical revision of the article.

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On the Use of Nudges to Affect Spillovers in Environmental Behaviors

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Environmental self-identity is considered a promising lever to generate positive spillovers across pro-environmental behaviors: existing evidence shows that it is positively correlated with pro-environmental choices and that it can be easily manipulated, by reminding individuals of their past pro-environmental actions. However, it remains unclear whether it can be successfully used for environmental policy making. In two online, incentive-compatible experiments, we manipulate participants' environmental self-identity and test whether this leads to increased donations to an environmental charity. Additionally, we investigate the interaction between self-identity priming and two commonly used behavioral policy tools: social information (Study 1, $N = 400$) and goal commitment (Study 2, $N = 495$). Our results suggest caution in leveraging environmental self-identity to promote pro-environmental behaviors, provide indications on how to target policies based on self-identity primes, and offer novel evidence on the interaction between different behavioral policy tools.

Keywords: spillover effect, moral licensing, environmental identity, social information, goal commitment, online experiment

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INTRODUCTION AND HYPOTHESIS

Promoting pro-environmental behavior in individuals and organizations is key to addressing global environmental threats such as climate change, air pollution, and resource depletion. Academics and policymakers have tested a variety of instruments to induce people to behave more environmentally, ranging from traditional policy tools, like incentives and regulation, to softer behavioral interventions, like information provision and nudging. Evaluation of these policies must crucially keep into account not only their direct impact, but also their spillover effects on other pro-environmental behaviors (Truelove et al., 2014; Dolan and Galizzi, 2015; d'Adda et al., 2017; Ghesla et al., 2018; Schmitz, 2018). The overall impact of environmental policies will be positive only in so far that any direct effect, that they may have, will not be offset by compensating behaviors, either in other domains or for the same activity over time. In designing effective policies, regulators therefore need to know whether encouraging people to act pro-environmentally will generate positive or negative spillovers over time or in other domains.

Acting pro-environmentally is likely to generate positive returns in terms of self and social image (Mazar et al., 2008; Ariely et al., 2009; Gneezy et al., 2012). But what is the impact of positive self and social image on subsequent pro-environmental conduct? A related concept is

environmental self-identity, defined as the extent, to which people see themselves as someone who behaves pro-environmentally (Van der Werff et al., 2014b). Environmental self-identity has been found to significantly correlate with pro-environmental behavior in a widespread set of domains, such as water and energy conservation, waste reduction, sustainable shopping, transportation and environmental activism (Cook et al., 2002; Clayton and Opotow, 2003; Fielding et al., 2008; Nigbur et al., 2010; Whitmarsh and O'Neill, 2010; Van der Werff et al., 2013b; Gatersleben et al., 2014; Peters et al., 2018).

Beyond a stable core that directly depends on values, identity can be manipulated to some extent. Namely, by reminding individuals of their past pro-environmental behaviors, it is possible to strengthen environmental self-identity (Cornelissen et al., 2008; Van der Werff et al., 2013a, 2014a,b). This methodology is grounded on self-perception theory, which states that "individuals come to know their own internal states by inferring them from observations of their own overt behavior" (Bem, 1972, p. 2). Implied by this method is the presence of positive spillover effects: having engaged in past pro-environmental behaviors increases the likelihood that one will behave pro-environmentally also in the future. Hence, self-identity theories suggest not only that policies inducing pro-environmental acts will generate positive spillover effects through their impact on individuals' environmental self-identity; but also that environmental self-identity primes should be included in the design of environmental campaigns, as they may encourage many different pro-environmental actions. Given that self-identity can be activated by means of situational cues, it would be a simple and inexpensive component of policies aimed at fostering individuals to behave pro-environmentally. For instance, Susewind and Hoelzl (2014) suggest leveraging past commitment to environmental activities in the design of fundraising campaigns. Similarly, Van der Werff et al. (2014a) argue that environmental policies could encourage consistency by placing billboards, commercials or reminders of previous engagement in pro-environmental deeds close to places where people make new environmental decisions.

Past moral actions have, however, also been found to discourage subsequent pro-environmental behaviors. In the environmental domain, negative spillover effects have been documented in water and energy consumption, purchase of green products, and cooperative decision-making (Thøgersen and Ölander, 2003; Sachdeva et al., 2009; Mazar and Zhong, 2010; Tiefenbeck et al., 2013). Negative spillover effects have also been detected by many studies on moral and prosocial behavior more in general, including charity support, blood donation, volunteering, and purchasing decisions (Strahilevitz and Myers, 1998; Monin and Miller, 2001; Khan and Dhar, 2006; Jordan et al., 2011; Merritt et al., 2010, 2012; Clot et al., 2016). One of the main explanations of the occurrence of negative spillovers is the moral credit model (Sachdeva et al., 2009), which suggests that individuals establish a moral self-image throughout their lifespan. Hence, they perform compensatory reasoning and actions (Zhong et al., 2009; Miller and Effron, 2010; Merritt et al., 2010; Jordan et al., 2011; Truelove et al., 2014): when engaging in what is commonly perceived as a moral or ethical action, individuals experience an enhanced sense of morality, which provides them with moral credits. Such credits serve to offset subsequent immoral behaviors – namely, moral licensing. In the same way, individuals act more morally when their moral self has been threatened by past immoral conduct – namely, moral cleansing.

In summary, evidence and psychological explanations account for past moral behaviors increasing, as well as decreasing, future moral striving. Reconciling these two sets of evidence requires, in our opinion, to compare the costs associated with the moral action with the psychological costs of behavioral inconsistency. Pro-environmental and moral behaviors entail personal costs, which decrease the attractiveness of moral alternatives (Van der Werff et al., 2013a; Steg et al., 2014). The literature on behavioral consistency shows that manipulating the salience of past pro-environmental decisions can increase the psychological costs of acting inconsistently in subsequent decisions (Festinger, 1962; Fishbach et al., 2006; Guadagno et al., 2001; Thøgersen, 2004). The perception of the target behavior also features in this process of costs evaluation: evidence shows that, if the behavior is relatively unimportant to one's moral self, past moral deeds are more likely to provide moral credits rather than incentivizing behavioral consistency (Thøgersen, 2004; Thøgersen and Crompton, 2009; Miller and Effron, 2010; Peters et al., 2018). Therefore, if past behaviors are central to the self, the discomfort of acting inconsistently can loom larger than the costs of behaving pro-environmentally.

The current work aims at testing the sign of spillover effects from self-identity priming with a heterogeneous sample and in an incentive compatible way. We conduct two studies with subjects recruited from an online labor platform.[1] In both studies, we observe how priming environmental self-identity affects subsequent costly donation decisions to an environmental NGO, and investigate sources of heterogeneity in participants' reaction to priming. We investigate the impact on the sign and magnitude of spillovers of combining self-identity priming with social information (Study 1), and goal commitment (Study 2). We select these two nudges not only because they are among the most popular behavioral policies, but also because existing theories point to social information and goal commitment as two potential levers capable of offsetting moral licensing. As for social information, others' social behavior can signal one's moral incompleteness or can correct the misperception of unbalanced contribution to the common cause (Kahneman et al., 1993; Guagnano et al., 1994; Thøgersen and Crompton, 2009; Jordan et al., 2011). Goal commitment shapes induces individuals to interpret previous behaviors as evidence of commitment toward an overarching goal, and motivates them to persist in its attainment (Dhar and Simonson, 1999; Shah et al., 2002; Fishbach et al., 2006; Fishbach et al., 2009; Mullen and Monin, 2016).

In both studies, priming self-identity does not result in positive spillovers. Rather, individuals who are more used to perform pro-environmental behaviors are not affected by the

[1]Despite their relatively recent adoption as data collection tools, online labor platforms offer reliable results, as shown by replications of well-known experiments (Paolacci et al., 2010; Horton et al., 2011; Suri and Watts, 2011; Crump et al., 2013).

priming, whereas remaining subjects display consistency in failing to act pro-environmentally and display negative cross-behavioral spillovers. Finally, we observe differences in the ability of different nudges to offset the undesired behavior: social information offsets the negative spillovers, whereas goal commitment amplifies them.

Our study makes two main contributions to the literature. First, we provide clean evidence on the impact of environmental identity priming on incentivized behavior. Previous studies reporting positive spillovers from reminding individuals of their past pro-environmental behaviors mainly relied on self-reported measures (Cornelissen et al., 2008; Van der Werff et al., 2013a, 2014a,b), or behaviors that required little or no effort or cost (Cornelissen et al., 2008; Van der Werff et al., 2014b). Given our view that consistency with one's moral self is a matter of balancing the psychological costs of behavioral inconsistency against the costs of behaving morally, identifying behavioral outcomes that are both directly observable and costly appears critical for testing rigorously and meaningfully the sign of spillovers. We can thus investigate whether the sign of spillover effects differs between our studies and previous ones using less demanding or self-reported tasks as outcomes.

Second, we complement self-identity priming with other common behavioral measures. As behavioral interventions become increasingly popular, individuals are likely to be subject to multiple nudges. However, so far little research exists on the combined effect of different behavioral interventions (Brandon et al., 2018). Since nudges leverage on individuals' psychology and behavioral fallacies, policy makers should pay attention to the unintended interplays that can occur between the different tools. Indeed, our results illustrate that goal commitment, a behavioral policy that is commonly recommended to prevent moral licensing (Fishbach and Dhar, 2005; Fishbach et al., 2006; Mukhopadhyay et al., 2008), does not achieve the same effect when implemented together with identity priming. Moreover, we identify an innovative strategy to tackle negative spillover effects: in spite of the overarching evidence that social influence affects individuals' behaviors in a widespread range of domains, such as waste prevention, energy and water saving, towel reuse in hotels, and technology adoption (e.g., Schultz, 1999; Schultz et al., 2007; Goldstein et al., 2008; Nolan et al., 2008; Allcott, 2011; Ferraro et al., 2011; Nomura et al., 2011; Toelch et al., 2011; Harries et al., 2013), to our knowledge, it has not yet been implemented as way to prevent negative spillover. Not only we prove that social information effectively addresses their occurrence, but also provide preliminary evidence on why this happens. Our findings suggest that the negative effect resulting from identity manipulation is likely to be caused by contribution ethic, whereby one refrains from a moral action because of the perception of having "already done one's own fair share" (Kahneman et al., 1993; Guagnano et al., 1994; Thøgersen and Crompton, 2009). Therefore, providing the information that also other individuals contribute to the common good alleviates this feeling and allows to offsets the negative spillover.

The remainder of the paper proceeds as follows. We describe the experimental design and the results of Study 1 in Section 2, and of Study 2 in Section 3. Section "General Discussion" proposes a discussion of the findings of the two studies, and their implications. Section "Conclusion" concludes.

STUDY 1

Materials and Methods

Participants and Procedure

We recruited respondents on the online platform Prolific Academic, a United Kingdom platform giving access to a predominantly European pool of users. In total, 397 subjects completed the experiment. Each participant received a participation fee of £1 and could earn up to £1 as an additional bonus, depending on her decision within the experiment. Namely, subjects decided how much of the £1 bonus, if any, to donate to an environmental organization. The donation was then deducted from the bonus when computing participants' final payoff. The decision to donate and the donation amount are our main outcome variables.

Before making the donation decision, subjects were randomly assigned to experimental conditions in a two (identity priming versus control) by two (social information versus control) between subjects design. Thus, the four experimental conditions allow to observe, relative to the control group, the impact of providing the identity prime and social information in isolation, and combined. Namely, we first assigned half of the subjects to receive the identity prime. Immediately after, we measured their environmental self-identity to perform a manipulation check, i.e., to test that the prime indeed had the intended effect. Next, half of the subjects from both the identity prime and control groups were randomly assigned to the social information treatment. Only then, all subjects made the donation decision. The experiment ended with a brief survey, including questions on environmental values. The last screen provided information on subjects' payoff and on how to receive it. **Figure 1** summarizes the experimental protocol for Study 1, which is reported in full in the **Supplementary Material** available online.

Materials

Treatment 1: identity priming

In order to prime environmental self-identity, we followed the methodology introduced by Cornelissen et al. (2008). The adoption of this priming method has been found to be correlated with higher levels of self-reported environmental self-identity among experimental subjects (Van der Werff et al., 2013a, 2014b). Specifically, we primed environmental self-identity by asking subjects how frequently they engaged in eight pro-environmental behaviors. Answers ranged on a 5-point scale between "Never" and "Always." The pro-environmental behaviors included in the priming exercise must be common across different countries, so that most subjects in our sample would infer a positive self-identity from their own affirmative answers to the priming questions. We thus selected the behaviors to be included in the priming exercise among the ones most commonly performed by respondents in a series of international studies, namely from

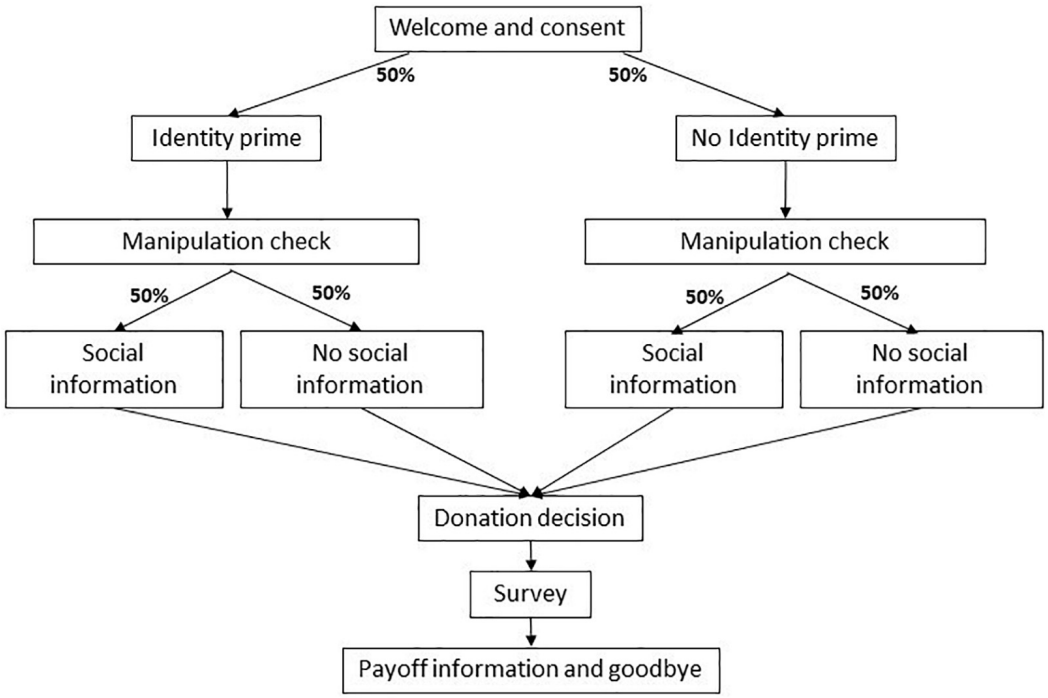

FIGURE 1 | Study 1 experimental protocol.

Belgium (Cornelissen et al., 2008), the Netherlands (Van der Werff et al., 2013a, 2014b) and United States (Gallup, 2010). **Table 1** reports the resulting set of eight actions and the average frequency of engagement among participants assigned to the priming treatment: the actions span a broad range of settings, from energy saving, to recycling, to transport and purchasing choices, and are indeed frequently performed by participants assigned to the identity prime conditions.

Participants assigned to the *No identity prime* conditions had to report how often they performed a different set of eight behaviors, unrelated to the environment (e.g., "I read the newspaper").

Treatment 2: social information

We implemented the social information treatment by providing information to subjects on the willingness to donate to the same environmental organization expressed by other users of the online platform. The pilot study was conducted before the main study and with different participants. Prior to Study 1, and with different participants, we conducted a pilot study on Prolific Academic, where we asked participants how much of their participation payment they would be willing to donate to WWF.[2] Out of the 85 subjects recruited for the pilot, 72.9% claimed to be willing to make a donation if given a chance, with an average hypothetical donation amount of £0.2, corresponding to 40% of the participation payment. We provided this figure in the social information treatment, by telling subjects that "Last week, we conducted a similar survey on Prolific: participants were willing to donate on average 40% of their bonus to WWF UK." This treatment draws from prior research on social information, showing how individuals tend to comply with behaviors that are perceived to be common among others from their same social environment (Goldstein et al., 2008).

Subjects in the *No social information* conditions did not receive any information while making the donation decision.

TABLE 1 | Actions included in the environmental priming exercise and frequency of reported engagement, Study 1.

Action	*M*	*SD*
I turn off the lights when no one is in the room	4.322	0.869
I do not throw litter on the street	4.573	0.966
I recycle newspapers, glass, aluminum, motor oil, or other items	3.794	1.190
I turn off electrical appliances (to save energy)	3.834	1.043
I move around by bike and/or public transportation	3.216	1.359
I buy a less polluting product if there is a choice in the shop	3.095	1.157
I use reusable shopping bags at grocery stores instead of the standard plastic or paper bags	3.769	0.653
I leave a clean spot after a picnic	4.653	0.762
Total	3.907	0.622
Number of observations: identity priming and identity priming plus social information	203	

[2]The Supplementary Material available online reports the entire text of the pilot study.

Measures

Manipulation check: environmental self-identity

Consistent with previous studies measuring environmental self-identity (Van der Werff et al., 2013a), we used three items: (a) "Acting environmentally friendly is an important part of who I am"; (b) "I am the type of person who acts environmentally friendly"; and (c) "I see myself as an environmentally friendly person" (Cronbach $\alpha = 0.91$, $M = 5.306$, $SD = 1.122$). Respondents answered on a 7-point scale from "Completely disagree" to "Completely agree." We construct an index of environmental self-identity by taking the unweighted average of the three questions.

Donation to an environmental organization

We measure pro-environmental behavior using an incentivized decision, namely donation of (any part of) the £1 bonus to WWF UK. We elicited the donation decision through an open question, so that participants could enter any amount between £0 and £1, with two decimals allowed. The beneficiary environmental organization was selected with the aim of maximizing its appeal to a wide audience: WWF UK is well known both in the United Kingdom and internationally, and is widely perceived as being politically neutral (Cracknell et al., 2013; Pharoah, 2017; Strauss, 2017).

Universalistic values

The literature on environmental self-identity models it as deriving from two main sources: past pro-environmental behaviors and values (Van der Werff et al., 2013b). We thus collected measures of universalistic values, in order to control for them in the empirical analysis. We used three survey questions from the European Social Survey (Davidov et al., 2008), asking respondents how much they felt similar to the individual described in different statements. The three statements we used to measure universalistic values are: (a) "It is important to this person that every person in the world is treated equally; everyone should have equal opportunities in life"; (b) "It is important to this person to listen to people who are different from him/her; even in case of disagreement, this person wants to understand them"; and (c) "This person strongly believes that people should care for nature. Looking after the environment is important to this person" ($\alpha = 0.62$, $M = 0.591$, $SD = 0.595$). We construct an index of environmental values by taking the unweighted average of the three questions.

Statistical Analysis

This section reports results of the analysis of the experimental data. We outline here the main steps we followed in the empirical analysis.

First, we investigate treatment effects on environmental self-identity. Namely, we use the data from the manipulation check on environmental self-identity to test whether the identity prime indeed had its intended effect.

We then study treatment effects on donation. We adopt different characterizations of the donation decision: first, we consider the overall average donation, including £0 donation amounts; second, we distinguish between the extensive margin, i.e., the decision of whether to donate or not, from the intensive margin, i.e., the choice of donation amount conditional on having donated. We use OLS regressions when the dependent variable is the donation amount and logit regressions when the outcome is an indicator equal to one if a positive donation is made.

In order to test whether the identity prime affects behavior through its influence on environmental self-identity, we follow the literature (Preacher and Hayes, 2008) and conduct mediated regression analysis. As recommended in the literature, we implement the mediation analysis through a total of 5,000 bootstrap samples, with 95% bias corrected and accelerated confidence intervals.

Finally, we examine a source of heterogeneity in treatment effects: prior pro-environmental behavior. It is likely that the impact of the prime depends on the number of environmental behaviors, asked about in the prime, that the individual actually performs. Since the rationale behind the prime relies on the assumption that claiming to perform regularly several pro-environmental behaviors will boost environmental self-identity, it is plausible that the prime will not affect the identity of individuals, who do not perform those behaviors frequently. We thus classify individuals depending on whether their reported engagement with the pro-environmental behaviors, listed in the prime, is above or below the median level of engagement in the sample. We define below median performers as the *Low frequency* group, and the above median ones as *High frequency* group and test whether the identity prime has a different impact on these two sets of subjects. Since engagement is not randomly allocated, but is likely to depend, among other things, on environmental values; and given that environmental values are also likely to independently influence the dependent variables, identity and donation, we control for them in the heterogeneity analysis.

Results

Sample Characteristics

Overall, participants are aged between 18 and 73, 44% of them are female, 56% have university-level education and their average household income is between £2,000 and £3,000. Of the final sample, the identity priming only group comprises 95 participants (44 female); aged between 19 and 63; and 64% have completed a university-level qualification. The group exposed both to identity priming and social information comprises 104 participants (46 female); age ranges from 18 to 61; and 49% have completed a university-level qualification. The social information only group comprises 95 participants (39 female); aged between 18 and 58; with 59% of them having university-level qualification. Finally, the control group comprises 103 participants (48 female) with age ranging from 18 to 73; and 54% of them with university-level qualification. **Supplementary Table S1**, available in the online appendix, reports summary statistics and balance tests.

Impact of Identity Priming on Donation

Overall, subjects donated on average £0.27. This is in line with previous studies on contribution to charities, where participants donated around a third of their endowment (Bolton et al., 1998; Clot et al., 2016). **Figure 2** reports the distribution of donation per

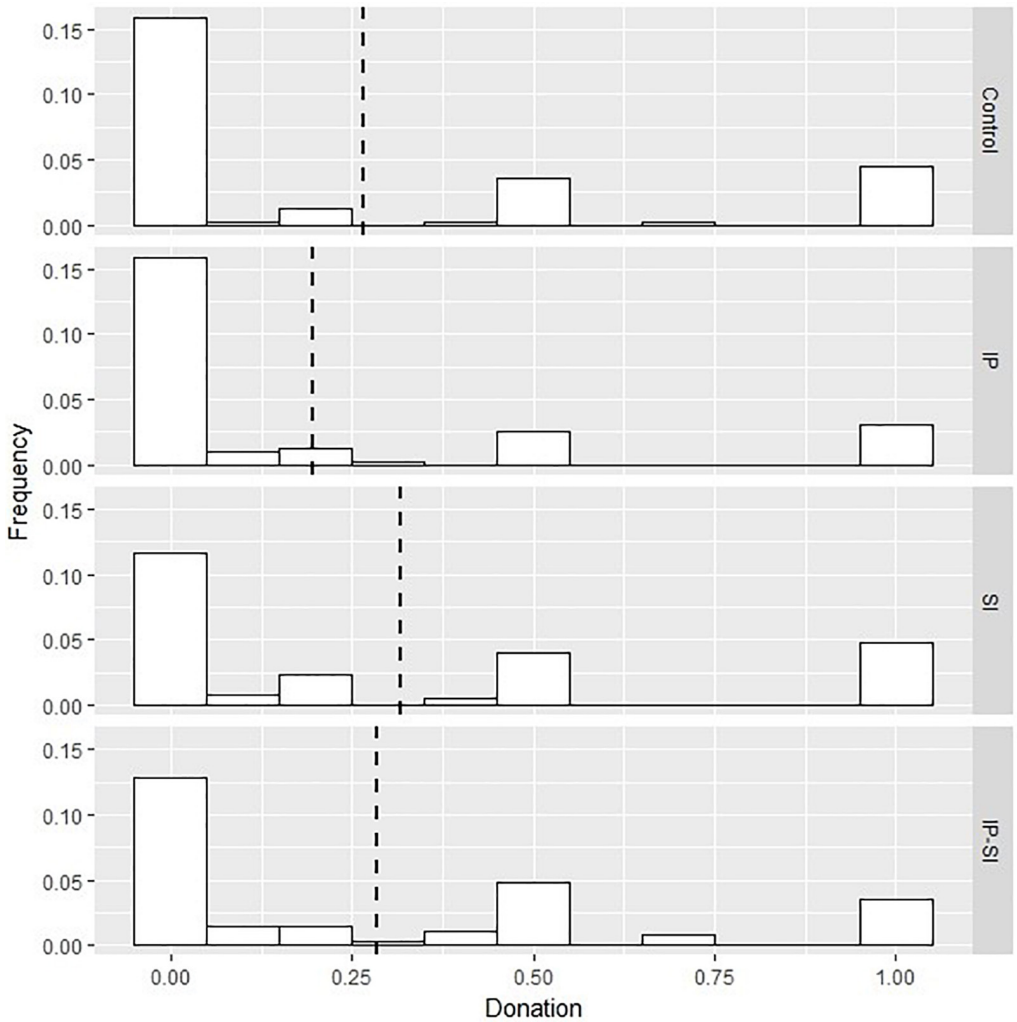

FIGURE 2 | Distribution of donation per experimental condition, Study 1. IP, identity priming; SI, social information; IP – SI, identity priming and social information. Dashed line represents mean value.

experimental condition: across conditions, the distribution has a mode at £0, with smaller modes at £0.5 and £1.

Our identity priming is successful: participants reminded of their past pro-environmental behaviors exhibit a stronger environmental self-identity compared to the control group (Column 1, **Table 2**).[3] Further, environmental self-identity is correlated to donation: the stronger environmental self-identity, the higher the average donation ($B = 0.053$, $p < 0.01$). This effect is due to the link between identity and donation on the extensive margin ($B = 0.376$, $p < 0.01$), while there is not a significant correlation on the intensive margin ($B = 0.002$, $p > 0.10$).

In spite of this positive correlation, the overall effect of the identity prime on donation is negative (Columns 2–4, **Table 2**), indicating no positive spillovers from prior pro-environmental behaviors to donation. Considering the effect of the prime on all participants exposed to the treatment, we find that, compared to the control group, the negative effect is significant only on the intensive margin ($B = -0.112$, $p < 0.10$). Similarly, Anderson Darling test reveals no differences between the distribution of average donation between participants in control and in identity only groups (**Figure 2**). To test whether the identity manipulation influenced average donation through its effect on environmental self-identity, we conduct mediation analysis.[4] We detect partial and inconsistent mediation effects (MacKinnon et al., 2007): while average indirect effects are positive ($B = 0.013$, $p < 0.10$), the average direct effect is negative ($B = -0.061$, $p < 0.10$). These results suggest that reminding people of their past pro-environmental behaviors strengthens

[3]We pool the self-identity only and self-identity plus social information treatments in Column 1 because the prime and manipulation check preceded the social information treatment. Indeed, the impact of the identity prime on self-identity does not differ between the two treatments. Result available upon request.

[4]The independent variable does not need to predict the dependent variable to test mediation effects (Shrout and Bolger, 2002; James et al., 2006).

TABLE 2 | Effect of identity priming and social information in Study 1.

	(1) Identity		(2) Average donation		(3) Extensive margin		(4) Intensive margin	
	B	*SE(B)*	*B*	*SE(B)*	*B*	*SE(B)*	*B*	*SE(B)*
IP	0.242**	0.112	−0.069	0.053	−0.264	0.296	−0.083	0.078
SI			0.051	0.053	0.477*	0.288	−0.053	0.070
IP*SI			0.037	0.074	0.316	0.410	0.007	0.102
Const	5.186***	0.079	0.266***	0.036	−0.414**	0.201	0.668***	0.052
Obs	397		397		397		177	
R^2	0.012		0.014				0.021	
Adj R^2	0.009		0.006				0.004	
Log Likelihood					−267.651			
Akaike Inf. Crit.					543.3			
F	4.61**		1.794				1.258	

*Linear regression (Columns 1, 2, and 4). Logit regression (Column 3). IP denotes the identity priming treatment, SI denotes the social information treatment. Standard errors reported in the SE(B) columns. * significant at 10%; ** significant at 5%; *** significant at 1%.*

their self-identity, which, in turn, is positively related to donation. Nevertheless, for a given level of environmental self-identity, individuals donate less in the identity prime than in the control condition.

Heterogeneous Effects of Identity Priming

We now test whether the impact of the identity prime depends on the reported frequency of engagement in the environmental behaviors included in the manipulation. Consistent with the goal of the prime, these behaviors are indeed common among participants, with the median level of engagement across all behaviors equal to four (very frequently) on a five-point scale. Universalistic values predict whether a participant is classified in the *Low* or *High* group ($B = 0.202$, $p < 0.01$). They also predict environmental identity ($B = 0.829$, $p < 0.01$), as well as donation ($B = 0.144$, $p < 0.01$). Universalistic values, however, are not influenced by identity priming ($B = 0.084$, $p > 0.10$). Therefore, to have a clean effect of the number of behaviors recalled with respect to environmental values, we control for them in the regressions.

In order to explore heterogeneity of treatment effects by prior engagement with the behaviors, **Table 3** shows separate regressions on self-identity and donation, among subjects in the *Low frequency* (Panel A) and in the *High frequency* (Panel B) groups. As hypothesized, the effect of the prime depends on reported frequency of engagement with the environmental behaviors. The impact on environmental self-identity increases in the number of behaviors: relative to the control group, only those in the *High frequency* group display higher self-identity (Panel B, Column 1), while negative but no significant effect is observed among *Low frequency* subjects (Panel A, Column 1). Both groups display lower donation levels compared to the control group, even though the negative impact is significant only in the *Low frequency* condition (Panel A, Columns 2–4).

Additional analysis, reported in **Table 2** of the online **Supplementary Material**, confirms the statistical significance of the heterogeneity results. Namely, we pool the entire sample and regress experimental outcomes on the identity priming dummy and its interaction with an indicator for *High Frequency* subjects. The coefficient on the interaction term is statistically significant in the regressions featuring environmental identity, average donation and the probability to donate as dependent variables.

Impact of Integration of Identity Priming and Social Information on Donation

Consistent with previous studies, the social information treatment has a positive impact on donation: exposing participants to others' moral behavior results in higher average donation (Column 2, **Table 2**). Distinguishing between the extensive and intensive margin, we see that social information positively and significantly affects the probability to make a positive donation (Column 3, **Table 2**), and negatively the amount donated conditional on making a positive donation (Column 4, **Table 2**). Moreover, the positive sign of the interaction term between the self-identity and social information treatments indicates that social information offsets the negative impact on donation of the self-identity prime; the lack of significance shows that the combined effect is roughly consistent with an additive effect of the two stimuli. This additive effect results in significant higher regression coefficient for the joint identity-social treatment compared to the identity only condition, both for average donation ($p < 0.10$) and for likelihood to donate ($p < 0.01$). Additionally, Anderson Darling test shows that the two samples belong to different distributions ($p < 0.01$) (**Figure 2**).

Discussion

In Study 1, we show that reminding individuals of their past pro-environmental behaviors results in higher reported environmental self-identity, and that higher self-identity is positively correlated to pro-environmental action within the experiment. However, we also show that the overall impact of priming self-identity on subsequent behavior is negative, although not significantly so. Mediation analysis reveals the mechanism underlying this effect: whereas identity priming has

TABLE 3 | Effect of identity priming and social information for Low frequency **(A)** and High frequency **(B)** groups in Study 1.

	(1) Identity		(2) Average donation		(3) Extensive margin		(4) Intensive margin	
	B	***SE(B)***	***B***	***SE(B)***	***B***	***SE(B)***	***B***	***SE(B)***
(A) Low frequency								
IP	−0.194	0.126	−0.155**	0.121	−0.757*	0.814	−0.299**	0.118
SI			0.038	0.064	0.427	0.437	−0.058	0.068
IP*SI			0.078	0.087	0.534	0.194	0.212	0.143
Univ	0.745***	0.085	0.132***	0.029	0.774***	0.300	0.108**	0.047
Const	2.193***	0.079	−0.255	0.121	−3.517***		0.215	0.203
Obs	292		292		292		122	
R^2	0.225		0.105				0.101	
Adj R^2	0.219		0.092				0.071	
Log Likelihood					−184.152			
Akaike Inf. Crit.					378.304			
F	41.912**		8.395***				3.304**	
(B) High frequency								
IP	0.507***		−0.027	0.065	−0.103	0.353	−0.022	0.087
SI			0.037	0.054	0.428	0.296	−0.057	0.070
IP*SI			0.023	0.023	0.357	0.502	−0.047	0.114
Univ	0.769***		0.138***	0.035	0.743***	0.202	0.079	0.057
Const	2.095***		−0.281*	0.143	−3.939***	0.845	0.336	0.215
Obs	303		303		303		145	
R^2	0.299		0.056				0.032	
Adj R^2	0.294		0.044				0.005	
Log Likelihood					−198.261			
Akaike Inf. Crit.					406.521			
F	63.990***		4.447***				1.169	

*Linear regression (Columns 1, 2, and 4). Logit regression (Column 3). IP denotes the identity priming treatment, SI denotes the social information treatment, Univ denotes universalistic values. Standard errors reported in the SE(B) columns. * significant at 10%; ** significant at 5%; *** significant at 1%.*

an indirect positive effect on donation through environmental self-identity, it also directly negatively affects donation. The negative coefficient on the priming treatment indicator indicates that no positive spillovers from past to future environmental behaviors occur within our experiment, and are at prima facie suggestive of the presence of moral licensing (Khan and Dhar, 2006; Sachdeva et al., 2009): remembering past pro-environmental behaviors provides participants with moral credits, which legitimate them to contribute less in the subsequent environmental decision.

Heterogeneity analysis, however, tells a different story. The identity prime does not have the same effect on all subjects. Namely, it increases environmental self-identity, relative to the control, only among subjects who engage in the behaviors contained in the prime on a recurring basis. If moral licensing were at work, we would expect negative spillovers from the prime to be most pronounced among highly engaged participants. On the contrary, it is unengaged subjects, who experience a decrease in self-identity as a result of the prime, who drive the negative overall impact of identity priming on donation. It is important to highlight, however, that, even among highly engaged subjects, the identity priming does not lead to positive spillovers: donation levels among the most engaged participants are still lower than those of control group subjects.

We identify a way to mitigate the negative spillovers from the identity prime, i.e., social information. Making others' moral behavior salient encourages individuals to act in a norm-consistent way. Negative spillovers from the prime are completely offset by social information: when the two treatments are combined, average donation is not significantly different from that in the control group. Two alternative psychological mechanisms may explain this result. On the one hand, the effect of social information may be driven by the threat to one's moral self, coming from not complying with others' moral behavior. On the other hand, contribution ethic would explain why the perception of having done one's share, fostered by the identity prime, is offset by the realization that others have also contributed to the common good.

In order to disentangle the effect of these two psychological mechanisms, and to provide clear explanation of why social information neutralizes negative spillover, in Study 2 we further investigate how past pro-environmental deeds affect subsequent behaviors depending on the prevalent conduct in a reference group. We argue that, if contribution ethic is the main driver of the behavior we observe in Study 1, then the identity prime will lead to a stronger anchoring between own and others' pro-environmental decisions. The causal link goes as follows: reminding individuals of their past pro-environmental behaviors makes them feel more strongly to have already contributed

enough to the common good; this feeling then makes them anchor their subsequent behavior more to the social norm. Namely, for others' low levels of contribution, they feel justified to make smaller contributions than in the absence of the prime; while for others' high levels of contribution, the realization that others are also doing their share neutralizes the negative spillover. Therefore, we expect the identity prime to increase the share of individuals behaving as conditional cooperators, if contribution ethic is at work.

We designed Study 2 to collect further evidence on the sign of spillover effects, to identify the mechanism behind them and to rule out alternative explanations for their occurrence. First, we replicate the identity prime treatment of Study 1. Second, to test whether contribution ethics can explain the combined effect of identity priming and social information, we elicit donation decisions both in terms of unconditional donation, and of donation conditional on other subjects' donation level. This allows us to investigate treatment effects on the full donation profile and to investigate whether the identity prime fosters conditional cooperation. Third, as we did not observe positive spillover even among highly engaged subjects, we try to investigate whether the lack of spillovers is due to the weak link, generated by the identity prime, between past deeds and one's moral self. We do so by augmenting the identity prime with a goal commitment exercise, another common behavioral policy. As previous experiments, we implement goal commitment with an attribution recall task (Mukhopadhyay et al., 2008). We believe attribution recall to be an effective strategy to increase the connection between simple past pro-environmental behaviors and one's moral self, because it requires subjects to make the moral drivers behind their past behaviors explicit.

In sum, Study 2 extends Study 1 in two ways. First, we test whether goal commitment is an effective strategy to promote positive spillover effects. Second, we elicit participants' donation decisions as unconditional and conditional to others' donation.

STUDY 2

Materials and Methods

Participants and Procedure

We conducted Study 2 on the same online platform, and using the same payment scheme, as Study 1, but with a different sample. In total, 471 Prolific Academic users completed the experiment. Participants were randomly assigned to the treatments in a between subjects design. The experimental protocol differs from that of Study 1 under three respects. First, since the goal commitment treatment builds on the identity prime one, and can therefore be administered only to subjects who received the identity prime, Study 2 features 3 experimental conditions: control, identity prime only and identity prime plus goal commitment. Second, we elicit the donation decision both as unconditional donation amount (unconditional donation), and as a profile of donation amounts, conditional on all the possible levels of average donation by the other participants in the experiment (conditional donation). Third, since the instructions for the donation task are longer than in Study 1, the post-donation survey begins with the questions on environmental values. The **Supplementary Material** available online reports the entire text of Study 2 instructions.

Materials

Treatment 1: identity priming

Identity priming takes place in the same way as in Study 1. **Table 4** shows that, consistent with Study 1, the eight pro-environmental behaviors are common among the Study 2 sample.

Treatment 2: goal commitment

Drawing from previous research (Mukhopadhyay et al., 2008), we activate participants' focus on goal commitment by asking them to recall and list three reasons why they performed the pro-environmental behaviors reported in identity priming. We framed the task in the form of an open-ended question, and participants were provided with three boxes to write the attributions.

Measures

Manipulation check: environmental self-identity

We measure environmental self-identity with the same items as in Study 1. Items form a reliable scale (Cronbach $\alpha = 0.91$, $M = 5.317$, $SD = 1.100$).

Environmental attributions recalled

We classify the reasons, listed by subjects in the goal commitment exercise, as driven by environmental motives or not, and count the number of environmental attributions mentioned by each participant. This variable ranges between 0 and 3.

Universalistic values

Universalistic values are measured with the same items as in Study 1. Items form a consistent scale (Cronbach $\alpha = 0.62$, $M = 0.605$, $SD = 0.578$).

Donation to an environmental organization

As in Study 1, we asked respondents whether they wanted to donate any part of the additional bonus of £1 to WWF

TABLE 4 | Actions included in the environmental priming exercise and frequency of reported engagement, Study 2.

Action	*M*	*SD*
I turn off the lights when no one is in the room	4.271	0.791
I do not throw litter on the street	4.526	1.029
I recycle newspapers, glass, aluminum, motor oil, or other items	3.942	1.096
I turn off electrical appliances (to save energy)	3.842	1.038
I move around by bike and/or public transportation	2.977	1.406
I buy a less polluting product if there is a choice in the shop	2.974	1.114
I use reusable shopping bags at grocery stores instead of the standard plastic or paper bags	3.878	1.230
I leave a clean spot after a picnic	4.700	0.708
Total	3.877	0.551
Number observations: identity priming and identity priming plus goal commitment	310	

UK. In addition to this, we used the strategy method to elicit donation amounts as a function of other subjects' average donation. We implemented the strategy method as follows: after entering the unconditional donation, subjects filled a "contribution table," where they had to indicate, for each of the 11 possible amounts donated on average by other participants (in £0.1 increments), how much they were willing to donate to WWF UK (Fischbacher et al., 2001). We randomized whether others' donation was displayed in increasing or decreasing order to prevent anchoring effects. To ensure incentive compatibility and provide a motivation to take both the unconditional and conditional decisions seriously, we told participants that each of them had the same probability to be drawn as the payoff relevant one at the end of the experiment. This means that half of the participants paid according to their unconditional donation. The average donation amount by this group of subjects determined the payoff of subjects paid according to their conditional donation amount.

Statistical Analysis

We adopt the same empirical strategy as in Study 1 to investigate treatment effects on identity and unconditional donation. To this, we add the analysis of treatment effects on conditional donation. We classify subjects' donation profiles according to the types identified by the literature on conditional cooperation (Fischbacher et al., 2001). To this end, as in Fischbacher et al. (2001), we compute Spearman's rank correlation coefficient between own and other's donation: among coefficients significant at the 5% level, we classify positive ones as identifying conditional cooperators and negative ones as denoting anti-cooperators. Subjects, whose conditional donations are not influenced by others' choices, are classified as unconditional contributors. We use visual inspection to classify hump-shaped conditional donation profiles, and to assign the remaining profiles to the existing categories, whenever possible. To take into account the multiple observations generated by the strategy method for each subject, when investigating treatment effects on conditional donation, we run a mixed model with random effects at individual level.[5]

Results

Sample Characteristics

Participants in Study 2 are aged between 18 and 79 years old, 52% are female, 58% have university-level education, and their average household income is between £3,000 and £5,000. Of the final sample of 471[6], the identity priming group comprises 156 participants (77 female); age ranges from 19 to 79; and 61% has completed a university-level qualification. The group exposed both to identity priming and social information comprises 154 participants (83 female); age ranges from 18 to 69; and 55% has completed a university-level qualification. The control group comprises 161 participants (89 female); age ranges from 18 to 63; 59% has completed a university-level qualification. The average household income for all groups is between £3,000 and £5,000. **Table 2**, available in the online **Supplementary Material**, reports summary statistics and balance test for the Study 2 sample.

Impact of Identity Priming on Donation

The overall average unconditional donation is £0.4 out of £1, slightly higher compared to Study 1 (t-test, $p < 0.01$) and to previous studies (Bolton et al., 1998; Clot et al., 2016). Relative to Study 1, the distribution of donation in all three treatments displays a less pronounced mode at 0, and larger shares of subjects contributing half and all of the bonus (**Figure 3**). We can only speculate on the possible causes of the difference between Study 1 and Study 2 donation patterns, since the two studies were conducted months apart, with different samples and using slightly different protocols. One reason for the difference may lie in the higher household income level of Study 2 participants (t-test, $p < 0.01$), as previous studies found a positive relationship between income and charity support (Lee and Chang, 2007), as well as between income and pro-environmental behaviors (Clark et al., 2003).

The results on the identity prime in Study 2 are broadly consistent with those from Study 1. First, environmental self-identity is significantly higher among subjects exposed to identity priming (Column 1, **Table 5**).[7] Second, participants who report higher environmental self-identity donate more ($B = 0.070$, $p < 0.01$), both on the extensive ($B = 0.357$, $p < 0.01$) and on the intensive margins ($B = 0.053$, $p < 0.01$). Third, the effect of the identity prime on unconditional donation is always not statistically significant, and generally negative (Columns 2–4, **Table 5**). Also, when comparing donation levels of all the participants exposed to identity priming with the control group, we find no difference for any formulation of the dependent variable. In addition, the distribution of average donation in identity priming only does not differ with the one of the control group (Anderson Darling test, $p > 0.10$). We can thus exclude that the prime had a positive or negative effect on unconditional donation: no positive spillovers nor moral licensing appear to occur within Study 2. Results of mediation analysis are also consistent with Study 1: average indirect effects are positive and significant ($B = 0.027$, $p < 0.01$), while the average direct effect is negative but not significant ($B = -0.043$, $p > 0.10$). Even if this pattern is qualitatively in line with Study 1, in Study 2 the average direct effect is weaker. Hence, also in Study 2 our results suggest that reminding individuals of their past pro-environmental behaviors strengthens their environmental self-identity, which, in turn, is positively related to donation. Nonetheless, even in the presence of a weaker negative direct effect, the positive indirect effect of priming identity does not induce an increase in subsequent pro-environmental behavior.

[5] Hausman test confirmed that random effects are appropriate in our setting.

[6] We dropped 23 participants from the sample: 22 of them because of missing data, and 1 because she repeated the task twice.

[7] As in Study 1, we pool the self-identity only and self-identity plus goal commitment treatments in Column 1. Even if the manipulation check followed goal commitment, the impact of the identity prime on self-identity does not differ between the two treatments. Result available upon request.

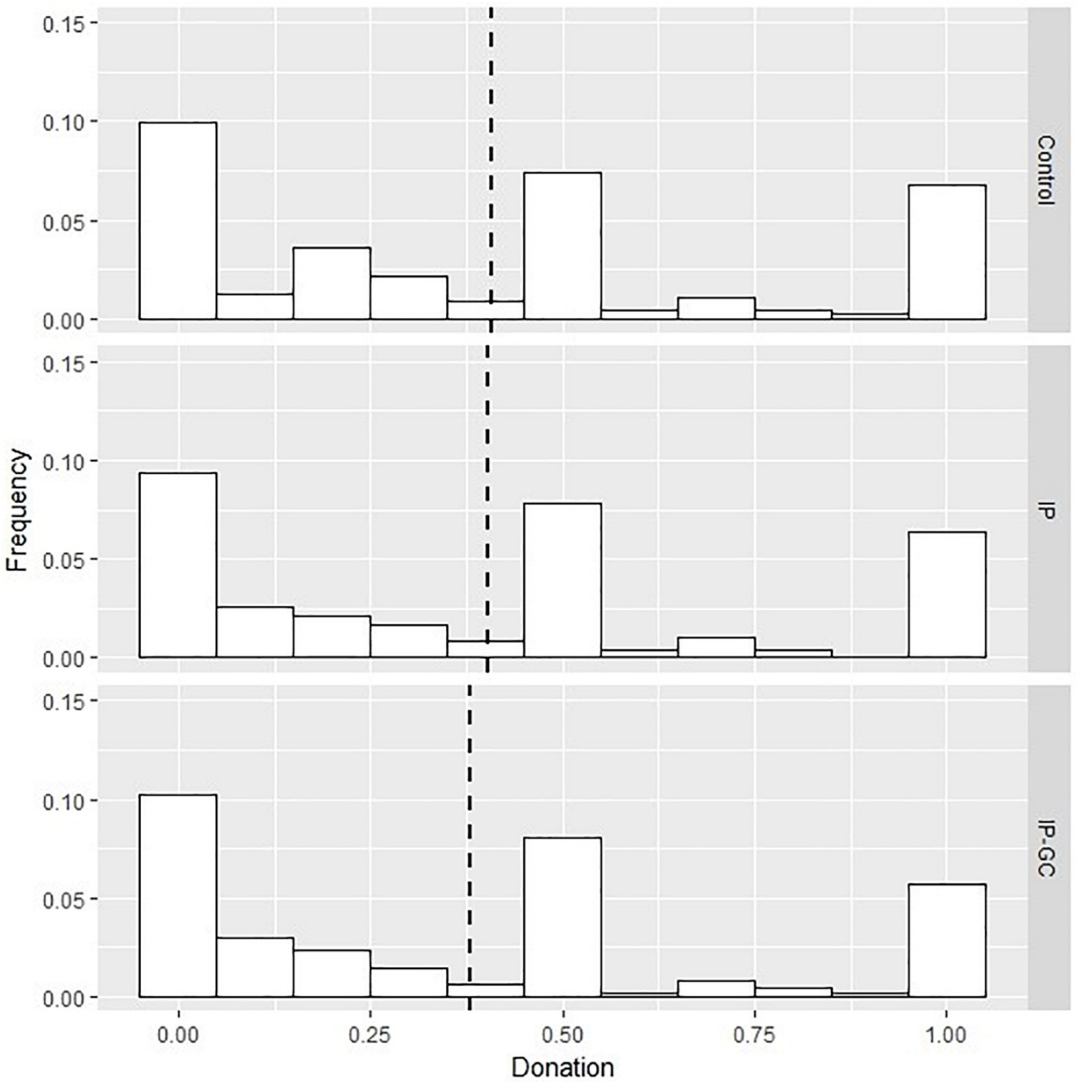

FIGURE 3 | Distribution of donation per experimental condition, Study 2. IP, identity priming; IP – GC, identity priming and goal commitment. Dashed lines represent mean values.

TABLE 5 | Effect of the self-identity prime and goal commitment in Study 2.

	(1) Identity		(2) Average donation		(3) Extensive margin		(4) Intensive margin	
	B	***SE(B)***	***B***	***SE(B)***	***B***	***SE(B)***	***B***	***SE(B)***
IP	0.375***	0.123	−0.004	0.041	0.062	0.803	−0.015	0.042
IP - GC		0.122	−0.028	0.041	−0.045	0.250	−0.033	0.042
Const	5.070***	0.086	0.407***	0.029	0.886***	0.173	0.575***	0.029
Obs	471		471		471		334	
R^2	0.026		0.002				0.002	
Adj R^2	0.024		−0.004				−0.004	
Log Likelihood					−283.887			
Akaike Inf. Crit.					573.77			
F	12.59***		1.794				0.311	

*Linear regression (Columns 1, 2, and 4). Logit regression (Column 3). IP denotes the identity priming treatment, GC stands for goal commitment. Standard errors reported in the SE(B) columns. * significant at 10%; ** significant at 5%; *** significant at 1%.*

Heterogeneous Effects of Identity Priming

We now turn to the study of heterogeneous treatment effects on the basis of subjects' reported level of engagement with the behaviors listed in the identity prime. As in Study 1, the median subject reported to perform 4 out of 5 behaviors. Again, universalistic values act as potential confounder by predicting whether a participant is in the *Low* or *High frequency* group ($B = 0.139$, $p < 0.05$), and the dependent variables: environmental identity ($B = 0.891$, $p < 0.01$), as well as donation ($B = 0.173$, $p < 0.01$). Universalistic values are balanced among the experimental conditions ($B = 0.029$, $p > 0.10$), so that they can be used as control.

Table 6 reports regressions on the dependent variables, distinguishing between the *Low frequency* (Panel A) and the *High frequency* (Panel B) groups. In line with Study 1, participants' reaction to the identity manipulation differs depending on prior engagement: compared to the control group, environmental self-identity is higher only among subjects in the *High frequency* group (Panel B, Column 1). As for donation, even not significantly, the *Low* and the *High frequency* groups show opposite effects: compared to the control group, below-median participants display lower, whilst above-median higher donation (Columns 2–4).

These results are confirmed when we investigate heterogeneous treatment effects on the full sample. **Table 4** of the online **Supplementary Material** shows a statistically significant and positive interaction term between our prime and the dummy *High Frequency* only when predicting environmental self-identity, but not for donation.

Impact of Integration of Goal Commitment and Identity Priming on Donation

In contrast with our hypothesis, augmenting the identity prime with the goal commitment exercise does not affect the sign, magnitude or statistical significance of the spillover effects of past pro-environmental behavior: participants exposed to both treatments donate less, even if not significantly so, than those in the identity prime only group (Columns 2–4, **Table 5**). Similarly, no difference is observed between the distribution of donation in the identity prime only and when combined with goal commitment (Anderson-Darling test: $p > 0.10$) (**Figure 3**).

We exploit data from the goal commitment exercise to unpack further this result. Participants in the *Low frequency* group listed fewer environmental reasons for performing the behaviors included in the prime during goal commitment, relative to subjects in the *High frequency* group ($B = -0.403$, $p < 0.01$). They also donated significantly less than participants in the control group, and marginally less than individuals, with a similar engagement level, exposed to the identity prime only (Panel A, Columns 2–4, **Table 6**).

TABLE 6 | Effect of identity priming and goal commitment for *Low frequency* **(A)** and *High frequency* **(B)** groups in Study 2.

	(1) Identity		(2) Average donation		(3) Extensive margin		(4) Intensive margin	
	B	***SE(B)***	***B***	***SE(B)***	***B***	***SE(B)***	***B***	***SE(B)***
(A) Low frequency								
IP	0.129	0.107	−0.039	0.047	−0.196	0.309	−0.022	0.051
IP-GC			−0.091*	0.047	−0.230	0.308	−0.074	0.148
Univ	0.827***	0.081	0.189***	0.0029	0.940***	0.202	0.146***	0.034
Const	1.745***	0.334	−0.352***	0.118	−2.813***	0.805	−0.038	0.147
Obs	312		312		312		211	
R^2	0.252		0.139				0.101	
Adj R^2	0.247		0.131				0.088	
Log Likelihood					−183.673			
Akaike Inf. Crit.					375.347			
F	51.205***		16.576***				7.785***	
Panel (B): High frequency								
IP	0.550***	0.103	0.019	0.049	0.246	0.346	0.000	0.049
IP-GC			0.029	0.049	0.100	0.329	0.027	0.049
Univ	0.895***	0.075	0.166***	0.029	1.062***	0.205	0.086**	0.034
Const	1.474***	0.311	−0.260**	0.122	−3.287***	0.815	0.213	0.146
Obs	320		320		320		237	
R^2	0.375		0.096				0.029	
Adj R^2	0.371		0.088				0.016	
Log Likelihood					−166.939			
Akaike Inf. Crit.					341.878			
F	95.06***		11.238***				2.284*	

*Linear regression (Columns 1, 2, and 4). Logit regression (Column 3). IP denotes the identity priming treatment, GC denotes the goal commitment treatment, Univ denotes universalistic values. Standard errors reported in the SE(B) columns. * significant at 10%; ** significant at 5%; *** significant at 1%.*

Impact of Identity Priming and Goal Commitment on Conditional Donation

We conclude the empirical analysis of Study 2 by reporting results on conditional donation. **Figure 4** displays donation levels, conditional on others' donation, by experimental treatment. Consistent with other studies, participants are willing to give more as others' average donation level increases (Fischbacher et al., 2001; Fischbacher and Gachter, 2010; Préget et al., 2016). This pattern is in line with the results on the social information treatment in Study 1, and is confirmed by regression analysis. Regressing subjects' own donation decision, elicited with the strategy method, on the level of others' average donation, we find that the former significantly increases with the latter (**Table 7**).

The set of types, which we derive from the classification of participants' donation profiles, is also consistent with those identified in the literature on public good games. We classify 53.7% of subjects as unconditional cooperators, of which 33.1% are free-riders; 21% as conditional cooperators; 5.5% as anti-cooperators; and 2.5% with hump-shaped donation profiles. We could not classify 17.2% of participants according to these types. These shares differ from those observed in the existing literature on public good games (Fischbacher et al., 2001; Fischbacher and Gachter, 2010; Préget et al., 2016). Many factors may explain this discrepancy, among which the difference in the experimental decision is likely to play a role.

We next explore whether the share of different donation profiles is affected by the treatments. **Table 8** shows that subjects in the identity prime treatment are significantly more likely to be classified as conditional cooperators (t-test, $p < 0.05$). This increase mirrors a decrease of similar magnitude in the share of

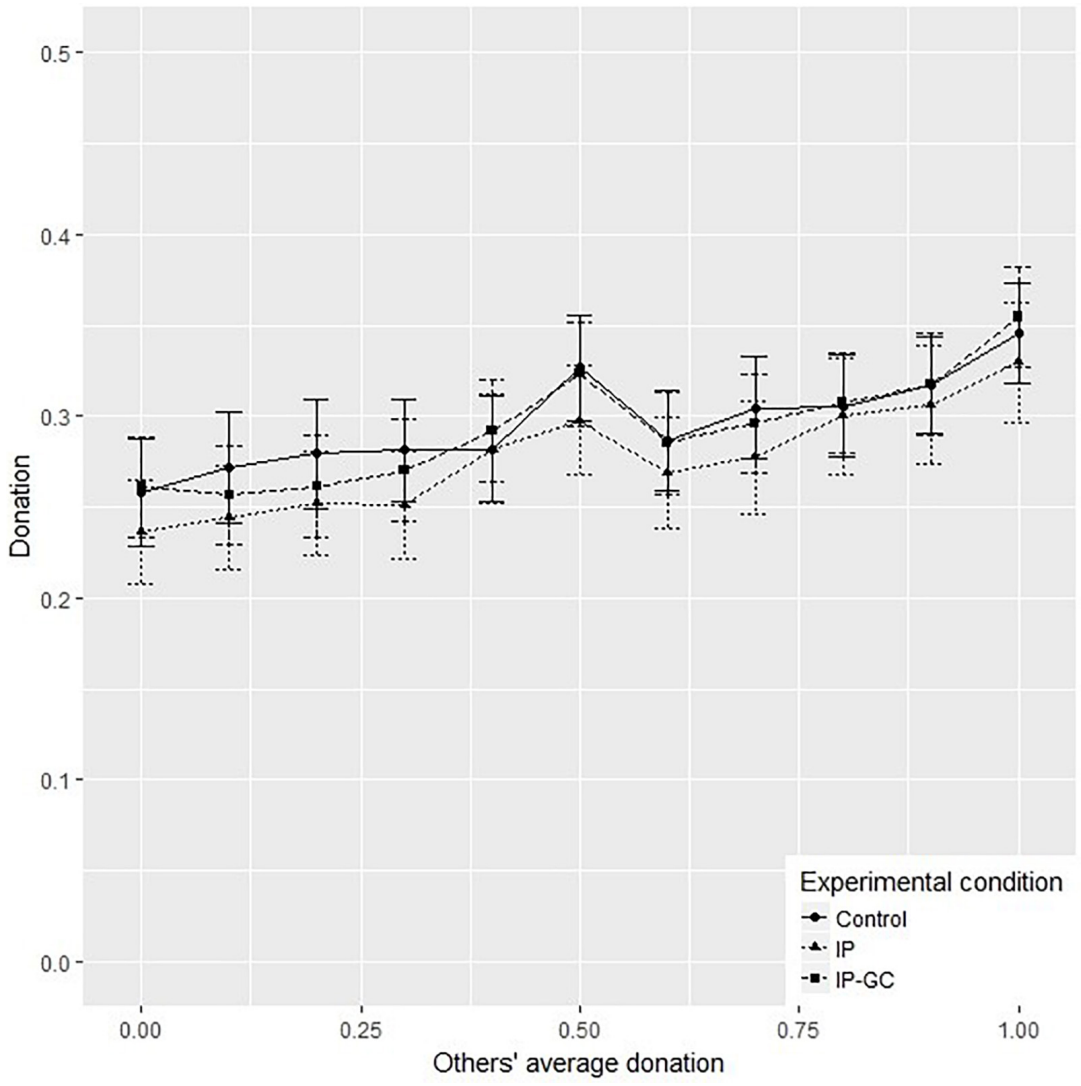

FIGURE 4 | Mean of conditional donation by treatment, Study 2. IP, identity priming; IP – GC, identity priming and goal commitment. Error bars represent 95% confidence intervals.

TABLE 7 | Effect of identity priming, goal commitment and level of others' donation on conditional donation, Study 2.

	Conditional donation	
	B	***SE(B)***
IP	−0.019	0.037
IP-GC	−0.003	0.037
Other's donation	0.077***	0.007
Const	0.258	0.026
Obs	5181	
No. clusters	471	
Log Likelihood	1296.991	
Akaike Inf. Crit.	−2581.983	

*IP denotes the identity priming treatment, GC denotes the goal commitment treatment. Standard errors reported in the SE(B) columns. * significant at 10%; ** significant at 5%; *** significant at 1%.*

TABLE 8 | Conditional donation profiles by treatment, Study 2.

Donation profile	**Control**	**IP**
Unconditional cooperator:	0.705[a]	0.618[a]
Free rider (donation < 0.3)	0.432	0.382
Medium ($0.3 \leq$ donation < 0.7)	0.115	0.084
High (donation ≥ 0.7)	0.158	0.151
Conditional cooperator	0.194[1]	0.287[1]
Anti-cooperator	0.065	0.068
Hump-shaped	0.036	0.028
Total classified	139	251

IP denotes the identity priming treatment. Letters and numbers represent the significance of pairwise comparisons per experimental condition with T-test with different variances, two tails. Same letter in the row represents a significant difference with $p < 0.10$; same number $p < 0.05$.

unconditional donors in the identity priming condition (t-test, $p < 0.10$).

Finally, we conduct regression analysis also on the conditional donation decisions. We obtain similar results as when we analyze treatment effects on unconditional donation: the impact of the identity prime is negative but not significant for any formulation of the dependent variable (**Table 7**).

Discussion

The results from Study 2 overall support those of Study 1. Reminding individuals of their past pro-environmental behaviors leads to significantly higher reported environmental self-identity, which is, in turn, related to higher donation. However, overall, the impact of our manipulation on following pro-environmental decisions is negative, albeit not statistically significant. Once again, our results illustrate that making salient participants' morality does not lead to positive spillovers.

Even though we qualitatively replicate all the Study 1 results in Study 2, the overall significance level of our estimates is lower in the second experiment. We suggest potential explanations for this. First, the sample in Study 2 features, on average, wealthier participants. Higher income may be associated with higher donations and with lower sensitivity to the small incentives provided within the experiment (Clark et al., 2003; Lee and Chang, 2007; Andreoni et al., 2017). Indeed, we observe higher giving in Study 2, both relative to Study 1 and to previous experiments (Bolton et al., 1998; Clot et al., 2016). Second, the elicitation of the donation decision differs between the two studies. Asking participants to make two choices and randomly selecting the payoff-relevant one may induce them to take each decision less seriously and translate in noisier decision outcomes. Third, the use of the strategy method may affect elicited donations. Evidence on the effect of the elicitation method on experimental subjects' behavior is mixed: whereas some studies observe consistent results across direct and strategy methods, others detect weaker treatment effects when the dependent variable is elicited through indirect strategies compared to direct ones (see Brandts and Charness, 2011 for a review).

As in Study 1, we observe strong heterogeneous effects of the identity prime, depending on subjects' engagement with the behaviors listed in the prime. The identity prime is positively associated with significantly higher levels of reported self-identity only among individuals who often engage in the prime's pro-environmental behaviors, but has no impact on subsequent donation among them. On the other hand, there is a negligible impact of the priming on identity and on donation among participants who seldom perform the behaviors.

Our results on conditional donation are consistent with the positive impact of social information that we observed in Study 1. Social information, it is argued, influences behaviors toward the desired social outcome thanks to the underlying positive correlation between one's and others' moral behavior (Schultz, 1999; Schultz et al., 2007; Goldstein et al., 2008; Nolan et al., 2008; Allcott, 2011; Ferraro et al., 2011; Nomura et al., 2011; Toelch et al., 2011; Harries et al., 2013). We confirm this mechanism thanks to the use of the strategy method. Further, the higher presence of conditional cooperators in the identity priming condition suggests that the lack of positive spillovers from the identity priming is primarily caused by contribution ethic, as individuals tend to be more compliant with the prevalent behavior.

Finally, contrary to our expectation and to prior evidence (Fishbach and Dhar, 2005; Fishbach et al., 2006; Mukhopadhyay et al., 2008), goal commitment does not reverse the sign of spillovers from the identity priming exercise. On the contrary, we illustrate that goal commitment may even intensify the negative spillovers caused by the identity prime. Heterogeneity analysis reveals that the significant negative effect of goal commitment primarily arises among those subjects who report low engagement levels in the identity manipulation –the same participants who recalled fewer environmental reasons in the goal commitment exercise.

GENERAL DISCUSSION

We have attempted to experimentally test how past pro-environmental behaviors affect subsequent environmental

decisions. In two online, incentive-compatible studies, we randomly manipulate environmental self-identity, by reminding participants of their past pro-environmental behaviors, and then ask them to make a pro-environmental decision. This set-up allows us to study the sign and magnitude of spillovers generated by the identity prime. Further, we explore the heterogeneous impact of the prime on the basis of individuals' responses to it. Finally, we investigate whether common behavioral policies, when integrated with identity priming, can affect the sign and magnitude of spillovers. Specifically, Study 1 focuses on social information, whereas Study 2 on goal commitment.

Sign and Magnitude of Spillover Effects

In both studies, identity priming does not result in positive spillover. Even when environmental self-identity is boosted by reminding individuals of a set of environmentally friendly behaviors they performed in the past, this positive effect on environmental self-identity hardly translates into higher levels of subsequent pro-environmental decisions. Rather, when asked to renounce to part of their participation endowment in support of an environmental organization, treated participants end up contributing lower amounts. This finding is at prima facie consistent with a moral credit model (Sachdeva et al., 2009), which posits that the heightened sense of morality, resulting from previous moral actions, justifies reduced moral behaviors in subsequent choices. Our heterogeneity analysis, however, tells a more nuanced story.

A puzzling aspect of our results is that our identity prime replicates a methodology that previous studies find effective in inducing positive spillovers (Cornelissen et al., 2008; Van der Werff et al., 2013a, 2014a,b). We speculate that the sign of spillovers depends on how the psychological costs of behavioral inconsistency compares with the inherent costs of behaving morally. Indeed, previous studies achieving consistency mainly relied on self-reported measures (Cornelissen et al., 2008; Van der Werff et al., 2013a, 2014a,b) or effortless behaviors (Cornelissen et al., 2008; Van der Werff et al., 2014b). Our behavioral outcome instead involves higher inherent personal cost. Hence, the negative spillovers we detect may conceivably be explained by the different relative weights of inconsistency with one's moral self and cost to behave morally faced by subjects in our studies. While we cannot formally test this, we support this speculation by noting that our results are consistent with evidence of moral licensing in the domain of charitable contribution (Khan and Dhar, 2006; Sachdeva et al., 2009; Clot et al., 2016), a very similar setting to ours.

Further research is needed to systematically investigate how the nature, and particularly the cost, of the dependent variable affects the sign and magnitude of spillovers from this type of intervention. The interaction between the features of past and subsequent moral environmental behaviors is also likely to matter. Indeed, our results are consistent with different theoretical perspectives. For instance, cognitive dissonance theory (Festinger, 1962) claims that the higher (lower) the similarity among two behaviors, the higher (lower) the costs associated with behavioral inconsistency, and the higher (lower) the likelihood that one will engage in both (Thøgersen, 2004; Thøgersen and Crompton, 2009). Thus, lack of consistency in our experiment may also derive from the difference between the outcome variable, donation to an environmental charity, and the behaviors included in the identity prime, rather than from the cost of the donation decision, as we hypothesize. Testing between different theories will require experimental studies, varying systematically the nature of both prior and subsequent behaviors.

Heterogeneity of Spillover Effects

Our heterogeneity analysis also supports this view. The fact that negative spillovers are more pronounced among subjects with low levels of engagement in the behaviors included in the prime is consistent with the literature in two ways. First, according to the self-perception theory (Bem, 1972), lack of engagement results in a negative or non-significant inference of attitude from past deeds, as observed in our studies and in previous research (Cornelissen et al., 2008; Van der Werff et al., 2013a, 2014b). Second, if past pro-environmental behaviors are too weakly connected to the moral self, or if they are not motivated by environmental considerations, they will not prompt cross-behavioral consistency. In a similar vein, it is possible to interpret the behavior of highly engaged participants, for whom we observe no positive spillovers either, in spite of the positive effect of the prime on their environmental self-identity. While they infer from the prime that they are environmentally friendly individuals, the signaling power of our manipulation is conceivably too low to give rise to positive spillovers for these individuals, given how common the target behaviors are (Thøgersen and Crompton, 2009).

Policy Implications

Our studies investigate the interplay of multiple nudges when implemented in conjunction. First, we show how a behavioral tool, social information, successfully mitigates the negative spillovers caused by identity priming (Study 1). We argue that the negative spillovers from the identity priming may result either from a heightened sense of morality (Sachdeva et al., 2009) or from the feeling of having already done one's own "fair share" (Kahneman et al., 1993; Guagnano et al., 1994; Thøgersen and Crompton, 2009). Social information may offset the former effect by inducing a feeling of moral incompleteness; and may overcome the latter by alleviating the feeling of unequal participation to the common cause. In Study 2, we provide evidence in favor of the second mechanism: the larger share of conditional cooperators in the identity priming treatments suggests that the intensity of negative spillovers depends on the prevailing norm. This implies that social influence mitigates such spillovers mainly because it corrects subjects' misperception that they contribute more than others.

Second, we find that goal commitment, which is found in other context to offset moral licensing (Fishbach and Dhar, 2005; Fishbach et al., 2006; Mukhopadhyay et al., 2008), has no effect when combined with identity manipulation (Study 2). This result was the opposite of what we expected, since the goal commitment exercise, by making more salient the reasons for prior behaviors, was meant to strengthen the connection between

those behaviors and the moral self and increase the psychological cost of inconsistency. The negative interplay between identity priming and goal commitment is conceivably due to the fact that those who fail to engage in prior environmental behaviors, also can recall few environmental motives behind those behaviors. Thus, for them, the combination of the two nudges undermined even more their self-identity, resulting in lower level of donation. This finding is in line with previous studies suggesting that, whenever it is possible to attribute the same behavior to different reasons, positive cross-behavioral spillovers are hardly achieved (Cornelissen et al., 2008).

Another possible reason why our results do not replicate those of other studies using similar methods may lie in the specific nature of environmental decision. While the environment is commonly considered part of the moral sphere (Thøgersen, 1996; Klöckner, 2013), it is in our opinion likely to fall within the category of imperfect duties, in spite of the severity of climate change. Fulfilling imperfect duties has a positive impact of one's moral self, but not following them does not threatened one's morality (Wiltermuth et al., 2010; Kant, 2013). Reminding individuals that they do not comply with imperfect duties does not activate compensating decisions, as it is usually observed in other moral decision settings (Sachdeva et al., 2009; Zhong et al., 2010; Jordan et al., 2011), but rather results in negative consistency or no effect (Cornelissen et al., 2008; Van der Werff et al., 2013a, 2014a,b). This reasoning would suggest caution when extending the literature about moral behaviors to the environmental domain. A formal test of this argument would require an investigation into individual perception of environmental behaviors relative to other moral decisions.

Our results have important theoretical and practical implications. First, they contribute to the literature on spillover effects, by experimentally testing the impact of priming past environmental behaviors on subsequent decisions, through an incentive-compatible design and with a large and heterogeneous sample. Second, our heterogeneity analysis highlights the importance of targeting identity priming interventions to minimize negative spillovers. Finally, we identify nudges that can offset or exacerbate the negative spillovers from identity priming. In a world characterized by increasing exposure to behavioral policies, practitioners should pay attention to the unintended consequences of combining multiple behavioral tools.

Our work also presents some limitations. First, the significance of our results is rather weak, especially in Study 2. Even though we provide plausible explanations, future research should test the robustness of our results. Second, our results do not shed light on the process through which, according to our interpretation of the empirical results, individuals balance the costs of behavioral consistency against the those of acting morally. Finally, it is certainly disappointing that we do not succeed in generating positive spillovers, even among the most engaged subjects.

CONCLUSION

To summarize, we study how past pro-environmental behaviors affect subsequent environmental decisions, and the role played by common behavioral policies. Overall, the two experimental studies – carried out on a heterogeneous sample and in an incentive compatible way – provide evidence that past pro-environmental actions strengthen environmental self-identity, but, at the same time, fail to promote following pro-environmental decisions. Even worse, they generate negative spillovers among subjects who engage less in pro-environmental behaviors. Finally, we show that, depending on which behavioral strategy is put in place, negative spillovers can be either mitigated or magnified.

ETHICS STATEMENT

The wider project of which this study was part (COBHAM) underwent ethical review, and received the approval of Politecnico di Milano's Ethical Committee. All participants gave written informed consent in accordance with the Declaration of Helsinki.

AUTHOR CONTRIBUTIONS

VF conceived the study, led the analysis of data, and the writing of the paper. Gd'A contributed to the conception and the design of the study, to the preparation of experimental material, and to the writing the manuscript. MT contributed to the conception and the design of the study, to the writing of the manuscript, and was in charge of overall direction and planning.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyg.2019.00061/full#supplementary-material

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Facilitating Positive Spillover Effects: New Insights From a Mixed-Methods Approach Exploring Factors Enabling People to Live More Sustainable Lifestyles

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Positive spillover occurs when changes in one behavior influence changes in subsequent behaviors. Evidence for such spillover and an understanding of when and how it may occur are still limited. This paper presents findings of a 1-year longitudinal behavior change project led by a commercial retailer in the United Kingdom and Ireland to examine behavior change and potential spillover of pro-environmental behavior, and how this may be associated with changes in environmental identity and perceptions of ease and affordability as well as perceptions of how participation in the project has helped support behavior change. We draw on both quantitative and qualitative data. Study 1 examines quantitative data from the experimental and a matched control group. Study 2 reports qualitative findings from a follow up interview study with participants of the experimental group. As expected, we found significant changes in reported pro-environmental behavior and identity in the experimental group as well as some indications of behavioral spillover. These changes were not significantly associated with changes in environmental identity. The interviews suggested that group dynamics played an important role in facilitating a sense of efficacy and promoting sustained behavior change and spillover. Moreover, the support by a trusted entity was deemed to be of crucial importance.

Keywords: spillover, sustainable lifestyles, identity, longitudinal, pro-environmental behavior

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INTRODUCTION

Tackling anthropogenic climate change and other major challenges of human impact on our ecological life support systems cannot be achieved without behavioral change by individuals and communities (Capstick et al., 2015). Over the last decades the social sciences have made significant advances in research targeting 'environmentally friendly' behaviors (e.g., Kollmuss and Agyeman, 2002). With mounting environmental pressures and climate change impacts already happening across the world (Intergovernmental Panel on Climate Change [IPCC], 2014), further approaches to sustainable consumption are needed to establish more sustainable lifestyles in which people act sustainable across a wide range of possible behavioral areas (Thøgersen, 1999).

However, research has shown that changing behaviors poses great difficulties (Whitmarsh, 2009). Moreover, changing entire lifestyles is more difficult than targeting single behaviors or behavioral

categories. Modern lifestyles consist of a highly complex mesh of moral, practical and cultural *commitments* to certain practices of consumption, and often involve very limited *capabilities* for self-directed change (see e.g., Nussbaum, 2011). For example, whereas people often hold a positive attitude toward pro-environmental behaviors (PEBs) such as recycling, a lack of recycling infrastructure and a supportive cultural context can present difficult barriers to realizing such behavior in everyday life.

At the same time individuals experience an ever-growing range of consumption and informational choices increasingly influenced by stimuli triggered by companies and governments (Thaler and Sunstein, 2008) with a major impact on both opportunities and abilities people have to shape their lifestyles, and to pursue more sustainable lifestyles. As noted by Jackson (2008), trying to engage in sustainable lifestyles thus throws up significant challenges for most people, sometimes leaving them with a feeling of being 'locked-in' (Sanne, 2002).

One way to approach the challenge of promoting more sustainable lifestyles is by studying behavioral spillover (Capstick et al., 2015). Lifestyles usually consist of a wide range of behavioral patterns, interests, beliefs, values and identities, among others. Theoretically, allowing behavior to spill from one behavior over to another can, potentially, trigger a chain-reaction that eventually changes entire lifestyles.

By positive spillover we refer to the adoption of further PEB, over and above the behavior targeted in a given intervention, and ideally extending beyond the duration of the intervention project. This means that sustainable lifestyles, characterized by consistent behavioral patterns with a relatively low environmental impact, can be achieved through behavior changes in both specific targeted behaviors and contexts which subsequently influence other behaviors.

This paper evaluates findings from a longitudinal behavior change project to examine how we might be able to promote more sustainable lifestyles through behaviors change and positive spillover.

Behavioral Spillover Effects

Behavioral spillover refers to the process where adoption of one behavior spills over into the adoption of another. Spillover effects are often seen to occur as a result of changes in motivation or preferences at the individual level that result from the adoption of a new behavior and impacts on further behavioral outcomes (Truelove et al., 2014). Spillovers can be both positive and negative (Truelove et al., 2014; Dolan and Galizzi, 2015). Whereas *positive* spillover describe the process of one behavior leading to a second behavior that is in line with the initial intervention, and thus follows a certain consistency (assimilation), *negative* spillovers describe the process of a subsequent behavior that is inconsistent with the previous one. Negative spillover may occur when the initial behavior was perceived as too easy or costless since it has been suggested to be less reflective of one's motivations (Truelove et al., 2014). Another, perhaps more common negative spillover effect occurs when individuals compensate for the initial behavior (e.g., Bargh et al., 2001; Gneezy et al., 2011; Dolan and Galizzi, 2015). Here, one potential explanation for negative spillover effects frequently offered by the literature is that of *moral licensing* (For a recent meta-analysis see: Mazar and Zhong, 2010; Blanken et al., 2015). Moral licensing refers to a process where adoption of one moral behavior results into a decreased likelihood of adoption of another. The idea is that the adoption of one moral behavior reduces motivation to engage in another, or may even increase the likelihood someone may adopt deviant behavior, because people feel they have "done their bit." Another form of negative spillover is the so-called *rebound* (Druckman et al., 2011), or *backfire effect* (Jenkins et al., 2011) where financial savings achieved through one type of PEB are subsequently spent on environmentally damaging behaviors which may sometimes cancel out (rebound), or even exceed (backfire) any environmental savings.

Over the last 20 years empirical research into spillover effects has made significant advances. It has been proposed that behavioral spillover theoretically has the potential to support people in their transition toward sustainable lifestyles (Whitmarsh and O'Neill, 2010; Capstick et al., 2015). However, the findings of this research are varied, and spillover is difficult to detect. In an early study using a correlational design, Thøgersen (1999) found little evidence for spontaneous spillover. He did find a small but significant effect of both positive and negative spillover, but without increasing the overall predictability of subsequent PEB. However, he did find that spillover was more likely when behaviors were perceived to be more similar. In a more recent study with a similar design, Lanzini and Thøgersen (2014) found positive spillover from 'green' purchasing to other PEB. Examining the role of different categories on positive spillover effects, Thøgersen and Ölander (2003) reported that spatial and temporally similar PEB seem to show stronger correlations than behaviors within different taxonomic categories. These findings were partly confirmed by a recent study by Margetts and Kashima (2016) in which the authors found that behaviors drawing on similar resources (e.g., time and/or money) had a stronger effect on the magnitude of spillover effects to occur. Existing evidence for positive spillover effects were mostly found for low-cost behaviors that are 'simple and painless' (Thøgersen and Crompton, 2009). However, in a recent study by Lauren et al. (2016), the authors note that easy behaviors can lead to a strengthened intention to enact more difficult behaviors in the future through an increased sense of self-efficacy. This is in line with what Deci (1975; Ryan and Deci, 2017, p. 152) calls "optimal challenge" where a first less onerous task demands a subsequent, more challenging task leading to new capabilities. In contrast, van der Werff et al. (2014) demonstrated that more difficult behaviors can function as stronger signals of an environmental identity and thereby promote positive spillover.

Identity, and Its Influence on Pro-environmental Behaviors and Lifestyles

Identities play important roles in guiding behaviors in everyday life. Self-identities provide an answer to the both explicit and implicit question of "Who are you?" (Vignoles et al., 2011). According to MacAdams (1995) identities encompass physical

attributes, values, goals, behavior and traits together with an individual's personal narratives. The significance of identities on human behavior is highlighted in numerous theories such as Self-Completion Theory (Wicklund and Gollwitzer, 1985), Identity Theory (Stryker, 1968, 1980; Burke and Reitzes, 1991), and Identity Based Motivation Theory (Oyserman and Lewis, 2017). Besides their conceptual differences, what these theories have in common is the assumption that humans have an inherent tendency to seek consistency in outlook and action.

According to Oyserman and Lewis (2017), identities "[a]re central to understanding motivation because people prefer to act and make meaning through the lens of their identities." They are thus crucial for the transition to more sustainable lifestyles. Moreover, identities carry action- and procedural-readiness, and are cued by situations and the availability of awareness (Oyserman, 2009). Identity is a highly relevant concept for studying spillover, as the notion that people strive for consistency (Festinger, 1957) also serves as basis for the work on spillover effects (Thøgersen, 2004).

For the purpose of this paper we follow Oyserman et al. (2012) definition of identities as "traits and characteristics, social relations, roles, and social group memberships that define who one is." This definition, as many others, highlight the important of social relationships, social norms and roles for identities. Identities reflect how people see themselves in relation to other people.

In summary, as suggested by Gatersleben et al. (2014), identities can be understood as stable factors that have the potential to transcend spatial and temporal situations and support behavioral consistency and potential spillover. As suggested by the literature, identity can strengthen perceived efficacy and the sense of belonging, and shift identity standards (Burke, 2006) toward a more pro-environmental understanding of oneself.

The Role of Identity as a Potential Driver for Positive Spillover Effects

Whitmarsh and O'Neill (2010) highlight the crucial role of identity, providing compelling evidence that self-identity operates as a significant behavioral determinant beyond usual variables for carbon offsetting behaviors. Additionally, van der Werff et al. (2014) showed in a series of studies that simply reminding people of their past PEB led, on average, to a strengthened pro-environmental identity and, in turn, to an increased probability of engaging in further PEB. Lacasse (2016) also found that people performed behaviors according to their past-behaviors when they were reminded of them. In addition, the study showed that labeling people with a pro-environmental identity had a stronger positive spillover effect than inducing guilt. On the other hand, Poortinga et al. (2013), found no spillover from increased use of reusable shopping bags (in response to a charge for disposable bags) and other PEBs. However, the research did find an increase in self-reported pro-environmental *identity*. It can be speculated that the absence of a positive spillover effect can be explained by the fact that the behavior was externally regulated (the bag charge), leading to a sense of compliance through the introduction of the new law rather than autonomously enacted behavior (Ryan and Deci, 2017, pp. 191, 226).

Current Research

The aim of our research is two-fold. Firstly, we examine changes in reported PEB, environmental identities and perceptions of ease and affordability among participants of a longitudinal behavior change project. Second, we examined the consistency of behavior and explored potential spillover of behaviors and explored how participation in the project may have supported (or not) such spillover. We draw on both quantitative and qualitative data from the so-called Live Lagom behavior change project executed by a commercial retailer in the United Kingdom and Ireland.

The word *lagom* is sometimes said to describe the Swedish way of life. Loosely translated it means 'just the right amount' or 'balance.' It is an alternative approach to sustainable lifestyles that emphasises the idea of sufficiency.

The project involved a continuous interaction between the participant (i.e., customer) and retailer (i.e., lifestyle change support system), with the aim to allow customers to overcome barriers to more sustainable lifestyles at home and create a movement of like-minded people. Based on the notion that simple education is no longer the dominant approach, it applied a wide range of behavior change techniques (see **Supplementary Data Sheet 1**, **Appendix A**) grounded in existing literature (e.g., Abraham and Michie, 2008).

The initial induction workshop, together with information material in the form of a brochure intended to generate an improved understanding and awareness of sustainability related issues such as resource (over-) consumption, among others. After the participants received their products, they engaged in a number of interventions such as workshops, online awareness-raising activities, and reflective blog writings (for an overview please refer to **Supplementary Data Sheet 1**, **Appendix A**). Here, the applied interventions targeted a wide range of behaviors. The bi-monthly workshops organized by the retailer targeted first and foremost behaviors that the retailer was able to support participants with through their product range (e.g., energy savings through an LED range, food storage containers). At the same time, informing participants about product labeling can be considered to be transferable so that some of the inventions potentially triggered behavior change that went beyond the retailer's own area of expertise.

Between the workshops the closed Facebook group allowed participants across different locations to communicate. This, together with an online question and answer session on energy savings with an industry expert intended to allow participants to engage in further PEB changes. Participants were then able to reflect on their process in their blog posts they wrote at different stages during the project.

STUDY 1: QUANTITATIVE STUDY

The quantitative survey study examined whether participation in the project resulted in changes in PEB, identity and perceptions, and how these were related. We hypothesized that reported PEB would increase more in the experimental group than in

the control group. To gain insight into potential spillover we examined how different behavior changes were related (those targeted and those not targeted by the project intervention). To gain insight into potential rebound we examined how people said they had spent money they had saved by adopting sustainable behaviors. We further examined whether behavior changes were associated with changes in reported environmental identity and perceptions of desirability and ease and affordability.

Design

Quantitative data were collected from a participant and a control group through a baseline questionnaire in November 2016 and through a subsequent follow-up questionnaire during July 2017. The project had an extended focus, and more detail can be found in **Supplementary Data Sheet 1**, **Appendix A**.

Sample and Procedure

The participant sample was recruited by the retailer through the company's loyalty program on the basis of location (to ensure participants could attend relevant workshops and other interventions – See **Supplementary Data Sheet 1**, **Appendix A**) and perceived interest in making changes to their current lifestyles. Each participating household received a voucher to the value of £300: they were allowed to spend this on a range of products that were categorized as sustainable (i.e., the products have the potential to support participants to engage in sustainable lifestyles). In all, 100 participants were recruited in 19 different locations across the United Kingdom and Ireland according to store locations of the retailer. A control group was then recruited by a market research company who matched the control sample to the participant sample. In total 1,000 people in the control group completed the baseline survey but only 170 respondents completed both baseline and follow up survey and were included in the analyses reported here. After cleaning the data and removing missing or non-matching data, a sample including 152 responses in the control group and 99 in the experimental group remained. In both groups there were more females (67% in the experimental group and 72% in the control group). In the control group 30% of the respondents were 35 or younger, 43% between 35 and 44, and 28% 45 or older.

Measures

All respondents completed a large survey including a wide range of questions on PEBs, environmental attitudes, values and identities. The analyses in this paper focus on the following parts of the survey only.

Desirable, Easy, and Affordable

Respondents were asked to rate on a scale from 1 (not at all) to 5 (very much so) to what extent they believe it was desirable, easy and affordable to live a sustainable lifestyle.

Identity

To measure identity respondents were asked four questions. How important (1 = extremely important, 5 = not at all important) is it to your sense of self: to try to live a sustainable lifestyle; [. . .] that other people think of you as someone who lives sustainably; [. . .] that those people living with you practice sustainable behaviors; [. . .].The items were combined into one identity variable by calculating the mean score across the three items for time 1 ($\alpha = 0.79$) and time 2 ($\alpha = 0.82$). At the end of the project participants were also asked to what extent they felt like a Lagomer (1 = not at all, 100 = completely).

Pro-environmental Behavior

Respondents were asked how often (point 1 = never, 5 = always) they enacted ten PEBs: switch off lights in rooms that aren't being used, switch off appliances and not leave them on standby, maintain, repair and/or "upcycle" things, avoid food waste, for example by planning meals ahead, measuring the right portions, using containers to prolong the life of food, or cooking with leftovers; use product labeling to help you choose the most energy- and water-efficient products; choose fairly traded, eco-labeled and independently certified foods, clothing, etc.; buy second hand or recycled products; hire, share and lend products instead of buying them; use reusable shopping bags; walk or take the bike instead of the car for short journeys. A new variable was created combining ten (never-always) of these behavior variables into one scale ($\alpha = 0.75$ for T1 and 0.76 for T2).

Rebound

To gain insight into potential rebound effects, respondents were asked whether they thought they had saved money during the project by saving energy and water. Here, 25% of the respondents stated they felt they had saved 'a lot' of money on electricity savings, and 42% said they had saved 'a little.' 14% said they had saved 'a lot' on gas bills, and 38% said they had saved 'a little.' In terms of water savings, 8% stated they had saved 'a lot' on water bills, and 32% said they had saved 'a little.' Finally, 27% said they had saved 'a lot' on food bills whereas 39% thought they had saved 'a little.'

Results

Desirable, Easy, and Affordable

Participating in the project had a significant positive effect on respondent's perceptions. Perceptions of the desirability of sustainable living did not change significantly more in the experimental than in the control group [Wilks = 0.99, $F(1,231) = 3.54$, $p = 0.06$, $\eta = 0.015$]. This is perhaps due to a ceiling effect as perceptions were already very high. However, participants in the experimental group were significantly more likely than participants in the control group to see sustainable living as easier [Wilks = 0.94, $F(1,231) = 15.91$, $p < 0.001$, $\eta = 0.064$] and affordable [Wilks = 0.96, $F(1,231) = 10.85$, $p = 0.001$, $\eta = 0.045$] at time 2 than at time 1 (see **Figure 1**).

Identity

At the start of the project participants were already more likely to see living sustainably as an important part of their identity. Yet, this difference increased further during the project (**Figure 2**). A significant interaction effect revealed that participants in the experimental group were significantly more likely than respondents in the control group to perceive living sustainably as important to their sense of self at the end of the project

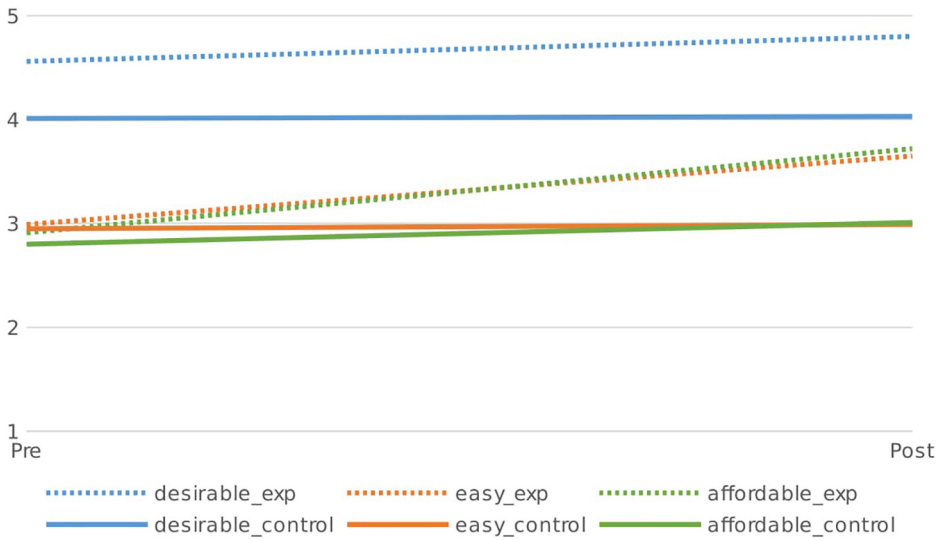

FIGURE 1 | Perceived desirability, ease and affordability of sustainable living at the start of the Project and 8 months later by respondents in the control and experimental condition (1 = low, 5 = high).

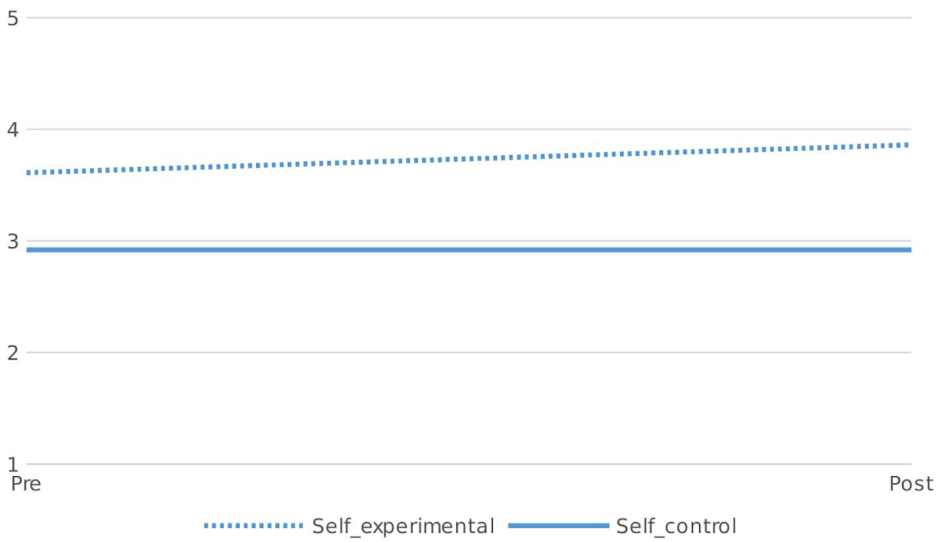

FIGURE 2 | Environmental identity at the start of the Project and 8 months later by respondents in the control and experimental condition (1 = low, 5 = high).

compared to the start of the project [interaction effect Wilks 0.98, $F(1,231) = 4.65$, $p = 0.032$, $\eta = 0.020$]. At the end of the project participants also tended to indicated that they felt like a Lagomer ($M = 79$, $SD = 17$) indicating that they had incorporated the project identity.

Behavior Change

Table 1 (left part) shows that all behaviors were adopted more at the end than at the start of the project. However, the changes were largest for "avoiding food waste" and "using labeling to buy more energy efficient products" and "eco-friendly products" (columns 2–4 of **Table 1**), behaviors targeted by the project interventions. However, behaviors that were not targeted also changed. The last three columns of **Table 1** show that, as expected, change scores for each behavior (post minus baseline) were larger in the experimental than in the control group. In fact, for most behaviors there was no evidence for any behavior change in the control group (mean change scores were close to zero). The largest differences between the control and the experimental groups were found for the item on *avoiding food waste*, *using reusable shopping bags*, and *using labeling*.

Spillover

Table 1 showed that reported behavior changes spanned a wide area. Reported behavior changes of participants in the experimental group were strongest for behaviors that were more

TABLE 1 | Changes in reported behaviors pre–post the intervention period, and differences between the experimental and control group in reported behavior changes.

	Changes in reported behavior			Differences in behavior change		
	Pre	Post		Experimental (*N* = 80)	Control (*N* = 152)	
	M SD	M SD	*t*	M SD	M SD	*t*
Lights	4.23 0.93	4.46 0.84	19.62***	0.51 0.83	0.07 1.02	7.51**
Standby	3.19 1.27	3.45 1.23	19.65***	0.61 1.06	0.06 1.13	11.12**
Maintain, repair upcycle	2.85 1.21	3.05 1.13	11.63**	0.49 1.04	0.04 1.16	6.57*
Avoid food waste	3.70 1.17	4.05 1.01	51.42***	1.11 1.09	−0.05 1.07	43.18***
Labeling energy	2.73 1.35	3.16 1.35	36.72***	1.05 1.14	0.11 1.50	16.89***
Labeling food clothes	3.70 1.17	4.05 1.01	51.42***	0.78 0.97	0.13 0.97	18.67***
Buy second hand	2.34 0.92	2.44 0.93	9.10**	0.44 0.85	−0.07 0.91	12.44**
Hire, share and borrow	1.90 0.81	2.07 0.82	13.18***	0.78 0.91	0.01 1.00	5.79*
Reusable shopping bags	4.26 0.88	4.48 0.89	10.23***	0.45 0.76	−0.11 0.79	25.97***
Walk or bike instead of car	3.11 1.30	3.27 1.35	8.30**	0.40 0.98	0.03 1.14	5.71*

*$p < 0.05$; **$p < 0.01$ Significance levels.

strongly linked to the project (reducing food waste, purchasing labeled products) but also for behaviors that were not addressed in the intervention (walking or cycling instead of using a car). These findings suggest spillover may have taken place. To explore this further correlations were computed between all behavior change scores. **Table 2** shows these correlations for the experimental group (top) and the control group (bottom). The findings confirm that there are more significant correlations in the experimental group than in the control group, suggesting that behavior changes for one behavior were more likely to be associated with behavior change for another behavior in the experimental group. Correlations in the experimental group are also stronger, pointing to the same conclusion. Finally, in the experimental group changes in behaviors that were addressed in the intervention (reducing food waste, using labeling, sharing and repairing) as well as those that were not (walking and cycling) were correlated with a number of other behavior changes.

Rebound

When asked what participants had done with the money savings resulting from the project, 22% of the respondents reported they had spent it on social events and trips (holidays (10%), visiting friends, weddings), 18% said it went toward savings (6%) or payment of household bills (12%). Interestingly, only 9% of the participants stated that they spent it on products to help them further cut down environmental impact. This was almost always on food containers, light bulbs or plants and seeds. Finally, 5% said they spent it on home improvements such as extensions, curtains, rugs and well as generic home improvements, in some cases to help energy saving.

Identity and Behavior Change

To examine whether changes in identity were associated with changes in PEB and rebound, we first created a new identity change score by calculating the difference between baseline and follow-up scores. The same was done for changes in perceived ease and affordability. Resulting scores could be negative (a reduction), zero (no change) or positive (an increase). Overall, sustainable identity became less salient for 34% of the respondents, stayed the same for 19% and became more salient for 47% of the respondents. 25% of the respondents thought it was less easy compared to 41% of the participants who thought it was easier to live sustainably after the project than before, for 34% it stayed the same. 45% thought it was more affordable, and 20% thought it was less affordable at the end than at the start of the project, for 35% it stayed the same.

Regression analyses were conducted to examine whether changes in reported PEB were associated with changes in reported identity and changes in the perception of how easy or difficult it is to adopt such behavior. For changes in reported PEB, a significant relationship was found. However, this effect was small, and only 6% of the variance in behavior change

TABLE 2 | Correlations between different behavior changes in the experimental and the control group.

	Light	Appl	Repair	Food waste	Label	Fair	Second hand	Share	Bags
Experimental group									
Lights	1								
Appliance	0.22	1							
Repair	0.35**	0.32**	1						
Food waste	0.17	0.12	0.36**	1					
Label	−0.04	0.21	0.16	0.21	1				
Fair	0.23*	0.20	0.16	0.22	0.20	1			
2nd hand	0.02	0.02	0.34**	0.27*	0.10	0.06	1		
Share	0.16	0.06	0.45**	0.40**	0.23*	0.27*	0.43**	1	
Bags	0.31**	0.08	0.26*	0.17	0.19	0.16	0.34**	0.20	1
Walk bike	0.17	0.30**	0.28*	0.06	0.29**	0.23*	0.05	0.22*	0.11
Control group									
Lights	1								
Appliance	0.09	1							
Repair	0.02	0.16*	1						
Food waste	0.14	−0.03	0.08	1					
Label	0.02	0.14	0.33**	0.24**	1				
Fair	0.07	0.07	0.11	0.21**	0.39**	1			
2nd hand	−0.11	0.14	0.14	0.15	0.18*	0.17*	1		
Share	0.03	−0.01	0.11	0.23**	0.16*	0.08	0.30**	1	
Bags	0.06	0.07	0.03	0.16	0.06	−0.03	0.02	0.00	1
Walk bike	0.07	−0.02	0.02	0.02	−0.01	−0.04	0.00	−0.08	0.10

*$p < 0.05$; **$p < 0.01$ Significance levels.

could be explained by changes in identity and perceptions [Adj $R^2 = 0.06$; $F(3,228) = 5.96$, $p = 0.001$]. Moreover, only changes in perceived ease of the behavior was a significant predictor ($\beta = 0.19$, $p = 0.023$), whereas changes in identity ($\beta = 0.10$, $p = 0.129$) and perceived affordability ($\beta = 0.06$, $p = 0.465$) were not. **Table 3** shows correlations for each of the behaviors separately. The table illustrates that increased perceptions of the desirability of PEB were associated with changes in consumer behaviors such as use of labeling, fair trade products and usage of reusable bags. This, however, was not related to energy saving behaviors such as turning lights and/or appliances off. Changes in perceived ease and affordability were related to a wider range of behaviors but least with low cost (or cost saving) behaviors such repairing things, using energy labeling, buying second hand and using reusable bags.

TABLE 3 | Correlations between changes in identity, perceptions of desirability, ease and affordability of sustainable behaviors, and changes in reported behaviors.

	Changes in			
	Identity	Desirable	Easy	Affordable
PEB	0.13*	0.21**	0.27**	0.21**
Lights	0.12	0.13	0.17**	0.13*
Appliance	0.06	0.03	0.14*	0.16*
Repair	0.08	0.09	0.09	0.07
Food waste	0.03	0.13	0.15*	0.12
Label	0.07	0.17*	0.06	−0.00
Fair	0.15*	0.16*	0.25**	0.18**
Second hand	0.10	0.14*	0.08	0.05
Share	−0.01	0.13	0.18**	0.18**
Bags	0.02	0.17*	0.13	0.13
Walk bike	0.08	−0.02	0.17**	0.11

*$p < 0.05$; **$p < 0.01$ Significance levels.

Although changes in identity did not related to changes in reported behavior, reported identity and perceptions at baseline were significant predictors of reported behavior at time 2 [Adj $R^2 = 0.22$; $F(3,228, 23.17)$, $p < 0.001$], with only pro-environmental identity being a significant predictor ($\beta = 0.44$, $p < 0.001$). Moreover, pro-environmental identity at time 1 was a significant predictor of behavior change [Adj $R^2 = 0.06$, $F(3,228) = 5.76$, $p = 0.001$; β identity $= 0.28$, $p < 0.001$; β easy $= -0.11$, $p = 0.213$; β affordable $= 0.02$, $p = 0.817$].

Examining respondents in the experimental group only, a positive correlation was found between reported PEB at the end of the project and the extent to which respondents indicated they felt like a Lagomer ($r = 0.36$, $p = 0.001$). They also indicated that a Lagom lifestyle was a sustainable lifestyle [$M = 87$ (1–100), $SD = 14$]. Not surprisingly then, the Lagom identity was correlated with the environmental identity ($r = 0.51$, $p < 0.001$). However, this relationship was only significant for four out of the ten behaviors: switching off lights ($r = 0.29$, $p < 0.001$), repairing/upcycling ($r = 0.41$, $p < 0.001$), reducing food waste ($r = 0.29$, $p < 0.01$) and using energy labels ($r = 0.27$, $p < 0.05$) suggesting that the Lagom identity, maybe unsurprisingly, was "lived" first and foremost at home, and did not necessarily translate into other behaviors.

Rebound and Identity

In the experimental group, environmental identity became less salient for the 21% of the respondents, it stayed the same for 14% of the respondents and increased for 49%. To examine whether reported rebound was associated with changes in identity, χ^2 tests were conducted. Unfortunately the sample size was too small to conduct reliable analyses. As we only had data from the experimental group and not all participants had answered the rebound question the samples were too small to conduct valid analyses (n = 54 in total, and too many cells, 66%, had expected count less than 0.5).

Summary

As expected, respondents in the experimental group were significantly more likely than respondents in the control group to report an increase in behavior change and pro-environmental identities. Moreover, changes in behavior were more likely to be correlated in the experimental than in the control group, suggesting that there was some consistency of behavior change and potential spillover. Unfortunately it was not possible specifically to test spillover as we could not determine which behavior change took place first. A further limitation of the quantitative approach is that we can only study spillover for behaviors that were included in the survey. A follow up study is therefore needed to examine further behavior change.

Although reported perceptions, identities and behaviors all changed, the extent to which these changed were only marginally related to each other. Environmental identity predicted behavior change but changes in identity did not relate to changes in behavior. In summary the project was clearly successful in changing perceptions and reported behaviors but it is not entirely clear what may have contributed to these changes. A follow-up interview study was conducted to gain more insight into the processes of change and what may have contributed to successful behavior change and potential spillover.

STUDY 2: QUALITATIVE INTERVIEWS

The aim of the interview study was to shed further light on underlying factors that *enabled* participants to change a range of behaviors during their participation in the Live Lagom project. Hence, we examine *whether* spillover took place, and what motivated participants to engage with more PEBs.

Methods

Participant Sample

Qualitative data were collected 9 months after the official end of the project during March 2018 by means of interviewing a sub-set of project participants. Potential interviewees (n = 44) were contacted on the basis of proximity to the first author's locality due to practical and financial reasons. Seven householders agreed to participate in a semi-structured interview (Bryman, 2008, p. 439) in their home. All participants were 'White British' or 'White other,' female, and all except one had children. In two interviews male partners actively participated. The mean age was 41.1 years (ranging from 30 to 50) with a mean annual gross household income of around £40,000.

Procedure

The semi-structured interviews took place in four different locations across England and lasted between 45 and 90 min. Questions focused on changes in behaviors and factors enabling them whereas a high degree of flexibility was maintained to address potentially important findings. All interviews were transcribed verbatim and analyzed using a thematic analysis approach (Braun and Clarke, 2006; Bryman, 2008, pp. 554–555.). Thematic analysis allows the researchers to explore recurring topics between the participants and add explanatory power to the quantitative findings. No further incentive was provided for their time and participation.

The qualitative analysis was an iterative process, and included coding and categorization. Following Braun and Clarke's (2006) six phases of thematic analyses, the first phase focused on becoming more familiar with the data. In a second step initial codes were generated. These were informed by a previous (similar) interview study conducted a year earlier with a different sample. First findings from this research, suggesting that identity *can* play a role in extended behavior change leading to spillover effects, were added where it seemed appropriate. In a third phase, the collated codes were used to build first themes that were subsequently reviewed in a fourth step before defining and naming them during the fifth phase. A sixth and final phase is the production of a report which builds the qualitative analysis of the research at hand.

Results

Table 4 shows the respondents' answers to the key questions discussed in the quantitative section. It also shows how the participants responded to some further exploratory questions that aimed to gain further insight into their behavior changes and perceptions. The table illustrates the interviewees' varied responses to the intervention. Behavior change was stronger for some than for other participants, as were changes in identity. Respondents RE2.2 and RE2.3 changed the least.

Results: Thematic Analysis

In addition, the thematic analysis uncovered a number of themes that provided insight into the ways in which participating in the project supported sustainable living. The first theme described below discusses evidence for behavior change and spillover and combines data from the qualitative and quantitative parts of the study. The following themes focus on perceptions of the ways in which project participation has supported behavior change: behavior change and spillover, support, belonging, identity, and structural barriers to making changes.

Behavior Change and Spillover

The quantitative findings had already provided evidence for reported behavior changes, yet, as in most spillover studies, demonstrating a strong spillover effect was more problematic. In line with the quantitative findings, interviewees were more likely to report a strong engagement with a range of PEBs at the end of the project compared to the start. Looking at the reported behavior changes on the quantitative survey for each of the interview respondents (**Supplementary Data Sheet 1**,

TABLE 4 | Respondents' environmental identity, reported pro-environmental behavior, perceptions of desirability, ease and affordability of sustainable behavior, reported rebound and perceived achievements and barriers for further change.

	ID	PEB	Desirable	Easy	Affordable	Rebound	Biggest achievement	Most sust. behavior	Main barrier
BR 2-4	+1	+0.9	0	+2	+3	(NA)	New focus, now writing book	Live without plastic No new clothes	Cost
BR 2-6	+1	0	0	+2	+2	Savings	Growing own food	Not sure	Availability
NOT2-1	+0.4	+0.2	0	+1	0	Holiday	Family more mindful	Nappies	Time
NOR2-1	+0.7	+0.6	0	+1	+2	Bills	Made home more efficient	Nappies	Culture Cost
RE2-1	+1	+0.7	+2	+1	+1	Holiday	Energy waste	Energy waste	Time
RE2-2	0	+0.6	0	0	0	(NA)	Organized/tidy	Greener car	Cost
RE2-3	0	+0.6	0	+2	+2	Savings	Saved energy reduced cost	No second car	Cost

Appendix B) suggests that behaviors enacted at home changed more than behaviors outside the households. These findings indicate two things. Firstly, that behaviors that were targeted by interventions (**Supplementary Data Sheet 1**, **Appendix A**) were mostly successful, and, secondly, that behaviors were more successfully changed when interviewees felt more in control of them. Moving from top to bottom, the table illustrates the difficulty to secure behavioral consistency across domains with the high PEB mean scores (i.e., the green areas) occurring much more on the top (i.e., in household behaviors).

The interviews also found evidence for self-reported spillover. **Table 5** provides an overview of participants' initially targeted behaviors, any reported positive spillover and reported reasons why no spillover had taken place. The table suggests that positive spillover occurred in the interview group. For example, a female participant from the southeast of England reported that the family initially intended to save energy and reduce their food waste. This, subsequently, led her to reuse her towels more when she traveled for work and try to use reusable water bottles instead of buying new ones, following an increase in awareness.

What follows is an overview of findings from the interviews conducted 9 months after the end of the project explaining in more detail the different roles of factors that influenced behavior change and positive spillover factors.

The Role of Support and Motivation for Behavioral Changes

Participants mainly described their motivation for applying to the project in terms of *support*, indicating both a willingness and an openness to change their existing lifestyles. Through entering into the project they hoped to receive help that would allow them to overcome barriers such as a lack of continuous motivation and awareness:

> "It [the reason for applying] was- if there was any way to improve it and to make it more eco-efficient and to, you know, minimize impact we were having, that was really-. . . that's quite important to us." (Nor-2)
>
> "It [taking part in the project] would give us a little bit of a push, if that makes sense, to kind of like. . . rethink of how we were living our lives here and we kind of needed that push to get us to be able to like review and. . . and, umm. . . think about how we can be more sustainable." (Re-1)

As presented in **Table 4**, all except one participants reported no change for 'desirability.' The ceiling effect, already described in the quantitative analysis, provides a potential explanation here. At the same time, it suggest that the participant group had a naturally strong interest in changing their lifestyles, equipping them with an initial motivation that perhaps served as a fertile ground for further behavior changes, and/or, in other words, potential spillover effects.

Indeed, analysis on the behavioral changes also provide additional insights into the role of the retailer as *Lifestyle Change Support System* in the process. The facilitation of both the interventions and an environment that allows participants to engage in more PEB was considered to be of great importance to motivate participants to engage in further PEB as part of sustainable lifestyles:

> "And I think just having someone to say 'look, set it up like this. It will be easy to do everything.' And then maybe a knock-on effect, isn't it? To go through and say 'oh, okay, that's easy. Now let's see if I can tackle this, or this, or this."' (Re-2)

Furthermore, the new relationship between the participants and the program, which we characterize as joint engagement in a *Lifestyle Change Support System*, resulted in a sense of *commitment* to enact newly developed capabilities and, eventually, change their lifestyles to more sustainable alternatives. The retailer refrained to inflict a sense of guilt to enact more PEB, nor did they directly remind participants of an earlier expressed pro-environmental identity. The resulting relationship between retailer and participating households had strong implications in participants' motivation to change their lifestyles:

> "You know, it's not like an actively, or a contractual relationship or I signed something like 'you must do this' but I think it is the conscious realization that you are participating in a project and that you actively want to make these changes and that you are getting the support. (. . .) Yeah, it sort of is like 'well, yeah I need to do this because they have done that.' Because they care and because they want people to change. So yeah, we want to be those people that do change." (Re-2)

This finding points toward a successful facilitation of what Ryan and Deci (2017, pp. 99, 617) call *need-supportive contexts* in which people have the opportunity to execute existing, and stretch newly developed, capabilities. Moreover, they suggest that within these environments people are much more likely to

TABLE 5 | Overview of self-reported spillover-effects and barriers to further positive spillovers.

Participant	Behavior 1	Behavior 2 (i.e., positive spillover)	Barrier to further positive spillovers
Br-4	• Saving energy, • Avoid food waste	• Zero waste • Plastic free • Grow vegetables	• Financial means
Br-6	• Saving energy	• Plastic avoidance • Grow own	• Travel for job • Living situation
Nor-2	• Saving energy	• Improve recycling further • Dry clothes on clothes airer	• Structural factors
Not-1	• Growing food • Saving energy	• Waste avoidance (e.g.: special bee wax sandwich wrap)	• Financial means
Re-1	• Avoid food waste • Save energy	• Waste avoidance (e.g., plastics) • Using rechargeable batteries • Do own washing products	• Structural factors • Lack of support from government (renewable energy)
Re-2	• Decluttering	• Energy savings	• Lack of interest and motivation
Re-3	• Save energy • Avoid food waste	• Being more mindful: reusing more when traveling	• About to move house soon • Structural factor (e.g., recycling facilities)

experience a process of internalization in which values, beliefs, or behavioral regulations from external sources, such as other participants and the Lifestyle Change Support System are taken in, and, eventually, transformed into the participant's own.

The Role of Belonging to a Like-Minded Group for Positive Spillover Effects

Another main supporting factor facilitated by the retailer was the creation of a group of like-minded people that eventually bonded. The involvement in the group provided supporting mechanism that especially affected two important outcomes. Indeed, group membership plays a significant role. Identifying with a certain group, can have far-reaching effects on one's belief systems, actions and motivations.

In the case of Live Lagom, it engaged participants to explore further PEB they did not initially intend to change, and, secondly, a strengthened sense of relatedness. For example, when prompted if they only focused on a certain goal, participants expanded on the process of how behaviors spilled over:

> "Yeah, it expanded beyond that. People involved in the programme were able to help us to, well-…like, you can also do this and this and this. And we were like, 'yeah, that's a great idea, we can do that.'" (Not-1)

Through the interaction with other participants belonging to the Live Lagom group, participants thus engaged in tasks that were readily but not easily ovecome, and thus offered 'optimal challenges' (Ryan and Deci, 2017, p. 448) which resulted in an increased sense of efficacy and nurtured an intrinsic motivation to engage in further behavior changes.

Overall, a general sense of belonging was seen of great significance, motivating participants to explore further behaviors that were initially not targeted – in other words, spillover activities:

> "You gonna have these friends and they gonna think the same things and it's gonna be 'yes come on, let's save it all.' And we've been online going 'does this-…taking pictures of packaging and can you recycle this, and can this go in the back?' And trying to work out if you can or not (laughs). It is a minefield of plastic packaging out there. The film-type stuff. I have no idea (laughs). We just trying our best." (Nor-2).

The Role of a Salient Pro-environmental Identity

As highlighted earlier, one main problem of engaging in sustainable lifestyles is a lack of consistency, which is also apparent in spillover studies. Here, establishing identity has been proposed to offer a potential way to generate commitments that can overcome this inconsistency. For the paper at hand, the increase in pro-environmental identity examined by the quantitative analysis was also apparent in the qualitative analysis in the form of sustainable behavioral outputs. For example, when asked if they would identify as sustainable citizens or, alternatively, with the Lagom project, most participants shied away from applying an identity label to themselves:

> "There is no point to like self-describing myself. But I would say that it has made a distinct in our attitude about things…and we are very, very, you know-…just because I don't describe myself as a Lagomer doesn't mean that it didn't have a massive impact on me or (name husband) or on our family." (Re-2)

Although participants did not feel comfortable labeling themselves explicitly the qualitative analysis suggested that the idea of living a *lagom* lifestyle was integrated in the sense of self of the participants. For example, participating households anchored the *lagom* concept as a framework for sustainable living:

> "I think it [lagom] became a word for our kids in the house as well. The kids would make a comment like 'oh, I am being lagom.' Or 'I *lagomed*' my lunch. Like it was a verb. (…) I mean, I think carrying a catch-phrase helps you to keep it in your mind and is playful and sort of like *I am on that team.*" (Not-2)

What happened here can be described as a combination of two socio-psychological processes forming a social representation (Moscovici, 1984, 1988). Whereas the first, anchoring, reflects

categorizing unfamiliar objects through comparing them with already existing, familiar and culturally accessible objects, the second, objectification, transforms these unfamiliar concepts into concrete and "objective" realities that can be integrated into everyday lives and already existing lifestyles (Jaspal and Cinnirella, 2012).

For example, the same participating family continued explaining how the readily objectified and anchored concept then works in practice, and then could be translated into actual behaviors:

> "(. . .) I think every day I liked to have them live lagom because once we sat down and talked about the concept, once we did that I think that was something that then we can say: 'the reason that we are packing lunches and putting them into these reusable containers is because this is better for our- the planet.' And 'remember, we talked about it.' (Not-2)

This finding supports the idea that the lagom concept helped project participants to adapt to new behavioral patterns through an increase in both action and procedural-readinessoriginating from their self-concept (Oyserman, 2009). It also lends sustenance via Heider's (1985 p. 32) seminal work in which he states that "[m]otives and sentiments are psychological entities. . . Mentalistic concepts (. . .) [t]hat bring order into behavior." For example:

> "It set us up to be more organized and to think more about stuff. You know, now, when I go food shopping I think about 'oh do I buy that in the plastic, do I buy that in the glass? Do I take these vegetables in the bag or not in the bag? So it impacted on everything! I don't think 'do I do that because [name retailer] not to or [name retailer] made me think not to, or do I actually do it because it is sensible, isn't it? The way it should be." (Re-1)
>
> "It puts it to the forefront of your mind. Especially 'cause I'm still on the Facebook group and you see the post for some of the new people all the time which is really useful. And then it's just in the back of my mind 'oh, one more thing, one more little change' so yeah, it is definitely sustainable." (Br-6)

The project operated on the assumption that in order to allow motivations to arise and behaviors to spill over, a certain level of awareness must be given. Raising awareness was mainly nurtured through the interaction between different participants with diverse focus areas and expertise, and a variety of workshop experiences with experts (see **Supplementary Data Sheet 1**, **Appendix A**). As a result, participants consciously changed behaviors, a move originating from an increased level of awareness and intrinsic motivation, rather than emerging from externally regulated factors and changes in the environment allowing for little or no agency (cf. Reckwitz, 2002). For example:

> "I think we are much more conscious what we spend our money on so we would much rather do things together as a family or experiences and things like that rather than buying things. So that's awesome." (Re-2)
>
> "I think for me it meant being mindful about *how* we are using things to try to minimize wastefulness" (Not-2).

Following an increased awareness, the strengthened motivation also resulted in an improved action readiness to enact more PEB in other settings and thus show more behavioral consistency between domains:

> "I don't think there can be [a limit to a lagom lifestyle]. I think it's just you have to keep reassessing your contribution and how you can make those small changes, note when you go to the supermarket or packaging you're buying. All of that, you know, do I need to buy the apples in a plastic bag or can I buy the ones that aren't? (Nor-2)

Limits and Barriers

Whereas the research uncovered an improved understanding of how to enable competences to engage in more sustainable lifestyles, the interviews also highlighted several barriers. One of the key obstacles common amongst the interviewees in relation to more sustainable lifestyles seem to be posed by structural factors, or the lack of them:

> "Particularly if there aren't kind of larger social structures in place to encourage to think that way [sustainably]. Umm, so I think a really good example is like recycling. I don't think people just actively think about doing it unless it's brought to their intention and then supported. Just as an active process (. . .)." (Re-3)

The interviewee then continued explaining how a lack of systems of provision (negatively) impacted their capability to engage in more environmental friendly behavioral patterns:

> "(. . .) [r]ight outside our apartment block there was a huge recycling container. We would just take whatever we could recycle downstairs and put it in the recycling containers (. . .). And it was like a no-brainer because you are walking out of your building anyway or you are walking up the street (. . .). So there were so many things about that environment there that just helped us to be more conscious of how we were as consumers. . . and our impact on the environment whereas here there is just so little of that." (Re-3)

Summary

The thematic analysis highlighted the importance of providing an entry point to more sustainable lifestyles such as a behavior change project. It showed that the interaction between a *Lifestyle Change Support System* and a household can change behaviors for an extended time and facilitate positive spillover effects. It also provided participants with important opportunities to raise awareness, rethink traditional ways of living and how to potentially (re-) organize one's everyday life. Study 2 helped to shed further light on findings from Study 1.

For example, the qualitative analysis showed that interviewees' initial behavior changes spilled over to other behaviors. At the same time, participants also highlighted factors which continue to cause barriers to engaging in further pro-environmental barriers. Especially *external* factors participants had little control over such as missing infrastructure to commute more sustainably or recycle better seem to cause seemingly insurmountable lock-ins.

Indeed, the main motivation to engage in the Live Lagom project was to receive support to overcome barriers to more sustainable lifestyles. The motivation that resulted from the

participation in the project can be linked to the continuous interaction with other participants who allowed each other to explore further PEB. Moreover, the increase in awareness operated as an additional motivator.

Ascribing PEB to their sense of self seems to be a fundamental prerequisite for positive spillover effects and, more generally, in the process toward more sustainable lifestyles. By anchoring a previously unknown concept and attributing (shared) meaning to it, Lagom, became a synonym for sustainable living.

In summary, the findings suggest that new capabilities emerged through the support offered by the Lifestyle Change Support System. This, together with an emerging sense of commitments through an increase in awareness of sustainability related issue, a strengthened sense of belongingness resulting from the interaction with other participants, and a supportive context led to more autonomously motivated PEB enactment that were *not* controlled through external mechanisms such laws. This can be of great importance since previous research has shown that fully integrated, intrinsically motivated behaviors are more stable over time (Hagger et al., 2006). As a result, PEB were explored, enacted and maintained and had the opportunity to spill over.

GENERAL DISCUSSION

The overall aim of the research was to investigate ways that support spillover processes toward crucially needed sustainable lifestyles. Using a mixed-methods approach, the study went beyond purely correlational studies to allow for wider insights, and lend explanatory power to quantitative findings.

We aimed to examine whether participating in a yearlong project ran by a commercial retailer could change PEB and promote positive spillover effects. Moreover, we examined whether behavior changes were associated with (changes) in identity and perceptions of engaging in sustainable lifestyles to be easy and affordable.

The quantitative study 1 showed that behaviors changed. As so often, finding evidence of strong positive spillover effects turned out to be difficult.

The qualitative study 2 interviewed a subsample 9 months later. In this study we found evidence of reported positive spillover effects. Findings suggest that this may be because of the interaction with the *Lifestyle Change Support System* which provided participants with ongoing instrumental and social support, as well as motivational encouragement facilitating capabilities and commitments participants need to adopt changes in behavior.

Pro-environmental Behavior Change and Spillover Effects

As expected, Study 1 found that respondents in the experimental group were significantly more likely than respondents in the control group to report a change in behavior change. The interventions offered as part of the support from the commercial retailer were thus considered to be successful. However, we were not able to clearly show any evidence of positive or negative spillover. Indeed, the lack of consistency suggests that spillover processes were unlikely.

Another is offered by the qualitative analysis. Study 2 in particular showed that, in order to allow for truly far-reaching behavior changes that do not stop at the foot-in-the-door stage (Thøgersen and Noblet, 2012), a number of supporting factors are needed. Findings suggest that a lack of continuous motivation or capabilities to autonomously enact other PEB is a determinant of positive spillover effects. It is important to note, however, that motivations differed among participants. This can be because the project was not purely framed along the lines of only pro-environmental motivated goals but also intended to show financial incentives. This might have resulted in a lack of causal clarity (Thøgersen and Crompton, 2009) and have even diminished the overall probability of positive spillover effects to occur In addition to that, (non-) existing structural factors such as recycling facilities or missing public transport can lead to inconsistencies of PEB and disallow positive spillover effects.

Enabler of Behavioral Spillover Effects

Sustainable Identity

In line with previous studies (e.g., Whitmarsh and O'Neill, 2010), the quantitative analysis found that environmental identity at time 1 was a significant predictor of behavior change. Yet, the analysis found only a small effect between an increase in pro-environmental identity in the experimental group and spillover effects. One potential explanation for this is that people hold negative stereotypes of environmentalists such as militant, aggressive, unconventional, and eccentric (Bashir et al., 2013) so that participants preferred to be seen as 'normal' rather than as sustainable citizens. Moreover, identities are highly relational and context-dependent (Strannegård and Dobers, 2010) allowing people to adapt a more sustainable identity in one context while behaving unsustainable in another.

Here qualitative study 2 found that participating households were often motivated and benefitted from the ongoing interaction with the supporting retailer and the like-minded people. This lead to the adaptation of a pro-environmental mindset operating as a framework for everyday behaviors rather than a prescribed identity.

Pro-environmental Capabilities

Contrasting quantitative with qualitative findings, it became obvious that capabilities to engage in further PEB were developed through the interaction between households and *Lifestyle Change Support System*, and households and other participating households. Interestingly, PEB followed the development of competences for sustainable lifestyles rather than through eliminating barriers such as time and money.

The study thus also adds to the understanding of how companies can serve as a force for good by operating as what has been named somewhere else as 'systems of provisions' (Spaargaren and Van Vliet, 2000) or, what we call a Lifestyle Change Support System for citizens that goes beyond a purely exchange relationship and that has the potential to fill in an important role in society. Instead a Lifestyle Change Support System needs to provide resources, knowledge and means to help

and to act on people's behalf to secure desired outcomes on the one hand, and to allow people to enact PEB on their own, or, in other words autonomously.

However, and more generally, findings show that humans have very different needs (Amel et al., 2017). For example, whereas some individuals might strive to gain a stronger feeling of belonging to motivate them to engage in further PEB, others might strive to learn more to build more skills and competences, to autonomously enact PEBs.

Limitations and Directions for Future Research

Limitations

One obvious limitation is the small number of interviewees. Whereas this is common in qualitative research studies using interview data, qualitative findings as part of the mixed-methods approach are much more equipped to serve as tool helping to make further sense of the quantitative results.

Moreover, as a real-life experiment the research faces a number of limitations such as making causal inferences between the great number of applied interventions and their specific impact on behaviors. The project involved a lot of different elements, this makes it difficult to assess exactly what the working ingredients are of the intervention. The qualitative data, however, suggest that this broad approach may have been key to its success providing broad support and a sense of belonging.

Drawing on findings from a sample recruited across a number of locations it is difficult to make wider conclusions due to potentially significant regional differences in behaviors based on differing laws, cultures and structural factors (Rentfrow et al., 2015). However, based on the findings there is no reason to assume that responses to the intervention would have been significantly different between demographic areas.

Lastly, both studies also had predominately female participants. According to Scannell and Gifford (2013), women enact more PEB than men so that findings must be interpreted with care when trying to make wider generalizations. Although we did not find significant differences between participating male and female respondents in the quantitative study future research may want to focus on male householders in more detail.

Future Directions for Research

Taken together, whereas psychology undoubtedly plays a major role in people's transitions toward a more sustainable lifestyle (Gifford, 2008), to master today's challenges posed by climate change and increasing environmental degradation, new mechanisms need to be in place to facilitate more sustainable lifestyles (Gatersleben et al., 2012). Following the Lewinian notion that, in the end, behavior is a function of organism and environment (Stern et al., 1999), and other studies in the field pointing to the importance of contextual and environmental factors (e.g., Lorenzoni et al., 2007; Oyserman and Lewis, 2017), future spillover studies will need to look much closer at contextual and other supporting factors.

Further research is necessary for exploring intervention projects that draw on our findings. In addition, future research can benefit from paying close attention to research in the field of human motivations and using established theories such as self-determination theory (SDT; Ryan and Deci, 2000). Initial studies informed by SDT have shown first promising insights (Webb et al., 2013; Whitmarsh et al., 2017). Lastly, more research is needed in order to examine how an improved customer-company relationship can facilitate autonomy supportive environments that allow for positive spillover effects to occur.

CONCLUSION

Lacroix and Gifford (2018) recently asked in a paper: "Can some psychological barriers be eliminated? If a barrier is eliminated, do spillover or, alternatively, rebound effects occur?" Although the participation in the project led to an overall positive shift in perception toward affordability and ease regarding the enactment of PEB, and thus an increase in capabilities, it did not lead to an increase in (positive) spillover effects. Instead, findings from the semi-structured interviews show that especially the interaction and a strong sense of relatedness between the Lifestyle Change Support System and with other households played an important role in facilitating competences and, eventually, to build capabilities allowing for wider lifestyle changes.

Moreover, in the light of recent debates about the potentially necessary degrowth of the consumer economy (e.g., Borowy and Schmelzer, 2017), a project such as this points to the scope for lifestyle change projects to contribute to radical shifts in lifestyle that enable participants to save money and reduce impacts. Moreover, the study indicates the potential of a positive relationship between a company and its customers that goes beyond the usual exchange relationship. At a time of increasing influences from the private sector on citizens it seems a matter of urgency to create more inclusive avenues that are able find ways to co-create sustainable lifestyles. Finally, the research adds to the existing body of spillover effects. In particular, it suggests new insights concerning the ways in which groups can positively influence PEB change. It shows how citizens' capabilities commitments for sustainable living can be enhanced by a supportive environment enabling identity adaptation. We consider this an exciting area for further research and practical exploration.

ETHICS STATEMENT

Please find below a short version of the ethics application for the Live LAGOM Project which was reviewed and received approval from the University of Surrey Ethics Committee.

Ethics Application

In September 2015 IKEA launched a major 3-year program of action research as part of its overall strategy for sustainable production and consumption. Its aim is to enable households to live more sustainable lifestyles at home. The Practitioner Doctorate Student (PDS) and his research team made sure that all data collection procedures were in line with the University of Surrey ethics guidelines at all times to allow that the ethics application at hand applies for ethical approval to use data already

collected by IKEA in year 1, as well as to all data collection over for the remaining 2 years of the Live LAGOM project until mid-2018.

Description Live LAGOM Project

The Live LAGOM project is an experimental program that fits into two larger contexts. First, it is part of a major international strategy by IKEA to become a leader in sustainable retail. Second, it reflects a sense that there remains a wide gap between the urgent need for more sustainable living and the response to date from businesses and citizens to the challenges of unsustainable development. The Live LAGOM project aims to generate insight into how barriers to more sustainable living can be overcome. More broadly, the project can be seen as a major opportunity for action research that builds on insights from academic work on sustainable lifestyles, behavior change and values, at the University of Surrey and elsewhere.

The role of CES at the University of Surrey in this project is primarily to analyze the data collected, to write reports and published papers in academic journals, but also to address on methodological issues as appropriate. The project is run by a small team that is part of the IKEA Sustainability Department, with support by the charity Hubbub UK (Hubbub UK is a charity working on a range of pro-environmental and social projects with links to behavior change. For further information please see www.hubbub.org.uk). At the end of the project the PDS and his research team at CES team will provide a report on the evaluation of the overall effectiveness of the project in the context of other behavior change projects.

Project Methodology

At the beginning of the start of each year, of the 3-years project in October, respectively, it starts with the recruitment of a pool of participating customers.

Participants (c.100 – c.125 per year) are recruited through the IKEA Family data base that formed the experimental group. In the pilot year/exploratory phase participants received a baseline questionnaire in paper form at an in-store workshop and an online follow-up questionnaire. In years 2 and 3 all questionnaires are now online questionnaires, prepared and collected in and through Qualtrics.

At the beginning of January, all participants received a £500 voucher (NB: in year 2, which is the basis for the paper at hand, it was reduced to £300) with which they purchased products from the IKEA sustainability range. This range of products is designed to help participants to live a more sustainable lifestyle, in other words, the products aim to help (i) save energy and water, and/or (ii) improve recycling and upcycling behaviors, and/or (iii) eat healthier, and/or (iv) live more active lifestyles.

Over the course of the project participants will experience a number of additional interventions such as:

(a) monthly newsletters with awareness raising information, among others;
(b) exchange of information on the project Facebook group (private group for participants);
(c) regional events (two to three over the course of the project) that will help participants to build a network and help to stay engaged and receive further inspiration;
(d) support in the form of Q&As or newsletter posts from experts working in different fields of sustainability.

The interviews will take place in the United Kingdom and are conducted by the PDS and, potentially, a member of his research team at the University of Surrey. Depending on the availability of the participants and further conversations with IKEA the research team might conduct interview in Ireland. If this is the case, an updated version of the ethics application at hand will follow in line with Ethics Handbook Section 2.4 on research conducted outside the United Kingdom.

All interviews will be audio recorded and transcribed in line with the University ethics guidelines.

Analysis

With regard to quantitative data, we use semi-structured questionnaire that will be updated depending on the requirements of the research. All questionnaire responses are marked with a unique identifier (four digit code) before they were collected and safely stored by the PDS according to the University guidelines. All participants' names were deleted to ensure that they remain anonymous and able to speak freely about their experiences. University of Surrey – Ethics v.7, November 2015.

AUTHOR CONTRIBUTIONS

PE, BG, and IC conceived of the overall approach and structure of the manuscript presented here. PE and BG developed the theory. PE collected the data and wrote the manuscript with support from BG and IC. PE carried out the data collection and conducted the semi-structured interviews and its analysis. BG performed the computations. IC and BG verified the analytical methods and IC supervised the findings of this work. All authors discussed the results and contributed to the final manuscript.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyg.2018.02699/full#supplementary-material

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Nudge for Good? Choice Defaults and Spillover Effects

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Policy makers increasingly use choice defaults to promote "good" causes by influencing socially relevant decisions in desirable ways, e.g., to increase pro-environmental choices or pro-social behavior in general. Such default nudges are remarkably successful when judged by their effects on the targeted behaviors in isolation. However, there is scant knowledge about possible spillover effects of pro-social behavior that was induced by defaults on subsequent related choices. Behavioral spillover effects could eliminate or even reverse the initially positive effects of choice defaults, and it is thus important to study their significance. We report results from a laboratory experiment exploring the subsequent behavioral consequences of pro-social choice defaults. Our results are promising: Pro-social behavior induced by choice defaults does not result in adverse spillover effects on later, subsequent behavior. This finding holds for both weak and strong choice defaults.

JEL Classification: C91, D01, D04

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1. INTRODUCTION

Behavioral policy interventions from the toolkits of psychology and behavioral economics have gained increasing attention recently (e.g., List and Price, 2016; Liebe et al., 2018, for reviews of the literature). The goal of such interventions is to steer behavior in a desired direction when the use of classical policy instruments, such as taxes, subsidies, or command-and-control regulation, is not feasible and policies need to rely on the voluntary participation of actors (e.g., Croson and Treich, 2014; Kesternich et al., 2017).

One particularly prominent behavioral policy instrument are choice defaults. Policy makers (and other practitioners) make increasing use of choice defaults because they believe that defaults offer successful and cost-effective ways of triggering behavior change. Indeed, choice defaults appear to be very effective nudges for promoting "good" causes. For instance, defaults successfully promote pro-environmental choices such as the uptake of green energy contracts (Pichert and Katsikopoulos, 2008; Ebeling and Lotz, 2015), they strongly impact charitable donations (Altmann et al., 2014; Goswami and Urminsky, 2016), and they help increase retirement savings (Choi et al., 2003; Cronqvist and Thaler, 2004). Thus, even though there is a lively debate on the ethicality of using defaults as nudges (Bovens, 2009; Hausman and Welch, 2010; Desai, 2011; Sunstein, 2015), their distributional effects (Brown et al., 2011; Loefgren et al., 2012), and whether their use fits the criteria of "libertarian paternalism" (Carroll et al., 2009; Keller et al., 2011; Ghesla, 2017b), the effectiveness of default nudges for promoting "good" causes has generally been taken for granted.

However, for an accurate assessment of the overall effects of default nudges on a socially desired behavior, policy makers should take into account not only the direct impact of default nudges on targeted choices, but also potential spillover effects of the initial behavior triggered by the default on subsequent, related behaviors (see also d'Adda et al., 2017).[1] In principle, such behavioral spillovers could amplify, eliminate or even reverse the initially positive effects of choice defaults, when judging their impact on the aggregate of relevant behaviors (for overviews see Truelove et al., 2014; Dolan and Galizzi, 2015). For instance, if nudging someone into a charitable donation crowds out other pro-social acts in the future, e.g., because of moral licensing (Khan and Dhar, 2006; Sachdeva et al., 2009; Mazar and Zhong, 2010), the net effect of the choice default for promoting pro-social behavior is clearly less positive—and could even become negative—than when no such spillover occurs.

In this paper, we use a laboratory experiment to study spillover effects of pro-social behavior triggered by choice defaults in a first stage on a *subsequent* pro-social behavior in a second stage. Our study is thus an intervention study of spillover effects (see Sintov et al., 2019), investigating whether default interventions can trigger behavioral spillovers to non-targeted, subsequent behavior. By doing so, our paper contributes to and links two strands of literature: on the one hand the literature studying behavioral spillovers (e.g., Meritt et al., 2010; Truelove et al., 2014; Dolan and Galizzi, 2015) and on the other hand the literature studying the effects of default nudges on pro-environmental or pro-social behavior (e.g., Thaler and Sunstein, 2003; Pichert and Katsikopoulos, 2008; Metcalfe and Dolan, 2012; Altmann et al., 2014; Sunstein and Reisch, 2014; Ebeling and Lotz, 2015; Goswami and Urminsky, 2016). To the best of our knowledge, there is only the study by d'Adda et al. (2017) that also links the literature on nudging interventions to the literature on behavioral spillovers and investigates the potential spillover effects of pro-social behavior triggered by nudges on subsequent behavior. D'Adda et al. (2017) use a similar design as ours in order to test relevant behavioral spillovers induced by various policy interventions, including a number of typical "nudges" such as choice defaults and information about social norms. They find that behavior influenced by traditional policy interventions in the form of monetary incentives or contractual regulation had positive spillover effects (mainly because of anchoring effects), whereas behavior triggered by nudging interventions had no spillover effects. However, with regard to choice defaults their results remained inconclusive, as their default manipulation did not produce a significant effect on the initial behavior. In our study, we ensured that the default manipulations yielded statistically significant effects on the targeted initial pro-social behavior. This allows testing the spillover effects of pro-social behavior triggered by successful default nudges on subsequent related decisions that were not directly targeted by the initial default nudge.

The existing empirical literature on behavioral spillovers in sequential pro-social decisions points to the possibility of moral licensing. After a first good deed, people can feel licensed to subsequently act in a negative way, thus resulting in negative spillovers of the initial positive behavior on the subsequent behavior (e.g., Monin and Miller, 2001; Jacobsen et al., 2010; Meritt et al., 2010; Conway and Peetz, 2012; Harding and Rapson, 2013; Tiefenbeck et al., 2013; Achtziger et al., 2015; Clot et al., 2016). As effective choice defaults in our setting increase pro-social behavior in the initial decision, they may trigger moral licensing tendencies leading people to compensate their high initial pro-social behavior (i.e., pro-social giving triggered by a default in our experiment) by subsequently less pro-social behavior. As such compensating behavior would undermine the overall effectiveness of default interventions, it is important to study whether pro-social behavior fostered through the use of pro-social default options leads to negative spillovers on subsequent, non-targeted pro-social behavior.

Contrary to moral licensing, the literature on behavioral spillovers also documents moral consistency effects according to which increased pro-social choices triggered by an intervention like a choice default should lead to even more pro-social behavior subsequently. However, many studies finding moral consistency did so in set-ups where the subsequent behavior was in the opposite domain than the initial behavior (i.e., pro-social behavior followed by anti-social behavior or vice versa, e.g., Freedman and Fraser, 1966; Beaman et al., 1983; Cialdini et al., 1995; Burger, 1999; Knez and Camerer, 2000; Fitzsimons and Shiv, 2001; Cherry et al., 2003; Grimm and Mengel, 2012; Baca-Motes et al., 2013; Brandon et al., 2017). As the goal of our study was to to investigate the behavioral spillover effects associated with choice defaults designed for fostering desirable, pro-social behavior, participants in our study faced an initial and a subsequent decision from the same domain (pro-social giving). This is different from making anti-social (e.g., cheating) decisions that harm others. Moreover, in set-ups with behavioral spillovers within the same (positive) domain (e.g., pro-environmental acts), positive spillovers are more likely when the conditions favor potential mediating mechanisms such as self-efficacy (as people learn that they are able and willing to perform certain behaviors, e.g., Steinhorst et al., 2015; Lauren et al., 2016), the cognitive accessibility of recent relevant behaviors (Sintov et al., 2019), or, relatedly, the self-signaling value of the behavior (Gneezy et al., 2012). By their nature, choice defaults do not seem likely to trigger these mediating pathways that could lead to positive spillovers, as defaults tend to affect behavior without people being explicitly aware of it (e.g., Smith et al., 2013), thus not fostering self-efficacy and making the pro-social behavior less easily cognitively accessible and thus also less relevant for self-signalling.

While previous literature thus suggests that moral licensing tendencies could be expected to occur if pro-social behavior is triggered by a choice default in a first decision, in our experiment we do not find that increased pro-social behavior triggered by choice defaults leads to negative spillovers on subsequent

[1]Note that in this paper we narrow down the term spillover effects to the effect of an initial behavior triggered by the default on related *subsequent* behavior. In the literature, the term spillover effect is also used to describe the backfiring of policy instruments because of psychological reactance to a given policy leading to direct adverse effects on the targeted *initial* behavior (Schultz et al., 2007), or to explain so-called rebound effects due to individual adjustments to relative price changes, which are induced by a given policy (Alcott, 2005).

pro-social behavior that was not directly targeted by the default nudge. These results carry some positive messages for policy makers and choice architects. On the basis of our findings, there is currently no reason that choice architects need to worry about negative spillover effects from the use of pro-social choice defaults.

The remainder of this paper is organized as follows. Section 2 presents the experimental design. In section 3 behavioral hypotheses are presented. Section 4 summarizes the study results. Section 5 discusses relevant findings and concludes.

2. EXPERIMENTAL DESIGN

To study whether choice defaults in a first *initial* decision affect behavior in an untreated *subsequent* decision we based our experimental design on a "sequential behavior paradigm," which is typically used to study behavioral spillover effects experimentally (Mullen and Monin, 2016). For both decisions, we implemented dictator games (Kahneman et al., 1986; Forsythe et al., 1994) in order to have two very similar pro-social deeds as an instrument to uncover potential spillover effects of a default in one decision on a related subsequent decision without a default. The dictator game is a standard game in experimental economics and psychology with typically two players. One player is an active decision maker (she) who receives a certain monetary endowment, which she is free to divide between herself and another (passive) player, the recipient (he). The recipient can be another person, but he can also be an environmental or social cause or charity to which decision makers can donate to. Importantly, the recipient cannot influence how much the decision maker decides to transfer and he has no way of rejecting the transfer. The game thus serves as a measure of voluntary pro-social behavior by the decision maker. It has been extensively used in pro-social decision research (see Engel, 2011, for a meta-analysis).

Specifically, in our study, in the first decision participants played a dictator game paired with a charity as the recipient ("Dictator Stage I"). In the subsequent second decision, participants played another dictator game in which they were paired with a randomly allotted person in the same laboratory session ("Dictator Stage II"). In both stages, participants could be either selfish (and keep the money for themselves) or pro-social (and share some of their endowment with the recipient). Importantly, if there are spillover effects, the decision in Dictator Stage II may depend on the behavior in Dictator Stage I and on the presence and strength of a choice default in that stage.

2.1. Method and Procedures

2.1.1. Dictator Stage I

Participants played a dictator game paired with a recipient in form of a charitable organization. They could choose from nine different charities, which served a well-balanced set of purposes, such as charities that deal with environmental and nature conservation, human rights, or health related matters. Thus, we tried to preclude situations in which participants would have liked to donate, but could not find a suitable charity to do so (Crumpler and Grossman, 2008). Participants received information on each charity by reading a statement of purpose.[2]

Participants received information about each charity, which they had to read before they were able to make a choice.[3] Once they had read about all charities, participants decided to which of the nine charities (only one could be selected) and how much to give. Participants received a total amount of 200 experimental points (ECU) for their choice, of which they kept 100 points as a show-up fee. 100 ECU remained to decide on how much to donate to a charity. Participants also had the option to donate nothing and keep all experimental points for themselves.

We implemented three treatment variations in Dictator Stage I:

1. **NO DEFAULT**: Participants could choose actively if and how much to donate to a charity. They had to actively type the desired amount into an input box. The input box was initially blank.
2. **WEAK DEFAULT**: We nudged participants into being fully pro-social and donating the maximum possible amount to a charity by default. The default donation was thus pre-set to the maximum amount participants could donate (100 ECU). Participants could change the pre-set amount simply by clicking on a box and entering the desired donation.
3. **STRONG DEFAULT**: We again nudged participants into being fully pro-social by setting the default donation to the maximum possible amount that could be donated. In order to change the amount, participants first had to perform a slider task (Gill and Prowse, 2018). Specifically, to change the default donation, participants had to shift 48 sliders to a value of 50. Only after having completed the task, participants could change the donation amount. If they did not complete the slider task, they had to donate the default amount.

Many defaults used in charitable giving (Altmann et al., 2014) or pro-environmental settings (see Brown et al., 2013; Egebark and Ekstroem, 2016) are comparable to our weak default treatment. However, the literature provides multiple explanations for why people stick to defaults. For example, defaults may be set such that it may be rational to follow the default (Croson and Treich, 2014), they may convey information about certain choices over others and signal quality (Dinner et al., 2011; Coffman et al., 2015), or following the default may simply be cognitively less challenging (Sintov and Schultz, 2017). The latter point indicates that often, defaults seem to work (i.e., people stay with the default) because it is laborious for people to make an active choice and to opt out of the default. Our strong default treatment thus varies the cost of opting out. Taken together, our two default treatments accommodate the fact that opting-out of the default may be more or less complex in different situations.

We completed the experimental design with a two-tiered control strategy:

[2]These statements were taken from the website of Zewo Foundation, a Swiss institution that certifies charitable organizations with respect to integrity, efficient use of funds, and transparency, see www.zewo.ch/en/

[3]**Appendix C** in Supplementary Material displays the instructions provided to participants and screen-shots of the decision screens.

1. **CONTROL INCOME**: Participants did not participate actively in Dictator Stage I, but received lump-sum payments in addition to their show-up fees. The amounts of these lump-sum payments were derived from the distributions of donation amounts participants chose in the treatment conditions outlined above. Thus, each donation decision in the NO DEFAULT, WEAK DEFAULT, and STRONG DEFAULT treatments was matched with a lump-sum payment a participant received in the CONTROL INCOME condition. In purely monetary terms, participants in CONTROL INCOME thus arrived at Dictator Stage II in exactly the same situation as a matched participant from one of the treatments, however without having made a donation decision in Dictator Stage I. Eliminating Dictator Stage I behavior while controlling for any possible income effects provides us with a conservative baseline to which we can compare the Dictator Stage II decisions in our three main treatments.
2. **CONTROL PASSIVE GIVING**: Participants received the identical lump-sum payments according to the same procedure as participants in CONTROL INCOME. Yet, they did participate (to a limited extent) in Dictator Stage I by choosing the charity to which a pre-defined donation was made. By letting participants choose the charity to which the donation was administered, we made sure that the altruistic utility component, i.e., the individual knowledge that there had been a donation in Dictator Stage I was comparable to participants' utility in the NO DEFAULT, WEAK DEFAULT, and STRONG DEFAULT treatments.[4] Additionally, as participants read about the charities in Dictator Stage I in the treatment condition, this condition also controls for any possible priming effects of that task on the subsequent decision in Dictator Stage II.

2.1.2. Dictator Stage II

Participants played a standard dictator game with another participant as the recipient. Each participant was thus paired randomly with another participant in the same session. Both participants remained completely anonymous with respect to each other and were not able to influence the other participant's decision. To maximize the number of observations, we used a variant of the strategy method (Selten, 1967) and elicited choices for both roles of the dictator and the recipient respectively. The strategy method is a common experimental procedure to elicit all possible choices in a behavioral game from one participant (see Brandts and Charness, 2011, for a more detailed discussion and for evidence that treatment effects found in direct response experiments also replicate with the strategy method). In our setting this meant that we asked participants to make decisions for both roles that exist in the game, the dictator (i.e., how much of their endowment would they like to share with the recipient) and the recipient. Each participant thus decided on the allocation of 200 experimental points between herself and the paired recipient. However, it was common knowledge that only one decision of each pair of participants was going to be implemented, and that the computer would randomly determine which one. Dictator Stage II was completely identical for participants in all treatments and control conditions. The decisions made in this stage constitute our main dependent variable. **Table 1** summarizes the experimental parameters.

2.1.3. Participants and Procedures

We conducted 23 sessions with a total of 678 participants at the Decision Science Laboratory (DeSciL) at ETH Zurich. The recruitment process followed standard protocols at the laboratory and we did not apply any exclusion rules, e.g., based on study or subject level. We recruited participants using hroot, a software tool frequently used to recruit participants for behavioral economics experiments and that allows for randomized invitation to experimental sessions (see Bock et al., 2014). The participant pool consisted of students at the University of Zurich and the Swiss Federal Institute of Technology (ETH) in Zurich. In our final sample, 53% of participants were women and the mean age was 22.9 years. **Table A1** in **Appendix A** (Supplementary Material) provides further descriptive statistics on the participant sample (including, in addition to age and gender, measures for income, education, Big 5 traits, need for cognition, reactance, regret, and IQ for each of the experimental conditions as well as in the sample overall.)

We collected data for the NO DEFAULT, WEAK DEFAULT and the corresponding control conditions in June, July and September 2016. The data for the STRONG DEFAULT and its corresponding control conditions were collected in May and June 2018. It is possible that unobserved changes in the participant pool between 2016 and 2018 could have affected participants' behavior. However, when we compare the 2016 and the 2018 data of the corresponding control conditions (CONTROL INCOME and CONTROL PASSIVE GIVING), we do not find any significant differences in behavior ($p > .100$ for all comparisons), which is why we pool the data from 2016 and 2018 for the analyses. **Figure 1** provides an illustration of the data collection timeline. Each box in the figure represents an experimental session and displays the experimental condition(s) implemented in that session.

In order to obtain the amounts and the distribution of the lump-sum payments ($\hat{X}$) in the control groups, we ran four sessions of NO DEFAULT and WEAK DEFAULT first (in the 2016 wave). Subsequently, we varied treatments and control between sessions[5] and sessions were executed such that treatments and controls were evenly distributed across different times and days. We followed the same procedure for the STRONG DEFAULT treatment and the corresponding CONTROL INCOME and CONTROL PASSIVE GIVING conditions in the data collection wave in 2018. Thus, we first conducted four sessions in the STRONG DEFAULT treatment to gather information about giving in Dictator Stage I and the

[4]What this condition does not control for is the warm-glow (Andreoni, 1990) stemming from the donation decision in Dictator Stage I. This is intentional, as it is exactly this warm-glow (i.e., the feeling of having done something good) which may yield a spillover effect and affect participants' decisions in Dictator Stage II (Schmitz, forthcoming).

[5]One treatment session was conducted in a within fashion due to unbalanced show up of participants. Results of this single session are not significantly different with respect to the remaining sessions [Kolmogorov-Smirnov test $n_1 = 24$, $n_2 = 234$, $p = 0.435$ (distribution of giving in Dictator Stage I), $n_1 = 24, n_2 = 234, p = 0.139$ (distribution of giving in Dictator Stage II)].

TABLE 1 | Overview of experimental parameters.

	Dictator Stage I		Dictator Stage II
	Show-up fee	**ECU for decision**	**ECU for decision**
T1 NO DEFAULT	100	100	200
T2 WEAK DEFAULT	100	100	200
T3 STRONG DEFAULT	100	100	200
C1 CONTROL INCOME	100+$\hat{X}$	–	200
C2 CONTROL PASSIVE GIVING	100+$\hat{X}$	Fixed: (100-$\hat{X}$)	200

*Participants in CONTROL INCOME and CONTROL PASSIVE GIVING received a lump-sum payment $\hat{X}$ matching the distribution of the donated amounts in Dictator Stage I in the treatment conditions (see **Appendix B** in Supplementary Material for details on the matching procedure). In Dictator Stage II, each participant decided on the allocation of 200 ECU, however, only one decision within each participant pair was implemented. 100 ECU ≡ CHF 10.*

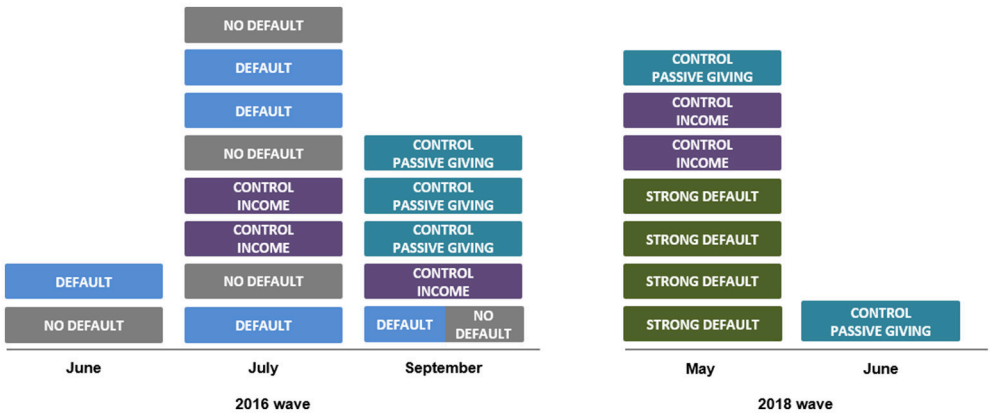

FIGURE 1 | The figure illustrates the timeline of our data collection. Each box represents one experimental session (lasting for around 50 min each), the label indicates the experimental condition implemented in that session and, in parentheses, we indicate the number of participants in the session. The split box at the very bottom for September 2016 indicates the one treatment session that we conducted in a within fashion in order to balance cell-sizes because of no-shows in previous sessions (see Footnote 5).

income distribution for Dictator Stage II. We computerized the experiment using z-tree, a software tool frequently used in experimental economics that allows conducting anonymous interactive decision making experiments in the laboratory (see Fischbacher, 2007). An experimental session lasted roughly 50 minutes.

At the beginning of a session, participants were randomly assigned to computer-equipped cubicles. Common rules for participation were read aloud and participants signed a consent form. They received on-screen instructions for each part of the study (see **Appendix C** in Supplementary Material that contains the entire set of experimental instructions provided to participants). Participants knew that the study would consist of several parts, but the contents of each part were not revealed before the respective instructions were provided. In order to ensure comprehension, participants had to answer control questions before each part. When participants had comprehension questions, the experimenter answered individually and in private.

Participants first completed Dictator Stage I (except in CONTROL INCOME). Subsequently, we included a filler task between Dictator Stage I and II. In this task, participants completed a shortened version of an IQ-test after Catell (1940). The test was divided into two parts, each part lasting for exactly 90 seconds. The intention of the filler task was to temporally separate Dictator Stage I and II. This separation may be of importance when reviewing the proposed underlying psychological mechanisms of consistency or licensing effects. One line of research argues that individuals store moral credits when behaving "good," which they then use later on, for instance, to offset a subsequent behavior (Jordan et al., 2011). Another line of research states that individuals use initial "good" behavior as a credential to interpret negative subsequent behavior as non-negative (Monin and Miller, 2001). The filler task serves both mechanisms as, on the one hand, it provided sufficient time for participants to build up moral credits, and on the other hand, it was still short enough so that in the subsequent behavior participants would remember their initial behavior. Additionally, the filler task limits the potential for demand (Zizzo, 2010) and anchoring effects (e.g., d'Adda et al., 2017) and adds to the external validity of the results, as in relevant real-life settings an initial behavior is most likely not followed immediately by a relevant subsequent behavior. After the filler task, participants proceeded to Dictator Stage II. Upon completion of these tasks, they received feedback on their final payoff and were asked to fill in a supplemental questionnaire. The average payment was approximately CHF 26. Moreover, participants donated CHF 2,155 to the nine different charities.

3. BEHAVIORAL PREDICTIONS AND HYPOTHESES

The experiment was designed to study potential behavioral spillover effects arising from initial pro-social giving behavior on subsequent giving behavior in a related decision. Particularly, we were interested in testing whether the use of choice defaults that triggered giving in the initial behavior in Dictator Stage I would affect behavioral spillovers to the subsequent decision in Dictator Stage II.

To guide our analysis in section 4, we provide behavioral predictions and testable hypotheses grounded in existing literature in this section. Because we want to test the effect of behavioral spillovers following pro-social behavior in conditions with a pre-set default, we first present hypotheses about Dictator Stage I giving behavior in the differently strong default treatments in section 3.1. Further, we present hypotheses about potential spillover effects arising from giving in Dictator Stage I on giving behavior in Dictator Stage II in section 3.2.

3.1. The Effect of Defaults on Giving in Dictator Stage I

A large body of literature documents that when presented with choice defaults, individuals oftentimes follow the pre-set option (e.g., Thaler and Sunstein, 2003; Altmann et al., 2014; Ebeling and Lotz, 2015). As we are interested in identifying potential spillover effects of pro-social behavior induced by choice defaults on subsequent, non-targeted pro-social behavior, providing further evidence for the direct effects of choice defaults is not the main concern of our study. However, to be able to study potential spillover effects, we first need to establish the presence of a default effect in our study on the directly targeted pro-social behavior (giving in Dictator Stage I). Specifically, we use two different defaults in Dictator Stage I. The defaults differ in the effort level required to change the pre-set donation amount. While reasons to follow default decisions are diverse, the literature also indicates that effort is a prime factor preventing individuals to change pre-set choices (Brown et al., 2013; Altmann et al., 2014; Egebark and Ekstroem, 2016; Sintov and Schultz, 2017). Based on the existing literature on choice defaults, we thus present Hypotheses 1a-c:

Hypothesis 1: The effect of defaults on giving in Dictator Stage I

- H1a The weak default nudge increases giving in Dictator Stage I compared to giving in the no default condition.
- H1b The strong default nudge increases giving in Dictator Stage I compared to giving in the no default condition.
- H1c The strong default nudge increases giving in Dictator Stage I compared to the weak default nudge.

Note that a non-rejection of H1a and H1b is indispensable to study our main research question which concerns the impact of choice defaults on potential spillover effects of first on second stage behavior (see Hypothesis 2 below). Thus, without the significant effects of defaults on giving in Dictator Stage I, an analysis of possible spillover effects on Dictator Stage II is obsolete.

3.2. Spillover Effects Arising From Giving in Dictator Stage I

Hypothesis 1 thus merely represents a necessary condition to investigate spillover effects from default induced giving in Dictator Stage I on giving in Dictator Stage II. Behavioral spillover effects in decision settings without choice defaults have been widely studied and the related literature on behavioral spillover effects from identical and closely related pro-social decisions points to the importance of moral licensing (e.g., Schmitz, forthcoming; Tiefenbeck et al., 2013; Hofmann et al., 2014; Achtziger et al., 2015; Effron and Conway, 2015; Sass et al., 2015). Individuals who give to others (or to charity) in a first decision tend to show less of this behavior in subsequent giving decisions. Since we use two related consecutive pro-social decisions it is likely to observe negative behavioral spillovers in our setting too. Following the arguments presented in the literature, higher giving induced by the default in Dictator Stage I should lead to negative spillover effects on giving in Dictator Stage II. We present Hypotheses 2a-c:

Hypothesis 2: The spillover effects of charitable giving in default conditions in Dictator Stage I on giving in Dictator Stage II

- H2a Compared to the no default condition, the higher initial giving to charity induced by the weak choice default in Dictator Stage I leads to lower giving in Dictator Stage II.
- H2b Compared to the no default condition, the higher initial giving to charity induced by the strong choice default in Dictator Stage I leads to lower giving in Dictator Stage II.
- H2c Compared to the weak default condition, the higher initial giving to charity induced by the strong choice default in Dictator Stage I leads to lower giving in Dictator Stage II.

These moral licensing hypotheses stand in contrast to literature describing moral consistency effects, i.e., higher pro-social behavior following anti-social behavior in an initial decision (e.g., Freedman and Fraser, 1966; Beaman et al., 1983; Cialdini et al., 1995; Burger, 1999; Knez and Camerer, 2000; Fitzsimons and Shiv, 2001; Cherry et al., 2003; Grimm and Mengel, 2012; Baca-Motes et al., 2013; Brandon et al., 2017). As discussed in the introduction, however, this literature identifies spillover effects from a first decision on a second decision where the first decision is conceptually different from the second. In our study, both decisions involve giving to others, and are thus highly similar. Moreover, as also discussed in the introduction, choice defaults seem unlikely to favor mediating mechanisms for positive spillovers such as self-efficacy (Steinhorst et al., 2015; Lauren et al., 2016), cognitive accessibility (Sintov et al., 2019) or self-signaling (Gneezy et al., 2012).

4. RESULTS

In presenting our results, we follow the structure of the hypotheses laid out in section 3 by first testing whether our default manipulations had a significant effect on giving in Dictator Stage I (Hypothesis 1) and then testing whether the choice defaults affected the spillover of giving in Dictator Stage

I on giving in Dictator Stage II (Hypothesis 2). Finally, we contrast the findings in the default treatments with behavior in the different control conditions disentangling possible income effects and altruistic motives from spillover effects arising from giving in Dictator Stage I. A final regression analysis provides a comprehensive overview of all the results that are concerned with potential spillover effects.

As a first descriptive analysis, **Table 2** provides an overview of giving choices [in experimental points (ECU)] in Dictator Stage I and II for all treatment and control conditions.[6]

4.1. Effects of Choice Defaults on Targeted Behavior

4.1.1. The Effect of a Weak Default on Giving in Dictator Stage I

Our weak default manipulation in Dictator Stage I had a significant effect on donation levels. Participants in the WEAK DEFAULT treatment donated on average 25% more than participants in the NO DEFAULT condition (34.26 ECU vs. 27.44 ECU). Thus, in line with H1a, the pro-socially set weak default marginally increased overall giving [$t_{(256)} = -1.92$, $p = 0.056$, Cohen's $d = 0.24$)].[7] Furthermore, participants in the WEAK DEFAULT treatment also had a marginally significant higher prevalence of choosing exactly the pro-socially set default amount (= 100 ECU) (11.6% in WEAK DEFAULT vs. 4.6% in NO DEFAULT, $z = 3.32$, $p = 0.069$, $n_1 = 129$, $n_2 = 129$).

The default effect can be further partitioned when considering giving as a two-stage decision process. Participants first decide whether they want to donate or not. Once chosen to donate, they decide on the size of their gift (e.g., Moffatt, 2016, who deems such an analysis particularly important for Dictator Game data). Our default manipulation did not affect the number of participants who decided to give nothing (24.8% in WEAK DEFAULT vs. 24.8% in NO DEFAULT, $z = 0.00$, $p = 1.000$, $n_1 = 129$, $n_2 = 129$). However, it did affect donation levels once participants decided to give. Comparing only participants who decided to give a positive amount, the effect of the weak default holds. Donations in the WEAK DEFAULT treatment (45.57 ECU) are on average 25% higher than in the NO DEFAULT treatment (36.49 ECU). This difference of 9.08 ECU is statistically significant [$t_{(192)} = -2.45$, $p = 0.015$].

4.1.2. The Effect of a Strong Default on Giving in Dictator Stage I

In line with H1b, participants in the STRONG DEFAULT treatment gave on average 114% more to charity than participants in the NO DEFAULT treatment (58.99 ECU vs. 27.44 ECU). Moreover, and in line with H1c, in Dictator Stage I, participants in the STRONG DEFAULT treatment donated on average 72% more to charity than participants in the WEAK DEFAULT treatment (58.98 ECU vs. 34.26 ECU). Therefore, supporting H1b and H1c our stronger default manipulation significantly increased donation levels when compared to these two conditions [STRONG DEFAULT vs. NO DEFAULT $t_{(255)} = -7.07, p < 0.001$, Cohen's $d = 0.77$; STRONG DEFAULT vs. WEAK DEFAULT: $t_{(255)} = -5.20, p < 0.001$, Cohen's $d = 0.54$]. Furthermore, participants in the STRONG DEFAULT treatment were also more likely to donate exactly the pre-set default amount when compared to participants in the WEAK DEFAULT treatment and when compared to participants in the NO DEFAULT treatment (proportion tests: 49.6% in STRONG DEFAULT vs. 4.6% NO DEFAULT: $z = 63.70$, $p < 0.001$, $n_1 = 128$, $n_2 = 129$; 49.6% in STRONG DEFAULT vs. 11.6% in WEAK DEFAULT: $z = 42.04$, $p < 0.001$, $n_1 = 128$, $n_2 = 129$). However, our strong default manipulation did not affect the number of participants who decided to give nothing (22.65% in STRONG DEFAULT vs. 24.8% in NO DEFAULT: $z = 0.07$, $p = 0.796$, $n_1 = 129$, $n_2 = 129$; 22.65% in STRONG DEFAULT vs. 24.8% WEAK DEFAULT: $z = 0.07$, $p = 0.796$, $n_1 = 129$, $n_2 = 129$).

Nevertheless, the strong default did affect donation levels once participants decided to give a positive amount. Participants who gave a positive amount to charity donated on average 67% more in STRONG DEFAULT (76.26 ECU) compared with participants in the WEAK DEFAULT treatment (45.57 ECU). This difference of 30.69 ECU is statistically significant [$t_{(194)} = -6.86$, $p < 0.001$]. Further, participants in the STRONG DEFAULT treatment (ECU 76.26) gave on average 109% more than participants in NO DEFAULT treatment (36.49 ECU). This difference of 39.77 ECU is again statistically significant [$t_{(194)} = -9.58$, $p < 0.001$].

4.2. Spillover Effects

4.2.1. The Spillover Effect of Giving in the Weak Default Treatment in Dictator Stage I on Giving in Dictator Stage II

In order to assess the spillover effect from giving in a weak default regime in stage one to giving behavior in stage two (H2a), we compare giving in Dictator Stage II between the WEAK DEFAULT and NO DEFAULT treatments. **Table 2** reveals that participants in both treatments gave about one fifth of their endowment to the paired recipient. In the NO DEFAULT treatment, participants gave 35.89 ECU (18% of their endowment). In the WEAK DEFAULT treatment, average giving amounted to 39.69 ECU (20% of the endowment). The difference of less than 4 ECU is not statistically significant [$t_{(256)} = -0.80$, $p = 0.427$, Cohen's $d = 0.10$]. There is thus no support for H2a, as we do not find a significant spillover effect in the weak default treatment. We summarize this finding as our first result:

Result 1. *There are no behavioral spillover effects from giving in stage one in the WEAK DEFAULT treatment on subsequent giving. Higher initial giving in Dictator Stage I in the WEAK DEFAULT treatment does not lead to lower giving in Dictator Stage II compared with the NO DEFAULT treatment.*

[6] The complete data-set and the *R* code for all analyses reported in the paper can be downloaded from https://figshare.com/s/a5ed8c829c7c0c80e2f5

[7] Although, we have directed hypotheses, we rely on two-sided tests for all inferential testing in this paper. We use t-tests to test for statistical significance of differences in giving. Results from non-parametric Wilcoxon rank-sum tests yield highly similar results and are available on request.

TABLE 2 | Summary statistics.

		Giving (ECU)	
Treatments	**N**	**Dictator Stage I**	**Dictator Stage II**
NO DEFAULT	129	27.44 (25.38)	35.89 (36.80)
WEAK DEFAULT	129	34.26 (31.47)	39.69 (39.80)
STRONG DEFAULT	128	58.98 (43.82)	40.94 (43.15)
Control Conditions	**N**		**Dictator Stage II**
CONTROL INCOME (NO DEFAULT matching)	49	–	39.39 (44.32)
CONTROL INCOME (WEAK DEFAULT matching)	49	–	40.20 (40.59)
CONTROL INCOME (STRONG DEFAULT matching)	50	–	50.80 (42.71)
CONTROL PASSIVE GIVING (NO DEFAULT matching)	46	–	34.57 (39.87)
CONTROL PASSIVE GIVING (WEAK DEFAULT matching)	46	–	43.70 (39.80)
CONTROL PASSIVE GIVING (STRONG DEFAULT matching)	52	–	43.65 (40.44)

Giving is denoted in ECU. Standard deviations are in parentheses. The data for the six control conditions are split into the respective income matching category, i.e., NO DEFAULT, WEAK DEFAULT, STRONG DEFAULT.

4.3. The Effect of Giving in the Strong Default Treatment in Dictator Stage I on Giving in Dictator Stage II

Table 2 documents that participants in the STRONG DEFAULT treatment also gave about one fifth of their endowment to the other recipient. This is very similar to the amounts given by participants in the WEAK DEFAULT treatment and the NO DEFAULT treatment. In fact, there are no differences in Dictator Stage II giving between treatments that are statistically significant [WEAK DEFAULT vs. STRONG DEFAULT: $t_{(255)} = -0.24, p = 0.810$, Cohen's $d = 0.03$; NO DEFAULT vs. STRONG DEFAULT $t_{(255)} = -1.01, p = 0.314$, Cohen's $d = 0.13$], and there is thus no support for either H2b or H2c. It does not seem to be the case that choice defaults on giving in Dictator Stage I lead to moral licensing in Dictator Stage II. We summarize these findings in our second result:

Result 2. *There are no behavioral spillover effects from giving in stage one in the STRONG DEFAULT treatment on subsequent giving. Higher initial giving in Dictator Stage I in the STRONG DEFAULT treatment does not lead to lower giving in Dictator Stage II compared with the NO DEFAULT treatment.*

Figure 2 illustrates the findings presented so-far. **Figure 2A** of the figure illustrates the statistically significant impact of both the weak and the strong default on giving in Dictator Stage I (with the STRONG DEFAULT condition adding a significant increase to donation levels compared to the WEAK DEFAULT). **Figure 2B** of the figure shows that in the untreated Dictator Stage II no differential spillover of the initial decision can be observed, as we do not find significant differences between the experimental conditions.

4.4. Income and Altruistic Motivations

To put our results concerning potential spillover effects to a more conservative test and to ensure the robustness of our findings, we employed a two-tiered control strategy. Solely comparing choices in the NO DEFAULT treatment with choices in the WEAK DEFAULT treatment and the STRONG DEFAULT treatment in Dictator Stage II may omit relevant differences between the treatments related to income effects and altruistic motivations. Specifically, because of their donation decision, participants arrived with different amounts of money in Dictator Stage II in the default treatments compared with participants in the NO DEFAULT treatment. This, on the one hand, impacts income of participants in the default treatments. On the other hand, motivations of altruism may also be affected by the higher donations in Dictator Stage I in the default treatments. To control for pure income effects, we employ the CONTROL INCOME condition in which participants did not make a donation decision in Dictator Stage I but had the same income as participants in the default treatments when they made their decisions in Dictator Stage II. To control also for altruistic motivations, we conducted the CONTROL PASSIVE GIVING condition in which participants also had the same income as participants in the default treatments in Dictator Stage I, but without having made an active donation in Stage I and instead simply learning that a donation was made to a charity (and in which amount) to keep altruistic utility constant. We compare giving in Dictator Stage II in these conditions to giving in in Dictator Stage II in the NO DEFAULT treatment and the WEAK DEFAULT and STRONG DEFAULT treatment respectively.

The results from our control conditions further support Results 1 and 2. Participants' choices in the NO DEFAULT treatment and the WEAK DEFAULT treatment were not significantly different to those of the matched cases in the CONTROL INCOME condition and the CONTROL PASSIVE GIVING condition [NO DEFAULT (35.89 ECU) vs. CONTROL INCOME (39.39 ECU): $t_{(176)} = -0.53$, $p = 0.594$; NO DEFAULT (35.89 ECU) vs. CONTROL PASSIVE GIVING (34.57 ECU): $t_{(173)} = 0.21$, $p = 0.838$; WEAK DEFAULT (39.69 ECU) vs. CONTROL INCOME (40.20 ECU): $t_{(176)} = 0.08$,

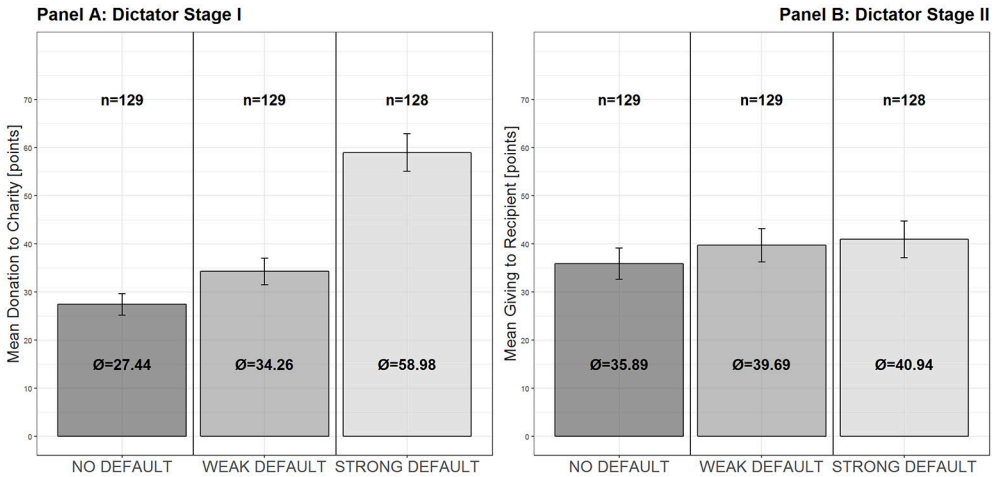

FIGURE 2 | Choices in Dictator Stage I and II. Panel **(A)** Shows giving decisions (mean points donated to charities) in Dictator Stage I for NO DEFAULT, WEAK DEFAULT and STRONG DEFAULT. Panel **(B)** Shows mean giving (points given to recipient) in the Dictator Stage II for the three treatment conditions. Error-bars denote plus/minus one standard error of the mean.

$p = 0.939$; WEAK DEFAULT (39.69 ECU) vs. CONTROL PASSIVE GIVING (43.70 ECU): $t_{(173)} = 0.57$, $p = 0.567$]. Similarly, supporting Result 2, participants' choices in the STRONG DEFAULT treatment were not significantly different to those in the CONTROL INCOME condition or the CONTROL PASSIVE GIVING condition [STRONG DEFAULT (40.94 ECU) vs. CONTROL INCOME (50.8 ECU): $t_{(176)} = 1.37$, $p = 0.171$; STRONG DEFAULT (40.94 ECU) vs. CONTROL PASSIVE GIVING (43.65 ECU): $t_{(178)} = 0.39$, $p = 0.697$].[8]

Thus, putting potential spillover-effects to a more rigorous test by controlling for altruistic motivations and income effects reinforces our Results 1 and 2. Neither different incomes nor different altruistic motivations resulting from higher giving in Dictator Stage I seem to impact giving in Dictator Stage II.

As a final step, in **Table 3** we report the results from regression analyses allowing to analyze whether spillover effects differed between the experimental conditions when controlling for potential income effects at the individual level. Note that for the pairwise comparisons of the default treatments to the CONTROL INCOME and the CONTROL PASSIVE GIVING conditions based on *t*-tests reported above, we had to split the observations from the CONTROL INCOME and CONTROL PASSIVE GIVING conditions into groups matching the respective treatment conditions (see **Appendix B** in Supplementary Material for details). The splitting into groups was conducted randomly, but it reduces statistical power. The regression approach avoids this splitting and has the advantage that instead we can simply add the individual monetary income a participant had received in the experiment up to Dictator Stage II as a control variable. This increases statistical power and thus provides an even stronger test of the findings we have established in section 4.2.

In the regressions reported in **Table 3**, the variable "Income before DG II" captures the monetary income a participant had earned in the experiment before making the giving decision in Dictator Stage II. We include dummies for our experimental conditions, with the NO DEFAULT treatment being the omitted base category. We interact the dummies for the experimental conditions with the "Income before DG II" variable to allow for the likely possibility that the effects of this variable are different between the experimental conditions. The reason is that the "income" with which a participant arrived in Dictator Stage II was endogenously determined through participants' giving in the NO DEFAULT, WEAK DEFAULT, and STRONG DEFAULT treatments, whereas it was exogenously assigned through the matching procedure in the CONTROL INCOME and CONTROL PASSIVE GIVING conditions.[9]

The treatment dummies in the regressions reported in **Table 3** can be interpreted straightforwardly as capturing a difference in

[8]For the *t*-tests reported in this section, we only considered the exact matches of income for each treatment condition in order to ensure perfect comparability. In the regressions reported in **Table 3** we use the full data from the control conditions when controlling for possible income effects and can thus increase statistical power.

[9]In this vein, note that the main effect coefficients for "Income before DG II" in the regressions reported in **Table 3** do not capture a causal income effect. Because the regressions also contain the interaction terms of this variable with the dummies for the experimental conditions, the coefficients for "Income before DG II" apply to the NO DEFAULT treatment, in which the "income" (i.e., the money a participant had earned in the experiment before entering Dictator Stage II) was determined by the participant's own donation decision in Dictator Stage I. Thus, the negative coefficients we find in the regressions are due to self-selection (as participants with a tendency to give little in Dictator Stage I also give little in Dictator Stage II). A causal income effect can be estimated in the CONTROL INCOME condition and corresponds to testing that the sum of the coefficients for "Income before DG II" and the interaction term "CONTROL INCOME x Income before DG II" is different from zero. We do not find evidence for a significant income effect on average giving in Dictator Stage II ($p = 0.967$, post-estimation F-test based on OLS results). The corresponding test for the CONTROL PASSIVE GIVING condition reveals that there is also no significant income effect when adding altruistic utility ($p = 0.938$, post-estimation F-test).

TABLE 3 | Regression models: giving in dictator stage II.

DV: Giving to Recipient	OLS	LPM	gamma-GLM
		Two-part model	
Intercept	40.806***	0.738***	4.008***
	(3.742)	(0.043)	(0.066)
WEAK DEFAULT	2.379	−0.042	0.085
	(5.051)	(0.057)	(0.091)
STRONG DEFAULT	−4.361	−0.199***	0.215**
	(5.413)	(0.062)	(0.104)
CONTROL INCOME	2.709	−0.069	0.168**
	(5.150)	(0.058)	(0.087)
CONTROL PASSIVE GIVING	−0.051	−0.065	0.096
	(5.091)	(0.059)	(0.090)
Income before DG II	−13.600***	−0.218***	−0.052
	(4.972)	(0.059)	(0.102)
WEAK DEFAULT × Income before DG II	−6.239	−0.036	−0.067
	(6.376)	(0.075)	(0.126)
STRONG DEFAULT × Income before DG II	4.523	0.074	0.070
	(5.819)	(0.069)	(0.120)
CONTROL INCOME × Income before DG II	13.736**	0.240***	0.023
	(6.119)	(0.071)	(0.114)
CONTROL PASSIVE GIVING × Income before DG II	13.342**	0.196***	0.074
	(6.079)	(0.071)	(0.118)
Observations	678	678	443
R^2	0.059	0.085	–
F(9, 668) / F(9, 668)/ $\chi^2(9)$	4.706	6.899	7.299

$^{+}p < 0.10$; $^{*}p < 0.05$; $^{**}p < 0.01$; $^{***}p < 0.0001$. *Robust standard errors are in parentheses. The dependent variable is giving to the recipient in Dictator Stage II. NO DEFAULT is the omitted treatment captured by the intercepts. "Income before DG II" represents the (mean-centered) monetary income a participant had earned in the experiment when arriving at Dictator Stage II (partly endogenously determined in NO DEFAULT, WEAK DEFAULT, and STRONG DEFAULT, exogenously assigned in control treatments). Gamma-GLM estimates are on a log-scale. The two-part model fits the data better than the OLS specification subsuming the complete data. The combined log-likelihood of the two-part model is –2628.207 compared to –3454.219 of the OLS. The table was compiled using the "stargazer" tool by Hlavac (2018).*

giving in Dictator Stage II between the respective treatment and the omitted base category, the NO DEFAULT condition, while controlling for income effects. The non-significant coefficients for the treatment dummies for WEAK DEFAULT and STRONG DEFAULT in the OLS regression thus indicate that, on average and compared to the NO DEFAULT treatment, neither a weak nor a strong default in the initial donation decision in Dictator Stage I led to different giving decisions in Dictator Stage II. Thus, despite the defaults significantly affecting the giving decisions in Dictator Stage I, there was no spillover effect of this increased giving in Dictator Stage I on Dictator Stage II. There were also no significant differences according to the OLS regression when comparing WEAK DEFAULT and STRONG DEFAULT to the two control conditions and WEAK DEFAULT and STRONG DEFAULT with each other ($p > .100$ for all post-estimation F-tests for these comparisons). The low R^2 values correspond to this lack of statistically significant differences between the experimental treatments.

Additionally, we again analyze the data on giving decisions in Dictator Stage II as a two-step decision process. This analysis is based on the assumption that participants first decide whether to give something at all and then decide, in a second step, how much to give. In a regression analysis, this two-stage decision process is most closely captured by a a two-part model (see Moffatt, 2016). To implement the two-part regression, we used a linear probability model (LPM) to model the binary decision to give any positive amount to the recipient in a first, and subsequently a gamma-GLM to assess how much a participant gave (conditional on giving a positive amount) in a second step. As the LPM results reported in the corresponding column of **Table 3** indicate, compared to the NO DEFAULT treatment, the STRONG DEFAULT treatment significantly reduced the number of people who chose to give a positive amount to the recipient in Dictator Stage II. This negative effect is also significant when comparing the STRONG DEFAULT treatment to WEAK DEFAULT ($p = 0.009$), CONTROL INCOME ($p = 0.024$), and CONTROL PASSIVE GIVING ($p = 0.021$) using post-estimation F-tests. However, those participants in STRONG DEFAULT who did give something to the recipient, gave more than participants in NO DEFAULT, thus leading to the non-significantly different giving on average that we found in the OLS regression. Comparing the gamma-GLM coefficient of the dummy for the STRONG DEFAULT treatment to those of the two control conditions and to WEAK DEFAULT, we find that, conditional on giving a positive amount, there were no significant differences in giving across these conditions ($p > 0.100$ for all post-estimation Wald tests).

Thus, in sum, also the regression analyses confirm that, on average, neither the weak nor the strong default in our study led to negative spillover effects from initial giving choices on subsequent giving choices on average. The results from the two-part model provide some additional interesting insights, as the STRONG DEFAULT decreased the number of people willing to give anything in Dictator Stage II. However, this negative effect of the strong default on the propensity to give was compensated by higher giving by those participants who still decided to give something.

5. DISCUSSION AND CONCLUSIONS

In this study, we investigated the potential spillover effects of increased pro-social behavior triggered by pro-social choice defaults on not directly targeted, subsequent behavior. To do so, we contrasted subsequent pro-social behavior when there was no default, an easily changeable "weak" default, and a costly to switch "strong" default implemented to foster an initial pro-social behavior. We tested the potential spillover effects of behavior triggered by these choice defaults on subsequent behavior by

applying a two-tiered control strategy taking into account potentially countervailing effects of different income levels and altruistic motivations stemming from the initial behavior.

Our findings provide important insights for policymakers and researchers alike. They carry good news for policymakers who make use of choice defaults for fostering pro-social choices, because both the non-obtrusive (weak) and the costly to switch (strong) default we implemented in our study did not cause problematic effects over time. Overall, the increase in pro-social giving triggered by the choice defaults did not lead participants to compensate and reduce their giving in a later choice without a default. Even though the STRONG DEFAULT led to fewer people making a positive transfer in Dictator Stage II, this effect was compensated by higher transfers by those participants who still decided to give something. Thus, while as intended—and in line with a large and growing literature documenting the effectiveness of choice defaults—the defaults we implemented in our study had a significant positive effect on the targeted pro-social behavior, there was no moral licensing in the form of negative spillover effects on subsequent behavior.

Our findings are further encouraging, because the increase in pro-social giving in Dictator Stage I triggered by the choice defaults was large, especially when considering the strong default treatment. The strong default more than doubled giving in Dictator Stage I compared to the no default condition and the effect size was large according to typical measures (Cohen's $d = 0.74$). These findings are important for researchers studying moral licensing. Given the existing literature on moral licensing, it is noteworthy that an intervention that increases pro-social behavior so strongly does not lead to any compensation in subsequent pro-social behavior. The absence of spillovers is even more notable given that the two behaviors were temporally very close to each other as they took place within a relatively short-lived laboratory session.

It could be argued that some features of our experimental design, specifically the filler task and the nature of the giving decision in Dictator Stage II, may have facilitated participants viewing the decisions as unrelated and thus favored the absence of spillovers. However, even though our observations and inferences are of course limited to the specific experimental set-up we implemented, we believe that this set-up provided an appropriate environment for detecting relevant spillover effects of pro-social behavior triggered by choice defaults on subsequent and similar pro-social decisions. First, the filler task lasted a maximum of 180 seconds during the conduct of the experiment. Hence, if it is the case that distractions, like filler tasks, are sufficient to eliminate potential spillover effects, it is unlikely that such spillovers are actually relevant in real-life decision making where the time that passes between potentially linked decisions is likely to be longer. Moreover, the use of filler tasks is common in studies following the sequential behavior paradigm, in order to ensure sufficient differentiation between initial and subsequent behavior (e.g., Sachdeva et al., 2009; Gneezy et al., 2012). Second, even though the recipient in the Dictator Game implemented in Dictator Stage II (another participant) was different than in Dictator Stage I (where it was a charity), conceptually the two decisions were highly similar. Both times the participants received a sum of money and decided how much to give to someone else. Previous studies have found negative or positive spillovers with behaviors that seem conceptually far more different than that, such as, for instance, saving water and electricity consumption (Tiefenbeck et al., 2013) or making a donation and telling the truth (Gneezy et al., 2012). Moreover, when designing the experiment we deliberately decided to implement a slightly different decision in Dictator Stage II compared to Dictator Stage I, as this case seems more relevant from a practical perspective. In reality, it is probably rarely the case that an individual faces the exact same pro-social decision again right away and that the first time it was subject to a choice default, whereas the second time it is not. Rather, and more relevantly from our perspective, the individual will likely face other pro-social decisions that are similar in the sense that they have a pro-social dimension to them, but that are not exactly the same. Thus, if behavioral spillovers matter for the overall effect of choice defaults on pro-social behavior, these spillover effects would need to be observed not on the exact same decision, but rather on related and similar—but not exactly identical—decisions.

Based on our data, we thus conclude that fostering pro-social decisions via the use of choice defaults—with or without significant costs to opt out—does not seem to influence non-targeted subsequent pro-social behavior. This is an encouraging finding for policy makers wanting to stimulate pro-social behavior via choice defaults, but fearing subsequent adverse effects.

Of course, our study is just a first step in the analysis of whether and how well-intended behavioral policy interventions such as choice defaults affect other, not directly targeted decisions and the potential spillover effects of choice defaults and other nudges should be investigated further in future research. One research question that should be explored in more detail is how spillover effects of such interventions depend on the nature of the subsequent behavior. As argued above, behavioral spillover effects seem to be of particular practical relevance if they occur not only on exactly identical subsequent decisions but also on related but not identical decisions. In general, it would be important to explore more systematically how this relatedness between behaviors affects spillover effects and what determines relatedness. Moreover, subsequent behavior may be due to and exposed to a large variety of contextual factors from which we abstracted in our laboratory study. Given the increasing popularity of nudging policies, it is important to increase our understanding about any desirable or undesirable side-effects such policy interventions may have. Especially, the evaluation of behavioral spillover effects of nudges in field-experimental settings would be important in this regard.

ETHICS STATEMENT

This study was carried out in accordance with the recommendations of ETH Zurich's ethics commission with written informed consent from all subjects. All subjects gave

written informed consent in accordance with the requirements of ETH Zurich's ethics commission. The protocol was approved by ETH Zurich's ethics commission.

AUTHOR CONTRIBUTIONS

CG, MG, and JS contributed equally to the conception of the study, the experimental design, and the final manuscript. CG managed the data collection, conducted the first data analyses and wrote the first version of the manuscript.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyg.2019.00178/full#supplementary-material

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The English Plastic Bag Charge Changed Behavior and Increased Support for Other Charges to Reduce Plastic Waste

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Plastic bags create large amounts of waste and cause lasting environmental problems when inappropriately discarded. In 2015, England introduced a mandatory five pence (US$0.06/€0.06) charge to customers for each single-use plastic bag taken from large stores. Combining a longitudinal survey (n = 1,230), supermarket observations (n = 3,764), and a longitudinal interview study (n = 43), we investigated people's behavioral and attitudinal responses to the charge. We show that all age, gender, and income groups in England substantially reduced their plastic bag usage within 1 month after the charge was introduced, with interviewees highlighting the ease of bringing their own bags. Support for the bag charge also increased among all key demographic groups. Increased support for the plastic bag charge in turn predicted greater support for other charges to reduce plastic waste, suggesting a "policy spillover" effect. Results indicate a broad and positive effect of the bag charge, which appears to have catalyzed wider waste awareness among the British public. This may facilitate the introduction of other policies to eliminate avoidable single-use plastics and packaging.

Keywords: sustainability, behavior, attitudes, spillover, plastic, policy, bag charge

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INTRODUCTION

The single-use plastic carrier bag has become a common feature of modern shopping since their introduction in the 1980s. In 2014, over 8.5 billion plastic bags were used by United Kingdom supermarket shoppers, estimated to produce 58,000 metric tons of plastic waste (WRAP, 2015). Plastic bags mostly end up in landfill as part of the household waste stream, but can also cause severe damage to wildlife and clog drains and waterways when they end up in the environment (Barnes et al., 2009; Gregory, 2009; BIO Intelligence Service, 2011). As such, they represent a significant environmental and public health threat, and are also emblematic of broader sustainability challenges arising from increasing levels of consumption and waste. In response, national and local governments across the world have introduced legislation to reduce the environmental burden of plastic bags, including bans and mandatory charges (Miller, 2012). All four countries of the United Kingdom (UK) have now introduced a mandatory five pence (US$0.06/€0.06) charge to customers for each single-use plastic carrier bag issued by retailers: typically defined as bags with handles that are less than 70 microns thick and not designed for reuse (HM Government, 2015). Consumers' behavioral and attitudinal responses to these policies have been dramatic and

consistent. Retailers estimate that the usage of single-use plastic bags has fallen by about 80% in Wales, Northern Ireland, and Scotland since their introduction in 2011, 2013, and 2014, respectively (WRAP, 2015; zero Waste Scotland, 2015). Mandatory charges are not only effective in reducing plastic bag use, they also appear to be popular among the public. Support for a carrier bag charge in Wales was already high before it was introduced, and increased even further after (Poortinga et al., 2013). A similar bag charge introduced in the Republic of Ireland in 2002 has been described as "the most popular tax in Europe" (Convery et al., 2007). The mechanism of how a bag charge affects people is still unclear. Some view a bag charge as an economic instrument, where increasing the cost of a plastic bag alters the cost-benefit calculation, and discourages purchase of the item (Dikgang et al., 2012). Alternatively, bag charges have been suggested as a way of disrupting the automatic use of plastic bags by changing people's typical bag-use routine (Poortinga et al., 2013; Jakovcevic et al., 2014).

Previous investigations into plastic bag charge policies vary in methodology but may not have captured a full range of behavioral and/or personal responses to such a policy. Economic-focused studies examined changes in behavior by observing bag use by shoppers in the field (Homonoff, 2013) or compared the volume of bags issued by supermarkets with different socio-economic profiles (Dikgang et al., 2012). Other investigations used pre and post-bag charge surveys in Wales to establish behavioral and attitude changes but used independent samples (Poortinga et al., 2013), or analyzed longitudinal secondary data with broad measurements that may not capture specific responses linked to the bag charge (Thomas et al., 2016). Additional research on a plastic bag charge in Argentina successfully combined observations and brief survey measurements, but without longitudinal comparisons (Jakovcevic et al., 2014), and we are not aware of any evidence based on qualitative data within bag charge policy studies. Here, we offer the first longitudinal analysis of how a national bag charge policy affects individuals experiencing the charge, and draw upon a range of methodologies to evaluate views and behavior at a personal and aggregate level.

The success of behavior change policies for sustainable outcomes is dependent on public support. However, little is known about how different groups respond to such policies and whether they might inadvertently exacerbate social sustainability problems while addressing environmental ones. As a flat fee, a bag charge may have a more profound effect on lower-income households, potentially leading to greater behavior change but lower levels of support. Conversely, a small charge could lead to less behavior change among higher-income households (Ayalon et al., 2009; Dikgang et al., 2012; Fairhead, 2015). Furthermore, older age groups are the most likely, and young men are the least likely, to use reusable bags for shopping (Homonoff, 2013; WRAP, 2014). While there is greater potential for behavior change among the latter group, the impact of a plastic bag charge on different socio-demographic groups remains uncertain. Among concerns of unfair application of a flat fee upon the population, it is worth considering how support for a bag charge after implementation varies among various demographic groups.

In terms of attitudinal responses, there is some evidence that people become more supportive of a bag charge after it is introduced (Poortinga et al., 2013). This effect has also been observed for other environmental, safety, and health policies. For example, Nilsson et al. (2016) showed that attitudes toward a congestion tax became more positive after its implementation in Gothenburg, Sweden; Fong et al. (2006) found increases in support for smoke-free public places following the implementation of comprehensive smoke-free workplace legislation in the Republic of Ireland; and Dinh-Zarr et al. (2001) reported that the public have increasingly positive attitudes toward enhanced safety belt enforcement programs. This raises some interesting questions about the role of public attitudes when implementing policy measures. It is also suggestive of attitudes following behavior and behavior change, as suggested by Cognitive Dissonance Theory (Festinger, 1957).

Beyond the primary effect of the charge on behavior and attitudes, it is also beneficial to determine whether wider policy support effects may be observed. The phenomenon of "behavioral spillover" is one such example, broadly defined as the effect where change in one behavior causes a change in another separate but related behavior. There is now a comprehensive literature on behavioral spillover, summarized in recent reviews (see e.g., Truelove et al., 2014; Nash et al., 2017). Spillover research is primarily focused on behaviors, with examples of spillover found between purchasing sustainable goods and increased frequency of other sustainable actions (Lanzini and Thøgersen, 2014), an example of positive spillover where increases in one behavior are matched in another. But there is also scope for negative spillover, as reported by Thøgersen and Ölander (2003) where purchasing organic food predicted lower usage of public transport. Mechanisms of spillover remain unclear, but are generally viewed as a process that involves some internal changes, be it environmental goals or values, personal identity, self-efficacy, or skills and knowledge (Thøgersen, 2012). Indeed, spillover is not limited to behavior, but may also be linked to changes in personal views, such as support for environmental policies. Previous work highlighted the relationship between sustainable consumerism and support for sustainable policies (Thøgersen and Noblet, 2012), but experimental work suggests that engaging in sustainable behavior may generate negative spillover effects (reduced support for a "green fund") among people more politically aligned to sustainable policies (Truelove et al., 2016). The introduction of plastic bag charges has generated several explorations of behavioral spillover, with previous investigations casting doubt upon a causal effect of charges and behavioral spillover (Poortinga et al., 2013; Thomas et al., 2016). The wider concept of *policy spillover* effects may play a role, however. Given the popularity of bag charges (Convery et al., 2007), additional sustainable policies may increase in popularity as a result of changed views on a plastic bag charge. That is, experiences with a policy may not only change public views regarding that particular policy, it may also change views regarding other. To date, we believe this is the first investigation to directly explore how introduction of a policy may cause spillover that would affect support for other, similar policies.

In October 2015, a plastic bag charge was introduced in England to reduce the use of avoidable single-use plastics. We conducted a multi-method, longitudinal and controlled investigation comprising three elements: (1) a longitudinal survey; (2) a longitudinal interview study; and (3) a longitudinal observational study. In all three elements, data from England were compared to Wales and/or Scotland to ensure that changes in attitudes and behavior cannot merely be attributed to some larger cultural shift in attitudes and/or other extraneous influences. At the time of the study, both Scotland and Wales had already introduced a charge on single-use carrier bags, and there were no known changes in the policy landscape that may have impacted on the results. The three methodological elements were combined to deliver a comprehensive, controlled and in-depth investigation of behavioral and attitudinal changes following the introduction of the charge, highlighting areas where the different methods converge, corroborate and complement each other (Johnson et al., 2007). This means that the results can be triangulated and validated using the different methodologies. In our study, the triangulation of survey findings with the observational data helped to corroborate the survey data and counteract the frequent biases of self-reports. In addition, the triangulated use of interview data not only helped corroborate survey and observational findings, but also gain a valuable in-depth insight into participants' lived experiences of the processes of behavior and attitude change that accompanied the charge introduction. Finally, adding both interview and observational methods allowed us to show how the intervention (i.e., introduction of the plastic bag charge policy) was implemented in real world.

MATERIALS AND METHODS

The study used a mixed-methods longitudinal approach, and involved (1) a longitudinal survey; (2) a longitudinal interview study; and (3) a longitudinal observational study. All materials and data for the three elements are available under user license from the United Kingdom Data Service: http://reshare.ukdataservice.ac.uk/852642/.

Longitudinal Survey

The longitudinal survey measured behavior and views from representative samples in England (n = 728), Wales (n = 271), and Scotland (n = 231) at three points: 1 month before (T1), 1 month after (T2), and 6 months after (T3) the English plastic bag charge was introduced. The longitudinal survey was approved by the Welsh School of Architecture Research Ethics Committee (EC1507.239). The survey was hosted by market research company Ipsos MORI, using their pre-established online access panel, with additional samples recruited in Wales to ensure representative coverage of all three countries. The survey was advertised as a household shopping behavior survey. Representative sampling quotas were set in all countries for age, gender and employment status, with employment status quotas based on Eurostat 2013, and other variables based on Eurostat 2012 data. Additional quotas for geographical region were set for England. The number of respondents completing the surveys at the three time points (T) is shown in **Table 1**.

TABLE 1 | Number of respondents completing each survey by country of residence.

	T1	T2	T3
Country	**September 2015**	**November 2015**	**April 2016**
England	1,802	1,191	728
Wales	664	422	271
Scotland	600	392	231
Total	3,066	2,005	1,230

Retention rates between T1 and T3 for England (40.4%), Wales (40.8%), and Scotland (40.1%) were comparable, $X^2(2) = 0.85$, $p = 0.655$. Additionally we found that attrition was not linked to any level of baseline support for the plastic bag charge, $X^2(4) = 2.76$, $p = 0.599$.

Shopping bag use was measured in two ways. First, we asked the question "*How often, if at all, do you take a single-use plastic bag from the till* [point of purchase] *when doing your main food shop/top-up food shop?*", with a five-point response scale ranging from 1 (Never) to 5 (Always), and a "don't know" response coded as missing. Second, we asked "*How often, if at all, do you usually take your own shopping bag(s) to each of the following stores?*" with options for "*Food store for a main food shop*" and "*Food store for a top-up food shop*" measured using the same response scale.

Public support for a bag charge was assessed using one item: "*To what extent do you support or oppose a 5p charge to the customer for each single-use plastic bag used?*" using a five-point scale ranging from 1 (Strongly oppose) to 5 (Strongly support), with an additional option of "don't know" coded as missing.

Support for other charges to reduce plastic waste: we presented two statements with hypothetical plastic waste reduction policies for people to indicate their support or opposition. The first statement read:

> *There have been some suggestions that because of the amount of plastic used in their manufacturing, there may be an additional charge of 5p added to the purchase of each plastic water bottle. To what extent would you support or oppose an additional charge of 5p for plastic bottles?*

The second statement read:

> *There has also been some discussion that with the amount of plastic used today, there may be an additional charge of 5p added to products with a lot of plastic packaging, such as individually wrapped fruit or vegetables. To what extent would you support or oppose an additional charge of 5p for products with a lot of plastic packaging?*

We presented a third statement discussing a fuel duty for people to indicate their support or opposition. This policy was included as a non-waste environmental measure, as a "control" measure for which we did not expect a policy spillover effect. The statement read:

> *To address the amount of emissions caused by burning motor fuel, there has been some discussion that the government may raise tax*

charged on petrol and diesel. To what extent would you support or oppose an increase in taxes charged on petrol and diesel?

People could indicate their opposition or support for the three policies on a five-point scale from 1 (Strongly oppose) to 5 (Strongly support), with an additional option of "don't know" coded as missing.

Analysis of data was performed in IBM SPSS V.20. Analysis of changes in behavior and policy support were run using Linear Mixed Models (LMM), which allows for longitudinal analyses that can work with incomplete data sets without loss of statistical power. The LMMs applied an unstructured repeated covariance matrix, which allows for greater flexibility when calculating variance of data points and covariances between measurements without prior assumptions. When analyzing changes in behavior or policy support over time, the time of each survey measurement ("Time") and country of respondent ("Country") were specified as fixed factors, with an interaction term between Time and Country establishing if the dependent variable varied between countries over time. Analyses of changes in behavior and policy support used a similar approach, replacing the fixed factor of Country with "Gender" (coded 0 = Male and 1 = Female), "Age" (four groups of age brackets), and "Income" (four groups of income bracket).

Longitudinal Interview Study

For the longitudinal interview study, we recruited respondents (n = 43) in England, Wales, and Scotland. Respondents were interviewed 1 month before (T1) and 1 month after (T2) the English bag charge was introduced. This was part of a larger methodological strategy using the diary-interview method (Zimmerman and Wieder, 1977). In this paper, we have chosen to present only the interview data because it provided the most in-depth information on behavior and attitude change. The interview study was approved by the Welsh School of Architecture Research Ethics Committee (EC1507.243). Interview participants lived in geographically diverse locations across England, Scotland, and Wales. An external company recruited participants who were broadly representative of gender, age, socioeconomic status, and urban/rural location across the three countries. In total, 14 participants in England, 13 in Scotland, and 16 in Wales were interviewed pre- and post-bag charge (**Table 2**).

The study aim was presented to participants as research on people's household behaviors, procedure was explained in detail, and participants were guaranteed anonymity. Semi-structured in-depth interviews were conducted over the telephone by three authors (ES, EW, and GT), and lasted between 45 and 75 min. Interviews were digitally recorded with participants' written informed consent and anonymised. Semi-structured interviews were designed to allow for an in-depth exploration of emerging themes as well as salient issues surrounding the processes of behavior and attitude change related to the English plastic bag charge. The interview topic guide included questions on shopping and bag use behaviors, attitudes to the plastic bag charge, attitudes to other environmental charges, environmental behaviors and attitudes, and socio-demographics.

Interview data was transcribed verbatim, and transcripts were checked against recorded audio-files. Transcripts were coded and thematic analysis (Miles and Huberman, 1994; Ritchie and Spencer, 1994) was used to analyze the interview data, assisted by NVivo 10 software. Analyses were guided by the following research questions: (1) did the bag use in England differ between T1 and T2, and how this was articulated by the participants; (2) did the attitudes to the English PBC differ between T1 and T2, and how this was explained by the participants; (3) did the attitudes to other similar environmental charges differ between T1 and T2, and how this was pointed out by the participants.

Data analysis was conducted in four steps. (1) All transcripts were read and pre-coded by one author (ES). This initial process resulted in the definition of codes related to the main topics (see above) as well as to new, emergent themes. An analysis of this pre-coding and code rearrangements were discussed between three authors (ES, WP, and GT). (2) Transcripts were fully coded by one author (ES), and then independently checked by another author (EW). Consensus over the diverging items was reached between the two authors through discussion, and categories refined. (3) Codes were abstracted, and the key themes mutually agreed between WP and ES. (4) The key themes were presented in detail to the rest of the team, discussed between them, and the necessary changes were made. Throughout the analysis, the interpretation was compared with the verbatim data. Direct anonymised quotations from the interviews are used in this paper in order to illustrate the key themes and sub-themes. Participant's gender, age category, country, and time points of the study are indicated for each quotation.

TABLE 2 | Sample sizes of the interview study.

	T1	T2
	September 2015	**November 2015**
England	18	14
Wales	18	16
Scotland	16	13
Total	52	43

Longitudinal Observational Study

For the longitudinal observation study, we observed bag use among shoppers as they exited supermarkets in two mid-sized cities in England and Wales in July 2015 (n = 1,637) and July 2016 (n = 2,127). The study was approved by the Welsh School of Architecture Research Ethics Committee (EC1506.237). The observations were conducted at four different supermarket stores of different size, location, and prestige, with comparable stores matched in England and Wales: (1) a local branch of a mid-range supermarket brand located in the city center, (2) a budget supermarket brand located on the outskirts of a city center, (3) a mid-range supermarket brand located on the outskirts of a city center, and (4) a premium supermarket brand located on the outskirts of a city center. All of these supermarket brands

provided single-use plastic bags for free prior to the introduction of the bag charge in England.

Observations for each store took place at three time points: a weekday between 10:30 and 11:30, a weekday between 16:30 and 17:30, and on a Saturday either at 11:00–12:00 or at 13:00–14:00. Observations were conducted between June 25 and July 25, 2015, when the Welsh carrier bag charge was already in effect but the English plastic bag charge was not, and again between June 22 and July 23, 2016, when both charges were in effect. Observations were conducted by one of the authors (EW), assisted by a second trained observer.

Supermarket brand status was derived from YouGov Profiles (YouGov, 2016), a market research company using data from a survey panel representative of Great Britain. YouGov Profiles provides data on characteristics of shoppers who visit supermarket chains, including the proportion of those using supermarkets who fit the National Readership Survey (NRS) social grade of ABC1 (Upper and upper middle class) and those of C2DE social grade (working and non-working class). Compared to 53% of the United Kingdom population classified as ABC1 social grade, 46% of Budget Supermarket shoppers were ABC1, 58% of Mid-range supermarket shoppers were ABC1, and 73% of Premium supermarket shoppers were ABC1.

A total of 3,764 shoppers were observed: 1,961 in Wales (818 in 2015 and 1,143 in 2016), and 1,803 in England (819 in 2015 and 984 in 2016). Two researchers located outside of stores observed all shoppers exiting the supermarkets at the different time slots. Researchers then recorded the type and number of bags used, as well as the age, gender, and group size of the observed shoppers (i.e., shopping alone, as a couple, etc.). Inter-rater reliability for recording bag use was high (all Cohen's $\kappa > 0.75$), with differences resolved through discussion between the two observers.

RESULTS

Full sets of statistical analyses can be in found in the Supplementary Information.

Changes in Behavior

Full details of behavior change can be found in Sections 2.1 and 2.2 of the Supplementary Information. Survey data indicated that frequency of plastic bag use in England fell substantially after the plastic bag charge was introduced (see **Figure 1A**), corroborating previous research (Poortinga et al., 2013; WRAP, 2015; zero Waste Scotland, 2015; Thomas et al., 2016). For frequency of taking plastic bags, the fixed effect of Country was significant, [$F(2,2576.76) = 72.28$, $p < 0.001$], as well as the fixed effect of Time, [$F(2,1731.31) = 116.13$, $p < 0.001$], demonstrating that frequency of behavior significantly varied over time and between countries. A significant interaction between Time and Country was observed [$F(4,1731.46) = 62.49$, $p < 0.001$], indicating that frequency of plastic bag use varied over time between countries. Respondents in England reported an immediate reduction in plastic bag use after the charge was introduced, with further significant reductions between 1 and 6 months after the charge. Accordingly, the frequency of taking own shopping bags continuously increased among respondents in England over the course of the survey (**Figure 1B**). The fixed effect of Country was significant for frequency of using own shopping bags, [$F(2,2722.16) = 52.14$, $p < 0.001$], as was

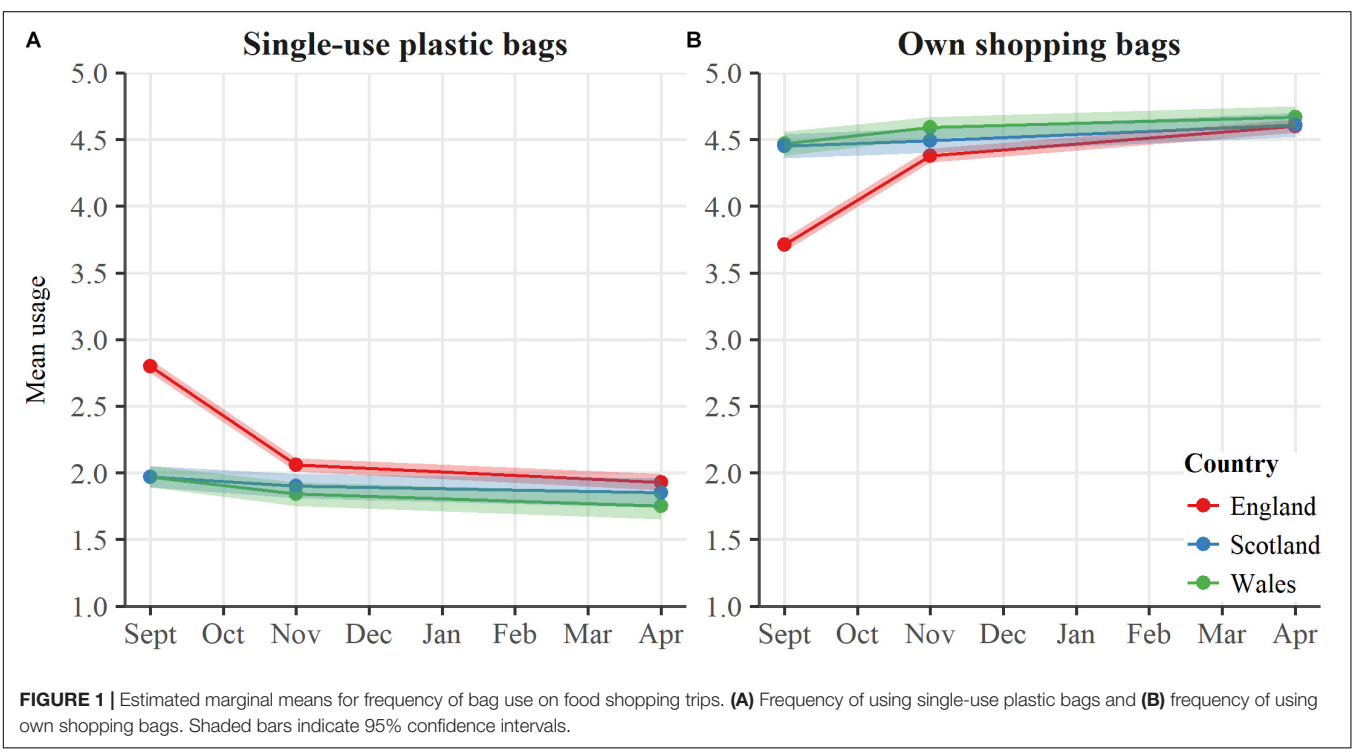

FIGURE 1 | Estimated marginal means for frequency of bag use on food shopping trips. **(A)** Frequency of using single-use plastic bags and **(B)** frequency of using own shopping bags. Shaded bars indicate 95% confidence intervals.

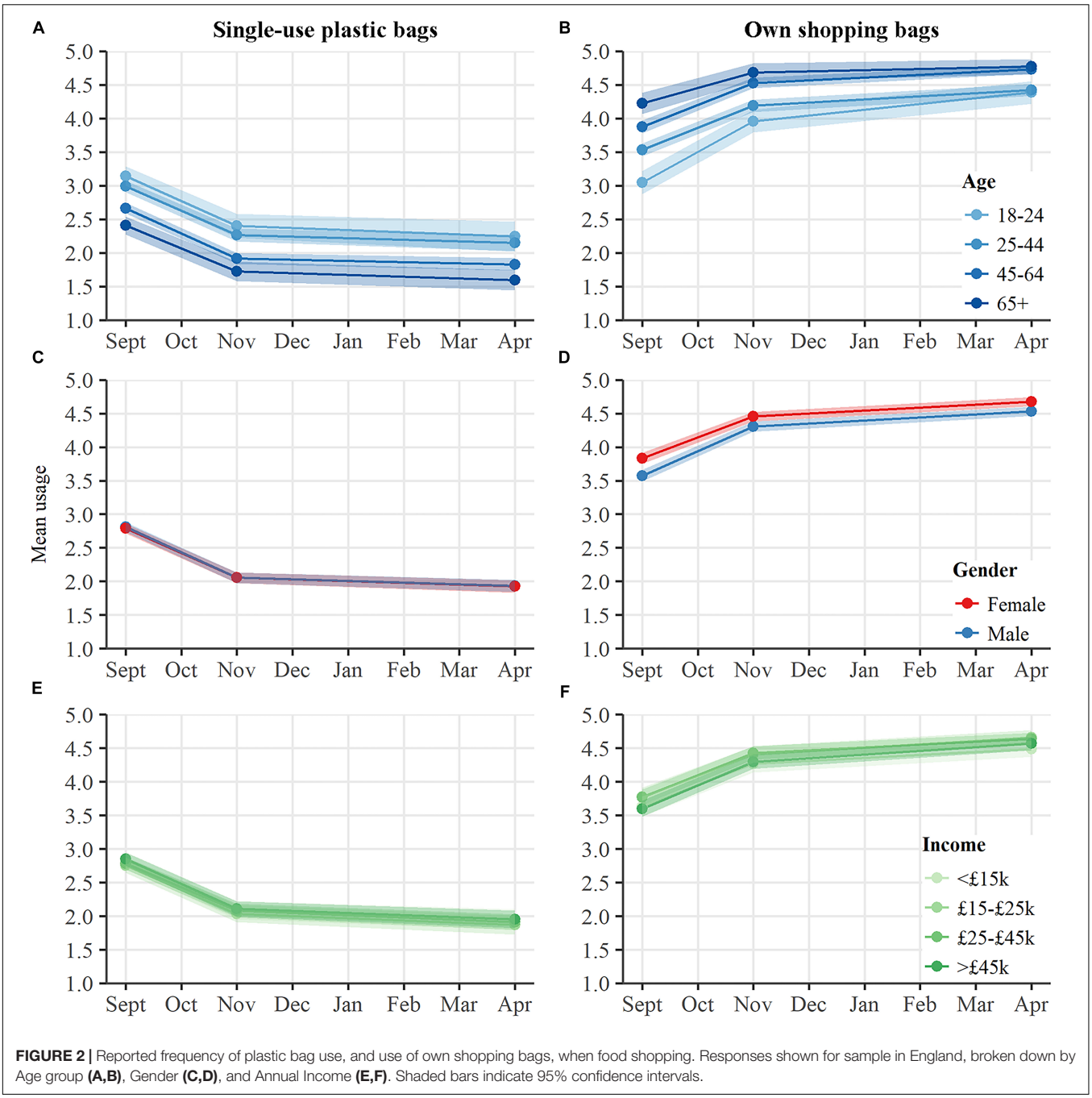

FIGURE 2 | Reported frequency of plastic bag use, and use of own shopping bags, when food shopping. Responses shown for sample in England, broken down by Age group **(A,B)**, Gender **(C,D)**, and Annual Income **(E,F)**. Shaded bars indicate 95% confidence intervals.

the fixed effect of Time, [$F(2,1876.67) = 132.99$, $p < 0.001$], demonstrating that frequency of own bag use significantly varied between countries and over time. A significant interaction between Time and Country was also found [$F(4,1876.29) = 65.62$, $p < 0.001$], indicating that change in frequency of own bag use over time varied between the countries. Six months after the plastic bag charge was introduced, plastic bag use and own bag use in England was statistically indistinguishable from Wales and Scotland where bag charges were introduced in 2011 and 2014, respectively, indicating a quick response to the English plastic bag charge, a consistency of effects of bag charges across countries, and a lasting influence of similar policies in Wales and Scotland.

We then compared bag use in England across demographic and socio-economic groups to determine how they responded to the plastic bag charge. As seen in **Figure 2**, younger respondents were significantly more likely to use plastic bags [significant fixed effect of Age, $F(3,1491.05) = 39.44$, $p < 0.001$], and less likely to take their own shopping bags [significant fixed effect of Age, $F(3,1615.84) = 45.56$, $p < 0.001$], while men were less likely to use own shopping bags than women [significant fixed effect of Gender, $F(3,1615.84) = 45.56$, $p < 0.001$], with

post hoc comparisons (Šidák corrected) indicating that in general, Men (M = 4.14, SE = 0.03) had lower use of own bags than women (M = 4.32, SE = 0.03), (M_{diff} = −0.18, $p < 0.001$). However, interaction effects between time and demographic groups indicate no evidence that the change in plastic bag use over time varied significantly between groups: all gender, age, and income groups reduced their use of plastic bags at a similar rate. Similarly, we found no evidence that the change in use of own shopping bags across time varied across the different demographic or socio-economic groups, despite some initial differences.

The behavior change identified in the survey was corroborated by the observational field study of shoppers' use of bags as they exited stores pre and post-bag charge. **Table 3** shows just over a half (55%) of shoppers in England used plastic bags prior to the bag charge, falling to one in five shoppers (21%) after the charge was introduced. Formal analyses indicate in Wales (where a bag charge was introduced in 2011) bag use remained stable over time, and similar to behavior observed in England 9 months after the English bag charge was introduced.

We collected observational data in England across supermarkets varying in typical socio-demographic shoppers, described here as budget, mid-range, and premium supermarket stores, as well as a smaller local store of the mid-range supermarket brand. Comparisons of bag use pre- and post-bag charge (**Table 4**) again demonstrate that behavior change occurred across the supermarket range in England, with no indication that plastic bag use was higher at stores that typically attract more affluent shoppers.

TABLE 3 | Proportion of shoppers classified by their observed use of bags when exiting stores in Cardiff (Wales) and Bristol (England) in July of 2015 and 2016.

	Wales		England	
	2015	2016	2015	2016
Only plastic bags	13%	14%	48%	17%
Plastic and reusable bags	4%	4%	7%	4%
Only reusable bags	53%	56%	21%	53%
Other containers	10%	11%	15%	18%
No bags observed	19%	16%	10%	8%
N (observations)	818	1143	819	984

Total number of observations within each country for 2015 or 2016 also shown.

TABLE 4 | Proportion of observed shoppers in England using types of shopping bags, separated by socio-economic profile of supermarket store.

	Local		Budget		Mid-range		Premium	
	2015	2016	2015	2016	2015	2016	2015	2016
Only single-use plastic bags	56%	25%	41%	11%	51%	18%	44%	14%
Single-use plastic and reusable bags	4%	5%	8%	2%	9%	5%	5%	5%
Only reusable bags	11%	33%	14%	57%	26%	64%	31%	59%
Other containers	22%	30%	22%	26%	8%	5%	8%	9%
No bags observed	8%	7%	14%	11%	7%	18%	12%	14%
N (observations)	203	236	208	260	208	249	200	239

Total number of observations at each supermarket for 2015 or 2016 also shown.

Findings from the interview study corroborate survey and observational data that indicate major behavior change following the introduction of the charge, and show how people in England themselves articulated these changes. In particular, interview data demonstrates how participants have experienced the charge as a catalyst for reducing the strength and automaticity of the single-use bag use habit. These changes in behavior occurred regardless of age, gender or income as all interview participants in England reduced or completely stopped single-use bag use.

After the charge was introduced in England, participants referred to the formation of a new habit of bringing own bags to stores: "*I have remembered* [to bring] *my bags a lot more now*" (Female, 31-40, England, T2); "*We're getting into the habit now of taking our own bags with us*" (Male, 51-60, England, T2). Participants mentioned that the charge has made them think and plan on using their own bags, instead of wasting plastic bags: "[The bag charge] *makes people think ahead and plan, and not just take things for granted*" (Female, 31-40, England, T2), "*It makes me aware of the fact that I'm paying for something that I'm only going to use for a few minutes*" (Male, 31-40, England, T2).

A large majority of interview participants in England found that they could change their behavior quickly and easily in response to the charge introduction: "*It's very easy to carry* [your] *own shopping bags*" (Male, 51-60, England, T2), "*I think it's* [the introduction of the charge] *gone reasonably smoothly*" (Male, 51-60, England, T2). Interview findings from Scotland and Wales equally show that adaptation to plastic bag charges in these countries was quick and effortless: "*Probably just a couple of weeks, once you got used to it, it didn't take long*" (Female, 20–30, Scotland, T1).

Interview data demonstrates how particular social practices were developed and sustained for this behavior change to be supported. For example, some female participants mentioned carrying pouch bags in their handbags: "*If I buy something on a whim, I have one of those little fold up ones* [bags] *that goes in my handbag*" (Female, 31–40, England, T2). The majority of people with vehicles adopted the new routine of storing reusable bags in their cars: "*It's part of my routine now. I do my food shop, I come in the house, empty the bags out, put all the food away, and before I forget, I get hold of the bags, and put them back in the car, so I know then, next time, if I need to get any shopping, I've got my reusable bags in the car already*" (Male, 41–50, England, T2).

Changes in Support

Full details of bag charge policy support change can be found in Sections 2.3 and 2.4 of the Supplementary Information. Analyzing survey respondents' attitudes toward the bag charge, we find that support for a five pence bag charge increased the month after the English bag charge was introduced (**Figure 3A**), which is in line with previous findings (Convery et al., 2007; Poortinga et al., 2013). A significant fixed effect for Country [$F(2,2898.44) = 53.60$, $p < 0.001$] and a significant fixed effect of Time were observed, [$F(2,1616.76) = 56.93$, $p < 0.001$], demonstrating that support for a bag charge significantly varied

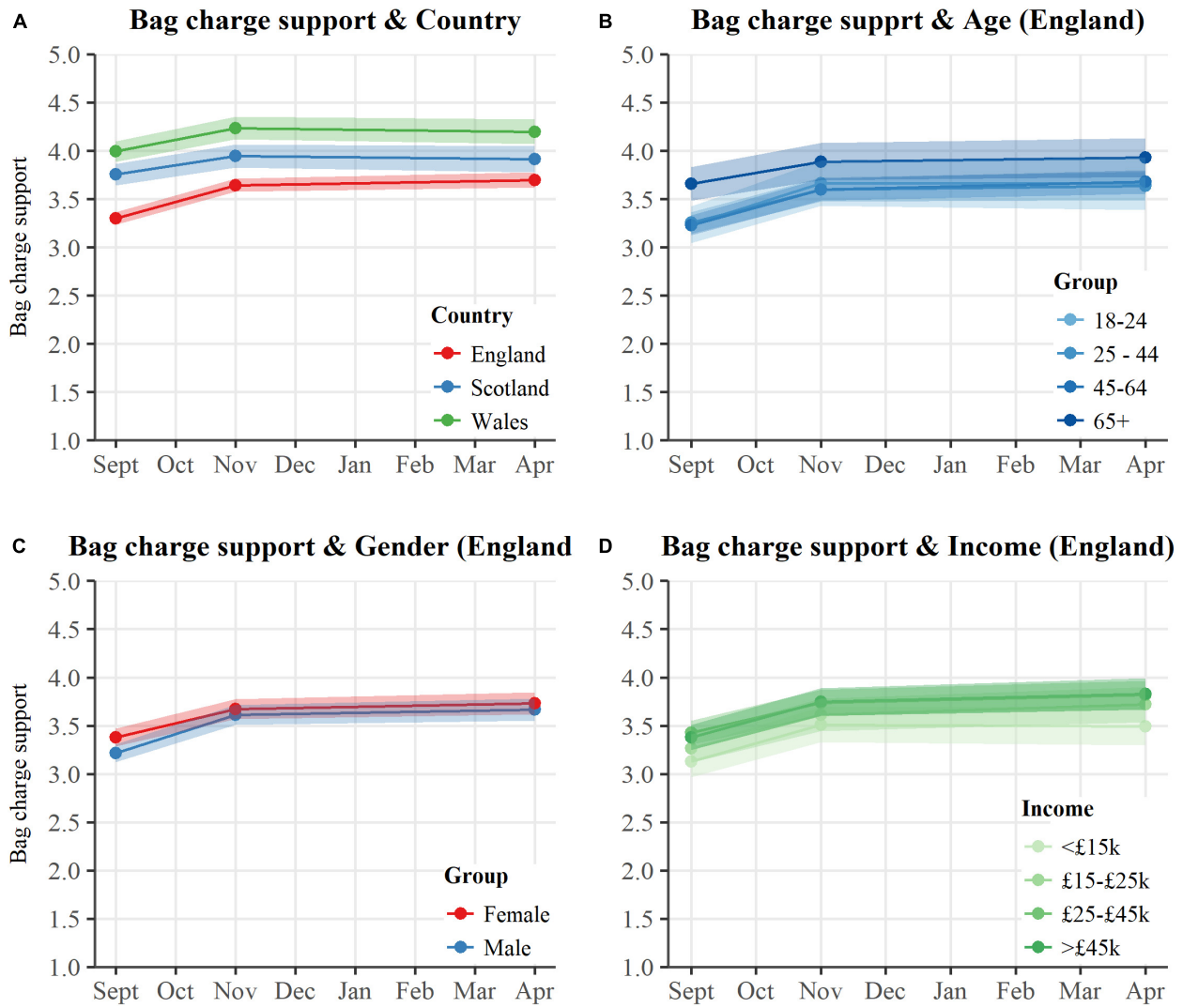

FIGURE 3 | Strength of support for a 5-pence charge to consumers for each plastic bag taken over an 8-month period from September 2015. Shaded bars indicate 95% confidence intervals. **(A)** Bag charge support over time between respondents in England, Scotland, and Wales. **(B)** Bag charge support among respondents in England, separated by age group. **(C)** Bag charge support among respondents in England, separated by gender. **(D)** Bag charge support among respondents in England, separated by annual income group.

between countries and over time. Analysis indicated a significant interaction between fixed effects of Country and Time for support for a plastic bag charge [$F(4,1617.98) = 4.20$, $p = 0.002$], where changes over time in bag charge support varied between countries. Prior to the English charge, public support was higher in Wales and Scotland where charges were already in place, but support also increased in these countries 1 month after the English charge was introduced. Šidák corrected *post hoc* comparisons showed plastic bag charge support grew between T1 and T2 in Wales ($M_{diff} = 0.24$, $p < 0.001$) and in Scotland ($M_{diff} = 0.19$, $p = 0.001$), but did not significantly change between T2 and T3 for Wales ($M_{diff} = 0.04$, $p = 0.839$) or for Scotland ($M_{diff} = 0.04$, $p = 0.906$).

Comparing policy support across demographics, some general differences in bag charge support can be seen, with younger people generally less supportive of a bag charge; significant fixed effect of Age, [$F(3,1729.44) = 4.16$, $p = 0.006$]. Yet as seen with the analysis of frequency of bag use, interaction terms between demographic group and change in support over time show no significant effects for variation in how support for a bag charge changed over time among gender [$F(2,960.22) = 1.50$, $p = 0.225$], age [$F(6,981.12) = 0.65$, $p = 0.687$], or income groups [$F(8,349.88) = 0.49$, $p = 0.860$] (**Figures 3B–D**). All demographics increased their support for the policy in the 1-month period after the charge was introduced, with no significant changes between one and 6 months post charge.

These changes in policy support were corroborated by interview findings that indicated an increase in the level of support for the charge in England, with all interview participants expressing positive views after the charge was introduced,

regardless of age, gender or socio-economic status. In particular, there was an understanding of environmental benefits of the charge. People in England spoke about the charge being an effective policy instrument to reduce plastic bag waste and raise environmental awareness: "*I don't think it's a bad idea. It definitely encourages people to either buy a reusable bag, or use other things to put them in, or just not take one at all if you've only got a couple of items*" (Female, 31–40, England, T2), "*I think it's a good idea, I've seen more people taking their* [own] *bags to the shop, so less is getting wasted*" (Male, 20–30, England, T2), "*I'm glad there's a charge on plastic bags because we need to do something. I would hope that it is going to make a difference to landfill and to the way people think in general about the things that they dispose of*" (Female, 51–60, England, T2). Support for the plastic bag charge was equally high in Wales and Scotland, where it was also recognized as an effective environmental policy instrument: "*I've been in total agreement with it* [bag charge] *for years before it came in, and I always thought it would have been a good idea to do it. So I was pleased when they did introduce that. Statistically, I've seen it on the news, that it's cut down the number of bags that we waste*" (Male, 41–50, Wales, T1).

Policy Spillover

With increased support for the bag charge in England, we investigated policy spillover, whereby people who increased their support for the bag charge may also increase their support for other environmental policies. The longitudinal survey measured support for three hypothetical policies: a five pence charge on plastic bottles, a five pence charge on items with excessive packaging, and higher tax on fuel for environmental reasons (Descriptive statistics for support for each policy by country and time can be found in section 2.5 of the Supplementary Information). Multiple regression analyses modeled how the change in support for the plastic bag charge predicted changes in support for each hypothetical policy (**Table 5**). Results show that among respondents in England, those who increased their support for the plastic bag charge were more likely to report increased support for two additional policies: a charge for plastic bottles and a charge for excessive packaging. The positive links between greater bag charge support and increased support for other waste-reduction policies were consistent between 1-month changes in policy support (between T1 and T2), and lasting changes in support (6 months between T1 and T3).

Interviews in England also addressed support for the same three hypothetical policies, and, once more, corroborated the survey findings. For the packaging-related policies, participants came to support these policies at T2, highlighting the values of the perceived need to reduce plastic waste and raise environmental awareness: "*I'm very aware of the amount of plastic bottles, so yeah, I think if that* [charge] *came in, it would make me think about what I was buying*" (Female, 41-50, England, T2), "*If you want to buy four apples and they come in a foam type dish, and then that's wrapped in plastic, I think that needs to be addressed. I don't think there's any need for all that plastic*" (Female, 20-30, England, T2).

We found no link in the survey data between changes in support for the bag charge and changes in support for increased fuel duties for environmental reasons. This suggests a limit to policy spillover effects, where people view other nominal fees to customers to reduce waste more favorably after a bag charge, but with no significant changes in views for less similar charges, despite having similar pro-environmental motives. Interview data also reflected low support for fuel duties rise, further highlighting that such policy would affect those on lower income and businesses: "*Well, the fuel charges, that affects everybody doesn't it: businesses, pensioners who only use their car once a week, so I don't think I'm in favor of that if it's right across the board*" (Female, 51-60, England, T2). Participants also suggested that instead of fuel duties rise, governments should seek more sustainable alternatives: "*I think instead of just putting charges on things, they should be looking more into utilizing renewable sources of energy, cleaner cars, things like that, that I think is better in the long run*" (Male, 20-30, England, T2).

TABLE 5 | Summary of linear regressions predicting change in support for hypothetical policies of a charge for plastic water bottles (ΔWater Bottle), charge for excessive packaging (ΔPackaging), or higher fuel duty (ΔFuel Duty), as predicted by change in support for the plastic bag charge (ΔBag Charge).

Timeframe	Outcome	Coefficient	*B*	SE	Beta	Sig	CI	*N*
T1 to T2	ΔWater Bottle	*Constant*	*0.83*	*0.08*	*0.00*	*<0.001*	*0.68: 0.98*	1124
		ΔBag Charge	0.23	0.03	0.22	<0.001	0.18: 0.29	
	ΔPackaging	*Constant*	0.96	0.08	0.00	*<0.001*	0.81: 1.11	1133
		ΔBag Charge	0.22	0.03	0.20	<0.001	0.16: 0.28	
	ΔFuel Duty	*Constant*	0.59	0.05	0.00	*<0.001*	0.49: 0.69	1132
		ΔBag Charge	0.01	0.02	0.02	0.586	−0.03: 0.06	
T1 to T3	ΔWater Bottle	*Constant*	0.95	0.09	0.00	*<0.001*	0.77: 1.13	695
		ΔBag Charge	0.22	0.04	0.21	<0.001	0.15: 0.29	
	ΔPackaging	*Constant*	0.99	0.10	0.00	*<0.001*	0.80: 1.18	698
		ΔBag Charge	0.20	0.04	0.17	<0.001	0.12: 0.27	
	ΔFuel Duty	*Constant*	0.69	0.07	0.00	*<0.001*	0.56: 0.83	703
		ΔBag Charge	0.03	0.03	0.03	0.340	−0.03: 0.09	

Regressions include changes between T1 and T2, and between T1 and T3. All regressions included covariate of baseline support (T1) for hypothetical policies to control for regression to the mean effects.

DISCUSSION

Policies enforcing a charge to customers for plastic bags have been implemented worldwide (Miller, 2012), and five pence charges on single-use bags have produced large changes in the wholesale volume of bags issued in Wales, Northern Ireland, and Scotland (Convery et al., 2007; Poortinga et al., 2013; zero Waste Scotland, 2015). Here we present a comprehensive evaluation of the English plastic bag charge introduced in October 2015, and the first longitudinal study to assess individual behaviors and attitudes immediately before and after the policy was introduced.

Results show widespread positive behavioral changes across socio-demographic groups, where single-use plastic bag use decreased and own shopping bag use increased. The observed broad compliance with the charge may be surprising given the small cost of the charge, especially given that high income groups and supermarkets of typically high-income shoppers also demonstrated significant behavior change. This suggests that a plastic bag charge is not only an economic instrument, but also a psychological one. From an economic perspective, we would expect responses to a bag charge to vary across different socio-economic groups (cf., Dikgang et al., 2012, 2012). Behavior of higher income groups would presumably be less affected by the charge as compared to lower income groups (as a five pence cost would constitute a smaller part of the household budget), and presumably lower income groups would have a lower favourability of the charge than higher income groups. Instead, the results are much more in line with a "habit disruption" perspective (Poortinga et al., 2013) in that the charge changed or "disrupted" habits regardless of financial situation. The qualitative results further support this interpretation, as shoppers reported that the charge made them reconsider their behavior, and adopt new routines.

One of the other main findings of the study is that support for the English plastic bag charge increased across the board. That is in line with previous research in Wales (Poortinga et al., 2013), as well as with studies showing similar attitudinal effects for other environmental, safety and health policies. Awareness and agreement with the policy likely explains the widespread significant increase in support for the policy just 1 month after it was introduced. Many of the interview respondents highlighted the ease of compliance with the policy, but also understood the environmental motivations behind the bag charge, and expressed widespread support for these policy goals. Together, this indicates that the bag charge did not have any adverse distributional effects, but rather was effective and supported across society and socio-economic groups.

The widespread support also appears to extend beyond bag charges, and we show what we believe to be the first evidence for policy spillover effects, whereby greater support for the bag charge predicted greater support for policies of similar size and scope. Bag charges have been largely unsuccessful at encouraging *behavioral* spillover (Poortinga et al., 2013; Thomas et al., 2016), where bag use behavior after a bag charge was introduced is not predictive of changes in other sustainable behaviors. The potential of *policy* spillover is substantial, however, given the importance of public support for creating and implementing policies (Burstein, 2003). Responses to climate change and other sustainability issues demand significant policy changes (IPCC Climate Change, 2014), and fostering public support may well embolden politicians to take stronger action. Although a bag charge may be limited in scope for tackling climate change or other consumption-related problems (e.g., resource depletion, landfilling), we show that accessible and popular policies may well foment a greater acceptance of similar policies, which may galvanize public support to additional sustainability policy action. We recognize that the policy spillover effects were not found to all policies that this study addressed. Indeed there appears to be a limit to policy-spillover effects, in that they appear to be restricted to the domain of the original policy, in this case (single-use) plastics and packaging. This is consistent with previous literature indicating behavioral spillover is more likely within than between domains (e.g., waste, transport; Thøgersen and Ölander, 2003; Whitmarsh and O'Neill, 2010) due to conceptual links being stronger between similar behaviors and/or situational barriers limiting spillover beyond a particular context. Additional work is needed to determine whether policy spillover effects can be used to strengthen public support for changing more structurally embedded unsustainable practices.

Our research also highlights the value of applying different methodologies on large-scale comparisons between the different United Kingdom countries, something that we have termed the "Devolution Lab." Paun et al. (2016) observed that devolution in the United Kingdom (i.e., the delegation of powers from national to subnational governments) is designed to allow for policy differentiation and divergence at the sub-national level. This provides an opportunity for policy innovation, whereby different approaches can be tried and tested. Furthermore, devolvement of policy powers produces a natural-experimental structure that allows for systematic data collection with ready-made comparators. This is clearly illustrated by the carrier bag charges that were introduced at different times in Wales (2011), Northern Ireland (2013), Scotland (2014), and England (2015), with some cross-country variation in the policy (the charge in England is only for plastic bags, whereas in the other countries it has to be paid for paper bags), but can also apply to other devolved policy areas, such as education, transport, health, and social care. The Devolution Lab as a place for testing new policies as well as a research methodology to examine their effectiveness and/or behavior change theory in a "real-life" natural experiment is not only relevant to the United Kingdom, but also to other countries with devolved Governments, such as Australia, and federal states, such as the United States and Germany.

A key strength of the current study was the use of multiple research methodologies, with data being collected at multiple time points before and after the charge was introduced. In particular, the inclusion of observational data has helped to validate the findings of the longitudinal survey. Measuring pro-environmental behavior and attitudes may be prone to self-presentation biases, with the desire to appear more environmentally friendly that one behaves (Thomas and Walker, 2016). Objective measures of bags used by shoppers in a field observation give additional credence to the survey. In addition, the interviews have further corroborated these findings and

provided information grounded in participants' experiences of the charge, on how the charge may have worked, and how it changed people's views on the policy, as well as catalyzed a wider waste awareness among the public. The findings across the different methods converges on a consistent picture of support for, and adaptation to, the bag charge. The use of surveys, interviews, and observations has enabled us to overcome limitations of single methods, such as bias in self-reports of bag reuse, and provided both depth and breadth to the analysis of a national behavior change policy. This can act as a model for evaluating other policies and or interventions aimed at changing (environmental) attitudes and behavior.

There remain several areas unaddressed here that warrant further investigation. We did not examine bag use outside the context of consumption. Reusable bags are generally beneficial over single-use plastic bags, but this depends on them being reused several times (Lewis et al., 2010; Edwards and Fry, 2011). Further research should examine how bags are reused and how bag charging may have impacted on other uses for carrier bags (e.g., lining bins). Research on bag charging is also needed over the longer term. While we explored a 7-month period here, other researchers have found some evidence of recidivism once consumers have adapted, suggesting the charge may need to be increased to maintain its "shock factor" in disrupting habits. A bag charge policy in South Africa (Dikgang et al., 2012) found plastic bag use fell once a charge was introduced, but after the charge was reduced 3 months after introduction, plastic bag usage increased over several years. The example of the Irish bag charge also suggested that bag use rose in the 6 years after the levy was introduced, and increasing the charge was linked to a further reduction in bag usage (Clarke, 2014). Although we find that bag usage in Wales remained low since their charge was introduced in 2011, further evaluation of bag charge policies is warranted to identify best practice for maintaining long term behavior change.

ETHICS STATEMENT

This study was carried out in accordance with the recommendations of the Ethics Committee of the Welsh School of Architecture, Cardiff University, for the longitudinal survey (EC1507.239), longitudinal interviews (EC1507.243), and longitudinal observation study (EC1506.237). All subjects in the survey and interview study gave written informed consent in accordance with the Declaration of Helsinki, and the observational study was conducted in a public place.

AUTHOR CONTRIBUTIONS

GT designed and conducted the study, led the analysis of the longitudinal survey study, the analysis of the observational study, and writing of the paper, contributed to the design and supervision, and participated in data collection and analysis for the interview study. ES designed and conducted the study, led the analysis of the longitudinal interview study, contributed to the design, supervision, and the analysis of the observational study, contributed to the design and analysis of the survey study, led on writing of the interview study, and contributed to the writing of all other sections of this paper. WP was the principal investigator on this project and contributed to the design and analysis of all elements of the research project and writing of all sections of this paper. EW co-designed the observational study, led the fieldwork for this study and contributed to the writing of its methodology, and participated in data collection of the interview study. LW was the co-investigator on this project and contributed to the design of survey and interview studies and writing of all sections of this paper.

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Understanding Contextual Spillover: Using Identity Process Theory as a Lens for Analyzing Behavioral Responses to a Workplace Dietary Choice Intervention

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Spillover occurs when one environmentally sustainable behavior leads to another, often initiated by a behavior change intervention. A number of studies have investigated positive and negative spillover effects, but empirical evidence is mixed, showing evidence for both positive and negative spillover effects, and lack of spillover altogether. Environmental identity has been identified as an influential factor for spillover effects. Building on identity process theory the current framework proposes that positive, negative, and a lack of spillover are determined by perceived threat of initial behavior and identity process mechanisms evaluating the behavior. It is proposed, that an environmental behavior change intervention may threaten one's existing identities, leading to either (a) integration, (b) compartmentalization, or (c) conflict between one's environmental identity and non-environmental identities. Initial evidence for the proposed framework is based on a field intervention which included a meat reduction programme in a canteen of a medium size private sector company. Semi-structured interviews and an explorative visualization method that aimed at assessing identity change were implemented with thirteen employees (i.e., intervention participants) before and after the intervention. The qualitative data was analyzed by using thematic analysis via NVivo12. Results of the visualization task and interview method provided initial evidence of direct and indirect positive contextual spillover effects, with comparatively less evidence a lack of spillover and a relative absence of reported negative spillover. This paper provides a novel theoretical approach, centered on identity process theory to enhance understanding of positive spillover, negative spillover, and the lack of spillover.

Keywords: contextual spillover, identity process theory, behavior change, workplace, identity

INTRODUCTION

Environmental spillover effects occur when the performance of one environmentally sustainable behavior (ESB) leads to a secondary behavior being performed (Nash et al., 2017). The secondary behavior can be in the same direction as the initial behavior (i.e., *positive* spillover) or in the opposite direction (i.e., *negative* spillover) (Thøgersen and Ölander, 2003). Equally, a lack of spillover can occur where there is an absence of either positive or negative spillover effects. While there are many different definitions of spillover, we focus on a popular definition that looks at behavior change in responses to an intervention, in which spillover is defined as "the effects of an intervention on subsequent behaviors not directly targeted by it" (Truelove et al., 2014, p. 127).

Whereas the presence and encouragement of positive spillover is clearly desirable for those wishing to promote greater consistency in people's ESBs; the absence of positive spillover or, more worryingly, the presence of negative spillover is clearly less desirable (Carrico et al., 2015). The perceived importance of promoting positive spillover and restricting negative spillover within the context of ESBs has led to growing interest in the study of spillover effects (for an overview see e.g., Nash et al., 2017). Interestingly, the findings in the extant literature present a mixed picture about the phenomenon, with evidence of both positive and negative spillover (and a lack of spillover) under different conditions.

For example, in relation to positive spillover, Van der Werff et al. (2014) found that people's past ESBs were positively related to other, different ESBs at a later time. Similarly, Steinhorst et al. (2015) found empirical evidence for positive spillover between electricity saving behaviors and other climate-friendly behavioral *intentions*. Midden et al. (2007) and Klöckner et al. (2013) claim to have identified evidence of negative *behavioral* and *motivational* spillover, respectively. By comparison, Midden et al. (2007) found that people believed that the negative environmental effects of driving to work, could be compensated for by not owning a tumble dryer (pro-environmental behavior), while Klöckner et al. (2013) found that buyers of electric cars had significantly lower motivations to engage in other pro-environmetnal behaviors than buyers of conventional combustion engine cars. Yet other research has reported upon the simultaneous co-occurrence of positive and negative spillover effects (Lacasse, 2016) or a lack of spillover altogether (Poortinga et al., 2013). For example, Poortinga et al. (2013) found that the introduction of a carrier bag charge in Wales, while strengthening people's environmental identity and prompting a reduction in single-use carrier bags, did not prompt change in other waste-related behaviors.

Research into spillover is still in its relative infancy and a number of knowledge gaps still exist. For example, while there have been attempts to explain spillover effects through a theoretical lens (e.g., Truelove et al., 2014; Dolan and Galizzi, 2015), there still exists a lack of conceptual clarity over the phenomenon. Even within the studies outlined above, spillover has been conceptualized as changes in non-target (a) behaviors, (b) intentions, and (c) motivations, respectively. Moreover, much of the extant evidence of spillover has beeni based upon the findings of correlational studies, where attribution of *causality* is limited, and laboratory experiments, where real-world implications are limited. Hence, academics increasingly point to the importance of "real-world" settings when examining spillover effects and to examine the *causal* processes underpinning spillover (Sintov et al., 2017; Verfuerth and Gregory-Smith, 2018).

The majority of research conducted to date has focussed on understanding the roots of positive spillover (as opposed to negative or a lack of spillover) within one behavioral context (e.g., at home). This means that there is currently a relative lack of research investigating cross-contextual effects. This is despite contextual spillover, in addition to cross-behavioral and temporal spillover, being a recognized phenomenon warranting investigation (Nilsson et al., 2017). Of particular interest to the current article is the study of contextual spillover and, more specifically, the presence (or absence) of spillover between the workplace and home. People spend a large amount of their day-to-day lives at work and at home making the behavior within and between both contexts crucial to living sustainably (Cox et al., 2012). Despite this, however, spillover between these two settings has to date received little attention (e.g., Littleford et al., 2014).

Previous research demonstrates that identity is one of the driving factors underlying spillover effects (e.g., Whitmarsh and O'Neill, 2010); however, the consideration of how identity processes might map to all spillover variations (i.e., positive, negative and a lack of spillover) is under investigated has yet to be made. We feel that this necessitates further research into the psychological underpinnings of spillover (or the absence thereof) and thus, within this paper, outline an integrated framework of spillover based upon Identity Process Theory (Breakwell, 1986). This framework seeks to shed light on the underlying identity processes that may lead to presence or absence of spillover effects. We then present empirical findings of exploratory work to provide an "initial" test of the assumptions of our theoretical framework. The framework presented in this paper makes a novel contribution to the extant literature by proposing a route via which the presence or absence of changes of one's pro-environmental identity may (or may not) lead to spillover effects. The remainder of the introduction outlines what is currently known about the relationships between identity and spillover before introducing the conceptual model that is central to our research.

Identity and Spillover

The way in which we see ourselves—our identity—helps us to be consistent in our behaviors across time and contexts (Whitmarsh and O'Neill, 2010). Accordingly, environmental identity (i.e., how we see ourselves in relation to the natural world) has been found to be an influencing factor for environmental actions (Clayton and Opotow, 2003) and spillover effects. For example, Lacasse (2016) found that reminding people of past environmentally sustainable behaviors and labeling them as "environmentalists" led to stronger environmental self-identity, which increased positive spillover effects. Similarly, Van der Werff et al. (2014) found that reminding people of

past environmentally sustainable behaviors strengthened their environmental self-identity, which in turn led to positive spillover effects.

There is much less evidence of links between identity and negative spillover effects. One experimental study that has investigated the relationships, though, found that environmental identity mediated spillover between recycling behavior and support for a green fund among a sample of U.S. students, however, engaging in recycling behavior had a negative impact on their green identity, which in turn lowered the support for a green fund (Truelove et al., 2016). In essence, Truelove et al. (2016) suggested that students with stronger green identities (i.e., the Democratic Party supporters) were likely to view recycling behavior as an easy or mundane pro-environmental act. As such, this intervention failed to enhance the green identities of this group and thus failed to increase their support for the "green fund."

In sum, evidence points to identity (and in particular environmental identity) as being potentially important underlying factor of environmental spillover effects. To date, though, a model of the identity-related processes that may lead to the emergence of positive *and* negative spillover effects (or a lack thereof) is noticeably lacking. We argue that Identity Process Theory (IPT, Breakwell, 1986; Jaspal and Breakwell, 2014) offers a suitable lens through which to analyse the identity-related mechanisms that might mediate the relationships between the performance of an initial environmentally sustainable behavior (e.g., following a persuasive appeal) and the emergence (or absence) of subsequent congruent or incongruent behaviors (i.e., spillover effects).

Identity Process Theory (IPT)

We are constantly exposed to life transitions and changes in our physical and social environment. IPT seeks to explain how these changes affect the way we think about ourselves and how individuals, in times of change, may integrate changes into their identity or, when changes are experienced as a threatening, cope with such changes (Amiot and Jaspal, 2014). IPT seeks to explain the changes that occur to one's identity in response to "threat" by examining the dynamics of social structure (e.g., society and expectations), social relationships (e.g., family) and the self-concept (i.e., ideas about the self; Breakwell, 1986; Baumeister, 1999; Amiot and Jaspal, 2014).

Two processes are thought to regulate one's identity: the process of assimilation-accommodation and the process of evaluation (Breakwell, 1986). The process of assimilation-accommodation refers to how new information is absorbed into one's self-concept and the adjustment that occurs in one's self-concept as this happens. During the assimilation-accommodation process, the goal is to maintain or modify the existing self-identity by integrating new information (e.g., new knowledge, attitudes, beliefs, or behavior) into the existing self-concept either by integrating information into existing identity structure (i.e., assimilation) or by making changes to the identity structure (i.e., adaptation). During the evaluation process, the individual attains meaning and value to the contents of one's self-identity and aims to achieve a balance in one's sense of self (Jaspal and Breakwell, 2014).

Four key principles guide these two processes: (1) continuity; (2) distinctiveness; (3) self-efficacy; and (4) self-esteem. Similar to the tenets of cognitive dissonance theory (Festinger, 1957), the principle of continuity suggests that people have a desire to maintain consistency. This drives them to maintain a consistency in their identity across contexts and time (Jaspal and Breakwell, 2014). The distinctiveness principle drives people to maintain a uniqueness or distinctiveness of character from others. While the principles of self-efficacy and self-esteem drive people to maintain a sense of perceived control over their lives and a feeling of self-worth, respectively. It is the interplay between the processes of assimilation-accommodation and evaluation, and these four guiding principles which, according to IPT, can lead to the presence or absence of a change in identity over time (Jaspal and Breakwell, 2014).

IPT asserts that where conflict arises between the universal processes and the guiding principles, for whatever reason, a person's identity is threatened, and this will activate intrapersonal (e.g., denial), interpersonal (e.g., isolation from others), and/or intergroup (e.g., social mobilization) coping strategies designed to resolve the threat. For example, someone who derives their sense of distinctiveness and self-worth from driving an attractive but fuel-inefficient car, could perceive persuasive attempts to reduce car use on environmental grounds to be threatening to their sense of self (Murtagh et al., 2012). This threat could be resolved in a number of ways. For example, one could seek to deny that there is an environmental issue (or their responsibility for causing the issue) and perhaps mobilize behind others who share this perception; or they might evolve their self-perception in response to the threat and alter their behavior accordingly (e.g., reduce their car use and/or purchase an attractive, fuel-efficient car to drive). According to Jaspal and Breakwell (2014) it is by examining how people respond to identity threat that one gets a sense of the processes that underpin identity construction.

Conceptual Framework

Our conceptual framework for understanding spillover (see **Figure 1**) operates on similar principles to IPT. In this context, we define spillover as being an observable change in an ESB caused by a change in an antecedent ESB. We argue that engaging in an ESB (e.g., triggered by environmental behavior change intervention) sets in motion a process of integration of the information into one's identity. If successful, such integration can result in positive spillover occurring but, if unsuccessful, the lack of appropriate identity integration may result in negative spillover effects (or a lack of spillover).

Using a workplace example, imagine a scenario in which an employee is exposed to an energy-saving intervention in the workplace. The person receives new information about the negative impacts that wasting energy at work can have on the environment and their options for reducing this impact. In processing this information, the person begins the process of integrating (i.e., assimilating or accommodating) the information into their existing identity structures and assessing (i.e., evaluating) the meaning this information holds for their

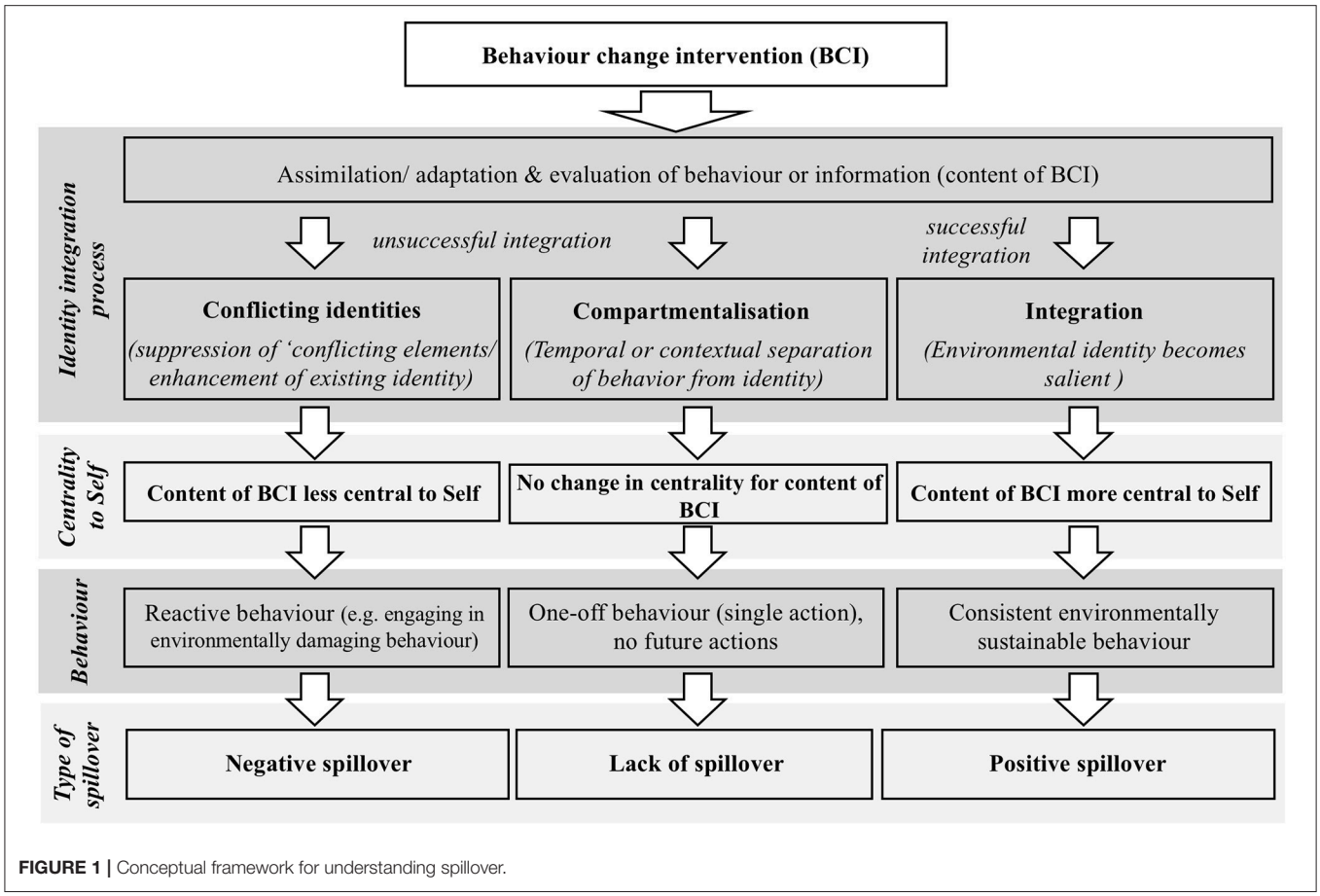

FIGURE 1 | Conceptual framework for understanding spillover.

sense of self. Where the information is deemed to fit with the four core guiding principles (e.g., the suggestions are perceptively achievable and facilitate their pro-environmental sense of self in the workplace context), the suggestions are likely to be absorbed (i.e., assimilated) and will strengthen the importance of his or her green identity—i.e., we see full *identity integration*. This hypothesis is consistent with prior research that shows how engaging in ESBs can strengthen one's environmental self-identity (e.g., Van der Werff et al., 2014) or serve to make one's pro-environmental self-identity more salient (Lacasse, 2016).

If assimilation of the information is not feasible or desirable to process the information received, for example, in a persuasive appeal, accommodation can occur. This is where one's identity structures is modified in some way in order to fit with the incoming information. For example, a person might watch a documentary about environmental and ethical issues of animal farming and decides to adopt a vegan diet. While the assimilation process strengthens one's existing identity, the adaptation process leads to qualitative changes in the identity structure.

According to our model, however, *identity integration* is not guaranteed. For instance, where the tenets of a persuasive appeal are viewed as inconsistent with one's guiding principles, we propose that one of two things will happen. Drawing on a stage model that explains the integration of multiple social identities into the self (Amiot et al., 2015), we suggest that an unsuccessful integration may lead to *compartmentalization* of identities or the emergence of *conflicting identities*.

In the case of *compartmentalization*, the individual maintains their existing self-identity by confining their response to a persuasive appeal to a particular time or context. Compartmentalization is a strategy taken to avoid the emergence of (undesirable) identity conflict (Hirsh and Kang, 2016). In terms of *temporal compartmentalization*, people will confine their response to a persuasive appeal to a particular point in time. By isolating their response to the appeal in this way, the person is likely to respond appropriately to the appeal at the time it is experienced but without any long-term changes to their identity. Thus, once the appeal is removed, the person's behavior is likely to return to how it was before the appeal. This form of compartmentalization is certainly consistent with phenomena such as the single action bias (Weber, 2006) or the tokenistic ESBs evoked by environmental behavior change interventions or mental accounting (Schütte and Gregory-Smith, 2015).

In the case of *contextual compartmentalization*, the individual compartmentalizes their identity into parts that may be context dependent. For instance, in our workplace example, our employee might separate their "workplace" identity from other aspects of their character (e.g., their identity in the home or in leisure contexts) and respond to the tenets of the appeal solely within the "workplace" context. This assertion is consistent with

the principles of boundary theory in which Ashforth et al. (2000) propose that people will sometimes segment their life-roles and associated identities (e.g., separating their home and work lives) to create boundaries to help simplify and order their social world. Where people successfully isolate a context within which a persuasive appeal is received, this restricts the chances of any longer-term identity-shift or behavior change in other contexts.

Where an individual fails to successfully absorb the tenets of a persuasive appeal or where they fail to manage the threat via compartmentalization, *conflicting identities* can emerge. Within our worked example, for instance, our employee might positively respond to the tenets of the energy saving appeal (due to their sense that being pro-environmental is a good thing) but simultaneously realize that acting in accordance with the appeal might compromise their abilities to make money for the company; pride in which is central to their sense of self. In the presence of conflict identities, coping processes are activated in order to dissolve the experienced conflict (see IPT, Breakwell, 1986). For the purposes of our proposed framework, we draw specifically upon two coping mechanisms advocated by Hirsh and Kang (2016): (1) *suppression* of conflicting elements; or (2) *enhancement* of elements that are central to the individual's identity.

Where *suppression* occurs, attempts will be made to undermine or devalue one of the conflicting elements in order to resolve the dissonance. For example, the employee in our example might question the net value of the workplace energy saving campaign. In doing so, they can justify not fully engaging with the appeal, while simultaneously maintaining an economically profitable (but energy intensive) "business as usual" approach to their workplace behavior. Where *enhancement* occurs, the conflict is resolved by bolstering (rather than undermining) one of the conflicting identities. For example, our employee might seek to resolve the conflict between their pro-environmental and pro-economic identities, by inflating the perceived importance of making money for the company in spite of the recognized need to be more pro-environmental.

In sum, our conceptual model indicates that there are broadly three ways in which people might respond to an environmental persuasive appeal, which have differing implications for their identity. Where the tenets of the appeal are successfully integrated, this should strengthen one's green identity making it more central to their sense of self. Where integration is unsuccessful, however, this could lead to temporal or contextual compartmentalization or the emergence of conflicting identities. Crucially, where conflicting identities arise, this could serve to decrease the centrality of one's green identity relative to other identities.

Implications for Spillover

We argue that the nature of the identity *integration* that occurs in response to a persuasive appeal will have implications for spillover effects. Specifically, if integration of the tenets of the appeal is successful, we predict that this will increase the likelihood that positive spillover will occur. The strength of one's green identity is known to have implications for one's likelihood of engaging in ESBs (Whitmarsh and O'Neill, 2010). Therefore, where the centrality of one's green identity is strengthened, one should anticipate greater expressions of ESBs to follow (as people seek to act in an identity-consistent way in order to avoid dissonance) and evidence of positive spillover to occur as a result.

We hypothesize that in situations where *compartmentalization* occurs, that there will be little likelihood of spillover (i.e., a lack of spillover). This is particularly likely in the case where the compartmentalization of identity is achieved on *temporal* grounds, as people are likely to respond to the tenets of a persuasive appeal only as they are received. In the case of *contextual* compartmentalization, we anticipate that while spillover *between* contexts would be unlikely (e.g., an employee of a company trialing a workplace energy efficiency campaign would not change their household behaviors), some evidence of spillover *within* the compartmentalized context might occur (e.g., the employee might also seek to save water or reduce general consumption in the workplace).

Finally, in the case of conflicting identities, we anticipate that there are two likely outcomes for spillover depending upon the coping mechanism employed. Where suppression of one's green identity occurs, we anticipate that this will lead to a tokenistic or nil response to the persuasive appeal and an associated lack of any spillover. By contrast, where an alternative (i.e., non-green identity) is bolstered in order to resolve the conflict, we argue that this could result in a maladaptive (i.e., environmentally damaging) response to the persuasive appeal and (potentially) the emergence of negative spillover effects.

More worryingly, perhaps, there is evidence that where conflicting identities arise people can seek to engage the support of others in order to resolve the dissonance (a form of intergroup coping mechanism; Breakwell, 1986). Within the context of maladaptive responses to environmental persuasive appeals, this could mean that people will seek to mobilize others to rebel against the tenets of the appeal, further undermining its effectiveness. We argue that this is a particularly pertinent consideration within group contexts, such as the workplace.

STUDY DESIGN AND CONTEXT

To test the theoretical assumptions drawn from our identity-based spillover framework, a field study was conducted in a medium size (c. 1,000 employees), private, service-sector company (i.e., internet service provider). The field study ran during the summer of 2017 and comprised a workplace behavior-change intervention (centered upon dietary choice) accompanied by a series of pre- and post-intervention qualitative interviews, observations and a survey.

The current article focuses specifically on the findings of the qualitative interviews, which were designed to probe participants' perceptions of sustainability, their identity in relation to dietary choice and to explore evidence for any contextual spillover effects from the work to the home setting resulting from the behavior change intervention. While there is still a tendency toward the use of quantitative methods within spillover research, our study joins a growing number of studies employing qualitative methods

to shed light on processes driving spillover (e.g., Schütte and Gregory-Smith, 2015; Uzzell and Räthzel, 2018).

This study was carried out in accordance with the recommendations of the Research Ethics Policy of the University of Sheffield. The study protocol was approved by University of Management School ethics committee in accordance with the University of Sheffield ethics policy. All participants gave written informed consent. While the company contributed to the research project by allowing employees to take part in interviews and surveys during their working hours, no financial contribution was made.

Materials and Methods

Participants and Sample Selection

Participants were recruited via a short online survey distributed via email to all employees of the partner company. This survey was distributed in advance of the planned behavior change intervention. The survey contained a number of questions designed to assess food consumption, environmental self-identity and included a "stages of change" scale (Bamberg, 2013), which was adapted to assess stages of change with respect to their transitions toward more sustainable dietary choice.

The survey also asked if participants would be willing to participate in each of two interviews, one to be held in advance of and one to be held after the intervention. Participants were informed that participation in this interview would be optional. As we were interested in understanding more about how people at different sustainable dietary stages would respond to the intervention, we screened participants' responses to this measure in order to identify a range or prospective interviewees.

The prospective interviewees ($N = 23$) were re-contacted and invited to take part the semi-structured interviews. All prospective participants were offered a £10 Amazon voucher as payment for their participation in the interviews. Of these prospective interviewees, $n = 13$ took part in both the pre- and post-intervention interviews (T1 and T2). It is these participants that constitute the sample for the following analysis.

The semi-structured interviews, each lasting between 30 and 60 min, were conducted 1 month before and after the behavior change intervention. All interviews took place in the canteen of the company. The sample comprised seven women and six men aged between 18 and 55 years (see **Table 1**). The interviewees' job role within the company varied but was mostly customer service or technical support related.

Behavior Change Intervention

The behavior change intervention targeted food choice with a particular focus on reducing red meat consumption among employees. Dietary choice, especially meat consumption, is associated with considerable negative environmental impacts, with recent estimates indicating that a saving of 0.8 tons CO_2 (equivalent) per year could be saved for every person who switches to a plant-based diet (Wynes and Nicholas, 2017). Moreover, to the extent that dietary choice is often related to identity (e.g., Bisogni et al., 2002; Fox and Ward, 2008), it became a natural target behavior for the intervention.

The company that hosted this study has a canteen in which simple meals are provided for free to the employees (e.g., sandwiches, jacket potatoes, salads provided as a buffet) and hot meals for a subsidized price. For the behavior change intervention, a new "sustainable choice" menu was developed along with the company chef. Menu options were based upon the recommendations made by the United Nations Food and Agriculture Organization (FAO) (Fischer and Garnett, 2016). Additional input into the menu design came from the results of a short employee survey and the pre-intervention interviews (for more information, see **Supplementary Material A**).

The sustainable choice menu reduced the quantity of available meat-based food options by 70% (relative to the normal menu and a total removal of beef or lamb) and saw an increase in the number of plant-based options, vegetables and low or non-processed foods. Each food item was assigned to an information sheet about nutrient content and ingredients (this had been provided in the canteen previously). The hot meals, which previously contained two meat options, were changed to include one vegan or vegetarian dish and one meat dish (only white meat). To increase the acceptance of the menu changes, all employees were invited to give feedback to the menu (see **Data Sheet 1**). The menu changes were implemented for 1 week in the summer of 2017.

This new menu was delivered as part of a broader information campaign, which sought to raise awareness of the impacts of food choice (in terms of CO_2 emissions, water use and land use), as well as including normative messaging. The information was delivered in the form of posters, that were hung in obvious places within the canteen and "table talkers" placed upon each table within the canteen (see **Figure 2**).

Semi-structured Interviews and Visualization

Semi-structured interviews were conducted using an interview guide (see example in **Supplementary Material B**). Themes of the interviews included personal food behavior and relation to identity at work and at home, perception of sustainable diets, and changes made after the behavior change intervention (for second interview only). For example, at T2 participants were asked about their perception of the behavior change intervention and how they liked the information campaign. To investigate the effects of the behavior change intervention to behaviors in the home context, participants were asked if anything had changed since the last interview (T1), how the behavior change intervention influenced any behaviors at home or how they thought about sustainability and sustainable foods. By interviewing participants at two time points (pre- and post-intervention) and specifically questioning them about their experiences of the behavior change intervention, it was possible for us to draw inferences about the causative roots of any spillover effects that were discussed. The absence of a matched control condition within this study, however, means that such inferences are necessarily tentative.

During the semi-structured interview, participants were invited to complete a visual sorting task. The method was inspired by similar tasks used to assess individual environmental

TABLE 1 | Sample information.

ID	Gender	Age	Education	Job role	Months worked at company	Stages of Change
104	Female	18–25	N/A	Payment Team	8	Precontemplation
108	Female	26–35	A/AS level	Engineer	72	Contemplation
117	Male	26–35	University degree (BSc/BA)	n/a	47	Contemplation
107	Male	26–35	University degree (BSc/BA)	Operations	18	Contemplation
110	Female	36–45	University degree (BSc/BA)	Digital manager	14	Contemplation
106	Female	26–35	Master's degree	Analyst	6	Contemplation
129	Female	36–45	University degree (BSc/BA)	Customer Service	21	Contemplation
112	Female	26–35	Master's degree	Analyst	11	Preparation/ Action
105	Male	26–35	GCSE/O level	Technical support	48	Preparation/ Action
126	Female	36–45	A/AS level	Team leader	72	Maintenance
131	Male	26–35	University degree (BSc/BA)	Junior Engineer	84	Maintenance
102	Male	36–45	University degree (BSc/BA)	Software Engineer	11	Maintenance
132	Male	46–55	GCSE/O level	Sales	46	Maintenance

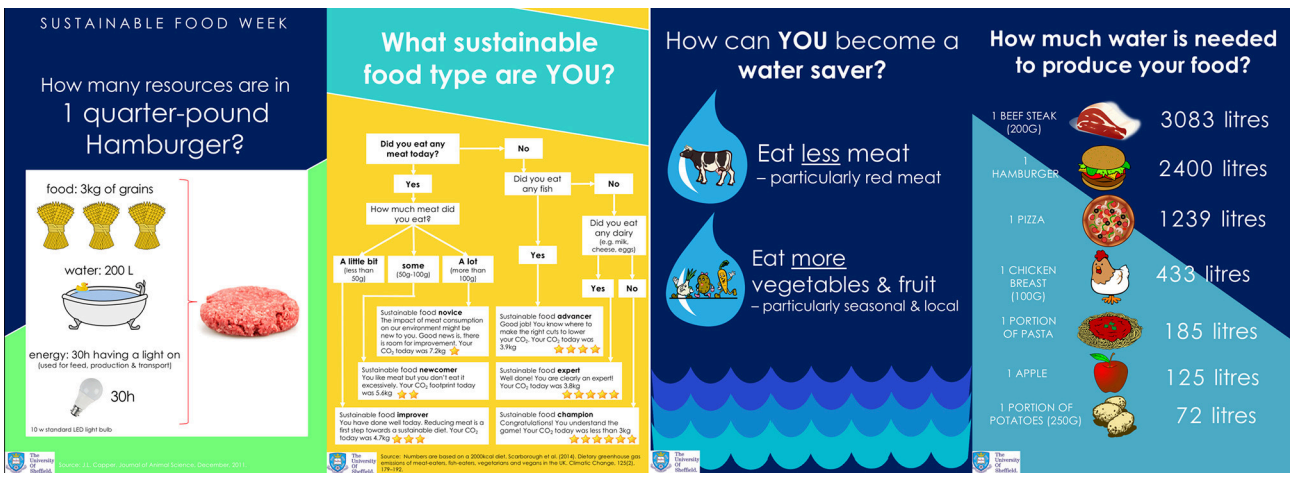

FIGURE 2 | Examples of information material used in behavior change intervention.

identity in the context of the Inclusion of Nature in Self scale (e.g., Schultz et al., 2004; Martin and Czellar, 2016). In the current context, the method was used to assess the relative centrality of three key terms (related to the behavioral intervention) to their self-identity. The first part of this task required participants to outline what they understood by the terms *environmentally-friendly-self*, *sustainability,* and *sustainable food*. The term *environmentally-friendly-self* was chosen to capture the essence of the participants' green identity. The term *sustainable food* was chosen as this mapped directly to the target of the behavior change intervention (i.e., encouraging more sustainable dietary choices). The term *sustainability* was chosen as it was thought to represent the more general concept driving the behavior change effort within the current study.

The second part of the task required interviewees to position the three aforementioned terms in relation to the outline drawing of a person (i.e., manikin) positioned within the center of a large piece of paper. They were asked to imagine that the manikin was a representation of themselves and to position each term (which had been printed separately on small pieces of paper) around the manikin based on the perceived centrality of the terms to them personally. For example, if a term was considered of central importance to the self, participants were instructed to place the term close to or overlapping the manikin. Conversely, if a term was considered of peripheral importance to the self, participants were instructed to place the term further away from the manikin.

The visual sorting task was carried out both pre- and post-intervention with a photograph taken of the arrangement reached by the participant after each session. By having participants complete the task twice, it was possible to learn more about the impact that the behavior change intervention had had upon the relative importance (i.e., centrality) of the aforementioned concepts to the participants' sense of self. Participants did not see the photograph of their responses to the pre-intervention sorting task before completing the post-intervention task.

FINDINGS

Data Analysis Approach

All interviews were transcribed and then analyzed using thematic analysis (Braun and Clarke, 2006) via NVivo12. The analysis

focused upon any references made to positive or negative spillover effects (or lack thereof) regarding ESBs following the behavior change intervention. We were particularly interested in any reported evidence of contextual spillover in ESBs from the workplace to home.

The thematic analysis of the interview transcripts, was supported by an analysis of participants' responses to the visualization task. This involved direct comparison of the placement of the three terms (i.e., *environmentally-friendly-self*, *sustainability,* and *sustainable food*) relative to the manikin pre- and post-intervention. The distance between the terms at each time point was analyzed by superimposing the photographs from the pre- and post-intervention sessions. The relative position of the terms and their distance from the manikin were visually inspected by looking at the extent of the shift of each term at T2 in comparison to T1. A gray circle encircling the manikin (see e.g., **Figure 3**; dashed line = T1; solid line and darker coloring = T2; red arrows indicate change from T1 to T2; the colors of the terms were added after the analysis for visualization purposes) was used to assist this process. Analysis of changes to the centrality of the terms focused on shifts in their relative distance from the center-point of the manikin only. Changes to the vertical or horizontal positioning of terms was not assessed (although it is acknowledged that horizontal or vertical axis movement using visual methods can be interpreted as a change, e.g., Meier and Robinson, 2004).

Reports of spillover derived from the interviews in combination with identified changes in the relative centrality of the key terms used within the visualization task were used to evaluate the theoretical framework proposed in this paper. It was hypothesized, for instance, that where there was evidence of a positive shift (centralization) in the centrality of the key terms used within the visualization task (indicative of successful integration into the self-concept) that this should be accompanied by verbal evidence of positive spillover effects. By contrast, evidence of a negative shift (decentralization) in the key terms would be indicative of a compartmentalization or emerging conflict of identity, which should be accompanied by verbal evidence of a lack of spillover or negative spillover effects.

Spillover Effects and Change in Centrality

Positive Spillover

Evidence of positive contextual spillover (i.e., increase of ESBs similar or dissimilar to the target behavior of the intervention in the home context) was identified following the intervention. Specifically, some participants reported on a reduction of meat (or specifically red meat) consumption at home; an increase in consumption of British produce at home; and/or an increase in alternative small and "easy" positive changes to their lifestyles. There was also reported evidence of an increase in participants' awareness of the potentially negative environmental consequences of dietary choice following the intervention. To the extent that behavior change in the target context (workplace) was enforced (on account that all red meat was removed and white meat options were limited compared to normal), we feel that it is possible to infer that the increased tendency for people to shop for local, British produce at the supermarket (non-target context) can be taken as evidence of indirect spillover.

Reduction in meat consumption

A reduction in meat consumption (or specifically red meat consumption) at home after the behavior change intervention was identified as a dominant theme. The reported behaviors range from swapping red meat for chicken to an overall cut of meat consumption by trying a vegetarian month, a day a week meat free (e.g., meat free Monday) or generally eating less meat. For example, participant 131 reported a drastic reduction in meat consumption including meat free days, while 107 reported swapping red meat for white meat or generally trying to eat less meat.

> *"we're trying to do the meat free Monday and that will then spillover to either the Tuesday or Wednesday cause we have got leftovers to eat as well" (131)*

> *"yes, just replacing the majority of red meat with white meat and then moving over to some cos I mean generally we have meat at most meals and we can get away from that" (107)*

Increase in consumption of british produce

An increase in consumption of British produce was identified as another dominant theme. Reported changes in grocery shopping behavior included taking longer to make decisions and checking food labels. The dominant behavior change in supermarkets was the increase in buying local and British produce which participants reported either in addition to or instead of a reduction in meat consumption. Buying local food was often perceived as an easier alternative to reducing meat consumption or calculating the relative impacts of different product alternatives.

> *"It is something I try and keep up with now a bit more instead of just giving it a lip service. [. . .] a good example is I was shopping on Saturday and I went to get some strawberries. And there were like two different punnets [baskets]. [. . .] The cheaper ones were from Spain whereas the other ones were from the UK. So, I thought, well I get the UK ones because we can grow strawberries, why do I need to get them from Spain. So little things like that, where the origin is in certain things, whereas previously I might not have" (131)*

> *"[. . .] the only realistic thing that I could really keep tabs on it where my food is coming from. The other stuff like how much water is going into making it I don't even know how to work that out. [. . .] I don't know how to choose in the supermarket whether something is grown under artificial conditions or whether it happens to be in season. [. . .] just where the food comes from is an easily controllable thing where I can choose food by quite easily." (106)*

Easy and small changes

Easy and small changes was identified as a third type of positive behavioral spillover in the interviews. Participants reported a variety of changes in ESBs at home which they described as being easier, more feasible or more controllable than reducing meat consumption. These changes included an increase in recycling

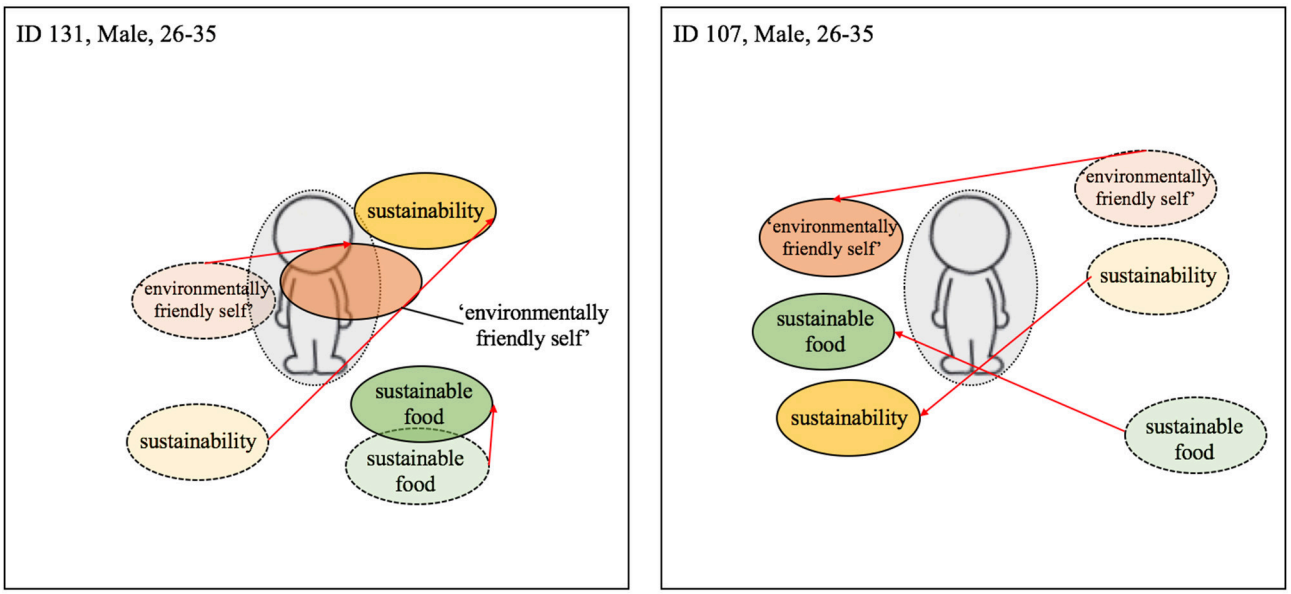

FIGURE 3 | Visualization of centrality of identity—Reduced meat consumption. Dashed line = T1; solid line and darker coloring = T2; Red arrow indicates change from T1 to T2 (the colors were added after the analysis).

behavior, consumption of smaller food portions, trying to reduce packaging, and using sustainable palm oil. Crucially, some participants saw these easier or smaller changes as being a step along the way to more substantial lifestyle change.

> *"Ehm, the way I was perceiving it is just trying to look at small changes that can be made and it is looking at the bigger pictures, knowing red meat is worse than white meat which means just moving to more white meat instead of just red meats and that takes more steps of that ladder with less environmental impacts for foods." (105)*

> *"I suppose because the cost is high. [. . .] taking up recycling is a bit of an extra pfaff but I can't really justify not doing it to myself. But changing you know how much meat and dairy I consume is, like it's a noticeable change. That is probably, it can be quite a painful change as well. I say painful but I'd miss it." (117)*

Increased awareness

An increased awareness was identified as the predominant non-behavioral response to the workplace intervention. Participants reported that the sustainable food week had altered the way they thought about food (e.g., where and how it is sourced) and their diet. While this change in awareness was affiliated with positive contextual spillover among some (see above) other participants only reported on a change in their relative awareness or interest, without an associated change in behavior.

> *"I don't really know there has been any other kind of behavioural changes. It is more like just thinking. The way I think has definitely changed" (104)*

> *"It wasn't so strong that I wanted to go and do extra research on it. But it was enough to just make me aware, I suppose" (102)*

Centrality of Identity and Positive Spillover

Where verbal evidence of positive spillover had been reported by participants, we also looked for any relative change in the centrality of the core terms used within the visualization task.

A reduction in meat consumption

Participants that reported a reduction in meat consumption following the workplace intervention were found to position the three terms closer to the manikin (i.e., the self) in the post-intervention task relative to the pre-intervention task (see **Figure 3**). For example, participant 131, who reported consuming less meat at home following the intervention, positioned the term *environmentally-friendly-self* more centrally on the manikin at T2. Similarly, participant 107, who reported a change from red to white meat consumption post-intervention, also positioned all three terms closer to manikin at T2. We argue that the relative overlap with the manikin itself can be taken as a register of the extent (full/partial) of the integration of the terms into the self.

An increase in consumption of british produce

While some participants reduced both their meat consumption and increased their consumption of British produce, others only increased their consumption of local produce at home. For former group, the centrality of all terms typically increased in centrality post-intervention. For example, participant 131 positioned all three terms closer to the manikin at Time 2 (see **Figure 4**). For the individuals that only increased their consumption of British produce, the shift in centrality was

much less apparent or a slight outward movement of some terms occurred, e.g., for participant 106 the term *sustainable food* (see **Figure 4**). This sign of non-integration of some terms and simultaneous integration of others could indicate a compartmentalization of sustainability and environmentally-friendly-self from sustainable food. This compartmentalization allows the individual, potentially guided by the consistency principle, to continue meat consumption while perceiving themselves as more pro-environmental. A similar shift pattern can be seen with participant 117 (**Figure 5**) and participant 126 (**Figure 7**), both of whom did not report upon changes their meat consumption behavior at home.

Easy and small changes

Among both participants reporting engaging in easy and small behavioral changes in response to the workplace intervention, positioning of all three terms became more centralized. As can be seen in **Figure 5**, the terms *sustainability* and *environmentally-friendly-self*, although relatively central pre-intervention, became more centralized post-intervention. The term *sustainable food* also became more central, but remained rather peripheral to the other terms. Moreover, the movement and centrality of the term *sustainable food* was less evident than among those participants showing a post-intervention shift in meat consumption at home (see **Figures 2**, **4**).

Increased awareness only

Participants reporting only an increased awareness of the implications of dietary choice post-intervention showed no change in centrality of the various terms. Similar to those individuals reporting evidence of spillover effects, however, all three terms were placed relatively centrally on the manikin. For example, participants 102 and 104 arranged all three terms relatively close to the manikin both before and after the intervention but any changes in centrality between these two time-points were marginal (see **Figure 6**).

Lack of Spillover

A lack of spillover was identified as an existing but less prominent theme. Where a lack of spillover was reported, this tended to be accompanied by excuses and justifications of why household behavior change did not occur.

Reaffirmation and mental accounting

Participants would often praise themselves for the ESBs they already engaged in so as to undermine the need for further change. Similarly, participants reported upon engaging in compensatory actions regarding their meat consumption so as to excuse themselves from changing this behavior. For example, participant 105 apparently protected their meat consumption habits by talking about the carbon emissions saved by buying their beef locally rather than from overseas.

> *"British beef is going to have less CO_2 emissions involved than getting beef from New Zealand. So, it doesn't have to be flown half way around the world to get here. So, it's always looking at carbon offsetting, there is always ways of looking at reducing CO_2 emissions in other ways as well. [. . .] And something that has always been a big thing for me is making sure that it's British produced, regardless of what I'm eating" (105)*

Conditional intention to change behavior

An intention to change dietary choices at home if certain pre-conditions were met (e.g., there was no extra effort and/or cost associated with doing so) was identified as another dominant pattern. Participants speaking about their intentions to change would often use the future tense and/or hypothetical scenarios to describe the likely future behaviors, but did not report upon having made any actual changes to the diets as a result of the workplace intervention.

> *"I would, it is something that I would consider kind of maybe doing like one or two days a week having like a conscious you know what, I'm going to eat vegetarian for a couple of days a week. And try vegetarian food. But it is not something I would. It would have to be an easy thing to do." (110)*

Centrality of Identity and a Lack of Spillover

Among those evidencing an apparent lack of spillover, the results of the visualization task presented a mixed picture. While all three terms became slightly more central for some participants, for others some of the terms increased in centrality while others decreased in their centrality (see **Figure 7**, ID 126). For example, for participant 126 the centrality of *sustainable food* decreased, while the term *environmentally-friendly-self* became more central and the term *sustainability* did not change noticeably.

Two participants showed explicit compartmentalization of the terms, positioning the terms differently for the home and work context (see **Figure 8**; ID 110). For example, for participant 110 the term *environmentally-friendly-self* became very central post-intervention in the home context but only slightly so in the workplace. While the terms *sustainability* and *sustainable food* were found to increase slightly in centrality in the home but decrease in centrality within the workplace setting.

Negative Spillover

There was little evidence of negative spillover among our interviewed sample, although anecdotally there were reports of negative behavioral responses to the intervention (e.g., some employees went to a shop nearby to by meat and came back to add the meat to the vegetarian sandwiches). One interviewee (participant 129) did, however, describe a response to the sustainable food week that could be taken as bordering upon negative spillover. Specifically, while not reporting on an increase in negative environmental behaviors following the workplace intervention *per se*, participant 129 did respond negatively to the "meat-reduction" theme of the intervention; verbalizing resistance to its aims and cynicism about its benefits.

> *"I don't think people would stop eating meat. And I think it would have far more disastrous consequences in terms of people's health, in terms of economies, things like that, if people stopped eating meat. [. . .] It was just a bit biased, the questions were a bit, you couldn't answer anything other (laughing) oh my, we should all be eating this sustainable food." (129)*

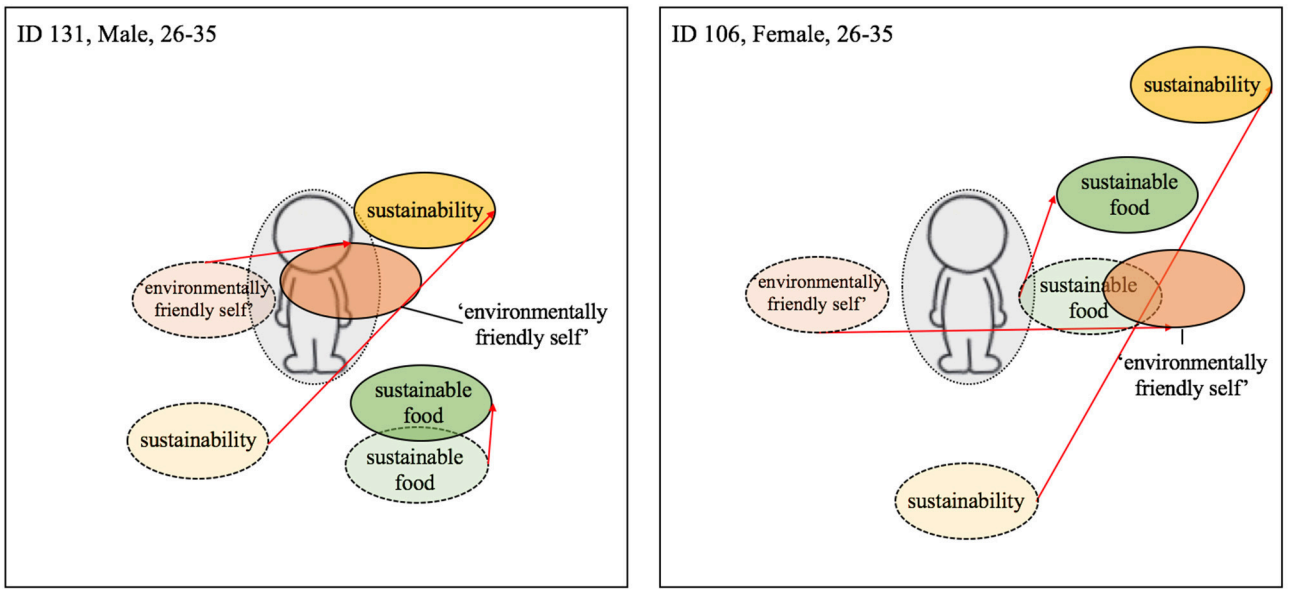

FIGURE 4 | Visualization centrality of identity—Local food; Dashed line = T1; solid line and darker coloring = T2; Red arrow indicates change from T1 to T2 (the colors were added after the analysis).

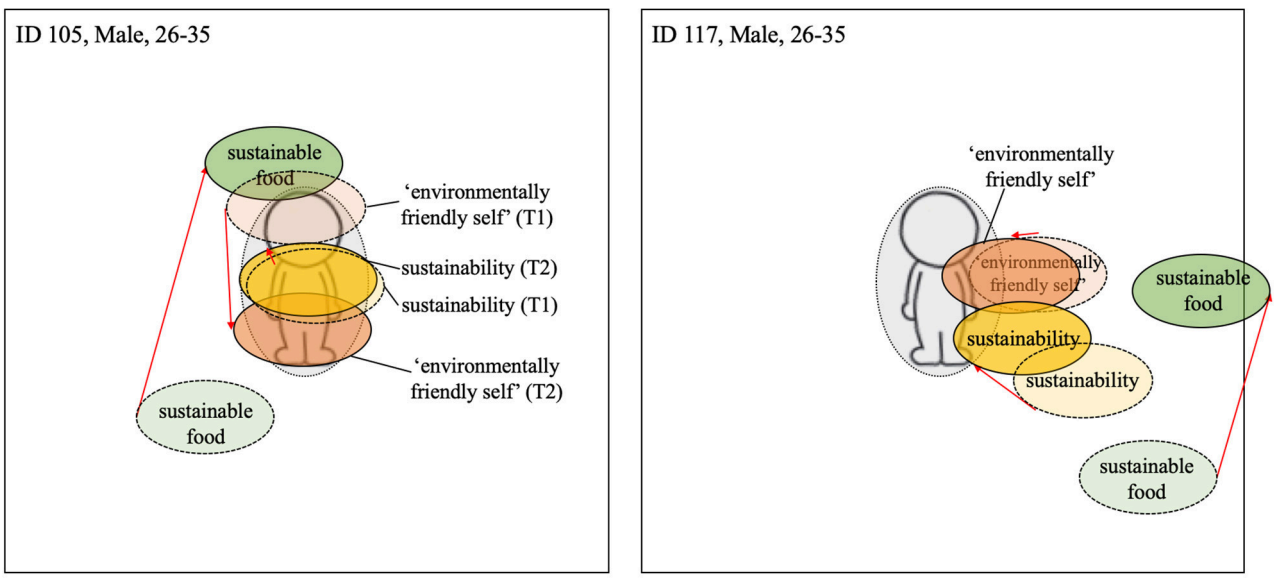

FIGURE 5 | Visualization for centrality of identity—"Easy"and small changes; Dashed line = T1; solid line and darker coloring = T2; Red arrow indicates change from T1 to T2 (the colors were added after the analysis).

Centrality of Identity and Negative Spillover

The negative reactions aired by participant 129 were accompanied by interesting changes to the centrality of the three terms within the manikin task. While the term *environmentally-friendly-self* became slightly more central, the term *sustainable food* changed only marginally, and the term *sustainability* decreased considerably in centrality (see **Figure 9**). In fact, the term *sustainability* was decentralized from a position relatively close to the manikin (pre-intervention) to being off the paper (post-intervention).

DISCUSSION

The current article proposed a theoretical framework, based upon the principles of identity process theory (IPT), designed to help explain the emergence of positive and negative

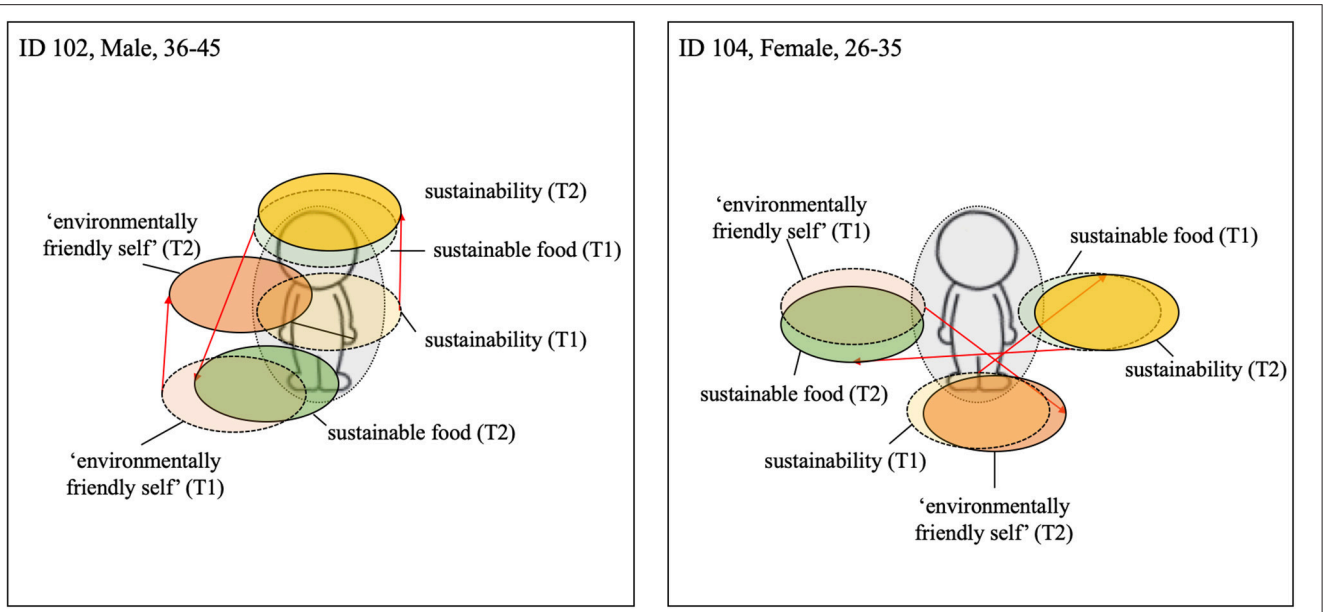

FIGURE 6 | Visualization of centrality of identity—Increased awareness and concern; Dashed line = T1; solid line and darker coloring = T2; Red arrow indicates change from T1 to T2 (the colors were added after the analysis).

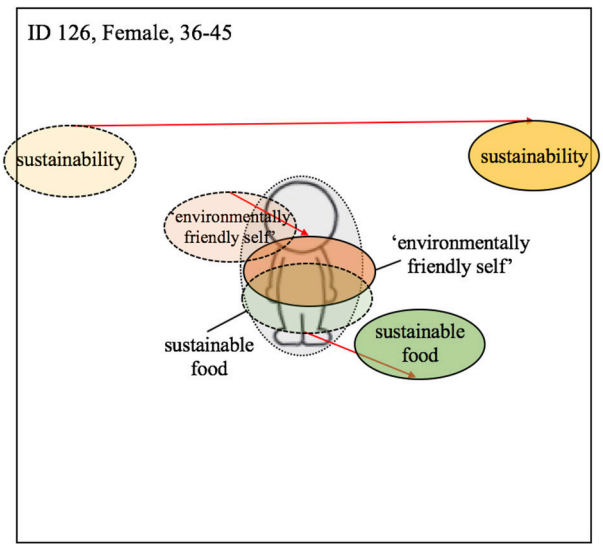

FIGURE 7 | Visualization of centrality of identity—Lack of spillover; Dashed line = T1; solid line and darker coloring = T2; Red arrow indicates change from T1 to T2 (the colors were added after the analysis).

spillover effects (and absence thereof) in relation to ESBs. In addition to outlining a theoretical framework, we provide empirical evidence in support of the framework from a real-life behavior change intervention in a workplace environment. Below, we discuss the results in light of the theoretical framework and identify limitations and gaps that future research should address.

Evidence for Theoretical Framework

Positive Spillover

Encouragingly, our study provides evidence for direct, positive contextual spillover from the workplace to the home setting (i.e., an increase in ESBs similar to the target behavior of the intervention in the home context), as well as more indirect spillover between behaviors across contexts (i.e., an increase in ESBs dissimilar to the target behavior of the intervention in the home context). Specifically, evidence for *direct* spillover effects in the form of decreased meat consumption at home was identified among our participants who participated in the pre- post-intervention study. Importantly, this evidence of contextual spillover was accompanied by a clear and associated increase in the centrality of a number of terms thought to map to a person's green identity (i.e., *environmentally-friendly-self*, *sustainability,* and *sustainable food*). We argue that, consistent with our theoretical framework, these initial findings are indicative of individuals having successfully (i.e., fully) integrated the tenets of the workplace intervention into their self-concept. In turn, we feel that this integration prompted a greater desire among these individuals to act pro-environmentally (yielding the recounted spillover effects) due to a strengthening of green identity and a desire to act consistently and in accordance with this identity (guided by the *consistency principle*).

The findings perhaps point to the nature of the integration that occurred within our respondents. Specifically, where there was clear movement in the centrality of the terms within the visualization task, one could infer evidence of accommodation. That is, the obvious changes to the centrality of the terms could be taken to illustrate change within the identity structures of the respondent. By contrast, where less obvious movement was in evidence, one might infer there was a strengthening of

existing identity via assimilative processes. These conclusions are speculative, however, and do require further investigation in future research. This is particularly important being that one could also infer that an increase in the centrality of all the terms might be a simple by-product of a strengthening of existing identity as opposed to being illustrative of an adaptation to identity *per se*.

Where *direct* contextual spillover did not occur (i.e., in terms of meat consumption at home and work), there was still evidence of more *indirect* positive spillover effects toward certain similar (e.g., increased selection of domestic produce) and dissimilar behaviors (e.g., increased recycling) in home-relevant contexts (including in the household and while shopping for produce to use at home). This *indirect* positive spillover was still associated with the increased centrality of the terms, although to a lesser extent than in the case of direct contextual spillover. We argue that this can again be seen as evidence of a strengthening of green identity in response to the tenets of the workplace appeal, but in the face of conflict driven by a person's desire to continue to eat meat. Crucially, however, participants still sought to act in accordance with their strengthened sense of green identity by actively engaging in alternative but ostensibly easier, more controllable and/or more personally desirable acts.

While indirect positive spillover is clearly desirable, we argue that an absence of change in the target behavior of an appeal across contexts could be evidence of partial or incomplete assimilation of the tenets of that appeal into ones self-identity. That is, while there is a general strengthening of one's green identity in response to the appeal (which drives people to wish to act more pro-environmentally), there is failure to fully integrate and respond to the more specific tenets of the appeal. In turn, we argue that indirect positive contextual spillover is therefore a product of a general increase in a person's desire to be pro-environmental but in the face of dispositional resistance to cross-contextual change in the specific target behavior. That being said, indirect positive spillover could also be expected to occur in response to full integration of the tenets of a persuasive appeal but in a situation where there are perceptively situational barriers to enacting direct cross-contextual spillover (e.g., due to satisfying the wishes of others at meal times). We feel that future research could usefully explore the extent to which indirect positive spillover is: (a) a product of full and/or partial identity-integration; and (b) mediated by dispositional resistance or perceived situational constraints.

Evidence for a Lack of Spillover

Unlike positive spillover, lack of spillover was typified by mixed changes in centrality of terms used within the visualization task. We argue that this is indicative of a relative failure of the intervention to produce enduring and substantive change to a given participants' green identity.

In line with our theoretical model, for instance, there was evidence of one participant seemingly resolving the conflict posed by the intervention by contextually separating (i.e., fully compartmentalizing) their workplace and home-life identities (see participant 110; **Figure 8**). Importantly, there was also some evidence of the other conflict management strategies predicted by our model, in particular *suppression*. However, as opposed to the suppression of green identity relative to other identity characteristics *per se*, the suppression appeared to relate to the relative importance of dietary choice *within* one's green identity. For example, participant 126 showed a post-intervention increase in the centrality of *environmentally-friendly-self* combined with a decrease in the relative centrality of the term *sustainable food*. We argue that this is again illustrative of the conflict that arose in the participant following the behavior change intervention (i.e., a growing awareness of the need to be pro-environmental but a desire to continue eating meat). Rather than choosing to proactively adapt their behavior, however, they ostensibly resolved the conflict by more clearly distinguishing dietary choice (peripheral) from their strengthened desire to be more environmentally friendly (more central; see **Figure 9**). In diminishing the relative centrality of dietary choice to green identity in this way, the participant could then more easily maintain a perception of themselves as pro-environmental while licensing their continued desire to eat meat.

Interestingly, in the context of a lack of spillover, this resolution appeared to be retrospectively justified, with people drawing upon past pro-environmental actions in order to license the lack of change in dietary behaviors. This meant there was no observable direct or indirect contextual positive spillover. Such retrospective justification in relation to ESBs has been identified in other research (e.g., compensatory green beliefs, Hope et al., 2018) and is apparently motivated by an *extrinsically* motivated desire for social approval.

The failure of the intervention to evoke substantive change in all respondents is perhaps to be expected. There is some evidence to suggest that green identity stems from relatively enduring characteristics like a person's biophilic tendencies (Hinds and Sparks, 2009; Fleury-Bahi et al., 2017). To the extent that the basis of one's green identity is derived from such enduring constructs, one might only anticipate a one-off behavior change intervention (like ours) to evoke registerable change among those with stronger biophilic tendencies. This is not to say that such change would not be evoked among less biophilic individuals under different conditions (e.g., in response to a more sustained, longitudinal intervention); however, in the context of the current study, such individual differences might have had more of an impact. Again, this conclusion is speculative at the current time and warrants further investigation within future work.

Evidence for Negative Spillover

According to our preferred definitions of spillover as relating to observable behavior change in response to an intervention, we recorded no categorical evidence of negative spillover effects within our study. That said, we did receive anecdotal evidence of negative spillover effects occurring among employees of the host company. The sentiment underlying these negative effects was, however, captured by one of our interviewees (participant 129; **Figure 8**) who, while not reporting to have personally sabotaged the campaign or engaged in negative environmental acts, illustrated a clear resistance to the intervention. It was this negative reactance that distinguished participant 129 from those

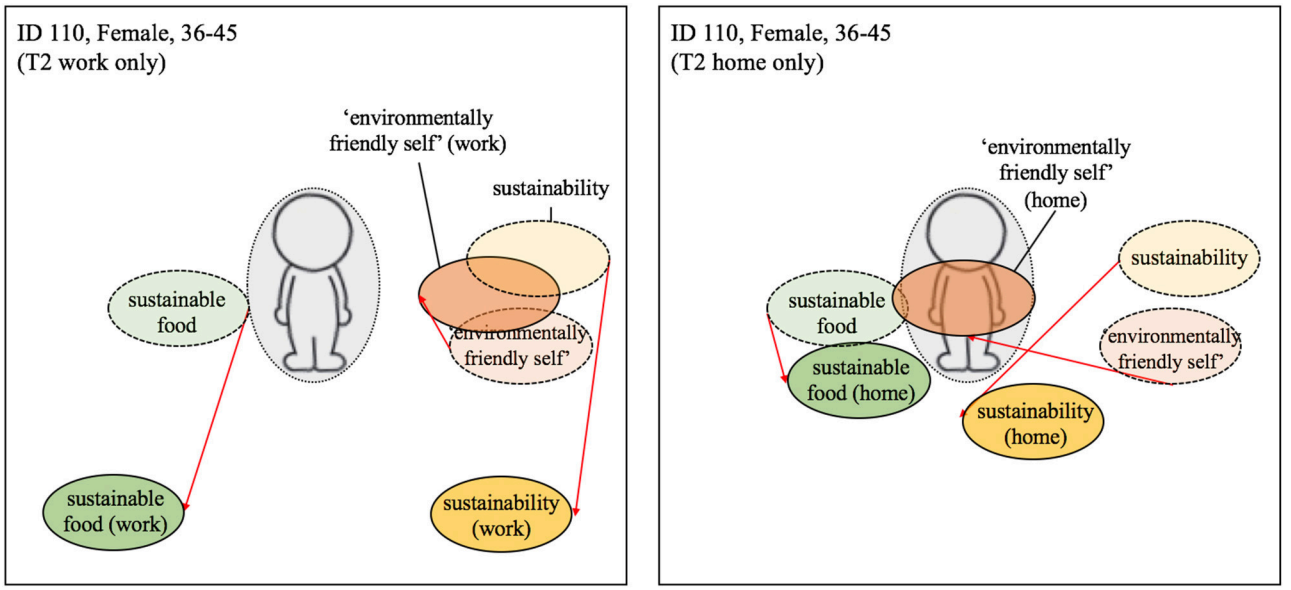

FIGURE 8 | Visualization of centrality of identity—Compartmentalization of work and home. Dashed line = T1; solid line and darker coloring = T2; Red arrow indicates change from T1 to T2 (the colors were added after the analysis). Participant differentiated between self at work and home at T2.

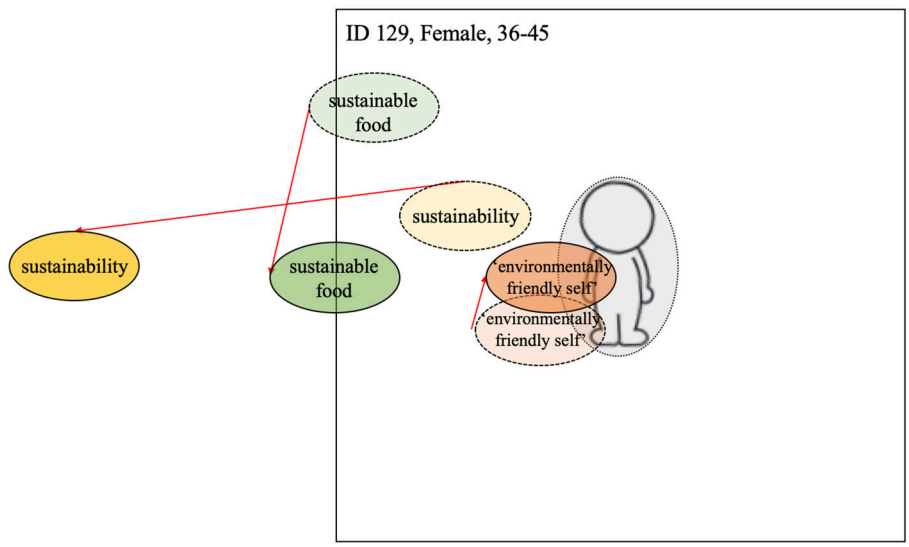

FIGURE 9 | Visualization of centrality of identity—Negative spillover. Dashed line = T1; solid line and darker coloring = T2; Red arrow indicates change from T1 to T2 (the colors were added after the analysis).

participants evidencing a more benign lack of spillover (e.g., participants 110 and 126; **Figures 8**, **7**).

While care must be taken in drawing firm conclusions about the mechanisms underpinning negative spillover from this one case (although the power of single cases should not be underestimated, see Eisenhardt and Graebner, 2007), there are some indicators within the participant's responses that speak to aspects of our theoretical model. For example, their verbal resistance to the campaign during the interview was partnered by a decentralization of two of the terms *sustainability* and *sustainable food* within the visualization task. And in the case of *sustainable food* this decentralization was so extreme so as to effectively remove the term from the table.

We argue that this finding could be taken as evidence of the intervention having threatened an important part of the participants' self-image (e.g., Giner-Sorolila and Chaiken, 1997), thus stimulating the emergence of conflicting identities (i.e., meat eater vs. sustainable person). It is possible that

the participant sought to resolve this conflict by figuratively removing the discussion of dietary choice (and reduction in meat consumption) from wider discussions about the need to be more environmentally sustainable. What perhaps prevented the negative sentiment evolving into actual negative behavioral spillover in this case was the countermovement of the term *environmentally-friendly-self* toward a position of greater centrality. Crucially, the trends reported here were only identified in one of the 13 participants and whether or not the increased centrality of the term *environmentally-friendly-self* was indicative of an *internal* strengthening of the participant's green identity or an *extrinsic* response to the interview context (i.e., a desire not to appear un-environmental in from of the interviewer), remains open. As such, these explanations need further investigation in future work.

Implications, Limitations, and Future Directions

The principal aims of the current study were to propose and provide some initial supporting evidence for a theoretically-informed, conceptual framework for understanding contextual (and broader) spillover. Our initial findings from post-intervention, qualitative interviews in association with the visualization task would appear to be broadly consistent with the predictions made within the conceptual framework and thus point to identity—and the relative success with which the tenets of behavior change appeals are integrated into one's identity—as being a mediator of the likelihood that contextual spillover will occur.

On the basis of our exploratory research, it would appear that where the tenets of an appeal are fully integrated (i.e., adapted), then there is an increased likelihood of observing *direct* positive contextual spillover (i.e., people taking the theme of a behavior change intervention from one context and transferring it to other contexts). Conversely, our initial findings show less successful integration is liable to lead to more *indirect* positive contextual spillover effects (i.e., people altering behaviors other than that target behavior), a lack of spillover or even (in some cases) negative spillover. That said, we did not find firm evidence of negative contextual spillover within our study.

While there are certain limitations to this research (outlined below), we argue that the initial findings hold a number of real-world implications also. Chiefly, by firmly implicating identity threat as a limiter of positive contextual spillover, we feel that behavior change interventions targeting change in ESBs, should be accompanied by efforts to reduce the potential threat felt by recipients. There is already growing evidence of the value of priming pride (as opposed to guilt) as a means of encouraging people to engage in more ESBs (e.g., Bissing-Olson et al., 2016) which is consistent with this suggestion. However, we would also argue that another option could be to draw upon the principles of self-affirmation theory (Sherman and Cohen, 2006). The principles of self-affirmation have already been used successfully in the domain of health behaviors. Studies show that by having people bolster their perception of self-worth before receiving ostensibly threatening (e.g., health risk) information, decreases defensive processing and is a good means of increasing the likelihood they will respond appropriately.

Care should, though, be taken in generalizing from the findings of this study due to a number of limitations. Aside from the obvious limitations to the transferability of the study posed by the small sample and the fact that this study was based upon a one-off intervention, with a narrow focus on meat consumption and confined to one particular workplace environment, there are other theoretical and methodological limitations to bear in mind.

Theoretically, for example, our model focuses solely on the role that identity processes might play in explaining contextual spillover. While this decision was made on the basis of the recognized importance that identity has in guiding behavior (Van der Werff et al., 2014), other psychological variables—such as environmental attitudes (e.g., De Dominicis et al., 2017), environmental values (e.g., Steg et al., 2014), or social norms (Keizer and Schultz, 2018)—are also known to shape people's ESBs. As such, these variables might also be anticipated to play a role in helping to explain the mechanisms behind the emergence of contextual spillover effects. Beyond dispositional characteristics, there are also certain situational characteristics that we did not consider within the current study but which could affect the likelihood of contextual spillover, e.g., the perceived similarities and differences in the intervention and spillover contexts (Littleford et al., 2014).

As such, we argue that future research could usefully seek to expand upon our proposed theoretical framework in order to recognize more of the potential psychological and situational factors governing contextual spillover. Such research might, for example, seek to delve deeper into the factors accounting for the emergence of indirect spillover in the absence of direct spillover (e.g., studying the role of compensatory beliefs and behaviors in inhibiting direct spillover effects, see Hope et al., 2018); or investigate how social dynamics affect the likelihood of contextual spillover occurring within group settings (e.g., looking at how the opinions or actions of others promote or inhibit spillover within and between social contexts, Sinclair et al., 2012).

Methodologically, our visualization task, while based upon existing research (e.g., Martin and Czellar, 2016), is a novel approach in assessing changes in the centrality of identity elements, particularly in the context of spillover. Further research should be conducted to further validate the use of this approach. Such validation might, employ "think aloud" methodology; where people can privately talk through their decisions regarding the positioning of the terms, out of the face-to-face presence of the experimenter (Kaklamanou et al., 2013; Hope et al., 2018) or in the form of a think aloud-visualization task, where participants could talk through their decisions regarding the positioning of the terms in an open manner. Not only would such studies likely yield a verbal account of the reasoning behind placement decisions (e.g., the extent to which the changes reflect a conflict in a participants identity) but also the reduction in the immediacy of the experimenter which could be introduced using such methods (vs. an interview) would likely yield less demand artifact, socially desirable responding or other experimenter induced bias (e.g., the Pygmalion effect).

Furthermore, in terms of methodology, we recognize that the absence of control condition within the current study means that any claims of cauzation within the findings are necessarily

tentative. We argue that more tightly controlled study designs, such as the use of multilevel experiments (e.g., Sinclair et al., 2012), could now be used to help confirm the assumptions inferred within this study, and other, spillover research.

Finally, we feel that in the future it would be prudent to include other key terms in the visualization task in order to explicitly test some of the assumptions arising from the current study. In particular, including terms that might be seen to represent conflicting identities that might form in relation to dietary choice could be interesting. For instance, the inclusion of the term *meat-eater* within the current study could have helped to provide more direct evidence of the conflict (or conflicting identities) that had been stimulated by our interventions. Also, to the extent that some people might question the health risks and/or benefits of eating animal-protein, introducing terms like *healthy eater* could also prove interesting in this regard. A further option could be to work with participants directly to identify pairs of terms relating to dietary choice, identity and environmental sustainability that they find to be opposing (similar to Q-sort methodology; Brown, 1996). In doing so, one could not only identify the terms that are subjectively important to each respondent (providing a clearer picture of their specific "consumer" identity) but one could then investigate how these opposing terms shift in relation to one another in response to a behavior-change intervention.

CONCLUSION

This paper used identity process theory as the basis for introducing a theoretically informed framework for behavioral spillover. Our focus on contextual spillover effects (workplace to home) was designed to directly address a current hole in the literature; however, we feel that the framework we have created should also be directly applicable to understanding other forms of behavioral spillover also. Results of an explorative visualization task and interview method provided initial evidence of direct and indirect positive contextual spillover effects, with comparatively less evidence of a lack of spillover and a relative absence of reported negative spillover. Consistent with the conceptual model developed within this study, whether or not positive spillover was observed seemed to be tied to the extent to which the tenets of the behavior change appeal (in this case designed to reduce meat consumption) were integrated into a person's sense of self. Future research is now required to test and evaluate the theoretical framework and confirm its relevance for understanding spillover effects, validate the methodological approach used in this initial study and address some of incumbent limitations.

ETHICS STATEMENT

Ethics approval for this research has been granted by the University of Sheffield Management School Ethics Committee.

AUTHOR CONTRIBUTIONS

The research outlined in this paper constitutes part of CV's Ph.D. thesis. CV was involved in developing the research question, designing the study, collecting and analyzing the data, and writing the manuscript. CJ was involved in co-writing all sections of this manuscript. CJ, DG-S, and CO were involved in developing the research questions and methodological approach used within this research, as well as editing the manuscript.

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Using a Goal Theoretical Perspective to Reduce Negative and Promote Positive Spillover After a Bike-to-Work Campaign

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Behavioral change interventions often focus on a specific behavior over a limited time period; for example, a bike-to-work intervention that incentivizes cycling to work over 2 months. While such interventions can successfully initiate behavior, they run the risk of triggering negative spillover effects after completion: Reaching the end of an intervention could reduce the motivation to maintain the behavior; or an increase in the targeted behavior (e.g., cycling to work more often) could lead to negative spillover across behaviors (e.g., cycling less in leisure time). Using a goal theoretical perspective, we tested whether an intervention focusing on a specific behavior during a limited time period (a subordinate goal) triggers negative spillover, and whether superordinate goals and/or action steps reduce negative or promote positive spillover. We conducted an experimental field study ($N = 1{,}269$) in the context of a bike-to-work campaign with a longitudinal multilevel design. Participants across all four experimental conditions had the campaign goal of cycling to work for a maximum of 2 months (a subordinate goal). A quarter of the participants additionally generated superordinate goals, a quarter action steps and a quarter superordinate goals *and* action steps. The last quarter was a control condition which only set the subordinate campaign goal. Surprisingly, the intervention caused no negative and some positive spillover effects. Participants increased the frequency of cycling to work across all groups and the increase could be maintained up to 2 months after the campaign. An increase in cycling to work spilled over to an increase in cycling in leisure time and to an increase in eating fruits and vegetables. No spillover effects were found regarding exercising and eating sweets and snacks. Participants focusing additionally on a superordinate goal cycled to work more frequently at the end of the campaign than the control group. Contrary to our expectations, the maintenance of cycling to work over time and the positive spillover effects across behaviors did not differ due to the goal manipulation. These results reduce the concern that interventions focusing on a subordinate goal could trigger negative spillover effects and show the need for additional experimental field studies.

Keywords: goal hierarchy, goal pursuit, behavior change, long-term, spillover effect, intervention, longitudinal multilevel analysis

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INTRODUCTION

Policy makers around the world are increasingly interested in how people's behavior can be changed (Frederiks et al., 2016). While regulatory mechanisms have traditionally been used to change behavior, campaign designers today increasingly rely on knowledge from behavioral research to motivate voluntary behavioral changes (Dolan and Galizzi, 2014; Moore and Boldero, 2017). In the environmental context, for example, there are numerous programs and interventions to encourage people to use less energy, focus more on renewable energy sources, produce less waste or switch to public transport, to name but a few (Abrahamse et al., 2005; for a review, see Osbaldiston and Schott, 2012; Abrahamse and Steg, 2013).

In order to be effective, behavior change interventions usually require people to adapt their behavior repeatedly over a long period of time and across different behavioral domains (Tiefenbeck et al., 2013; Moore and Boldero, 2017). To illustrate, one cannot lead a healthy life by exercising, or skipping dessert a single time. Thus, interventions aimed at changing behavior in the long-term and across behavioral domains have to consider not only the initiation of a targeted behavior, but also the long-term maintenance of an intervention effect, as well as possible effects that the change in the targeted behavior can have on other related behaviors. These effects are referred to as "spillover effects." These spillover effects are positive when a first behavior increases the likelihood of engaging in a second related behavior and are negative when they decrease the likelihood of engaging in a second related behavior (e.g., Poortinga et al., 2013; Truelove et al., 2014; Dolan and Galizzi, 2015; Nilsson et al., 2017). Spillover effects can occur over time (when conducting behavior X affects the probability of conducting behavior X later on); across socio-spatial contexts (when conducting behavior X in one context affects the probability of conducting behavior X in another context) or across behaviors (when conducting behavior X affects the probability of conducting behavior Y, either in the same or in a distinct behavioral domain) (Nilsson et al., 2017).

In the context of goal setting theory, interventions that focus on the pursuit of a single concrete goal that describes *what* a person is trying to achieve in the short run (i.e., subordinate goals) have proven to be successful in initiating behavioral change. The motivational benefit of focusing on subordinate goals has been widely researched and documented (Abrahamse et al., 2005; Locke and Latham, 2013). However, if their effect is considered in the context of broad, long-term challenges that include possible spillover effects, it is unclear whether pursuing subordinate goals is still the most effective way to change behavior. Subordinate goals should not be used as a panacea for changing behavior within the design of interventions (Ordóñez et al., 2009). Potential negative spillover effects of subordinate goals are increasingly discussed; for example, interventions that focus on a subordinate goal are constrained in time and often focus specifically on the intervention period. Thus, they run the risk that people stop pursuing the goal as soon as the intervention has finished (Jeffery et al., 2000; Geller, 2002; Lally and Gardner, 2013). This can limit or even reverse possible intervention effects. We argue that when addressing broad, long-term challenges that require repeated behavior in the long-term and across different domains, superordinate goals fulfill a crucial role in motivating behavior, and a combination of both subordinate and superordinate is most effective (Höchli et al., 2018).

Using an experimental field study with a longitudinal multilevel design, the objective of this paper is to test whether (1) an intervention focusing on a subordinate goal gives rise to negative spillover effects over time and across behaviors, and whether (2) adding a superordinate goal can reduce negative and foster positive spillover effects over time and across behaviors. In order to better contextualize the results, a combination of a subordinate goal plus a concrete action step and a combination of all three—a subordinate goal, a superordinate goal and action steps—was tested.

USING A GOAL THEORETICAL PERSPECTIVE TO REDUCE NEGATIVE AND PROMOTE POSITIVE SPILLOVER

In recent years, policy makers have started to consider how to address behavioral spillover in their campaign strategies (Lanzini and Thøgersen, 2014; Moore and Boldero, 2017). However, it is difficult to draw unequivocal conclusions about the design of interventions from previous research on spillover effects. Existing research has reported both positive spillover effects that foster the intended intervention effect (e.g., Whitmarsh and O'Neill, 2010; Thøgersen and Noblet, 2012; Willis and Schor, 2012) but also negative spillover that could nullify or even reverse the intended intervention effect (e.g., Sorrell, 2007; Barr et al., 2010). To date, no general consensus exists about when and why positive or negative spillover effects occur (Truelove et al., 2014).

These inconsistent and contradictory theories and results show the need for a deeper understanding of why positive and negative spillover effects occur and what conditions increase or decrease their likelihood (Whitmarsh and O'Neill, 2010; Truelove et al., 2014).

We take a goal theoretical perspective to explain why negative spillover effects occur and to offer a strategy for how negative spillover effects can be reduced and positive spillover effects can be promoted.

Goal Hierarchy

When aiming to change behavior, the importance of planning and the usefulness of goals has been established (Carver and Scheier, 2001; Locke and Latham, 2013). Goals can differ in various characteristics, which can influence subsequent motivation and performance. To understand when positive and negative spillover effects occur, one characteristic of a goal is particularly relevant: the level of abstraction (Fujita and MacGregor, 2012). Concrete subordinate goals describe an action in detail: they convey exactly *what* action has to be done. As subordinate goals are constrained in time, and goal progress and achievement are easy to determine (e.g., Bandura, 1997), they can provide immediate incentives for performance and thus boost motivation. Abstract superordinate goals refer to idealized conceptualizations of one's self, one's relationships, or the society

one is part of, and are closely linked with values. Superordinate goals constitute the reasons or motives for goal striving and convey *why* an action is performed. They are, by definition, more vague than subordinate goals but may better represent people's ultimate wishes and aspirations (e.g., Carver and Scheier, 2001), and promote vision and guidance (Locke and Latham, 2013).

Goals at different levels of abstraction are interconnected: Superordinate goals (e.g., living a healthy life) determine subordinate goals (e.g., lose 10 pounds) which in turn give rise to more concrete goals, such as action steps, that describe *how* to behave in a specific situation (e.g., run for 30 min as soon as one gets home from work on Tuesdays). Goals at different levels of abstraction can be seen as hierarchically ordered, with superordinate goals at the top and concrete goals at the bottom (e.g., Carver and Scheier, 2001).

A Goal Theoretical Perspective and Negative Spillover

Focusing on subordinate goals has been shown to boost motivation and facilitate goal achievement. However, achieving a goal is not always an advantage. Achieving a goal can be negative because people stop working toward a goal when they perceive it to be completed (e.g., resting on laurels, Amir and Ariely, 2008; post-fulfillment inhibition, Förster et al., 2005; Zeigarnik effect, Zeigarnik, 1927). When pursuing a goal, the discrepancy between the status quo and the desired end-state results in an aversive and unpleasant tension (e.g., Carver and Scheier, 2001). In order to avoid this negative tension, people are motivated to decrease the discrepancy by acting in a goal-consistent way. Thus, the discrepancy encourages people to decrease the gap between their current state and their goal. Crucially, this also implies that once a goal is achieved, the discrepancy and the motivational impetus following from it will disappear. Goal achievement signals to people that they have done what is necessary and that they can stop pursuing that particular goal.

This tendency to relax one's efforts is unproblematic and even helpful if people really have achieved the goal they aspire to. However, many goals require continued effort over long periods of time. In addition, a goal is often only one of many steps that contribute to what is one's ultimate aspiration (i.e. their superordinate goal). Thus, achieving a subordinate goal (e.g., losing 10 pounds) will increase the tendency to relax efforts and may deter people from pursuing and achieving what they really want (e.g., living healthy life) and thus give rise to negative spillover over time. These arguments, which combine a goal theoretical perspective with negative spillover over time, are largely consistent with two other approaches explaining negative spillover effects: moral licensing and single-action bias (e.g., Truelove et al., 2014; Nilsson et al., 2017). *Moral licensing* occurs when a person who initially behaves in a moral way later on shows immoral, unethical or otherwise problematic behaviors (Mazar and Zhong, 2010; Merritt et al., 2010; Mullen and Monin, 2016). After doing good, a person thinks that she has done "enough" and allows herself to engage in less-moral behavior, believing she can balance out the prior moral and the latter less-moral behavior. *Single-action bias* occurs when a first action is perceived as a big step toward tackling a challenge or solving a problem, when in reality it was only a small step. As an illustration, a person who has insulated their house feels that this one action reduces climate change and therefore no longer considers it necessary to take further steps to prevent climate change (Hansen et al., 2004; Girod and De Haan, 2009).

Designing a campaign around subordinate goals could hinder positive and give rise to negative spillover effects not only over time but also across socio-spatial contexts and across behavioral domains. Subordinate goals motivate behavior as they focus attention on the goal-relevant behavior, which is crucial for goal pursuit (Locke and Latham, 2002). However, this focus can be too narrow, as when people overlook other important tasks that serve the pursuit of the goal in a broader sense (Ordóñez et al., 2009). For example, a person might focus on the goal of buying ecologically produced food for environmental reasons, without realizing that flying to Bali for the holidays contradicts her first behavior. Designing a campaign with a narrow focus on a subordinate goal could thus undermine positive spillover effects and foster negative spillover effects—especially across behaviors that are not similar, for example across socio-spatial contexts or across different behavioral domains.

Taken together, interventions that focus on a specific behavior over a limited time period—that is, behavior that focuses on a subordinate goal—may be prone to negative spillover effects both over time and across behaviors.

A Goal Theoretical Perspective and Positive Spillover

One approach that might hinder negative spillover and foster positive spillover over time as well as across different behaviors is to design campaigns with a stronger focus on superordinate goals.

Superordinate goals can promote positive spillover effects over time as they often entail a long time span or do not have a clear end-state. In this case, achieving a subordinate goal or completing a campaign only signals partial fulfillment and the discrepancy between the status quo and the desired end-state is sustained. Because of this sustained discrepancy, people will not feel that they have "done enough," which should motivate them to carry out further goal-consistent activities (Fishbach et al., 2006). This argument overlaps with several consistency theories that explain positive spillover effects, such as the foot-in-the-door effect (Freedman and Fraser, 1966) or the cognitive dissonance theory (Festinger, 1962; for a review on consistency theories, see Gawronski and Strack, 2012). These theories suggest that a first behavior activates a positive self-image or social identity and people infer feelings of distressing dissonance when acting inconsistently (Festinger, 1962). As a person tries to avoid this dissonance, the likelihood of performing a subsequent behavior that is consistent with the activated identity or concept increases (Truelove et al., 2014).

Furthermore, superordinate goals may foster positive behavioral spillover across socio-spatial contexts and across domains, as they interconnect several behaviors. When focusing on a superordinate goal, it becomes apparent that there are

several means for pursuit (Kruglanski et al., 2002). For example, the goal of living a healthy life can be pursued by eating healthily, exercising regularly, and getting enough sleep. While these three distinct behaviors do not appear to be related in isolation, their interconnection becomes apparent when focusing on the common superordinate goal (Dolan and Galizzi, 2015). When a person focuses on a superordinate goal, engaging in a first goal-consistent action only signals partial completion, thereby motivating further actions. These further actions are not bound to the same or very similar repeated behavior, but can entail several distinct actions connected to the superordinate goal. For example, in order to progress toward a goal of "living a healthy life," one could eat less convenience food, join a sports group, meditate, and get regular health checks. This also implies that, as long as the discrepancy between the status quo and the superordinate goal is sustained, a person will not engage in negative spillover behavior across other related contexts or behavioral domains, as the harmful effect of engaging in a behavior that contradicts the pursuit of the superordinate goal will be apparent.

Taken together, we argue that goals at all levels of abstraction have distinct advantages for the promotion of goal pursuit and work best when combined. Subordinate goals help to promote the initiation of a specific action, but they run the risk of triggering negative spillover effects. Superordinate goals are shown to be less motivating in initiating a behavior, but may be helpful to maintain a behavior over time as well as to foster positive spillover effects across other behaviors and domains. Thus, superordinate goals may help forestall negative spillover effects after reaching a first subordinate goal.

The Present Study

To complement existing research on spillover effects, this study focuses on the spillover effects of an existing behavior change intervention (a bike-to-work campaign in Switzerland) over time and across behaviors in different socio-spatial contexts (cycling to work and cycling in leisure time) and in different domains (exercising, eating) in an experimental field setting. By taking part in the existing bike-to-work campaign, all participants pursued a subordinate goal defining *what* had to be achieved (i.e., cycling to work on at least half of the working days during the intervention period). We investigate whether the bike-to-work campaign, which focuses on a specific behavior over a limited period of time, triggers negative spillover effects over time (research question 1) and whether the campaign triggers negative spillover effects across behavior (research question 2). Based on the assumption that superordinate goals sustain discrepancy between the status quo and the desired state and that superordinate goals highlight the relationship between distinct behaviors, for both research questions we analyze whether adding a superordinate goal can reduce negative spillover and foster positive spillover over time and across behaviors.

In addition to a condition that combined the subordinate bike-to-work goal (*what*) with a superordinate goal (*why*), we also investigated a condition that combined the bike-to-work goal with concrete action steps that must be completed in order to achieve the bike-to-work goal (*how*). Focusing on *how* to achieve a goal has proven to be particularly helpful in the successful pursuit of goals when initiating a new behavior (see action phase model, Heckhausen and Gollwitzer, 1987) and when facing unfamiliar, complex situations (see control theory, Carver and Scheier, 1982; or action identification theory, Vallacher and Wegner, 1987). The advantage of action steps in goal pursuit is further reflected in the research on implementation intentions, which concentrates on *how* to achieve a goal and specifies in detail *when* and *where* this action will take place. In this way, implementation intentions link an intended action to a specific situation. Implementation intentions are shown to have a medium to large effect on promoting the initiation of an intended behavior (Gollwitzer and Sheeran, 2006) and are also helpful in maintaining a new behavior over time (Holland et al., 2006). Additionally, an experimental condition that references the empirically-supported, positive influence of action steps on goal achievement enables a better contextualization of the results (Watkins, 2011).

A combination of all three goal formulations is also examined as the final group of the study; this combination includes a subordinate goal (*what* do I pursue?), a superordinate goal (*why* do I pursue it?), and action steps (*how* do I pursue it?). It thus investigates how combining goals at different hierarchical levels could reap the benefits of superordinate goals, subordinate goals and action steps while canceling out the disadvantages (Höchli et al., 2018).

To summarize, the present study tests the following research questions.

Research question 1a: Does the effect of the bike-to-work campaign on cycling to work disappear at the end of the campaign and trigger negative spillover over time?

Research question 1b: Does formulating a superordinate goal and/or action steps in addition to the subordinate goal lead to a longer maintenance of the intervention effect on cycling to work, and therefore reduce negative and foster positive spillover effects over time?

Research question 2a: Does the effect of the bike-to-work campaign on cycling to work trigger negative spillover across behaviors?

Research question 2b: Does formulating a superordinate goal and/or action steps in addition to the subordinate goal reduce negative and foster positive spillover effects across behaviors?

METHODS

Participants

Participants were recruited via official emails from the bike-to-work organization in Switzerland that were sent to all participants in the bike-to-work campaign. As an incentive, participants who completed the study were entered in a prize draw for 5 wellness weekends each worth CHF 800. The registration questionnaire was started by 1,842 people; of these participants, 309 did not complete the registration questionnaire, meaning that they could not be contacted and were excluded from the sample. Of the 1,533 participants who registered, 1,377 began the starting questionnaire, and out of these, 1,285 finished it and underwent the manipulation, thus meeting the minimal criteria

to participate in this study. Within this sample, participants who changed their email address during the study and could no longer be uniquely identified were excluded from the study. Participants who were unable to provide meaningful answers regarding their cycling behavior (i.e., those who were injured or on holiday when they had to complete one of the questionnaires) were excluded from the corresponding questionnaire but remained in the sample for the remaining questionnaires. In addition, the study excluded responses regarding eating behaviors when the responses indicated that a person was consuming over 60 portions of fruit and vegetables per week (the total number of fruit and vegetable portions per week is determined by multiplying the number of days per week during which fruit or vegetables were eaten and the number of portions per day). Values above the mean at baseline plus six standard deviations, i.e., 60 portions per week, may indicate that those individuals have already indicated the number of portions per week rather than per day and were thus treated as inaccurate disclosures). But these participants were kept in the sample for the remaining questionnaires. Our final sample included 1,269 participants (746 women, 523 men, $M_{age} = 38.57$ years, $SD_{age} = 10.89$ years).

Design

Participants were randomly assigned to one of four conditions of a between-subjects design with repeated assessment of the outcome variable (e.g., frequency of cycling to work) within 7 months starting at the end of the bike-to-work campaign. By taking part in the bike-to-work campaign, all participants committed to pursue the goal of cycling to work on at least half of the working days for a maximum of 2 months. The control condition focused solely on this subordinate goal. In addition to the subordinate goal, the first intervention condition was asked to think about *why* they wanted to bike to work and, on this basis, formulate a superordinate goal (*superordinate* condition); a second intervention condition was asked to think about *how* to meet the target of the bike-to-work campaign and, on this basis, formulate concrete action steps (*action step* condition); and a third intervention condition was asked to formulate action steps as well as a superordinate goal (*combined goal hierarchy* condition). As outcome variables, we measured the frequency of cycling to work (spillover effect over time), the frequency of cycling during leisure time (spillover effect across socio-spatial contexts), the frequency of exercising, and the frequency of eating healthy and unhealthy foods (spillover across behavioral domains) at the end of the campaign and up to 7 months afterwards.

Procedure

Data were collected by the research team via seven online questionnaires: A registration questionnaire (1), an initial questionnaire at the start of the campaign (2), an end questionnaire at the end of the campaign (3), and three follow-up questionnaires (4–6). Additionally, a final follow-up questionnaire (7) was sent 7 months after the end of the campaign, in the winter, to all participants who had agreed to be contacted again. During the campaign, participants received a reminder message approximately every 2 weeks.

The registration questionnaire was sent 1 week before the start of the campaign. Consent for participating in the research was attained by asking participants to continue only if they had read the provided instructions, agreed to them, and were willing to participate in our study. To establish a baseline, we asked participants how frequently they cycled to work and during their leisure time, as well as about their exercising and eating behaviors. Furthermore, participants answered socio-demographic questions. The starting questionnaire was sent out the day that the campaign started. In the starting questionnaire, participants completed the goal manipulation and a manipulation check. To make sure that participants did not forget the details of the experimental condition they were assigned to, they received reminder messages approximately every 2 weeks during the campaign. On the last day of the campaign, participants received the end questionnaire. It assessed their frequency of cycling to work, cycling in their leisure time, and exercising, and also assessed their eating behaviors. Participants answered the same questions 2, 3, and 7 months after the end of the campaign (see **Figure 1**). All study elements were designed in Qualtrics and distributed via email.

Various additional variables were assessed which are not topic of this article (e.g., whether participants interpreted their behavior as progress or commitment, or the level of self-efficacy), and thus will not be described in the material and will not be evaluated in this context.

Measures and Materials

Goal Manipulation

The control condition ($N = 327$) focused only on the goal of the bike-to-work campaign: that is to cycle to work on at least half of the working days during the campaign.

The first intervention condition (superordinate goal, $N = 316$) was asked, in addition to the bike-to-work goal, to consider why they would like to pursue the bike-to-work campaign goal and write down their answer in their own words. Participants were then asked to address their answer and explain why it was important to them and again write down their answer. With these considerations in mind, participants were asked to consider which greater life goal the bike-to-work campaign and the desire to ride a bike more often is connected with, and to formulate a personal goal starting with "I want to be a person who…" (for a similar approach see laddering technique, e.g., Reynolds and Gutman, 1988).

The second intervention condition (action steps, $N = 311$) was asked, in addition to the bike-to-work goal, to write down three specific behaviors that will help them to achieve the bike-to-work campaign goal successfully. Participants were informed that ideally, these should be new behaviors that they have not yet implemented regularly and want to repeat. They were then asked to select the behavior that seemed to be the easiest and most effective to implement, and to formulate it as a personal goal. The third intervention group (combined goal hierarchy, $N = 315$) was asked, in addition to the bike-to-work goal, to formulate both action steps and a superordinate goal.

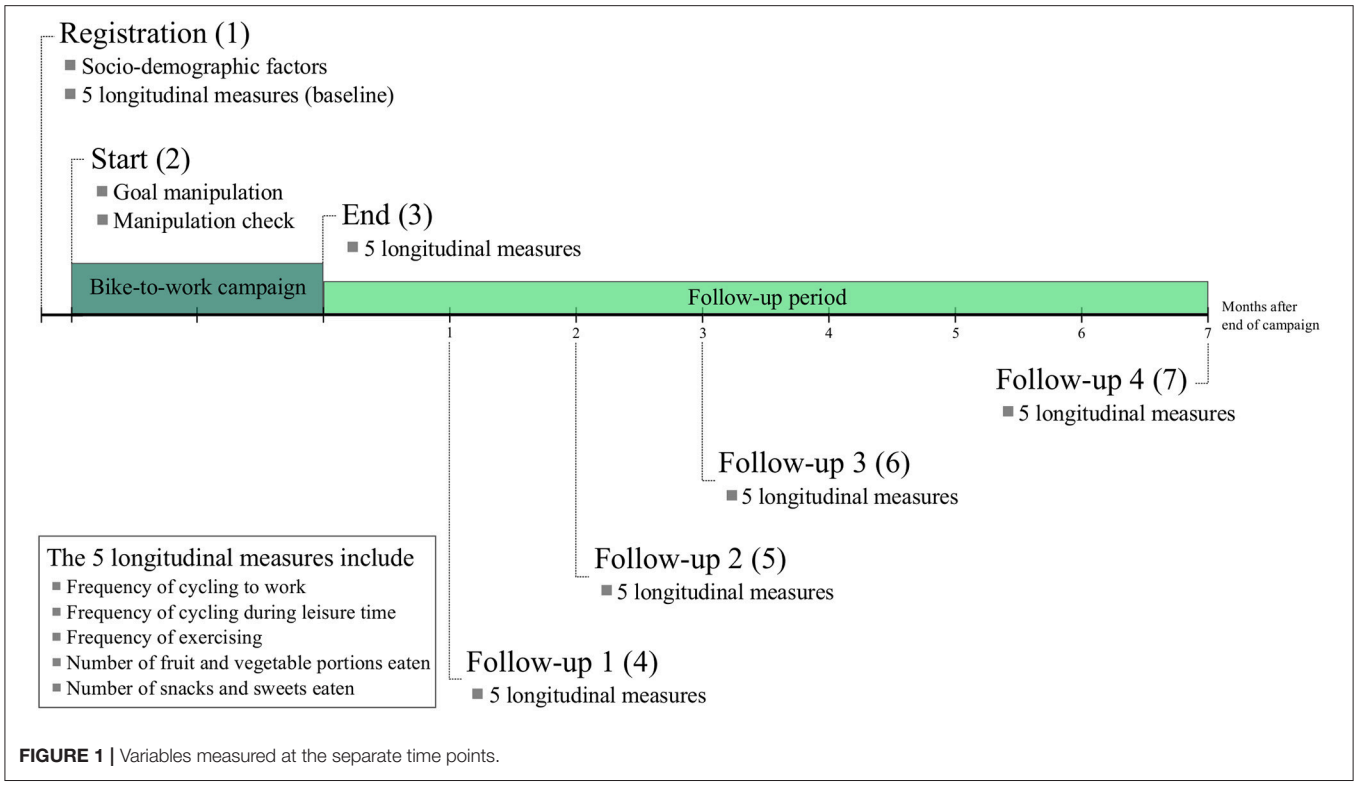

FIGURE 1 | Variables measured at the separate time points.

Manipulation Check

To measure the hierarchical level of abstraction of participants' goals, participants rated their goal on a 5-point scale using eight semantic differential items (adapted from Burrus, 2006, Cronbach's α =.78): from *central to life as a whole* (=1) to *side issue for life as a whole* (=5), from *complicated* to *simple*, from *long-term goal* to *short-term goal*, from *concerns life as a whole* to *concerns a specific aspect of life*, from *focusing on why something gets done* to *focusing on how something gets done*, from *influences overall path of life* to *influences minor detours in life*, from *is strongly linked to personal values* to *is detached from personal values*, and from *important* to *not important*. For the control condition, this rating refers to the subordinate goal of the bike-to-work campaign; for the superordinate and combined goal hierarchy conditions to their self-formulated superordinate goal and for the action step condition to their self-formulated action step.

Longitudinal Measures

Five variables were measured on six separate time points: as baseline measurement just before the start of the campaign (baseline measurement), at the end of the campaign (end measurement), and after 1, 2, 3, and 7 months after the end of the campaign (4 follow-up measurements). **Figure 1** gives an overview of the variables measured at the separate time points.

Participants were asked on how many of the past 7 days they cycled to work, they cycled in their leisure time and they did strenuous and moderate physical activities. Furthermore, participants were asked on how many of the past 7 days they have eaten vegetables and fruits as well as sweets and snacks, and the number of portions of each they ate on average per day. To compute the total number of fruit and vegetable portions as well as snacks and sweets eaten, the number of days was multiplied by the average number of portions of the respective food.

RESULTS

The results are presented in three parts. First, we report several data quality checks. Second, we describe the spillover effects of the intervention over time, both for the sample as a whole and separately for the four experimental conditions (research question 1). Third, we describe the spillover effects of the intervention across behaviors, again both for the sample as a whole and separately for the four experimental conditions (research question 2).

Data Quality Checks

Attrition Analysis

Among the participants who completed the start questionnaire, not all completed all five subsequent questionnaires (end questionnaire and four follow-up questionnaires, M = 4.09, SD = 1.344). To examine potential bias introduced by differential attrition between groups, we compared the number of completed questionnaires across groups but did not find any differences, [$F_{(3,1265)} = 0.69$, $p = 0.556$]. That is, there is no reason to assume that the conditions had an effect on the motivation to participate.

TABLE 1 | Kruskal–Dunn comparisons of self-reported hierarchical abstractions of participants' goals.

				Kruskal–Dunn comparisons (bonferroni)		
Group	***n***	**Mean**	**SD**	**Combined goal hierarchy**	**Superordinate goal**	**Action steps**
Combined goal hierarchy	315	2.42	0.51			
Superordinate goal	316	2.42	0.56	1.000		
Action step	311	2.72	0.58	<0.001	<0.001	
Control	327	2.84	0.48	<0.001	<0.001	0.007

Manipulation Check

To test whether the goal manipulation had the intended effect, we measured the self-reported hierarchical abstraction of participants' goals. A Kruskal–Wallis test showed differences among the four goal conditions, $\chi^2(3) = 167.63$, $p < 0.001$. Follow-up tests were conducted to evaluate pairwise differences among the four groups, controlling for Type I error across tests by using the Bonferroni approach. A Kruskal–Dunn test indicated that participants who formulated a superordinate goal (superordinate goal condition and combined goal hierarchy condition) assessed their goal as more abstract than did the control condition and the action step condition (see **Table 1**), which indicates a successful manipulation.

Randomization Check

To check whether randomization was successful, a one-way multivariate analysis of variance (MANOVA) with baseline measures of cycling to work, cycling in leisure time, intensive physical activity, moderate physical activity, eating fruit and vegetables, and eating snacks and sweets as the dependent variables and condition (control vs. action step vs. superordinate goal vs. combined goal hierarchy) as the independent variable was performed. The MANOVA did not reveal a significant multivariate effect, [$F_{(3,1205)} = 1.32$, $p = 0.180$], and no significant univariate effects, indicating successful randomization (all $p > 0.153$).

Effects of the Bike-to-Work Campaign Over Time

To answer our first research question, the spillover effects are analyzed over time; first in relation to the overall intervention effect (research question 1a) and then in relation to the four experimental goal manipulation conditions (research question 1b).

Overall Effect of the Campaign on Cycling to Work Over Time: More Rides to Work Until Two Months After the Campaign

Our data—that is, repeated measurements on individuals—had a hierarchical structure with measures nested within persons. Accordingly, we analyzed the data by applying a hierarchical linear modeling approach using the R-package lme4 (Bates et al., 2014). The first level of analysis was at the repeated-measures level (i.e., respondents reported longitudinal measures on cycling to work at the six measurement points at the within-person level). The second level of analysis was at the level of the individual respondent and captured changes in behavior between individuals.

In order to assess the overall effect of the campaign on cycling to work (research question 1a), we fitted a multivariate, multilevel model with random intercepts (for model specification see **Supplementary Model 1**). We examined the mean change of cycling to work at each of the five-measurement point compared to the baseline measure before the campaign and tested whether these means differed significantly. Results of this multivariate multilevel model are presented in **Table 2**.

At the end of the campaign, participants cycled to work on average almost 1 more day (0.88) per week than they did before the campaign, $b = 0.88$, $t = 17.51$, $p < 0.001$. This positive effect, when compared to baseline, was still present (although to lesser extents) 1 month, $b = 0.35$, $t = 6.75$, $p < 0.001$ and 2 months after the end of the campaign, $b = 0.27$, $t = 5.09$, $p < 0.001$. Three months after the end of the campaign, the positive effect on cycling to work was no longer discernable as the frequency of cycling to work was similar to baseline measurement, $b = 0.09$, $t = 1.70$, $p = 0.09$. Seven months after the end of the campaign—which corresponded to the winter season in Switzerland—participants cycled to work less often than they did at baseline, $b = -0.65$, $t = -11.14$, $p < 0.001$. In short, participants cycled more frequently during and up to 2 months after the campaign. Three months after the campaign, however, they returned to the same frequency as before the campaign, and in winter the frequency dropped below baseline levels (see **Figure 2**).

Effect of the Goal Type Manipulation on Cycling to Work Over Time: Superordinate Goals Show Some Positive Effects

To assess how cycling to work will develop after the end of the campaign and answer research question 1b, model 1 was slightly adapted. On the first level of analysis (the repeated-measures level within an individual), we included five measures per participant starting with the measurement at the end of the campaign where time was set to zero. The baseline measurement of cycling to work was included as a covariate at the between-person level. Furthermore, to assess whether formulating a superordinate goal and/or action steps in addition to the subordinate goal leads to longer maintenance of the intervention effect on cycling to work, we included goal type as a second-level (between persons) predictor. On this basis, we fit a multilevel growth model with random intercepts and random slopes as justified by the data (for model specifications see **Supplementary Model 2**). Results are presented in **Table 3**.

TABLE 2 | Application of a multivariate multilevel model for a within-subjects pre-/post-design with six fixed occasions.

		Fixed					Random	
Predictor	**Coef.**	***b***	**SE**	**df**	***t***	**95% CI**	**Coef.**	**SD**
MODEL 1: CYCLING TO WORK								
Intercept	β_{00}	2.98	0.05	2589.45	54.87***	2.88 to 3.09	r_{0i}	1.49
End	β_{10}	0.88	0.05	5246.79	17.51***	0.79 to 0.98		
Follow-up 1	β_{20}	0.35	0.05	5264.59	6.75***	0.25 to 0.45		
Follow-up 2	β_{30}	0.27	0.05	5274.69	5.09***	0.16 to 0.37		
Follow-up 3	β_{40}	0.09	0.05	5277.66	1.70	−0.01 to 0.19		
Follow-up 4 (winter)	β_{50}	−0.65	0.06	5304.74	−11.14***	−0.76 to −0.54		

*Coef. = Coefficient in corresponding model equation; b = unstandardized regression coefficient; $N_{occasions}$ = 6,459, $N_{persons}$ = 1,269. *p < 0.05, **p < 0.01, ***p < 0.001.*

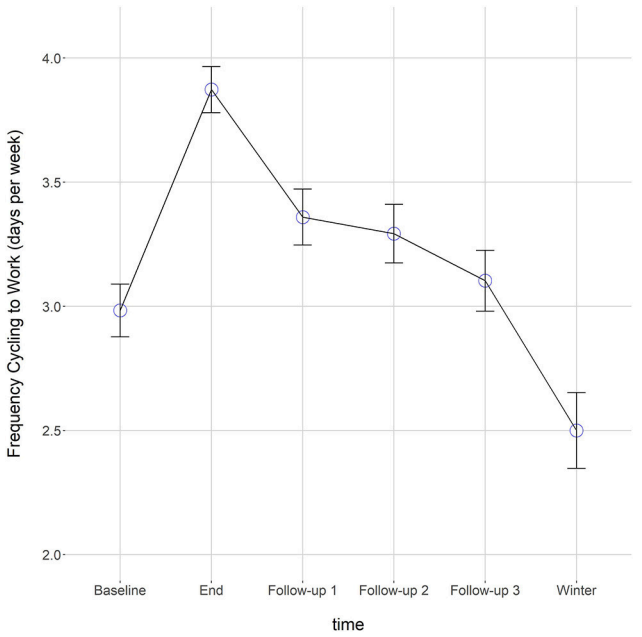

FIGURE 2 | Mean frequency of cycling to work for all participants at six measurement points.

The Intercept (β_{00}) shows that at the end of the campaign the control group cycled to work on average 3.61 days per week. At the between-person level, the frequency of cycling to work before the campaign (β_{01}, baseline) has a positive effect on cycling to work after the campaign across individuals, $b = 0.59$, $t = 35.53$, $p < 0.001$, indicating that people who cycled frequently before the start of the campaign were also more likely to cycle more frequently at the end of the campaign. The coefficients $\beta_{02-}\beta_{04}$ shows the effect of the goal manipulation on cycling to work at the end of the campaign. For the group with an additional superordinate goal, a positive change in mean at the end of the campaign compared to the control group was observed, indicating that the campaign had a stronger effect for participants with a superordinate goal compared to the control group, $b = 0.21$, $t = 2.03$, $p = 0.020$, Pseudo-$R^2 = 0.003$[1]. No differences were observed between the combined goal hierarchy and the control condition or between the action steps and the control condition.

At the within-person level, time had a negative effect on cycling to work (β_{10}), indicating that the frequency of people riding their bike to work is declining after the end of the campaign, $b = -0.21$, $t = -11.00$, $p < 0.001$, Pseudo-$R^2 = 0.25$. This negative trend over time was observed for 87.13% of the sample (the percentage of individuals for whom the time slope was negative; see Hox et al., 2017). Thus, for the large majority of participants, the frequency of cycling to work decreased over time. This result is consistent with the results regarding the overall effect of the campaign: People maintained an increased level of cycling to work up to 2 months after the campaign. Three months after the intervention, the frequency of cycling to work did not differ from baseline, and 7 months after the campaign, during winter, a significant decrease compared to baseline was observed.

To test whether the goal manipulation had an effect on cycling to work over time—that is to see whether additionally formulating a superordinate goals and/or action steps could reduce or even dissolve this negative trend on cycling to work over time—the cross-level interaction between goal manipulation and time ($\beta_{11-}\beta_{13}$) is of interest. For the goal manipulation to be effective at fostering cycling to work in the long-run, we would expect $\beta_{11-}\beta_{13}$ to be significantly larger than zero. The cross-level effects of all three goal manipulations x time did not yield any significant effects. This indicates that complementing a subordinate goal with a superordinate goal and/or action steps did not lead to longer maintenance of the positive intervention effect, and thus did not mitigate the decrease of the target behavior over time.

Effects of the Bike-to-Work Campaign Across Behaviors

To answer our second research question, the spillover effects are analyzed over across behaviors; first in relation to an increase in

[1]Pseudo-R^2 = [(unrestricted error – restricted error)/unrestricted error] (Raudenbush and Bryk, 2002).

TABLE 3 | Application of a multilevel growth model examining the effect of goal type on cycling to work.

	Fixed						Random		
Predictor	**Coef.**	***b***	**SE**	**df**	***t***	**95% CI**	**Coef.**	**SD**	**Slopes < 0**
MODEL 2: CYCLING TO WORK									
Intercept	β_{00}	3.61	0.07	1178.41	50.87***	3.47 to 3.74	r_{0i}	0.96	
Baseline cycling to work (cgm)	β_{01}	0.59	0.02	1203.68	35.53***	0.56 to 0.63			
Combined goal hierarchy	β_{02}	0.14	0.10	1170.97	1.39	−0.05 to 0.34			
Superordinate goal	β_{03}	0.21	0.10	1180.74	2.03*	0.01 to 0.41			
Action step	β_{04}	0.06	0.10	1172.84	0.62	−0.13 to 0.26			
Time	β_{10}	−0.21	0.02	930.26	−11.00***	−0.25 to −0.17	r_{1i}	0.19	87.13%
Combined goal hierarchy: time	β_{11}	−0.02	0.03	910.05	−0.64	−0.07 to 0.04			
Superordinate goal: time	β_{12}	−0.01	0.03	920.15	−0.33	−0.06 to 0.04			
Action step: time	β_{13}	0.03	0.03	926.24	1.05	−0.02 to 0.08			

*Coef. = coefficient in corresponding model equation; b = unstandardized regression coefficient; slopes < 0 = percentage of random slopes that were estimated to be negative (calculated on the basis of the assumption of normally distributed random slopes; see Hox et al., 2017); $N_{occasions}$ = 5,190, $N_{persons}$ = 1,269. The baseline measure of cycling to work was centered at the grand mean. *p < 0.05, **p < 0.01, ***p < 0.001.*

cycling to work (research question 2a), and then in relation to the goal manipulation (research question 2b).

Spillover Effects of the Campaign Across Socio-Spatial Contexts and Behavioral Domains: Partly Positive Effects From an Increase in Cycling to Work

The frequency of cycling to work increased on average across all participants as a result of the intervention. In the next step, to answer research question 2a (whether an increase in cycling to work could trigger negative spillover across behaviors), we investigated spillover effects from this change in cycling to work to cycling in leisure time, as well as across behavioral domains such as exercising and eating. We used a series of longitudinal multilevel models (**Supplementary Models 3–6**), to examine the effect of a change in cycling to work on the four possible spillover behaviors. The respective possible spillover behavior is the first-level outcome variable and cycling to work is the first-level predictor variable centered at the individuals mean; it is denoted by the suffix "cwc" (or "centered within clusters"; Enders and Tofighi, 2007). Additionally, we took the mean of all five measurements of cycling to work as a second-level predictor to control for the mean cycling frequency of each person. And finally, we included the baseline measure of cycling to work and the baseline measure of the respective possible spillover effect as a second-level predictor. All second-level predictors are denoted with the suffix "cgm" (or "centered at grand mean"; Enders and Tofighi, 2007). All models included random intercepts and random slopes as justified by the data (for model specifications, see **Supplementary Models 3–6**). Results of these multilevel models are presented in **Table 4**.

All baseline values of the behaviors that we tested for potential spillover effects had a positive effect on the respective potential spillover behavior in all four models (see **Table 4**). For example, participants who cycled more frequently in their leisure time before the campaign also cycled more frequently in their leisure time after the campaign. The baseline value of cycling to work only showed a small negative effect on cycling in leisure time, $b = -0.06$, $t = -2.40$, $p = 0.017$, Pseudo-$R^2 = 0.004$.

At the between-person level, individual means of cycling to work predicted cycling in leisure time, $b = 0.28$, $t = 10.04$, $p < 0.001$, Pseudo-$R^2 = 0.10$, indicating that people who on average cycle more to work also cycle more in their leisure time.

To answer the research question whether an increase in cycling to work gives rise to spillover effects across behaviors, the within-person level is of importance. At the within-person level, cycling to work positively predicted cycling in leisure time, $b = 0.17$, $t = 10.40$, $p < 0.001$, Pseudo-$R^2 = 0.09$, and eating fruits and vegetables, $b = 0.31$, $t = 3.99$, $p < 0.001$, Pseudo-$R^2 = 0.005$ (see **Figures 3A,B**). No effect was found regarding exercising, and eating snacks and sweets.

The individual differences in cycling to work moderated the within-person slope for cycling to work regarding cycling in leisure time, $b = 0.03$, $t = 2.31$, $p = 0.021$, and exercising, $b = 0.08$, $t = 4.62$, $p < 0.001$. This indicates that participants with a higher level of individual means of cycling to work showed a larger positive spillover effect on cycling in leisure time and on exercising than participants with a lower level. In the case of exercise, even a change from a positive spillover for persons with a high person-mean to a negative spillover for persons with a low person-mean can be observed (see **Figures 3C,D**).

Spillover Effects of the Goal Type Manipulation Across Socio-Spatial Contexts and Across Behavioral Domains: No Effect of the Goal Manipulation

Although the goal manipulation did not have a consistent statistically significant impact on cycling to work, it is still possible that the goal manipulation affected other behaviors (Lanzini and Thøgersen, 2014). To answer research question 2b, whether goal manipulation can hinder negative and foster positive spillover effects across behavior, we tested whether there is a more positive change in cycling in leisure time, exercising and eating in the intervention groups than in the control group.

TABLE 4 | Application of multilevel models examining the relation between cycling to work and four possible spillover behaviors.

		Fixed					Random		
Predictor	**Coef.**	***b***	**SE**	**df**	***t***	**95% CI**	**Coef.**	**SD**	**Slopes < 0**
MODEL 3: LEISURE CYCLING									
Intercept	β_{00}	1.97	0.03	1196.60	63.31***	1.91 to 2.03	r_{0i}	0.92	
Baseline leisure cycling (cgm)	β_{01}	0.58	0.02	1172.72	32.33***	0.54 to 0.61			
Baseline cycling to work (cgm)	β_{02}	−0.06	0.02	1230.04	−2.40*	−0.10 to −0.01			
Person mean cycling to work (cgm)	β_{03}	0.28	0.03	1248.54	10.04***	0.23 to 0.34			
Cycling to work (cwc)	β_{10}	0.17	0.02	625.99	10.40***	0.14 to 0.21	r_{1i}	0.21	79.9%
Person mean cycling to work (cgm): cycling to work (cwc)	β_{11}	0.03	0.01	955.53	2.31*	0.00 to 0.05			
MODEL 4: EXERCISE									
Intercept	β_{00}	3.50	0.05	1187.40	75.62***	3.42 to 3.60	r_{0i}	1.41	
Baseline exercise (cgm)	β_{01}	0.54	0.02	1190.41	28.14***	0.50 to 0.58			
Baseline cycling to work (cgm)	β_{02}	0.02	0.03	1227.99	0.48	−0.05 to 0.09			
Person mean cycling to work (cgm)	β_{03}	0.05	0.04	1237.82	1.1	−0.04 to 0.13			
Cycling to work (cwc)	β_{10}	0.04	0.02	511.78	1.82	−0.01 to 0.09	r_{1i}	0.28	55.8%
Person mean cycling to work (cgm): cycling to work (cwc)	β_{11}	0.08	0.02	795.05	4.62***	0.04 to 0.11			
MODEL 5: FRUITS AND VEGETABLES									
Intercept	β_{00}	21.25	0.23	1151.52	90.89***	20.80 to 21.72	r_{0i}	7.35	
Baseline fruits and vegetables (cgm)	β_{01}	0.47	0.02	1152.88	27.76***	0.44 to 0.51			
Baseline cycling to work (cgm)	β_{02}	−0.04	0.17	1185.93	−0.21	−0.40 to 0.33			
Person mean cycling to work (cgm)	β_{03}	0.26	0.21	1195.22	1.23	−0.15 to 0.67			
Cycling to work (cwc)	β_{10}	0.31	0.08	3731.46	3.99***	0.15 to 0.47	r_{1i}	0.09	99.9%
Person mean cycling to work (cgm): cycling to work (cwc)	β_{11}	−0.08	0.06	3741.39	−1.39	−0.20 to 0.03			
MODEL 6: SNACKS AND SWEETS									
Intercept	β_{00}	6.63	0.1	1192.13	65.04***	6.43 to 6.84	r_{0i}	3.05	
Baseline snacks and sweets (cgm)	β_{01}	0.51	0.02	1178.04	31.26***	0.48 to 0.54			
Baseline cycling to work (cgm)	β_{02}	0.11	0.08	1243.20	1.38	−0.04 to 0.26			
Person mean cycling to work (cgm)	β_{03}	0.01	0.09	1248.65	0.16	−0.17 to 0.20			
Cycling to work (cwc)	β_{10}	0.03	0.05	513.45	0.7	−0.06 to 0.12	r_{1i}	0.39	53.3%
Person mean cycling to work (cgm): cycling to work (cwc)	β_{11}	0.02	0.03	829.83	0.61	−0.04 to 0.08			

*Coef. = coefficient in corresponding model equation; b = unstandardized regression coefficient; slopes < 0 = percentage of random slopes that were estimated to be negative (calculated on the basis of the assumption of normally distributed random slopes; see Hox et al., 2017); $N_{occasions}$ = 5,190, $N_{persons}$ = 1,269. The baseline measure of cycling to work was centered at the grand mean. *p < 0.05, **p < 0.01, ***p < 0.001.*

We repeated the statistical analyses in **Table 3** with the exception of the respective possible spillover behavior replacing cycling to work as the dependent variable and the baseline of the respective possible spillover behavior replacing the baseline of cycling to work (see **Supplementary Models 7–10**). All models included random intercepts and random slopes as justified by the data. The results are presented in **Table 5**.

The baseline of the respective behavior had, in all models, a positive effect on the respective behavior (see **Table 5**). At the between-person level, goal manipulation had no effect on the four spillover behaviors. At the within-person level, time had a negative effect regarding cycling in leisure time, $b = -0.14$, $t = -8.56$, $p < 0.001$, Pseudo-$R^2 = 0.13$, and eating fruits and vegetables, $b = -0.21$, $t = -2.30$, $p = 0.022$, Pseudo-$R^2 = 0.07$.

To test research question 2b, whether goal manipulation can hinder negative (and foster positive) spillover effects across behaviors, the cross-level interaction between goal manipulation and time ($\beta_{11-}\beta_{13}$) is of importance. For the goal manipulation to be effective at fostering the four spillover effects in the long-run, we would expect $\beta_{11-}\beta_{13}$ to be significantly larger than zero. None of the three goal manipulations x time interactions yielded any significant effects, indicating that the goal manipulation did not affect the spillover behaviors over time.

DISCUSSION

Many individual and societal challenges require people to change their behavior over the long-term and across several behaviors. Thus, intervention designers have to take into account not only a specific, time-bound targeted behavior but also possible spillover effects of this targeted behavior, across time and across behaviors. However, no general consensus exists about the direction and size of possible spillover effects, nor about which factors can promote positive spillovers and reduce negative spillovers (Truelove et al., 2014). Furthermore, studies testing spillover effects experimentally in the field are still scarce and there is a need for more experimental research (Lanzini and Thøgersen, 2014). To contribute to this, based on a goal theoretical perspective, we

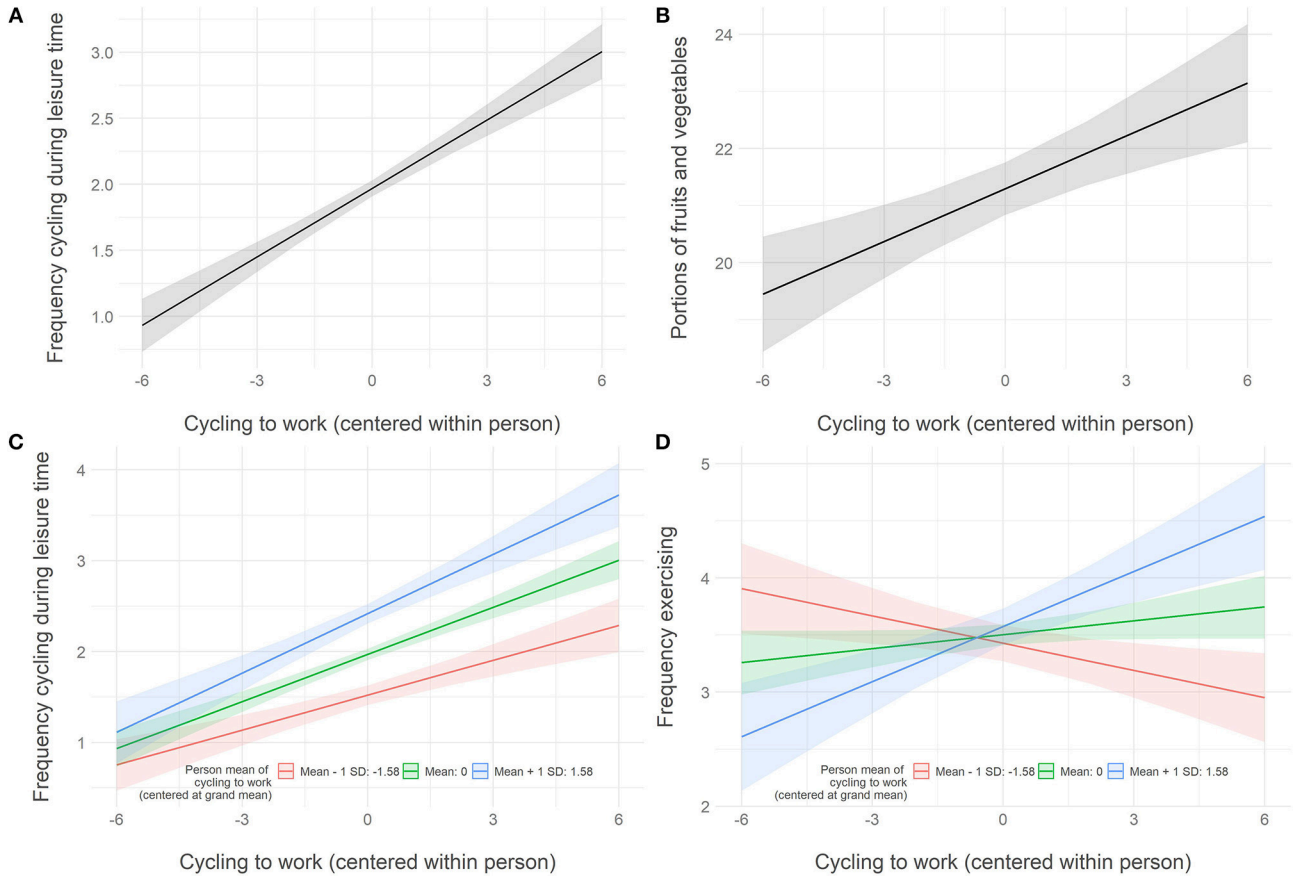

FIGURE 3 | (A,B) respectively show the frequency of cycling during leisure time and portions of fruits and vegetables eaten as a function of the frequency of cycling to work (centered within persons). **(C,D)** show the relationship between the frequency of cycling to work and, respectively, the frequency of cycling during leisure time **(C)** and the frequency of exercise **(D)** for three different levels of person means of cycling to work.

tested whether an intervention focusing on a specific behavior over a limited period of time (i.e., a subordinate goal) gives rise to negative spillover effects over time and across behaviors, and whether the formulation of a superordinate goal and/or action steps can hinder negative and foster positive spillover effects.

The campaign was successful in various aspects: Irrespective of the goal conditions, participants cycled to work more often at the end of the campaign than they did before the campaign. The increase in the cycling frequency was maintained up to 2 months after the campaign and thus the risk that the intervention effect will disappear immediately after the end of the intervention was not confirmed. While the results indicate that focusing on a superordinate goal increased the intervention effect measured at the end of the campaign, no effect of the goal manipulation was observed regarding the maintenance of the intervention effect over time. An increase in cycling to work spilled over across socio-spatial contexts to an increase in cycling in leisure time, and across behavioral domains to an increase in eating fruits and vegetables, which does not confirm the risk of negative spillover across behaviors. However, counter to our expectations, the goal manipulation did not yield any effect on the direction or size of the spillover effects across behaviors.

Spillover Effects in the Field

Embedding the present study in an existing large-scale campaign allows for an experimental design that enables the investigation of spillover effects in the field. Thus, the results of this study provide several insights on spillover effects across time and across behaviors in field settings. To start with, the overall increase in cycling to work compared to baseline for up to 2 months after the end of the campaign somewhat reduces the concern that the effect of a time-limited intervention will only last as long as the intervention itself (Jeffery et al., 2000; Geller, 2002; Lally and Gardner, 2013). Nevertheless, 2 months is a short period, and the decline in the intervention effect back to the initial level 3 months after the end of the campaign indicates that the participants did not change their behavior sustainably in the long-run (Lally and Gardner, 2013).

Furthermore, the evidence emerging from this study does not support the concern of negative spillover effect in field studies that could potentially nullify or even reverse the intervention effect on the targeted behavior, but corroborates earlier findings suggesting that behavior can, under certain circumstances, positively spill over from one behavior to other related behaviors (e.g., Lanzini and Thøgersen, 2014; Chatelain et al., 2018). The

TABLE 5 | Application of multilevel growth models examining the effect of goal type on several spillover behaviors.

		Fixed					Random		
Predictor	**Coef.**	***b***	**SE**	**df**	***t***	**95% CI**	**Coef.**	**SD**	**Slopes < 0**
Model 7: LEISURE CYCLING									
Intercept	β_{00}	2.24	0.08	1195.92	29.79***	2.10 to 2.38	r_{0i}	11.08	
Baseline cycling leisure (cgm)	β_{01}	0.63	0.02	1174.62	35.42***	0.60 to 0.67			
Combined goal hierarchy	β_{02}	0.02	0.11	1189.82	0.2	−0.18 to 0.23			
Superordinate goal	β_{03}	0.02	0.11	1200.28	0.2	−0.18 to 0.24			
Action step	β_{04}	0.00	0.11	1190.28	0.04	−0.19 to 0.21			
Time	β_{10}	−0.14	0.02	963.20	−8.56***	−0.17 to −0.11	r_{1i}	0.12	87.8%
Combined goal hierarchy: time	β_{11}	0.00	0.02	944.15	−0.1	−0.05 to 0.04			
Superordinate goal: time	β_{12}	0.02	0.02	955.05	0.98	−0.02 to 0.07			
Action step: time	β_{13}	0.01	0.02	957.81	0.42	−0.03 to 0.06			
MODEL 8: EXERCISE									
Intercept	β_{00}	3.63	0.1	1203.59	34.95***	3.42 to 3.85	r_{0i}	1.50	
Baseline exercise (cgm)	β_{01}	0.54	0.02	1190.65	28.06***	0.50 to 0.58			
Combined goal hierarchy	β_{02}	−0.09	0.15	1199.31	−0.62	−0.37 to 0.20			
Superordinate goal	β_{03}	−0.12	0.15	1208.39	−0.82	−0.42 to 0.18			
Action step	β_{04}	0.16	0.15	1199.12	1.09	−0.12 to 0.47			
Time	β_{10}	−0.04	0.02	943.45	−1.74	−0.08 to −0.01	r_{1i}	0.15	60.3%
Combined goal hierarchy: time	β_{11}	0.01	0.03	925.38	0.26	−0.05 to 0.07			
Superordinate goal: time	β_{12}	−0.03	0.03	935.85	−0.81	−0.09 to 0.03			
Action step: time	β_{13}	−0.04	0.03	938.55	−1.21	−0.10 to 0.02			
MODEL 9: FRUITS AND VEGETABLES									
Intercept	β_{00}	21.81	0.51	1155.92	43.03***	20.75 to 22.89	r_{0i}	7.74	
Baseline fruits and vegetables (cgm)	β_{01}	0.48	0.02	1155.09	27.89***	0.44 to 0.51			
Combined goal hierarchy	β_{02}	0.09	0.73	1149.31	0.13	−1.24 to 1.56			
Superordinate goal	β_{03}	0.61	0.73	1155.91	0.84	−0.86 to 2.01			
Action step	β_{04}	−0.51	0.73	1153.15	−0.70	−1.95 to 0.88			
Time	β_{10}	−0.21	0.09	886.11	−2.30*	−0.38 to −0.02	r_{1i}	0.63	62.9%
Combined goal hierarchy: time	β_{11}	−0.03	0.13	858.59	−0.27	−0.29 to 0.21			
Superordinate goal: time	β_{12}	−0.12	0.13	867.12	−0.94	−0.35 to 0.13			
Action step: time	β_{13}	−0.17	0.13	874.78	−1.29	−0.43 to 0.11			
MODEL 10: SNACKS AND SWEETS									
Intercept	β_{00}	3.07	0.26	1309.71	11.99***	2.55 to 3.58	r_{0i}	3.26	
Baseline snacks and sweets (cgm)	β_{01}	0.51	0.02	1175.19	31.10***	0.48 to 0.54			
Combined goal hierarchy	β_{02}	−0.27	0.33	1197.31	−0.81	−0.92 to 0.41			
Superordinate goal	β_{03}	0.06	0.33	1204.77	0.19	−0.61 to 0.70			
Action step	β_{04}	−0.46	0.33	1201.48	−1.40	−1.13 to 0.22			
Time	β_{10}	0.03	0.05	930.61	0.64	−0.06 to 0.13	r_{1i}	0.33	46.6%
Combined goal hierarchy: time	β_{11}	−0.13	0.07	907.91	−1.93	−0.27 to 0.00			
Superordinate goal: time	β_{12}	−0.09	0.07	915.85	−1.33	−0.23 to 0.05			
Action step: time	β_{13}	−0.02	0.07	921.19	−0.33	−0.16 to 0.11			

*Coef. = coefficient in corresponding model equation; b = unstandardized regression coefficient; slopes < 0 = percentage of random slopes that were estimated to be negative (calculated on the basis of the assumption of normally distributed random slopes; see Hox, 2010, p. 19); $N_{occasions}$ = 6345, $N_{persons}$ = 1269. All baseline measurements as well as the person means of cycling to work were centered at the grand mean. p < 0.1, *p < 0.05, **p < 0.01, ***p < 0.001.*

observed spillover effects are not very strong, although small effect sizes are not unusual in the context of spillover (see Blanken et al., 2015). However, the results show no consistent positive spillover effect across all observed behaviors, suggesting that the occurrence of spillover effects depends on certain attributes of the observed behaviors. There are at least two relevant attributes in this respect: similarity between and cost of the behaviors. Spillover effects—negative and positive—are more likely to occur between similar behaviors (Truelove et al., 2014). Similarity may be with respect to the behavioral domain but also to the cost and effort or frequency of performance, to the symbolic meaning of the behavior, or to how the behavior is performed (Lanzini and

Thøgersen, 2014). This is consistent with our finding that an increase in cycling to work positively spills over to an increase in cycling in leisure time. Furthermore, earlier findings suggest that individuals are more likely to adopt new behaviors that are not costly, and spillover is more likely to impact low-cost than high-cost behavior, where cost in the broad sense can refer to any kind of expenditure (e.g., money, time, physical strength, attention) (Lanzini and Thøgersen, 2014). This line of research may explain why, in the present study, an increase in cycling to work positively spilled over to healthy eating but not to unhealthy eating and exercising. It can be hypothesized that the costliness and effort of the specific spillover accounts for the observed effects: Performing an additional workout requires more time and physical effort than eating an additional apple. As spillover is more likely to impact low-cost than high-cost behavior, an increase in cycling to work is more likely to spillover to eating more fruits and vegetables, which requires relatively low effort, and less likely to spillover to exercising, which requires relatively high effort. Furthermore, a decrease in eating sweets and snacks can be seen as resisting a temptation. Temptations offer an immediate outcome which exerts a strong motivational pull (Fishbach et al., 2003) and thus often stand in conflict with goals that are higher in importance but whose outcomes are less salient and further away (Cavallo and Fitzsimons, 2012). Resisting temptation is difficult and requires high effort and willpower (Gollwitzer et al., 2010). If eating sweets and snacks is considered a temptation, observing no spillover effect is consistent with earlier results suggesting that spillover is less likely to impact high effort behaviors.

Finally, the results show the relevant role of moderating variables in the occurrence of spillover effects—namely, the average frequency of conducting the targeted behavior. While the positive spillover effect of *cycling to work* to *cycling in leisure time* was greater for people who, on average, cycled more frequently to work, the spillover effect on exercising was even reversed depending on the average frequency of cycling to work. Alternatively, the spillover effect was positive for those who, on average, cycled more frequently to work, and it was negative for those who cycled less often to work. This gives us the first indication of the possible risk of compensatory behavior: for people who conduct a target behavior infrequently, an increase in the target behavior could lead to a reduction in the associated behavior (for a similar reasoning, see Brügger and Höchli, submitted).

The Role of a Goal Theoretical Perspective in Spillover Effects

While some results indicate that focusing on a superordinate goal as well as a subordinate goal reinforces the positive intervention effect, there was no consistent positive impact of the goal manipulation—both superordinate goals and/or action steps—on spillover effects.

The lack of effect of action steps on cycling to work does not support previous results. The effect of action steps has been widely studied and shows positive effects on goal pursuit across various domains (see for example research on implementation intentions, Gollwitzer and Sheeran, 2006). While the focus of this technique is mainly on initiating behaviors (e.g., Gollwitzer, 1999; Brandstätter et al., 2001), there are also some studies that highlight the advantage of implementation intentions for maintaining behavior over time, especially in combination with further self-regulatory measures such as mental contrasting (e.g., Stadler et al., 2010; Oettingen, 2012; Duckworth et al., 2013). However, our results show no effect of formulating action steps on cycling to work during the bike-to-work campaign as well as up to 7 months after the campaign. We can speculate that many people participating in the bike-to-work campaign already cycled before the campaign started and some of them may have already developed the habit of cycling to work. Some evidence for this explanation comes from research on implementation intentions: Implementation intentions are shown to have a strong effect on adopting a new behavior (Gollwitzer and Sheeran, 2006) or breaking old unwanted habits and developing new ones (Adriaanse et al., 2010; Osbaldiston and Schott, 2012). However, the effect of implementation intentions to reinforce or strengthen an already existing habit might be much smaller and could explain the lack of effect of implementation intentions on cycling to work.

Focusing on a superordinate goal in addition to the subordinate goal also did not show any effect on cycling to work. Based on a goal theoretical perspective, we expected that adding a superordinate goal would foster cycling to work over time as well as generate positive spillover effects across socio-spatial contexts (cycling in leisure time) and across different behavioral domains (exercising and eating). Compared to action steps and implementation intentions, very little research has dealt with the idea that focusing on superordinate goals could maintain the motivation to work toward a goal. To our knowledge, only one study has empirically tested the effect of focusing on superordinate goals when faced with repeated goal-relevant decisions (Fishbach et al., 2006). Thereby, four studies revealed a consistent pattern showing that activating a superordinate goal increased the tendency to act goal-consistent; that is, to make two decisions that both contribute to achieving the shared superordinate goal. These results indicate that focusing on a superordinate goal leads to a longer maintenance of the positive intervention effect, which is not consistent with our results. Importantly, though, whereas Fishbach's study was conducted in a laboratory setting, our study was a large field study. As such, the present findings complement previous research and show the need for further research highlighting possible mechanisms that could lead to the expected effect in a laboratory setting but not in a field study.

Furthermore, adding a focus on a superordinate goal did not influence spillover effects across behaviors. This result also does not support earlier results from similar streams of research, such as research on the effect of social identity on spillover effects. In the environmental domain for example, focusing on or highlighting a pro-environmental identity increases the likelihood of acting in a pro-environmental way and fosters positive spillover effects across different pro-environmental behaviors (Cornelissen et al., 2013; Van der Werff et al., 2014). In the present study, participants who formulated a superordinate goal were asked to think about why cycling to work is important

to them and to derive a personal goal starting with "I want to be a person who…," which highlights the proximity and conceptual similarity of a superordinate goal and social identities (Oyserman and James, 2011; Van der Werff et al., 2014) and would suggest a positive effect of superordinate goals on spillover effects that was not observed. However, it cannot be ruled out that people in the control condition or in the action step condition may not think of a superordinate goal on their own. Goals at different hierarchical levels are associated with each other (Kruglanski et al., 2002). Depending on the association strength, the activation of a subordinate goal can activate an associated superordinate goal. By thinking about the subordinate goal of cycling to work, a connected superordinate may become accessible, without deliberately undergoing a goal manipulation and explicitly activating it. This assumption is further corroborated by a more recent stream of research that states that goals can guide behavior outside of a person's awareness (e.g., Custers et al., 2012). Contextual stimuli such as priming are shown to activate goals unconsciously and guide behavior (Aarts and Dijksterhuis, 2000; Fishbach et al., 2006). Thus, cycling to work or reporting one's cycling effort could unconsciously activate related superordinate goals. The impossibility of experimentally excluding the activation of superordinate goals in the control condition or action step condition may be one reason why no differences between the four conditions on cycling to work and possible spillover effects could be observed.

The lack of the expected spillover effects over time and across behaviors through the goal formulation—action steps, superordinate goals and the combination of them—could further indicate that the present experimental design is only partially suitable for demonstrating the effects of the goal manipulation. First, no negative spillover effects and even positive spillover effects in some behaviors were observed across all experimental groups. This shows that the original campaign has already succeeded in bringing about a positive change in behavior without any additional interventions. While these results shed a good light on the campaign, however, it is a difficult starting point for identifying possible effects of additional intervention groups, which are expected to prevent negative spillover effects and foster positive spillover effects. Second, the goal formulation might have been too weak. The bike-to-work campaign is well-known in Switzerland and the goal of the campaign—to cycle to work at least half of the working days—is in the foreground of the campaign.[2] It can be hypothesized that an additional superordinate goal or action steps might therefore have little influence in the context of the existing campaign. This assumption is supported by the self-perception theory (Bem, 1972), according to which people infer attitudes from observing their own behavior which then affects their behavior. Participants of the bike-to-work campaign were advised to report their cycling every day during the campaign. This means that the participants considered their cycling behavior on a daily basis. According to the self-perception theory, this promotes cycling behavior independent of the goal manipulation, which could lead to a suppression of the effect of the goal manipulation and thus explain the lack thereof. Finally, it cannot be ruled out that different processes influence the effect on cycling to work and on related behaviors, with different goals triggering different processes (Höchli et al., 2018). For example, subordinate goals may increase self-efficacy which fosters goal pursuit (Bandura, 1997) but run the risk of decreased motivation after achieving a first subordinate goals (Amir and Ariely, 2008), while superordinate goals may increase commitment (Boudrenghien et al., 2013) but may be too vague to be motivating in the moment (Locke and Latham, 2002). It is possible that these processes contradict each other and cancel each other out, and therefore no direct effect of the goal manipulation is visible.

Limitations

This study has a number of limitations that should be addressed. First, the sample of the study might be biased due to self-selection. Voluntary participation in the bike-to-work campaign already indicates an affinity for cycling compared to the total population. The willingness of the participants to participate in the present study, in addition to taking part in the bike-to-work campaign, results in a sample with highly motivated participants who likely show higher commitment and willingness to cycle to work compared to the other participants in the bike-to-work campaign who did not take part in the present study, and to the general population. However, in this study, it was not possible to compare commitment or behavior to a control group that did not participate in the campaign, as the sample consists exclusively of participants in the bike-to-work campaign. To assess the effect of the campaign more comprehensively, it would be necessary to both (1) look at within-person variance comparing the frequency of cycling to work of a person to his or her baseline level and (2) compared it to a control group not taking part in the campaign.

A second limitation of this study is that self-reporting behaviors leads to several known errors and biases, such as erroneous beliefs about one's behavior or social desirability bias (e.g., Chao and Lam, 2011; Kormos and Gifford, 2014). This shows the need to replicate the results in additional studies that are not based on self-reports. In addition, several longitudinal measurements (the self-reported frequency of cycling to work, cycling in leisure time, and exercising) in this study consisted of single item indicators (frequency of activity per week). It is generally accepted that, in many cases, short measurement instruments are inferior to multi-item measurement instruments, especially as there is no easy statistical way to determine (and report on) their reliability (Diamantopoulos et al., 2012; Postmes et al., 2013). Nevertheless, in this study we deliberately opted for single item measurements for the longitudinal frequency measurements. First, we made this decision for pragmatic reasons: Due to the high number of repeated measurements in this study, we have kept the number of questions as low as possible in order to keep the participant effort at an acceptable level throughout the study (Robins et al., 2001). Secondly, we also opted for single item measurements from a conceptual point of view: Single item measures and short scales can achieve a satisfactory level of reliability when they evaluate homogeneous and clearly defined concepts (Loo and Kelts, 1998; Postmes et al., 2013). The measurement of the frequency of

[2]https://www.biketowork.ch/en/

the performance of an activity in a given limited time period seems to be sufficiently homogeneous to be operationalized with a single element. The use of single item measures is further supported by encouraging results from recent research that investigated the comparative reliability and validity of individual items and multi-item measures (Gogol et al., 2014). Having said this, we encourage further research into the behavior of interest using reliable and valid multi-item measurements to identify and complement any weaknesses in the measurement. When undergoing the goal manipulation, the participants of this study formulated their own superordinate goals; this could be seen as a third limitation because it does not allow control over the exact content and behavioral context of the goals. According to the goal systems theory, a superordinate goal is interconnected with several distinct behaviors and vice versa: a behavior can be interconnected with multiple superordinate goals (Kruglanski et al., 2002). Cycling to work, for example, could be connected to the superordinate goal of living a healthy life, but could also be connected to an environmental goal (e.g., leading an environmentally friendly life) or social goal (e.g., being a person who cultivates social contacts). For this reason, it is difficult to make clear predictions as to what extent different behaviors or subordinate goals are related to each other and thus between which behaviors spillover effects are most likely to be expected. When a person focuses on a superordinate goal in the health domain, a spillover effect on healthy eating requires a different interpretation than when a person focuses on a superordinate goal in the environmental domain. In order to avoid this uncertainty, it would be possible to avoid individual formulations of superordinate goals by the participants by setting the same superordinate goal for all participants in the design of the study. But we decided against this course of action due to the personal nature of superordinate goals; these goals describes who a person is trying to be and thus is a central aspect of a person's identity (e.g., Emmons, 1989, 2005; Carver and Scheier, 2001). And as such, it is highly unlikely that a superordinate goal imposed by the intervention design would meet these criteria for all participants.

Finally, no special attention was paid to seasonal effects on the study even though it is colder, rainier, and snowier in Switzerland during the winter. That said, this seasonal change occurs across Switzerland during the winter, and weather and road conditions varied in a similar way for all participants. This is clearly visible in that the entire sample, regardless of the condition, cycled to work significantly less frequently in winter than they did in the baseline measurement in spring. Because data from the different experimental conditions were examined in parallel, it is unlikely that the seasonal variations differentially affected our central research questions. However, when it comes to investigating the main reasons and obstacles which encourage or hinder cycling, weather and seasonal effects as well as conditions for adapting bicycle use, such as road conditions, the presence of cycle paths, distance to the workplace or elevation of terrain, must certainly be considered. Furthermore, in order to investigate the influence of different goal formulations on behavior over time, it would be interesting to observe how cycling behavior develops in the spring and summer following the study. More specifically, it would be interesting to investigate whether the goal manipulation affects the time, extent and intensity that participants start cycling after a winter break.

Future Research

While the present study sheds light on the effect of interventions in the field over time and across behaviors, most research on spillover effects is still based on correlational studies or laboratory studies with small sample sizes. This makes it difficult to draw causal inferences regarding the effect of an intervention over time and across different behaviors and thus to derive relevant implications for the design of environmental policy. We therefore encourage further experimental field studies (e.g., randomized controlled trials) to achieve a comprehensive understanding of the net effect of an intervention in the field after accounting for possible spillover effects.

The observed positive spillover effects on some behaviors, but not on others, lead to the same conclusion as the inconsistent results on the direction and size of spillover effects from earlier research: In order to understand spillover effects, it is indispensable to examine processes and boundary conditions regarding the effects studied. This concerns both the behavior targeted by an intervention and the behaviors to which a change in the targeted behavior could spill over. More research is needed to understand why spillover effects are more or less likely to occur across some behaviors than others, and to understand the types of behaviors that may be valuable targets for policy interventions after accounting for spillover effects (Dietz et al., 2009; Truelove et al., 2014). The similarity between behaviors and the effort and cost necessary to perform the behavior, or the interconnection with an underlying superordinate goal that relates different behaviors to each other, are promising starting points to shed light on this matter.

Furthermore, our results show that participants with a higher level of individual means of cycling to work showed a slightly larger spillover effect on cycling in leisure time and on exercising than participants with a lower level. This suggests that the existence and size of spillover effects may depend on the frequency or intensity of the targeted behavior prior to intervention. We suggest further research that looks at different levels of expertise, frequency of performance or existing habits regarding the behavior targeted by the intervention. Since many large-scale interventions, such as the bike-to-work campaign, are aimed at a wide range of participants with different starting situations, we expect such insights to be of great practical relevance for policy makers and intervention designers.

Finally, this study shows some evidence that focusing on a superordinate goal in addition to a subordinate goal can increase the positive intervention effect. This suggests that, despite the lack of a clear positive effect in the present studies, a goal theoretical perspective could be a valuable approach to increasing the effectiveness of future interventions. Due to several limitations of the present study—for example, that the control group also participated in the campaign, and that the goal manipulation was carried out within the framework of a campaign with a prevailing and widely known campaign goal—we recommend further experimental studies that highlight the role of superordinate goals and action steps in interventions.

CONCLUSION

The present experimental field study reduces the concern that an intervention focusing on a specific behavior over a limited period of time (i.e., a subordinate goal) gives rise to negative spillover effects over time and across behaviors that could nullify or even reverse the intended intervention effect. In addition, the study shows that positive spillover over time and across behaviors is possible, but does not occur consistently, indicating that several additional factors such as the similarity or cost of a behavior or the pre-intervention behavior also affect the presence and size of spillover effects. Although the observed positive spillover effects over time and across behavior cannot be traced back to the goal manipulation, the results give first indications that an additional focus on a superordinate goal can reinforce the intervention effect.

The results show the need for further experimental field research to shed light on the boundary conditions and processes by which positive spillover effects occur, and on the role of a goal theoretical perspective to increase the effectiveness of behavioral change interventions.

DATA AVAILABILITY

The dataset and R code for this study can be found in the open science framework: https://osf.io/rx9bu/?view_only=e0daaebafb5d44418891216488b3e446.

ETHICS STATEMENT

This study was carried out as part of a larger research project in accordance with the recommendations of the Federal Act on Research involving Human Beings (Human Research Act, HRA) of the Swiss Confederation. The research project was approved by the ethics committee of the canton of Bern, member of the Swiss Ethics Committee on research involving humans.

AUTHOR CONTRIBUTIONS

BH, AB, and CM jointly developed the ideas in the paper. BH collected the data. RA merged and prepared the data set. BH and RA analyzed the data. BH wrote the paper. AB and CM read the paper and provided feedback on several drafts of the paper.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyg.2019.00433/full#supplementary-material

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REVIEW
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How to Measure Behavioral Spillovers: A Methodological Review and Checklist

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A growing stream of literature at the interface between economics and psychology is currently investigating 'behavioral spillovers' in (and across) different domains, including health, environmental, and pro-social behaviors. A variety of empirical methods have been used to measure behavioral spillovers to date, from qualitative self-reports to statistical/econometric analyses, from online and lab experiments to field experiments. The aim of this paper is to critically review the main experimental and non-experimental methods to measure behavioral spillovers to date, and to discuss their methodological strengths and weaknesses. A consensus mixed-method approach is then discussed which uses between-subjects randomization and behavioral observations together with qualitative self-reports in a longitudinal design in order to follow up subjects over time. In particular, participants to an experiment are randomly assigned to a treatment group where a behavioral intervention takes place to target behavior 1, or to a control group where behavior 1 takes place absent any behavioral intervention. A behavioral spillover is empirically identified as the effect of the behavioral intervention in the treatment group on a subsequent, not targeted, behavior 2, compared to the corresponding change in behavior 2 in the control group. Unexpected spillovers and additional insights (e.g., drivers, barriers, mechanisms) are elicited through analysis of qualitative data. In the spirit of the pre-analysis plan, a systematic checklist is finally proposed to guide researchers and policy-makers through the main stages and features of the study design in order to rigorously test and identify behavioral spillovers, and to favor transparency, replicability, and meta-analysis of studies.

Keywords: spillovers, mixed-methods, experimental design, lab-field experiments, behavioral spillovers

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INTRODUCTION

What Does Spillover Offer?

Academic and policy interest in 'behavioral spillover' has grown considerably in recent years (e.g., Austin et al., 2011; Truelove et al., 2014; Nilsson et al., 2016). Spillover is where the adoption of one behavior causes the adoption of additional, related behaviors. As we discuss below, we assume that the initial behavior change is due to an intervention, although other definitions of behavioral spillovers do not assume this (Nash et al., 2017). From a policy or practitioner perspective, the notion of behavioral spillover is attractive because it appears to hold the promise of changing a suite of behaviors in a cost-effective manner with little regulation which might be politically unpopular. For many pressing social issues, such as climate change or obesity, spillover is thus a promising method of achieving the scale of lifestyle change required to address these, in contrast to the typically

small-scale behavioral changes achieved from most individually focussed interventions (Capstick et al., 2014). From an academic perspective, spillover is intriguing because it sheds new light on the process of lifestyle change: rather than examining behavior change from the perspective of individual behaviors in isolation, spillover draws attention to the holistic relationships between behaviors within and between contexts, and hence refocus the researchers' perspective on the complex behavioral ecologies that represent lifestyles (Geller, 2001; Schatzki, 2010).

A variety of empirical methods have been used to measure behavioral spillovers to date, from qualitative self-reports to statistical/econometric analyses, from online and lab experiments to field experiments. Detecting spillover has often proved challenging, and there is a need for both conceptual and methodological clarity in order to move the field forward. The aim of this paper is to critically review the main experimental and non-experimental methods to measure behavioral spillovers to date, and to discuss their methodological strengths and weaknesses. A consensus mixed-method approach is then discussed which uses between-subjects randomization and behavioral observations together with qualitative self-reports in a longitudinal design in order to follow up subjects over time. We conclude by proposing a systematic checklist to guide researchers and policy-makers through the main stages and features of the study design in order to rigorously test and identify behavioral spillovers, and to favor transparency, replicability, and meta-analysis of studies.

Definition of Behavioral Spillover

The term 'spillover' has been applied to a wide variety of phenomena, including the spread of knowledge, attitudes, roles/identities, or behaviors from a given domain (e.g., health, environment, care-giving), group, or location, to a different domain, group or location (e.g., Geller, 2001; Poortinga et al., 2013; Littleford et al., 2014; Rodriguez-Muñoz et al., 2014; Poroli and Huang, 2018). The main appeal of such broad definition of behavioral spillover is that it encompasses a rich variety of spillover effects at both a micro and a macro level which are of key interest for policy and practice purposes, such as cross-domains, inter-personal, and cross-regional spillover effects of phenomena and interventions. However, the processes underpinning these diverse effects are highly heterogeneous, ranging from cognition (e.g., learning, problem-solving) and self-regulation, through interpersonal effects (e.g., modeling, contagion) to individual behavior change, and there is little these processes have in common besides the idea of (often unanticipated) diffusion of some effect.

In what follows, we assume a narrower and more specific definition of behavioral spillover that matches more closely the methodological approach that we have in mind. In particular, behavioral spillover can be defined as the observable and causal effect that a change in one behavior (behavior 1) has on a different, subsequent behavior (behavior 2). More specifically, to constitute behavioral spillover, the two behaviors must be different (i.e., not related components of a single behavior), sequential (i.e., behavior 2 follows behavior 1), and sharing, at a conscious or unconscious way, an underlying motive (i.e., an overarching goal or a 'deep preference,' such as, for example, pro-environmentalism or a healthy life) (Dolan and Galizzi, 2015; Nash et al., 2017). This concept of spillover has been examined in relation to different domains (safety, environment, health, finances, etc.) for some decades, although these effects have previously been labeled in diverse ways, including 'response generalization' (Ludwig and Geller, 1997; Geller, 2001), 'the foot in the door effect' (Freedman and Fraser, 1966; Beaman et al., 1983), and 'moral licensing' (Blanken et al., 2015; Mullen and Monin, 2016). We have conducted a systematic review of the literature (see **Appendix** for full details) and found that a total of 106 studies to date have used the above, more specific, definition of behavioral spillovers.[1]

Behavioral spillovers can be categorized as 'promoting,' 'permitting,' 'purging,' or 'precipitating,' as illustrated in **Table 1**.

Other real world examples from environmental behavior are whether a behavioral intervention to monetarily incentivize household waste separation has a significant effect not just on waste separation (behavior 1), but also on green shopping, traveling, and support to environmental policies (behavior 2), for instance (Xu et al., 2018a); or whether an intervention to restrict irrigation has a significant impact not just on water conservation (behavior 1), but also on recycling behavior (behavior 2), for example (Sintov et al., 2019).

The mechanisms thought to explain promoting or positive spillovers vary by discipline and theoretical framework. Psychological approaches have focussed particularly on two mechanisms: (a) self-perception, identity, or preference for consistency (behavior 1 changes how one sees oneself and the desire to act consistently with that self-image leads to behavior 2) and (b) self-efficacy, knowledge, or self-motivation/empowerment (satisfactorily undertaking

[1]These 106 studies are: Bratt (1999), Thøgersen (1999), Hertwich (2005), Karremans et al. (2005), Cornelissen et al. (2008), Hecht and Boies (2009), Sorrell et al. (2009), Zimmerman (2009), Savikhin (2010), Sheremeta et al. (2010), Dickinson and Oxoby (2011), Nolan (2011), Bednar et al. (2012, 2015), Cason et al. (2012), Thøgersen and Noblet (2012), Xanthopoulou and Papagiannidis (2012), Alpizar et al. (2013a,b), Baca-Motes et al. (2013), Cason and Gangadharan (2013), Falk et al. (2013), Godoy et al. (2013), Juvina et al. (2013), Norden (2013), Poortinga et al. (2013), Savikhin and Sheremeta (2013), Swim and Bloodhart (2013), Tiefenbeck et al. (2013), Bech-Larsen and Kazbare (2014), Dolan and Galizzi (2014, 2015), Lanzini and Thøgersen (2014), Littleford et al. (2014), Spence et al. (2014), Tiefenbeck (2014), Truelove et al. (2014, 2016), Van der Werff et al. (2014a,b), Goswami and Urminsky (2015), Kaida and Kaida (2015), Karmarkar and Bollinger (2015), Lacasse (2015, 2016, 2017), Schütte and Gregory-Smith (2015), Steinhorst et al. (2015), Zawadzki (2015), Banerjee (2016), Dittmer and Blazejewski (2016), Eby (2016), Gholamzadehmir (2016), Ha and Kwon (2016), Lauren et al. (2016, 2017), Margetts and Kashima (2016), Nilsson et al. (2016), Polizzi di Sorrentino et al. (2016), Steinhorst and Matthies (2016), Suffolk (2016), Suffolk and Poortinga (2016), Thomas et al. (2016, 2019), Carpenter and Lawler (2017), Carrico et al. (2017), Crookes (2017), Fenger (2017), Galbiati et al. (2017), Hedrick et al. (2017), Jessoe et al. (2017), Juhl et al. (2017), Kesternich et al. (2017), Klein (2017), Krieg and Samek (2017), McCoy and Lyons (2017), Nash et al. (2017, 2019), Werfel (2017), Xie et al. (2017), Angelovski et al. (2018), Bednar and Page (2018), Chatelain et al. (2018), Claes and Miliute-Plepiene (2018), Dutschke et al. (2018), Ghesla et al. (2018), Lawler (2018), Liu et al. (2018), Panos (2018), Peters et al. (2018), Santarius and Soland (2018), Schmitz (2018), Seebauer (2018), Shreedhar (2018), Shreedhar and Mourato (2018), Tippet (2018), Vasan (2018), Verfuerth and Gregory-Smith (2018), Vincent and Koessler (2018), Whitmarsh et al. (2018), Xu et al. (2018a,b), Capstick et al. (2019), Fanghella et al. (2019), Krpan et al. (2019), Sintov et al. (2019).

TABLE 1 | Types of behavioral spillovers (adapted from Dolan and Galizzi, 2015: no copyright permissions are required for the reproduction of this table): examples from health behavior.

		Behavior 2	
Behavior 1		***Eat healthily***	***Eat less healthily***
	A run after work	**Promoting**	**Permitting**
		I ran an hour, let's keep up the good work	I ran an hour, I deserve a big slice of cake
	Sofa-sitting after work	**Purging**	**Precipitating**
		I've been lazy today, best not eat so much tonight	I've been lazy today, so, what the heck, let's have a big slice of cake

behavior 1 increases confidence and perceived efficacy of action, motivating change in behavior 2; Nash et al., 2017). Permitting or negative spillovers have been typically explained in terms of moral licensing, whereby a virtuous initial behavior licenses or 'permits' a second indulgent or morally questionable behavior, or by a contribution ethic whereby an initial behavior justifies subsequent inaction (e.g., Thøgersen, 1999; Karmarkar and Bollinger, 2015). Rebound effects are a related phenomenon, studied more from an economic than psychological perspective, and describe increased energy consumption due to technical efficiency gains, thereby offsetting energy savings achieved (e.g., Sorrell et al., 2009).

Evidence for spillover remains somewhat mixed, with some studies finding effects under certain conditions that are not replicated in other studies (Nash et al., 2017). Conceptually, spillover remains defined and explained in a variety of ways, and there remain considerable gaps in understanding (e.g., the role of social processes, such as norms, in spillover; Nash et al., 2017). Methodologically, there is also no coherent approach to researching spillover, which may in part explain the mixed and inconsistent empirical results, and critically highlights a need to improve the rigor and transparency of spillover research.

Overview of Spillover Research Methods and Measurement

A growing stream of the literature at the interface between economics and psychology is currently investigating 'behavioral spillovers' in (and across) different domains, including health, environmental, and pro-social behaviors. To date, there have been a variety of methods applied to studying spillover (see **Table 2**). These range from qualitative retrospective self-reports using biographical interviews (e.g., Nash et al., 2019) to controlled laboratory experiments with randomization to condition (e.g., Van der Werff et al., 2014a,b). Each approach offers different strengths and weaknesses. For example, qualitative approaches are able to elucidate unexpected spillovers and additional insights (e.g., drivers, barriers, mechanisms) not anticipated or measured in quantitative approaches. On the other hand, quantitative approaches allow for more measurement standardization and potentially for generalization, as well as affording insights into factors shaping behavior that individuals may be unable or unwilling to reflect on consciously through self-report.

Measurement of spillover has been undertaken in a variety of ways that reflect the range of methods used. Qualitative approaches tend to rely on self-reported accounts of behavior change; whereas quantitative approaches may use self-reports or observations of behavior. A key weakness in the literature to date, has been a reliance on self-reported behavior, which is known to be only weakly correlated with actual behavior (e.g., Kormos and Gifford, 2014). Furthermore, several studies claiming to find spillover have found change in behavioral intentions or attitudes following an initial behavior change, which is not strictly spillover (Van der Werff et al., 2014a). Few studies also conduct follow-up measurements, so the durability of any immediate spillover effects is unknown. There has also been a reliance on correlational or longitudinal designs which are unable to shed light on causal processes; and within longitudinal designs approaches differ in how to detect spillover (Capstick et al., submitted). Finally, there have also been few attempts to bring together quantitative and qualitative approaches, thus providing complementary insights and addressing respective weaknesses in approaches (Creswell, 2014). In the following section, we describe how spillover should be measured in experimental and non-experimental approaches that seeks to build on this literature and address limitations in the methods used to date.

MEASURING SPILLOVER

We now turn from our observations of previous spillover research to a discussion of how we propose spillover research should ideally be conducted in order to reliably detect any spillover effects and expose mechanisms through which they may operate. Drawing on best practice in research design and reflecting principles of transparency and validity (e.g., Open Science Collaboration, 2015), we first discuss experimental studies, which elucidate causal mechanisms, and then non-experimental approaches, which afford other insights into spillover, as discussed above.

How to Measure Behavioral Spillover: Experimental Studies

Rigorously designing and implementing randomized controlled experiments allows the researchers to obtain an unbiased estimate of the average treatment effect of a behavioral intervention (e.g., a 'nudge,' a monetary or non-monetary incentive, a 'boost' or 'prime'). Because of sample selection bias, it is only by randomly assigning subjects to a treatment or to a control group that the researchers can identify the causal effect of a behavioral intervention on an observed outcome (Heckman, 1979; Burtless, 1995; Angrist and Pischke, 2009; List, 2011; Gerber and Green, 2012).

In practice, a variety of different randomized controlled experiments is available to researchers interested in testing behavioral spillovers. It is useful to refer here to the influential taxonomy of experiments in social sciences originally proposed by Harrison and List (2004): *conventional lab* experiments

TABLE 2 | Overview of methods used to research behavioral spillover: examples from environmental behavior.

Methodological approach	Data collection and analysis methods	Examples from environmental behavior	Strengths	Weaknesses
Qualitative	• Interviews or open-ended survey questions • Thematic, content, discourse (or similar) analysis • Self-reports or other (e.g., practitioner) accounts • Biographical (retrospective) or evaluative (during/immediately after intervention)	Austin et al., 2011; Boström et al., 2015; Nash et al., 2019; Uzzell and Räthzel, 2018	• Expose unexpected spillovers • Shed light on spillover mechanisms, drivers and barriers	• Risk of presentational bias • Partial or selective recollection • No measurement standardization
Quantitative (cross-sectional)	• Survey, card sort or secondary data analysis (e.g., retail data) • Cluster or factor analysis • Correlational analysis • Regression analysis	Thøgersen, 1999; Barr et al., 2010; Whitmarsh and O'Neill, 2010; Austin et al., 2011; Gabe-Thomas et al., 2016	• Quantify strength of relationships between measured behaviors • Measurement standardization	• No causal relationships identified • Limited to expected spillovers
Quantitative (longitudinal)	• Surveys at 2+ timepoints • Repeated measures analysis or multi-level modeling • Correlational analysis • Regression analysis (including time series, panel data, and difference-in-difference models)	Thøgersen and Noblet, 2012; Kaida and Kaida, 2015; Poortinga et al., 2013; Thomas et al., 2016.	• Quantify strength of relationships between measured behaviors • Measurement standardization	• No causal relationships identified • Limited to expected spillovers
Quantitative (experimental)	• Online, laboratory, or field experiments • Self-reported or observed behavior • Randomization to behavioral intervention • Analysis of variance • Regression analysis	Van der Werff et al., 2014a,b; Juhl et al., 2017.	• Causal relationships and mechanisms identified • Measurement standardization	• Limited to expected spillovers
Mixed-methods	• Combination of qualitative and quantitative methods (e.g., experiment and interviews)	Verfuerth, in preparation; Lede, in preparation.	As above	As above

involve student subjects, abstract framing, a lab context, and a set of imposed rules; *artefactual field* experiments depart from conventional lab experiments in that they involve non-student samples; *framed field* experiments add to artefactual field experiments a field context in the commodity, stakes, task or information; and, finally, *natural field* experiments depart from framed field experiments in that subjects undertake the tasks in their natural environment, and subjects do not know that they take part into an experiment. The main idea behind *natural field* experiments is that the mere act of observation and measurement necessarily alters what is being observed and measured. In key areas of interest for behavioral spillovers, such as health, the environment or pro-social behavior, for instance, there are potential *experimenter demand effects* (i.e., participants change behavior due to cues about what represents 'appropriate' behavior for the experimenter: Bardsley, 2005; Levitt and List, 2007a,b; Zizzo, 2010); *Hawthorne effects* (i.e., simply knowing they are part of a study makes participants feel important and improves their effort and performance: Franke and Kaul, 1978; Adair, 1984; Jones, 1992; Levitt and List, 2011); and *John Henry effects* (i.e., participants who perceive that they are in the control group exert greater effort because they treat the experiment like a competitive contest and they want to overcome the disadvantage of being in the control group: Campbell and Stanley, 1963; Cook and Campbell, 1979).

Other, more recent, typologies of randomized controlled experiments are *online experiments* (Horton et al., 2011) conducted, for instance, using Amazon's *Mechanical Turk* (*MTurk*) (Paolacci et al., 2010; Horton et al., 2011; Paolacci and Chandler, 2014); and *lab-field experiments* that consist of a first-stage intervention under controlled conditions (in the lab) linked to a naturalistic situation (in the field) where subjects are not aware that their behavior is actually observed. Lab-field experiments have been used to look at the unintended spillover effects of behavioral interventions in health (Dolan and Galizzi, 2014, 2015; Dolan et al., 2015), as well as at the spillover effects in terms of external validity of lab-based behavioral economics games of pro-social behavior (Galizzi and Navarro-Martinez, 2018).

Investigating experimentally the occurrence of behavioral spillover requires a mixed, longitudinal experimental design combining elements of between- and within-subjects design.

TABLE 3 | Experimental design and variables to test behavioral spillovers.

	Behavior 1	Behavior 2
Control group (C)	B1C	B2C
Treatment group (T)	B1T	B2T
Difference	ΔB1	ΔB2

Participants in an experiment are randomly allocated by the researcher either to a control group, or to (at least) one behavioral intervention group. In the control group (C), subjects are observed while they engage in a first behavior (behavior 1) and then in a different, subsequent, behavior (behavior 2). Each of the two subsequent behaviors is operationally captured and reflected into (at least) one corresponding outcome variable: B1 and B2. In practice, the choice of behavior 1 and behavior 2, as well as the choice of the corresponding outcome variables B1 and B2, is often based on theoretical expectations, previous literature, or qualitative evidence. It is also based on other, more pragmatic, considerations related, for example, to the ease of observing some specific positive or negative spillovers in the lab or the field, and to the ethical and logistical acceptability of changing some behaviors in an experimental setting. In what follows, we illustrate the measurement of behavioral spillovers in the simplest possible case of one single behavioral intervention group, and one single outcome variable for both B1 and B2. The extension to more complex cases is straightforward.

In the treatment group (T), a behavioral intervention (e.g., a 'nudge,' a monetary or non-monetary incentive, a 'boost' or 'prime') is introduced to directly target behavior 1, thus affecting the outcome variable B1. The between-subjects design naturally allows the researcher to test the effects of the behavioral intervention on the targeted behavior 1, by directly comparing B1 across the control and the treatment groups, that is, by comparing B1C versus B1T.

The between-subjects design, together with the longitudinal dimension of the experiment, also allows the researcher to check if the behavioral intervention has a ramification effect on the non-targeted behavior 2, thus affecting the outcome variable B2. In particular, the outcome of behavior 2 in the control group (B2C) serves as the baseline level for the extent to which behavior 2 is affected by behavior 1 in the absence of any behavioral intervention targeting behavior 1 (B1C) (see **Table 3**).

In contrast, the outcome of behavior 2 in the treatment group (B2T) captures the extent to which behavior 2 is affected by the 'perturbed' level of behavior 1 as a consequence of the introduction of the behavioral intervention (B1T).

Therefore, by directly comparing B2T and B2C, the difference $\Delta B2 = B2T - B2C$ captures the positive or negative change in the outcome variable for behavior 2 which is directly attributable to the change in the outcome variable for behavior 1, $\Delta B1 = B1T - B1C$, which, in turn, is causally affected by the introduction of the behavioral intervention. That is, $\Delta B2 = B2T - B2C$ captures the 'knock on' behavioral spillover effect of the behavioral intervention targeting behavior 1 on the non-targeted, subsequent behavior 2.

In terms of sizes and statistical significance, such spillover effects may not be significantly different from zero ($\Delta B2 = 0$), may be significantly and positively different from zero (i.e., $\Delta B2 > 0$), or, finally, may be significantly and negatively different from zero (i.e., $\Delta B2 < 0$). If the two behaviors share one common underlying 'motive' (in the sense of Dolan and Galizzi, 2015, of some overarching goal or deep preference such as 'being healthy,' 'being pro-environmental,' or 'being pro-social') then the experimental findings may thus be interpreted as evidence of no behavioral spillovers ($\Delta B2 = 0$), evidence of originating 'promoting' or 'precipitating' behavioral spillover ($\Delta B2 > 0$) or, finally, evidence of 'permitting' or 'purging' behavioral spillover ($\Delta B2 < 0$).

Such an experimental design also allows the researchers to estimate not only the sign and the statistical significance of the behavioral spillover effects, but also their size. In particular, by comparing the relative changes in the outcome variables for behavior 1 and 2 as effects of the introduction of the behavioral intervention, the ratio between the proportional change ($\Delta B2/B2C$) and the proportional change ($\Delta B1/B1C$) allows the researcher to estimate the 'elasticity' of the behavioral spillovers: in analogy with standard price elasticity concepts, the elasticity is defined as the percentage change in behavior 2 per unitary percentage change in behavior 1, that is $\varepsilon_{BS} = (\Delta B2/B2C)/(\Delta B1/B1C)$.

This, in turn, allows the researcher to conclude whether a behavioral intervention causes behavioral ramifications which are small or large compared to the directly targeted change in behavior. In case of permitting or purging behavioral spillovers (i.e., $\Delta B1$ and $\Delta B2$ having opposite signs), and provided that B1 and B2 share the same metrics (or provided that they feed into the underlying motive in a way that the relative sizes of their changes $\Delta B1$ and $\Delta B2$ are conceptually comparable), this can provide further evidence on whether the permitting or purging spillovers are compensating each other completely or only partially (e.g., 'backfire' or 'rebound' effects).

Two further considerations are in order here. First, the above described definition and framework to measure behavioral spillovers in an experimental setting is sufficiently general and comprehensive to nest as a special case the situation where the behavioral intervention consists of behavior 1 itself. For example, in the 'question-behavior' and 'survey' promoting spillover effects discussed in Dolan and Galizzi (2015), the behavioral intervention consists of randomly assigning subjects to a brief survey or questionnaire eliciting past health, environmental, or purchasing behavior (e.g., Fitzsimons and Shiv, 2001; Zwane et al., 2011; Van der Werff et al., 2014a). In such a case, in fact, the behavioral intervention in the treatment group merely consists of exposing subjects to behavior 1 (e.g., a survey) before behavior 2 takes place. In the control group, on the other hand subjects go through behavior 2 without being previously exposed to behavior 1. Also in this, simpler, special case, behavioral spillover is measured as $\Delta B2 = B2T - B2C$, but in this case the behavioral spillover captures the positive or negative change in the outcome variable for behavior 2 which is directly attributable to the mere exposure of subjects to behavior 1 in the treatment group (which, in this case, coincides with the behavioral intervention).

Second, the decision about the timeframe is crucial for the measurement of behavioral spillovers. Following subjects over longer timeframes implies, naturally, that it is more likely that spillover effects are effectively detected (Poortinga et al., 2013). Considering substantially long timeframe (ideally a few weeks or even months after the end of the intervention) is desirable in order to be able to assess the durability of spillover effects. Considering even longer timeframes (ideally over 3 or 6 months after the end of the intervention) is particularly important to be able to detect the formation of new habits sustained over time (Lally et al., 2010), rather than a behavioral change that is only transient. In any case, in order to favor transparency and replicability of experimental results, it is crucial that the researchers pre-specify in advance the timeframe over which subjects are followed up over time. The timeframe, in fact, is a key point of the checklist that we propose below.

How to Measure Behavioral Spillover: Non-experimental Quantitative Studies

An analogous strategy can be used in non-experimental settings along the line of the difference-in-difference empirical approach (e.g., Card, 1992, 1996; Card and Krueger, 1994, 2000; see more below). In particular, the researcher can exploit the variation occurring naturally in the field outside their control and can use some 'natural experiment' as an exogenous 'intervention' in order to identify the likely effect of such an exogenous change on the variables of interest, despite the fact that participants are not randomly assigned to a proper experimental intervention.

The exogenous variation occurring naturally in the field can be a change in policy, a natural 'shock' (e.g., a health shock, a natural disaster, a political shock, an economic shock), a life event (e.g., birth of a child, death of a relative, divorce, unemployment), a technological advance, a discontinuity in the availability or in the access of a resource or an infrastructure. The source of the exogenous variation can also be 'cognitive' or 'behavioral,' such as an exogenous change in attention or awareness, provided that there are convincing reasons to argue that such a source of variation is exogenous (rather than endogenous) to the occurrence of behavioral spillovers.

In the standard difference-in-difference approach, two areas (e.g., two regions, two countries, two schools, two hospitals), are compared before and after the occurrence of a natural event (e.g., a policy, a shock) affecting one area (T) but not the other one (C). Typically, the change of the outcome of behavior 1 before ($t = 0$) and after ($t = 1$) the natural event in the 'control' area $B1C_{t=1} - B1C_{t=0}$ is compared over time to the analogous change in the 'treatment' area $B1T_{t=1} - B1T_{t=0}$, in order to see whether the trends show any significant difference in differences across the two areas (i.e., if $B1T_{t=1} - B1T_{t=0}$, is statistically significantly different from $B1C_{t=1} - B1C_{t=0}$).

In principle, an analogous comparison can be made considering the outcome variable of behavior 2 (B2, instead of B1), to see whether the natural event also has ramifications on a different, subsequent behavior, far and beyond the initial change on behavior 1. Therefore, the researcher can compare the change over time of the outcome variable for behavior 2 before ($t = 0$) and after ($t = 1$) the natural event in the 'control' area $B2C_{t=1} - B2C_{t=0}$ to the analogous change in the outcome variable for behavior 2 in the 'treatment' area $B2T_{t=1} - B2T_{t=0}$, in order to see whether the trends show any significant difference in differences across the two areas (i.e., whether $B2T_{t=1} - B2T_{t=0}$, is statistically significantly different from $B2C_{t=1} - B2C_{t=0}$). Analogous considerations to the ones described above can be made here concerning the sign, significance, and size of the behavioral spillovers in a non-experimental setting (e.g., Claes and Miliute-Plepiene, 2018).

As mentioned above, our framework is sufficiently general and comprehensive to nest, as a special case, the situation where the 'intervention' in an experimental setting, or the 'shock' or exogenous variation in a non-experimental setting, consists of behavior 1 itself. In such a case, the difference-in-difference approach described above reduces to the comparison of the change in the outcome variable for behavior 2 in the 'treatment' area that has been exposed to behavior 1 ($B2T_{t=1} - B2T_{t=0}$) with the analogous change in the 'control' area which has not been exposed to behavior 1 ($B2C_{t=1} - B2C_{t=0}$).

The empirical strategy described above has been illustrated having in mind our specific definition of behavioral spillover proposed in section "Definition of Behavioral Spillover," that is, the observable and causal effect that a change in one behavior (behavior 1) has on a different, subsequent behavior (behavior 2). Nonetheless, a corresponding strategy can be adapted to some of the instances encompassed by the broader definition of spillover reported at the beginning of section "Definition of Behavioral Spillover," that is the impact that an intervention in a given domain (e.g., health, the environment), group, or location, has on a different domain, group or location. In principle, two locations (e.g., two countries), can be compared before and after the occurrence of a natural event (e.g., a natural phenomenon, an intervention) affecting one domain (e.g., the environment) in one area (T) but not in the other one (C). The researcher can compare not only the change over time of the outcome variable for the domain directly involved in the phenomenon or originally targeted by the intervention (e.g., the environment), but also the change over time of the outcome variable for a different domain (e.g., health). Considering the knock-on effects of the phenomenon or intervention on different groups or regions is also possible in principle, although in practice the empirical analysis would need to account for other underlying intra-groups or intra-regional differences between the 'control' and the 'treatment' areas.

How to Study Behavioral Spillover: Qualitative and Mixed-Methods Studies

A different, but potentially complementary, approach to studying spillover involves using qualitative methods, such as interviews analyzed thematically (e.g., Boström et al., 2015; Dittmer and Blazejewski, 2016; Nash et al., 2017; Uzzell and Räthzel, 2018; Thomas et al., 2019). As noted, such approaches have the advantage over quantitative approaches of exposing unexpected spillovers, as well as the shedding light on the drivers, barriers and mechanisms of spillover, and on participants' experience

and meanings associated with spillover. For example, Uzzell and Räthzel (2018) used life history interviews to examine how equivalent practices (as well as identities and meanings) develop over time and may be transferred between work and home; using diachronic and synchronic analyses allowed them to identify drivers and barriers to consistency of actions across time, as well as across contexts. Verfuerth et al. (2018) used depth interviews to explore the impacts of a workplace meat reduction intervention, and found unanticipated spillover across behaviors (e.g., to avoiding food waste) and contexts (to home); while Schütte and Gregory-Smith's (2015) semi-structured interviews exposed cognitive and emotional barriers to pro-environmental spillover between home and holiday.

As such, qualitative methods provide valuable insight in their own right into spillover phenomena, but can also be combined with quantitative approaches in mixed-methods designs to address quantitative limitations (Verfuerth and Gregory-Smith, 2018). Various approaches can be used to ensure the quality of qualitative data, such as member validation (i.e., asking participants to check researcher interpretations), inter-rater reliability of coded data (i.e., using multiple coders and resolving any disagreement in interpretation), and reflexivity (i.e., fully documenting the processes used to collect data and the role and background of the researcher; Breakwell et al., 2012). Others have noted that the diversity of qualitative methods requires a range of criteria for assessing quality and validity (Reicher, 2000); but most agree at least that transparency and consistency are key (Braun and Clarke, 2006). The importance of being systematic is therefore a criterion of quality shared by both quantitative and qualitative methods.

A growing literature advocates the use of mixed-methods approaches in order to triangulate and provide complementary insights. Despite associations of qualitative and quantitative methods with divergent epistemological and ontological paradigms (Blaikie, 1991), this should not imply that qualitative and quantitative methods are essentially incommensurate (Bryman, 1988). Rather, the distinction between particular qualitative and quantitative methods can be understood as primarily technical, and not necessarily philosophical. Qualitative and quantitative methods offer different insights into spillover and each is better suited to answering different types of research question (e.g., What are the range of effects of an intervention? How is the development of identity and practices experienced over time and contexts? What causes and mediates spillover?). Thus, the rationale for combining methods stems from "the basic and plausible assertion that life is multifaceted and is best approached by the use of techniques that have a specialized relevance" (Fielding and Fielding, 1986, p. 34). Furthermore, using multiple methods allows interesting lines of inquiry exposed through one method to be explored further through another (Whitmarsh, 2009). At the same time, however, it is not assumed that aggregating data sources can provide a complete or 'true' picture of the social world (Silverman, 2001). Indeed, "the differences between types of data can be as illuminating as their points of coherence" (Fielding and Fielding, 1986, p. 31), for example leading to a re-examination of conceptual frameworks or assumptions (Tashakkori and Teddlie, 2003). The distinct challenges of researching spillover imply both qualitative and quantitative approaches are warranted to address different facets of the problem.

Mixed-methods designs may be sequential or concurrent, or both (Creswell, 2014). In the case of spillover studies, a mixed methods design might start with an initial qualitative and/or correlational phase to identify clusters of co-occurring behaviors which may indicate spillover, for which candidate behaviors (B1, B2, etc.) and the causal pathways connecting them can be examined in a subsequent experimental design, as outlined above. In addition, qualitative methods can be used alongside quantitative behavioral measures within the intervention phase to explore the experience, perceptions, and subjective wellbeing implications of the intervention, and to expose potentially unexpected spillover effects, as well as possible drivers, barriers, mechanisms, and mediating/moderating factors for any spillover. This might take the form of interviews with a sub-sample of experimental participants, or one or more open-ended questions in a post-intervention survey. Where spillover is detected through quantitative experimental methods, qualitative data may help explain why this effect has occurred, and how this has been subjectively perceived and experienced. In the event that spillover is not detected via the experimental methods outlined above, qualitative methods may explain why not, or they may expose other, unquantified spillover effects. Qualitative, quantitative, and experimental methods should thus be seen as complementary, rather than substitute, empirical methods to explore and assess behavioral spillovers. So far, there exist few mixed-methods studies of spillover, but those that have been undertaken appear to demonstrate that a mixed methodology can elucidate multiple aspects of spillover processes and experiences (Barr et al., 2010; Verfuerth et al., 2018; Thomas et al., 2019).

A PRACTICAL CHECKLIST

Exploring and detecting behavioral spillovers is a research and policy task which should be undertaken using a systematic and transparent approach, in the same spirit of, and closely in line with, the recent best practices favoring and advocating systematization and transparency in psychological and behavioral sciences (Ioannidis, 2005; Higgins and Green, 2011; Simmons et al., 2011; Miguel et al., 2014; Simonsohn et al., 2014; Open Science Collaboration, 2015; Munafò et al., 2017). In the previous section, we outlined how this might be achieved using different research designs.

Abstracting from these exemplar designs, here we propose a checklist of points which should be explicitly stated and addressed by the researcher prior to undertaking of experimental and empirical analysis. The 20-item checklist is in line with, and in the same spirit of, other checklists designed to systematically assess the methodological quality of prospective studies, for example by the Cochrane Collaboration (Higgins and Green, 2011). The checklist is also in line with, and in the same spirit of, other more general checklists guiding researchers through pre-registration of studies and pre-analysis

plans (e.g., the Open Science Framework[2]). Once filled in, the checklist for a prospective study should be deposited in a dedicated website which is going to be launched with the publication of this special issue, and which will be available at: https://osf.io/9cqjf/. The website will also include a data template where data from deposited studies could be shared, collated, and combined in order to conduct collaborative systematic reviews and meta-analyses of the literature.

The 20 questions of the checklist are below. In what follows we briefly illustrate each question with a real case study, the recent study by Xu et al. (2018a) on household waste separation:

1. What are the setting and population of interest?
   - Four geographically adjacent communities in the Yuhang District of Hangzhou, Zhejiang Province, China.
2. Is this an experimental or a non-experimental study?
   - An experimental study (a framed field experiment).
3. If this is a non-experimental quantitative study, what is the empirical identification strategy (e.g., difference-in-difference)?
   - N/A.
4. If this is a quantitative study, what is the control group?
   - The control group were participants in each community who were not exposed to any formal promotion of waste separation.
5. How have the behaviors been selected (e.g., existing literature, qualitative evidence)?
   - Based on previous findings and on the literature.
6. What is the targeted behavior 1?
   - Sorting daily garbage and bringing it to waste collection sites.
7. What are the outcome variables for behavior 1 (i.e., how will you measure behavior 1)? (Please list them and briefly describe each outcome variable, indicating whether this is directly observed or self-reported behavior.)
   - Difference in self-reported household waste collection before and after the interventions.
8. How many intervention groups there are?
   - Originally there were three intervention groups, but one condition ('mixed condition') was then excluded (see footnote 1 in page 28).
9. What are the behavioral interventions targeting behavior 1? (Please list them and briefly describe each of them.)
   - In the Environmental Appeal (EA) condition participants were given 3 monthly 30-min presentations where they were informed about the environmental benefits of waste separation. In the Monetary Incentive (MI) condition participants were given 3 monthly 30-min presentations where they were informed that they could earn 'green scores' from a recycling firm if they sorted their daily garbage and brought it to waste collection sites. In the 'mixed condition' participants were given 3 monthly 30-min presentations where they were informed of both EA and MI (this condition was later excluded from the analysis).
10. What is the non-targeted behavior 2?
    - A set of 25 self-reported environmental behaviors or self-reported willingness to engage in environmental behaviors, including both 'private-sphere' behaviors (e.g., green shopping, traveling) and 'public-sphere' behaviors (e.g., support to environmental policies, environmental citizenship actions).
11. What are the outcome variables for behavior 2 (i.e., how will you measure behavior 2)? (Please list them and briefly describe each outcome variable, indicating whether this is directly observed or self-reported behavior.). If there are multiple outcome variables for behavior 2, does the study correct for multiple hypotheses testing? (Please describe which correction is used.)
    - All the outcome variables for the 25 environmental behaviors or willingness to engage in environmental behaviors are self-reported, and are collected by a monthly survey. There is no explicit correction for multiple hypotheses testing.
12. What is the expected underlying motive linking behavior 1 and behavior 2?
    - Pro-environmental identity (page 28).
13. What are the expected mechanisms moderating and/or mediating the changes in the outcome variables for behavior 2?
    - The expected mechanisms are both promoting/positive behavioral spillovers such as the activation of a stronger pro-environmental identity, and permitting/negative behavioral spillovers such as moral licensing (page 28). Pro-environmental identity and environmental concern are expected to mediate promoting/positive spillovers. Relief of guilt is expected to mediate permitting/negative spillovers.
14. What is the expected time frame during which behavioral spillovers will be tested, and during which the durability of spillover and habit formation will be assessed?
    - The expected time frame is not explicitly mentioned, but participants are followed up for 3 months.
15. What is the expected participant attrition between behavior 1 and behavior 2?
    - There is no explicit discussion of expected attrition. However, attrition was not only high, but it was asymmetric across different conditions. At the end of

[2]https://osf.io/

the experiment (3 months after), only 195 out of the 400 participants originally recruited remained in the study: 80 (out of 100) in the EA group, 36 (out of 100) in the MI group, and 79 (out of 100) in the control group (all the 100 participants in the mixed condition group were excluded).

16. What is the expected direction of the changes in the outcome variables for behaviors 1 and 2 between the intervention groups and the control group (i.e., are positive or negative spillovers expected)?
    - Both promoting/positive and permitting/negative spillovers were expected (page 28).
17. What are the expected sizes and standard errors of the changes in the outcome variables for behaviors 1 and 2 between the intervention groups and the control group?
    - There is no explicit discussion of the expected effect size or standard errors of the changes in the outcome variables for behaviors 1 and 2.
18. What is the minimum expected sample size to test and detect the occurrence of behavioral spillover?
    - The study recruits n = 100 participants in each of the four groups, but there is no explicit justification of the minimum expected sample size to test and detect the occurrence of behavioral spillovers.
19. If collecting qualitative data, how will the quality of this data be ensured and assessed (e.g., reflexivity, consistency)?
    - A number of psychological constructs were collected (including four items to measure personal identification with environmental protection; three items to measure personal concern for the environment, ecology, and the earth; three items to measure feelings of disappointment, guilt, and regret for past environmentally unfriendly behaviors) and used in exploratory factor analysis, but no further qualitative data was collected.
20. If using mixed-methods approaches, how will insights from different methods be combined?
    - N/A.

CONCLUSION

We have critically reviewed the main methods to measure behavioral spillovers to date, and discussed their methodological strengths and weaknesses. We have proposed a consensus mixed-method approach which uses a longitudinal between-subject design together with qualitative self-reports: participants are randomly assigned to a treatment group where a behavioral intervention takes place to target behavior 1, or to a control group where behavior 1 takes place absent any behavioral intervention. A behavioral spillover is empirically identified as the effect of the behavioral intervention in the treatment group on a subsequent, not targeted, behavior 2, compared to the corresponding change in behavior 2 in the control group.

In the spirit of the pre-analysis plan, we have also proposed a systematic checklist to guide researchers and policy-makers through the main stages and features of the study design in order to rigorously test and identify behavioral spillovers, and to ensure transparency, reproducibility, and meta-analysis of studies.

While ours is arguably the first methodological note on how to measure behavioral spillovers, it has of course limitations. The main limitation is that our experimental and empirical identification strategy relies on our specific definition of behavioral spillover – i.e., the observable and causal effect that a change in one behavior (behavior 1) has on a different, subsequent behavior (behavior 2). As mentioned in section "Definition of Behavioral Spillover," broader definitions of spillover exist that can encompass attitudinal change, learning, interpersonal influences, and other disparate processes. While we have suggested here that a similar approach to ours (i.e., longitudinal mixed-methodology) might apply in these cases, there may be also be methodological considerations specific to each type of spillover that warrants its own methodological checklist. Even applying our more specific definition of behavioral spillover, it would be possible to define alternative methodological checklists that, for example, apply solely quantitative or qualitative methods (cf. Uzzell and Räthzel, 2018). However, as we have argued, we believe there is benefit in combining methods as they can offer different insights or address different research questions relating to spillover.

We would like to conclude by briefly mentioning a few other directions where we envisage promising methodological developments in the years to come. First, the current technological landscape naturally lends itself to a systematic measurement of behavioral spillovers in a variety of research and policy domains. Today an unprecedented richness of longitudinal data are routinely collected at an individual level in terms of online surveys, apps, smart phones, internet of things (IoT) and mobile devices, smart cards and scan data, electronic administrative records, biomarkers, and other longitudinal panels. This is creating, for the first time in history, an immense potential for following up individuals across different contexts and domains, and over time, for months, years, and even decades. This new technological landscape is also creating previously unexplored opportunities for 'behavioral data linking,' that is, for the linkage of behavioral experiments with other sources of longitudinal data (Galizzi, 2017; Galizzi et al., 2017; Galizzi and Wiesen, 2018; Krpan et al., 2019). On the one hand, the scope for systematically testing the occurrence of behavioral spillovers using rigorous empirical and experimental methods is therefore enormous. On the other hand, the endless wealth of research hypotheses, outcome variables, and data points makes even more important for researchers to embrace the best practices discussed above in order to ensure transparency, openness, and reproducibility of science.

Second, a promising methodological line of research about behavioral spillover concerns the rigorous investigation of the factors mediating and moderating the occurrence of behavioral spillover, for example in terms of accessibility (Sintov et al., 2019).

Further work in this direction is likely to develop also thanks to the triangulation of different sources of data enabled by the above described shift in the technological landscape.

All these future developments reinstate the importance of developing a collective discussion about clear and transparent methodological guidelines to measure behavioral spillovers. We hope that with the present article we have contributed to at least start such a discussion. The time is ripe to foster a collaborative endeavor to systematically test behavioral spillovers across all research and policy domains, contexts, and settings.

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MG initiated and led the paper writing. LW contributed to paper writing.

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APPENDIX: METHODOLOGY OF SYSTEMATIC REVIEW OF THE LITERATURE

In conducting and reporting our systematic review of the literature, we followed as closely as possible the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) checklist and guidelines (Moher et al., 2009), as explained below.

Search Strategy and Key Terms

Google Scholar was searched in December 2018 using the following combinations of exact phrases in the advanced search settings:

(1) "behavioral spillover" (field TX all text) OR
(2) "behavioral spillover" (field TX all text).

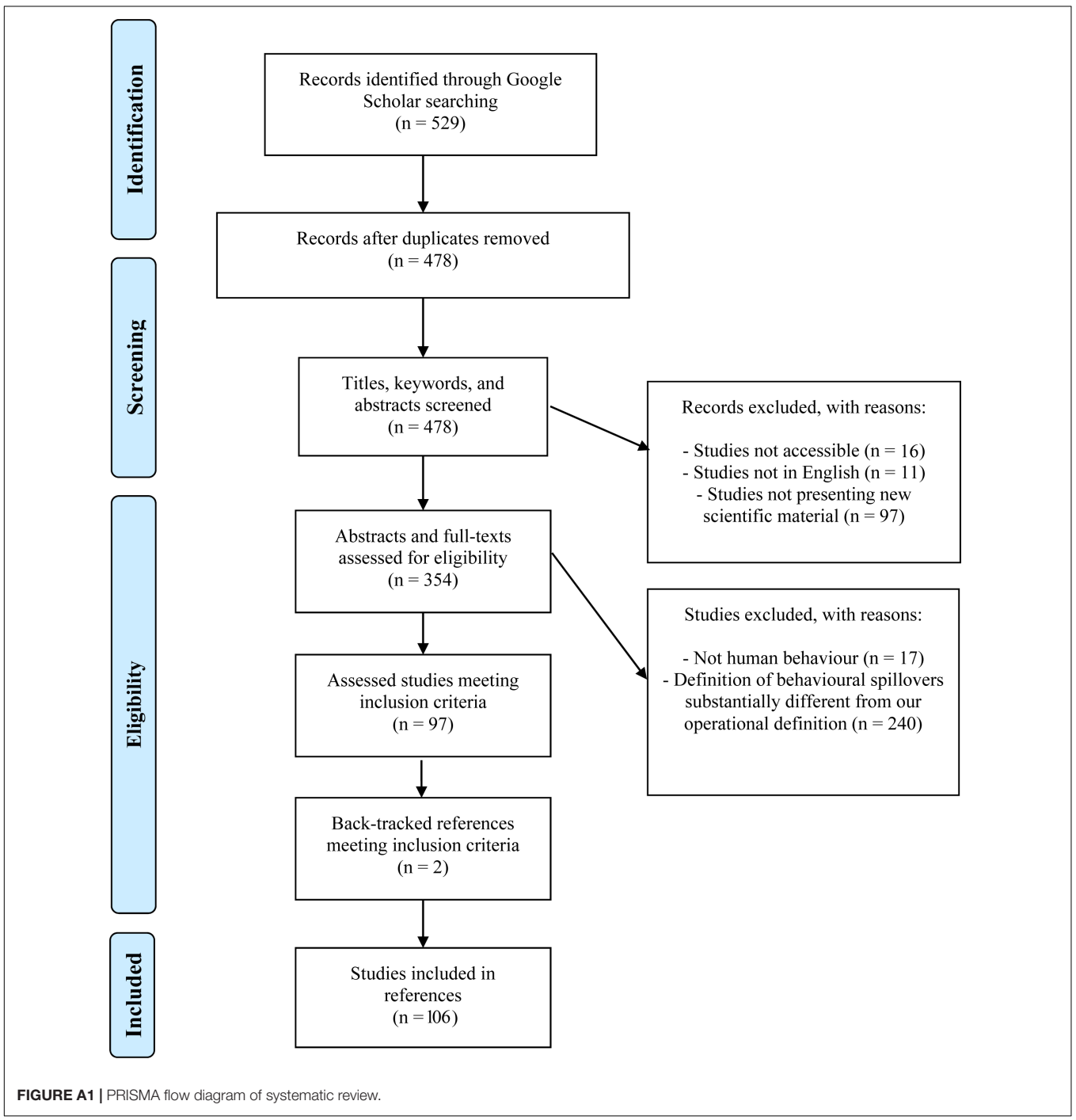

FIGURE A1 | PRISMA flow diagram of systematic review.

Selection and Exclusion Criteria

The authors reviewed and assessed all the references systematically, following a two-stage strategy. In the first stage, the inclusion criteria were applied to the title, the keywords, and the abstract; in the second stage, the criteria were applied to the abstract and the full text. All the papers were independently assessed for inclusion by each of the authors. Differences in opinions between the authors were solved through discussion.

The two stages worked as follows. In the first stage, a study was included only if it satisfied the following three criteria:

(1) The study was available (no broken link).
(2) The study was written in English.
(3) The study presented new scientific material, in terms of: new empirical evidence or original experimental analysis of behavioral spillover; new theoretical definitions or conceptual frameworks for behavioral spillovers; systematic reviews or meta-analyses of existing studies on behavioral spillovers. This criterion excluded non-systematic reviews, commentaries, editorials, letters, or similar items.

Each article was sequentially evaluated against the three criteria, starting with criterion one and ending on criterion three. Whenever a criterion was not met, the article was excluded.

In the second stage, the abstract and the full text of the studies shortlisted in the first stage were screened, evaluated, and finally included according to two further criteria:

(4) The study considered human behavior.
(5) The study used a definition of behavioral spillover substantially in line with our operational definition in section "Definition of Behavioral Spillover," that is, the observable and causal effect that a change in one behavior (behavior 1) has on a different, subsequent behavior (behavior 2).

We included both published and unpublished studies, for example studies in working paper or in dissertation form. If both published and unpublished versions of the study were available, we considered the published version. If different dates of the unpublished versions were available, we considered the most recent one.

To ensure that the set of studies retrieved was exhaustive and comprehensive, for each included study, we also back-tracked and screened all the references cited in the article, applying the same inclusion criteria explained above.

Search Results

The initial Google Scholar search resulted in a total number of $n = 529$ entries on December 17th, 2018 ($n = 305$ for "behavioral spillovers" and $n = 224$ for "behavioral spillovers." After $n = 51$ duplicates were removed, the resulting number of studies was $n = 478$. We then excluded the papers that were not accessible ($n = 16$), were not written in English ($n = 11$), or did not present new scientific material ($n = 97$). A total of $n = 354$ studies met all three criteria in this first stage of our selection strategy.

The abstract and the full text of the $n = 354$ studies shortlisted were then screened and evaluated. We then excluded the studies that did not focus on human behavior ($n = 17$), and the studies whose definitions of behavioral spillovers was substantially different from our operational definition – or which did not define behavioral spillovers at all ($n = 240$). A total of $n = 97$ studies matched all the inclusion criteria in this second stage.

Back-tracking, screening, and evaluating the references cited in these $n = 97$ articles against the same inclusion criteria retrieved further $n = 9$ studies. So, at the end of the whole process, the systematic review resulted in a total of $n = 106$ selected studies.

Of the $n = 106$ selected studies, $n = 12$ are Doctoral theses, $n = 5$ are Master theses, and $n = 12$ are still unpublished works, all which shows the growing interest on behavioral spillovers.

The selection process and the number of papers excluded and included in each stage are summarized in the PRISMA flow chart in **Figure A1**.

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ORIGINAL RESEARCH
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The Role of Attitude Strength in Behavioral Spillover: Attitude Matters—But Not Necessarily as a Moderator

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Studies on how one behavior affects subsequent behaviors find evidence for two opposite trends: Sometimes a first behavior increases the likelihood of engaging in additional behaviors that contribute to the same goal (positive behavioral spillover), and at other times a first behavior decreases this likelihood (negative spillover). A factor that may explain both patterns is attitude strength. A stronger (more favorable) attitude toward an issue may make the connections between related behaviors more salient and increase the motivation to work toward the underlying goal. We predicted that people with a stronger (more favorable) attitude are more likely to engage in subsequent behaviors that address an issue they care about. Two experiments tested the prediction in the contexts of pro-environmental and health behavior. Study 1 (N = 378) provided some support for the predicted moderating role of attitude toward the environment when participants recalled either an environmentally friendly or unfriendly action: A strong attitude increased the likelihood, whereas a weak attitude decreased the likelihood of carrying out successive goal-conducive behaviors. When compared to a neutral control condition in Study 2 (N = 929), participants with a weak environmental attitude supported pro-environmental petitions *less* strongly after an environmentally harmful action. Support for such petitions did not waver, however, among participants with a strong environmental attitude: They consistently acted environmentally friendly. Contrary to the hypothesis, in neither study did strength of attitude toward personal health moderate the effect of an initial behavior in the expected direction. In sum, the two studies provided only limited evidence for behavioral spillover: Participants mostly acted in accordance with their attitude but were hardly affected by recalling previous actions. When behavioral spillover did occur, however, a strong environmental attitude tended to increase the likelihood of acting in an environmentally friendly way, whereas the behavior of those with a weak attitude was less predictable. This research contributes to a more nuanced theoretical understanding of the role of attitude in spillover, but provides only limited evidence for its role as a moderator.

Keywords: pro-environmental behavior, health behavior, environmental attitude, health attitude, spillover, moral licensing, moral cleansing

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INTRODUCTION

Many personal and societal goals can be achieved only if people repeatedly work toward them. For example, to lead a healthy life, it is not enough to eat a single healthy meal. People need to repeatedly make healthy food choices and also do other things that benefit their health, like get enough sleep and exercise regularly. Similarly, if people want to reduce their environmental footprint, they need to do more than recycle one glass bottle; they need to repeatedly recycle different types of things and engage in additional behaviors, such as using energy-efficient appliances and modes of transport. In short, in many contexts people need to engage in several successive actions to achieve their goals.

Despite the need for such consistent behavior, we know relatively little about when an action that helps achieve a goal affects subsequent actions that contribute to the same goal. In accordance with previous research, we refer to relationships between initial and subsequent behaviors as "spillover." *Positive* spillover refers to situations where a first behavior increases the likelihood of a different second behavior (i.e., spillover across behaviors), or the same behavior again across time (i.e., spillover across time) or in a different context (i.e., spillover across contexts) that contributes to the same goal as the first (Truelove et al., 2014; Dolan and Galizzi, 2015; Nilsson et al., 2017; Carrico et al., 2018). By contrast, *negative* spillover describes situations in which a first goal-conducive behavior *reduces* the likelihood of engaging in other, similar behaviors or the same behavior across time or contexts (or in which a first, goal-inconsistent behavior increases this likelihood, see **Figure 1** for all the variations).

The literature provides compelling theoretical explanations and empirical evidence for both types of spillover (Dolan and Galizzi, 2015). On the one hand, research in the context of moral behavior shows that after performing a first moral behavior, individuals feel that they have earned the moral entitlement to reward themselves by refraining from further moral behavior (Monin and Miller, 2001; Merritt et al., 2010). To illustrate, individuals who recalled a moral behavior were more likely to cheat on a math task (Jordan et al., 2011) and donated less money to charity (Sachdeva et al., 2009). Other research corroborates the idea that an initial behavior can induce the feeling that a person has "done enough" and that no further behavior along the same lines is necessary, which fosters negative spillover effects (variously termed resting on one's laurels, Amir and Ariely, 2008; goal attainment, Longoni et al., 2014; single-action bias, Weber, 1997a).

On the other hand, other perspectives such as cognitive dissonance theory (Festinger, 1957), self-perception theory (Bem, 1972), and the foot-in-the-door effect (Freedman and Fraser, 1966) suggest that individuals have a strong urge for consistency and tend to act in a way that is consistent with previous actions and existing beliefs, which should lead to positive spillover (Albarracín and Wyer, 2000; Gawronski and Strack, 2012).

A crucial question that arises from these two contradictory patterns of spillover concerns why a first goal-conducive behavior sometimes increases the likelihood of further similar behaviors and why it sometimes reduces it. One explanation is that additional psychological processes may be at work (Truelove et al., 2014; Mullen and Monin, 2016). For example, it is possible that the extent to which a behavior and its broader context matter to a person influences which psychological processes are triggered and whether they result in positive or negative spillover (Effron et al., 2009; Meijers, 2014; Nilsson et al., 2017). Our research builds on this idea: We argue that the more a person cares about an issue such as the environment or personal health – the strength of their attitude – the more likely they are to engage in multiple behaviors conducive to the underlying goal (positive spillover). By contrast, when people engage in behaviors to do with issues they do not care strongly about, they feel they have done enough (Weber, 1997b; Amir and Ariely, 2008), and use their limited resources (e.g., attention, physical strength, time, money) to pursue other goals (Moskowitz, 2012).

	Initial positive (goal-conducive) behavior	Initial negative (not goal-conducive) behavior
Positive Spillover (consistency)	Behavior 1 + Behavior 2 +	Behavior 1 - Behavior 2 -
Negative Spillover (inconsistency)	Behavior 1 + Behavior 2 -	Behavior 1 - Behavior 2 +

FIGURE 1 | Overview of how the valence and (in)consistency of successive behaviors lead to positive and negative spillover (adopted from Dolan and Galizzi, 2015).

Previous spillover research focused on behaviors with obvious links to morality, and often relied on moral processes to explain spillover effects (including behaviors connected to environmental protection, which has clear moral connotations; Monin and Miller, 2001; Effron et al., 2009; Mazar and Zhong, 2010; Merritt et al., 2010; Meijers, 2014). We tie in to this research tradition by using an established experimental paradigm (Sachdeva et al., 2009), examining the predicted moderating influence of attitude strength on spillover in the context of environmental protection, which is often strongly morally connoted (e.g., Feinberg and Willer, 2013). We extend the scope of previous research by testing assumptions in two different contexts: environmental protection and health. As a result, we explore whether spillover processes are restricted to behaviors related to morality or whether they also occur in domains less morally charged.

Personal Relevance as a Moderator of Behavioral Spillover

The idea that personal relevance could influence the extent and type of behavioral spillover is supported by different theoretical perspectives and some empirical evidence. We take a goal-theoretical perspective to reconcile different streams of research into conceptually similar constructs (e.g., superordinate goals or identity). The central hypothesis is that the more relevant an issue is to a person, the more an initial goal-conducive act should decrease negative spillover and promote positive spillover (see Höchli et al., 2018).

According to goal-theoretical perspectives, people pursue goals that are related to each other but vary in level of abstraction (Vallacher and Wegner, 1987; Carver and Scheier, 2001). For

example, "be healthy" is a relatively abstract and broad health goal at the top of the hierarchy, whereas "do 40 push-ups on Wednesday afternoon" is a specific health goal at the bottom (Carver and Scheier, 2001; Kruglanski et al., 2002). The most concrete goals (sub-goals) correspond to specific, single actions.

More abstract goals are often referred to as "superordinate" (Carver and Scheier, 2001). These broad representations determine what people ultimately value and aspire to; they provide a general orientation as to what is important to a person (Carver and Scheier, 2001; Schwartz et al., 2001; Boekaerts et al., 2006).

This understanding of superordinate goals points to similarities with functionally and conceptually related concepts. For instance, goals are often equated with values (e.g., Schwartz, 1992). Further, superordinate goals are described as "be" goals – that is, the kind of self one aspires to be (Carver and Scheier, 2001). This links superordinate goals closely to theoretical concepts such as "self-identity" and "possible selves," which are as well representations of the self that motivate behavior (Hoyle and Sherrill, 2006; Oyserman and James, 2011; Van der Werff et al., 2013). Although superordinate goals, values, identity, and possible selves are theoretically distinct concepts, the terms are often used interchangeably (Schwartz, 1992; Masuda et al., 2010).

There are at least two characteristics of superordinate goals that point to their possible role as moderators of spillover. First, the intrinsic importance of superordinate goals and their crucial role for the overriding sense of self (Carver and Scheier, 2001) can have a stabilizing effect on behavior. More specifically, it is likely that people experience cognitive dissonance if they engage in behaviors that jeopardize their superordinate goals (Festinger, 1957). Because cognitive dissonance is unpleasant, avoiding it could be an important driver for consistently carrying out goal-conducive behaviors (Sintov et al., 2019). Similar arguments can be made concerning theories of identity and self-perception: The more people see themselves as environmentalists or health-conscious persons, the more they are likely to experience cognitive dissonance and negative emotions such as guilt or remorse when they do not act according to their identity or self-perception (Lanzini and Thøgersen, 2014; Van der Werff et al., 2014a; Byrka and Kaminska, 2015; Lacasse, 2016). Importantly, this stabilizing effect can be expected only among people who hold relevant superordinate goals. This is why we expect superordinate goals to moderate spillover: To the extent that people hold a superordinate goal (or have strong values, identity, self-perception) in a given domain, the more they should engage in behaviors that qualify as positive spillover after an initial goal-conducive act (and as negative spillover after an initial act that is inconsistent with their goal) (Fishbach et al., 2006; Thøgersen and Crompton, 2009; Meijers et al., 2014; Nilsson et al., 2017).

Second, the interconnected structure of goals is likely to enhance this stabilizing effect. Superordinate goals typically include multiple concrete sub-goals that are instrumental to achieving them (Carver and Scheier, 2001; Kruglanski et al., 2002). For example, to "be healthy," a person needs to do more than hit the gym once a week – they need to be physically active in other ways as well (e.g., take the stairs instead of the elevator), and pursue additional broad and specific health goals such as "eat healthily" and "have fruit instead of a chocolate bar as a snack." It can be assumed that the more people represent an issue as a superordinate goal (i.e., the more it matters to them), the more salient are the connections between the superordinate goal and relevant behaviors, and the more different goal-conducive behaviors should be linked to each other through the superordinate goal. A characteristic of this interconnectedness is that goals can activate (or inhibit) each other: Dealing with a concrete action or a subordinate goal can activate the associated superordinate goal (bottom-up activation; Shah and Kruglanski, 2003), and focusing on a superordinate goal can activate the associated subordinate goals or actions (top-down activation; Kruglanski et al., 2002). Thus, when people carry out a behavior for which they have a corresponding superordinate goal, this should increase the salience of the goal, highlight the importance of carrying out other goal-conducive behaviors, and increase the likelihood of doing so (Bargh et al., 1992; Ratneshwar et al., 2001; Kruglanski et al., 2002; Thøgersen and Noblet, 2012). Positive spillover effects can therefore be understood as the result of an initial goal-conducive behavior that activates a superordinate goal, that in turn guides other behaviors (Lanzini and Thøgersen, 2014; Margetts and Kashima, 2017). Again, this process is contingent on people holding a relevant superordinate goal (or identity, self-perception, values).

Support for this idea comes, for example, from a community field experiment that tested an intervention to save electricity (Steinhorst et al., 2015). Participants received electricity-saving tips, combined with either a monetary (savings in euros) or an environmental framing (savings in CO_2), or no framing in the control group. Although an increase in the target behavior – saving electricity – was observed in both framing groups, spillover to other pro-environmental behaviors was observed only in the environmental condition.

There is also empirical evidence to support the idea that the more importance people attach to an issue or a cause, the more they tend to engage in behaviors that maintain, advance, and defend it. To illustrate, the effect of personal importance on behavior is evident in positive correlations between a broad range of environmentally friendly behaviors and concepts related to the personal importance of environmentalism, such as an *ecocentric belief structure* (i.e., humans are a part of natural systems and constrained by their limits; Dunlap and Van Liere, 1978; see also Olli et al., 2001; Kortenkamp and Moore, 2006), *self-transcending* and *biospheric values* (Karp, 1996; Stern et al., 1998; Schultz, 2001; Schultz et al., 2005; Thøgersen and Ölander, 2006; Gatersleben et al., 2014), *connectedness to nature* (Schultz, 2001; Brügger et al., 2011; Otto and Pensini, 2017), *identity/self-perception* as someone who acts in an environmentally friendly way (Nigbur et al., 2010; Whitmarsh and O'Neill, 2010; Gatersleben et al., 2014; Kashima et al., 2014; Van der Werff et al., 2014b; Meijers et al., 2015), and *environmental attitude* (Hines et al., 1986; Bamberg and Möser, 2007). Similar relationships can also be found between higher scores on similar concepts and health behavior (e.g., Theodorakis, 1994; Godin and Kok, 1996; Sparks and Guthrie, 1998; Hagger et al., 2007).

The literature also holds more direct evidence for the idea that following an initial goal-conducive act, personal importance should increase positive and reduce negative spillover. For instance, the higher people score on measures that reflect personal importance, the less likely they are to endorse the idea that they can justify or neutralize environmentally harmful behaviors with other, more environmentally friendly behaviors (Bratt, 1999; Kaklamanou et al., 2015).

The most direct support for the idea that personal importance can explain behavioral spillover comes from three experiments that examined how a first behavior affected a second behavior. The first study found that the expression of a non-racist intention (to vote for Obama in the 2008 election) tends to lead to racist behavior (allocating more resources to Whites than Blacks), but only for those with higher racist scores (Effron et al., 2009, Study 3).

Another study found that after imagining purchasing an environmentally friendly product, participants with a strong environmental identity tended to express pro-environmental intentions to the same extent as their counterparts who had bought a conventional product. By contrast, when participants with a weak environmental identity purchased an environmentally friendly product, they expressed lower environmentally friendly intentions than after buying the conventional product (Meijers, 2014).

The third experiment (Noblet and McCoy, 2018) manipulated whether participants perceived their past ecological behavior as either environmentally friendly or unfriendly, then asked them how strongly they supported a pro-environment energy policy. It was found that the perception of one's past behavior as environmentally friendly decreased support for the policy among those with low intrinsic environmental motivation. However, those with high environmental motivation supported the policy to an equal extent, irrespective of whether they were led to see their past behavior as environmentally friendly or not. These studies provide compelling initial evidence for the idea that after an initial goal-conducive behavior, personal importance – in the reported studies, operationalized as attitude, identity, or intrinsic environmental motivation – leads to positive spillover effects, whereas low personal importance leads to negative spillover effects.

Behavior-Based Attitude as a Measure of Personal Importance

From a methodological point of view, how to measure abstract concepts such as personal relevance, superordinate goals, values, or possible selves is not a trivial matter. It is *technically* feasible to ask questions that directly tap into such abstract concepts: Schwartz (1992) assessed values by asking people to indicate the extent to which different values act as "guiding principles" in their lives. However, such direct ways of assessing abstract concepts require introspection and self-reflection. This is problematic because abstract concepts are by definition difficult to grasp intellectually; respondents may not necessarily understand the concepts in the same way researchers do. A second problem is that the information required to evaluate such abstract concepts is often not readily available, which makes these types of question prone to recollection bias (Dillman, 2001), response bias (e.g., Wittenbrink and Schwarz, 2007), and social desirability bias (Crowne and Marlowe, 1960).

In this paper, we take an *indirect* approach to measuring personal relevance that is grounded in the Campbell paradigm (Kaiser et al., 2010), an innovative paradigm from attitude research. Based on Donald Campbell's conceptualization of attitude as an "acquired behavioral disposition" (Campbell, 1963, p. 97), Kaiser et al. (2010) argue that attitudes and behaviors are formally – but not causally – linked. This means that a latent attitude is manifest in people's behaviors and, conversely, that the attitude denotes the subjective importance of the behavior to the person (Kaiser et al., 2010). A second crucial proposition of Kaiser et al. (2010) is that behavior is determined by two factors: (1) the strength of the latent attitude and (2) the costs of the behavior (e.g., money, physical effort, time, sacrifice, or social risk).

An implication of this conceptualization is that the latent attitude can be inferred from a *systematic* inspection of behaviors that are ordered according to their cost (Kaiser et al., 2010): The more costly, difficult, and demanding a person's behaviors are, the stronger must be their corresponding attitude. Why would someone install expensive solar panels or spend a lot of time traveling by train rather than by airplane if they did not have a strong environmental attitude? Likewise, when the tiniest difficulty is enough to stop a person from engaging in a healthy behavior, their health attitude is probably weak.[1]

Conceptualizing attitude as a behavior-based latent trait has several advantages: Answering questions about past actions requires a minimal amount of introspection (see Otto et al., 2018). Therefore, answering questions about one's behavior should be easier than answering questions about abstract concepts such as superordinate goals, values, or identity. Furthermore, previous research suggests that questions about one's behavior are less vulnerable to response biases such as social desirability than conventional attitude questions (Milfont, 2009). Moreover, behavior-derived attitudes are relatively stable across time (Kaiser et al., 2014), which makes them particularly useful for measuring trait-like individual preferences.

This approach of assessing latent constructs through behaviors has already been implemented in various contexts. They include environmental attitude (Kaiser et al., 2013, 2014; Ogunbode et al., 2018), attitude toward nature (Brügger et al., 2011; Kaiser et al., 2013, 2014), attitude toward climate change (Urban, 2016), health attitude (Byrka and Kaiser, 2013), attitude toward conformity (Brügger et al., 2019), and need for recovery at work (Smolders et al., 2012). Although most instruments developed within the Campbell paradigm are formally denoted as attitude scales, the latent trait being assessed can also be thought of as an indication of people's motivation: how "personally important" a goal is to them (Kaiser et al., 2017). As such, using behavior-based attitude scales is a promising approach to measuring the extent

[1]Importantly, though, the Campbell paradigm does not suggest that a single behavior can be equated with attitude. The latent trait can be inferred only by inspecting a broad range of behaviors, ordered by difficulty.

to which environmental protection and health are personally important to people.

Overview of Studies

The goal of the research is to examine whether personal importance – operationalized as the strength of behavior-based attitude – can shed light on when positive and negative behavioral spillover occurs. To examine the role of attitude strength as a moderator, we conducted two experiments. In both, we used an experimental paradigm that is often used in research on moral licensing (Blanken et al., 2015): Participants recalled a recent past behavior that was either consistent or inconsistent with the goal to be healthy or to protect the environment, and that therefore had the potential to trigger spillover effects, and then answered questions about future behaviors.

Using this recall paradigm offers at least three advantages over other approaches. First, participants are not forced to carry out behaviors that they would not do of their own free will, which could otherwise raise ethical questions for researchers. Second, using a design in which participants are either selected because they already perform a specific behavior or are asked to adopt a specific behavior could lead to samples in which, for example, relevant individual attitudes are already very positive. Using the recall paradigm should result in more inclusive samples in which the variance in participants' attitudes is not restricted. Third, asking participants to describe an event of their own choice guarantees that the behavior has the intended subjective meaning (see also Thøgersen, 2004).

Study 1 provided initial evidence for the expected role of attitude strength as a moderator. However, it did not include a neutral control group and its sample (N = 378) consisted mainly of female students. By using a broader and larger sample (N = 929) and by including an additional neutral condition, Study 2 overcame these shortcomings, and again found some support for the predicted role of attitude strength as a moderator.

STUDY 1

To examine the moderating influence of attitude strength, we tested for interaction effects between the experimental conditions (recalling a behavior that was consistent vs. inconsistent with the goals to protect the environment and to be healthy) and attitude strength in the contexts of environmental protection and health. (For a similar approach, see Conway and Peetz, 2012; Cornelissen et al., 2013; Noblet and McCoy, 2018.)

We predicted that participants with a strong attitude would engage in positive spillover after an initial goal-conducive behavior and in negative spillover after an initial goal-inconsistent behavior, leading to high motivation to engage in goal-conducive behaviors in both experimental conditions. These predictions were based on the following assumptions: When participants with a strong attitude carry out a behavior that is relevant to their attitude, this should (a) increase the salience of their attitude; and (b) the relationships between different attitude-relevant behaviors and how they are relevant to the underlying attitude; and (c) they would experience cognitive dissonance if behaviors were inconsistent with their attitude.

By contrast, we expected that, after recalling a goal-consistent behavior, participants with low attitude strength would feel that they had "done enough" and therefore be less motivated to engage in further behaviors than their counterparts who recalled a goal-inconsistent behavior.

Materials and Methods

Procedure

Data were collected through a web-based survey tool (Qualtrics) in spring 2013.

To reduce the risk that questions about participants' attitudes had carryover effects on either the recall manipulation or the dependent variables, we collected the data at two points in time. At time 1, respondents were asked if they wanted to participate seriously or only look at the survey. A "seriousness check" is a recommended means of reducing dropout rates and increasing data quality (Reips, 2002). Participants then answered questions about their attitudes toward the environment, health, and various risks. These items were intermixed and presented in eight question blocks. The risk-related questions were filler items. The survey also included socio-demographic questions.

At time 2 (10–14 days later), participants were again asked if they were willing to participate seriously. They then completed one of four recall conditions, to which they were assigned randomly. After a short filler task (unscramble 12 sequences of four to eight letters into words), participants answered the questions that were used as dependent variables. Finally, participants completed a manipulation check, were thanked and debriefed.

Participants

The sample was recruited via various Swiss Internet forums (e.g., Swiss variations of Craigslist such as pinwand.ch, platforms for students such as students.ch) and social media networks. As an incentive, those who participated in both parts of the survey were entered in a raffle to win Amazon vouchers (4 × EUR 100 and 10 × EUR 10). In total, 738 participants accessed the survey at time 1. Of those, 190 were removed because they responded to fewer than 20% of the questions or because they participated more than once (in which case we discarded the second participation). Of the 548 participants who participated at time 1, 490 accessed the study at time 2. Two participants participated twice; we again excluded the answers from their second participation.

To ensure good data quality, we retained participants only (a) who in both parts passed the seriousness check (Reips, 2002), (b) whose participation time in both surveys lasted at least one third of the sample's median time (16 min at time 1; 17 min at time 2), and (c) who provided a semantically meaningful answer in the recall task (judged by two independent raters). The mean age of participants who met these criteria (N = 378) was 28.78 (SD = 9.29). The proportion of women was 71%. Of the participants who revealed their academic affiliation, 61% were students.

A comparison between the 170 participants who participated at time 1 but either did not participate at time 2 or did participate but were excluded to ensure good data quality and the 378 participants who were retained for the analyses revealed that the proportion of these two groups was not associated with the experimental conditions [$\chi^2(3) = 0.45$, $p = 0.93$]. However, the 378 participants who were retained had a more environmentally friendly attitude ($M = 0.12$, $SD = 0.85$) than those excluded [$M = -0.10$, $SD = 0.96$; $t(294.18) = -2.56$, $p = 0.01$]. Importantly, though, this self-selection bias did not reduce the variance in environmental attitude, which suggests that the sample was still broad enough to conduct the intended analyses. The two groups did not differ with respect to health attitude, $t(324.98) = -1.57$, $p = 0.12$.

Manipulation

Participants were randomly assigned to one of four experimental conditions in which they were asked to recall one of the following types of behavior carried out during the past week: (1) environmentally friendly, (2) environmentally harmful, (3) healthy, or (4) unhealthy. Participants were instructed to take 5–10 min to write down their action in detail (Jordan et al., 2011; Weibel et al., 2014).

To examine whether the manipulation had the intended effect, two manipulation checks were used. First, participants were asked to indicate the valence of the described deed (seven-point scale: −3 = very negative, +3 = very positive). Second, two coders who were blind to conditions rated how environmentally friendly and healthy the deeds were (seven-point scale: −3 = very environmentally harmful/very unhealthy, +3 = very environmentally friendly/very healthy) (Jordan et al., 2011). Interrater reliability was high for both contexts (intraclass correlation coefficient $[ICC]_{environmentally\ friendly}] = 0.92$, $ICC_{healthy} = 0.93$). The ratings of the two coders were combined to create an environmental friendliness and a healthiness scale.

Moderators

To test the hypothesis that the extent of positive and negative spillover is contingent on people's attitudes, we included two behavior-based attitude scales (Kaiser and Wilson, 2004; Byrka and Kaiser, 2013; Kaiser et al., 2014). Following Kaiser et al.'s (2010) suggestion, we used the probabilistic Rasch model (for details, see Bond and Fox, 2007) to estimate attitude levels for persons and behavioral difficulties. This approach is consistent with previous implementations of the Campbell paradigm (Smolders et al., 2012; Kaiser et al., 2013; Urban, 2016; Ogunbode et al., 2018; Brügger et al., 2019).

Environmental attitude was measured with 50 items from Kaiser and Wilson (2004) (see **Supplementary Table 1**). Of the 50, items 32 were presented in a five-point frequency format. Responses to these items were recoded into a dichotomous format by collapsing "never," "seldom," and "occasionally" into "unreliable pro-environmental engagement," and "often" and "always" into "reliable pro-environmental engagement." The remaining 18 items were presented in a yes/no format. Nineteen behaviors represented environmentally unfriendly activities and were recoded prior to analysis. The dichotomization, calibration of the behavior scale, and estimation of person scores were based on the classical Rasch model and consistent with previous calibrations of the same instrument (see Kaiser and Wilson, 2004). Attitude scores were estimated in logits; the more negative the score, the weaker the person's environmental attitude. All behavior items were found to fit the model very well (infit mean square values < 1.18; for reference values, see Bond and Fox, 2007). The Rasch-model-based reliability estimate of the measure was *rel* = 0.80.

Health attitude was measured with 46 items from Byrka and Kaiser (2013) and five items from Kibbe (2011) (**Supplementary Table 2**). For 27 items, we used a five-point frequency answer scale and then dichotomized responses in a similar way as for the environmental scale. The remaining 24 items were presented in a yes/no format. Nine items represented unhealthy behaviors and were recoded prior to analysis. The dichotomization, calibration of the behavior scale, and estimation of person scores were again based on the classical Rasch model and consistent with previous calibrations (Byrka and Kaiser, 2013). All behavior items were found to fit the model very well (infit mean square values < 1.15). The Rasch-model-based reliability estimate of the measure was *rel* = 0.66.

Dependent Variables

To assess the extent of positive and negative spillover, we used two types of dependent variables as proxies for future goal-conducive behaviors. First, participants indicated on a seven-point scale (1 = I will not do that under any circumstances, 7 = I will certainly do that) the extent to which they intended to engage in 18 behaviors in different contexts during the next month. Of these *behavioral intentions*, five were related to protecting the environment and five concerned their personal health and were used as dependent variables (**Table 1**). The other eight were fillers.

Second, we asked participants if they would be interested in using online apps that provided support and tips to better achieve goals. Of the nine apps, three were related to environmental protection and three to improving health (**Table 1**); the other three were fillers. Participants used a seven-point scale to indicate how much they were interested in these apps (1 = not interested at all, 7 = very interested).

Results

Levels of Environmental and Health Attitudes in the Four Experimental Conditions

We first established that the random allocation of participants to the four conditions was successful with respect to the strength of attitudes. Levels of environmental [$F(1,376) = 0.03$, $p = 0.86$, $\eta^2 = 0.00$] and health attitude [$F(1,376) = 0.40$, $p = 0.53$, $\eta^2 = 0.00$] were not statistically different in the four conditions.

Manipulation Checks

Environmental behavior

Manipulation checks showed that the recall manipulation had the intended effect. Participants in the environmentally friendly condition rated the recalled environmental action as more positive ($M = 5.63$, $SD = 0.99$) than participants in the

environmentally unfriendly condition (M = 3.10, SD = 1.14), $t(179) = 16.04$, $p < 0.001$, $d = 2.39$. Coders also rated the recalled environmental behaviors in the environmentally friendly condition as more positive ($M = 2.00$, $SD = 0.61$) than those in the environmentally unfriendly condition ($M = -1.58$, $SD = 0.85$), $t(183) = 32.93$, $p \leq 0.001$, $d = 4.84$.

Health behavior

The recall manipulation had the intended effect. Participants in the healthy condition rated the recalled health behavior as more positive ($M = 6.18$, $SD = 0.77$) than participants in the unhealthy condition (M = 2.90, SD = 1.11), $t(188) = 23.84$, $p < 0.001$, $d = 3.46$. Coders rated the health behaviors in the healthy condition as more positive ($M = 2.14$, $SD = 0.48$) than those in the unhealthy condition ($M = -1.71$, $SD = 0.54$), $t(190) = 52.11$, $p \leq 0.001$, $d = 7.53$.

Environmental Attitude Moderates the Effect of Past Environmental Actions on Some Intentions

Multiple regression analyses examined the effects of the recall manipulation (environmentally friendly vs. unfriendly behavior), environmental attitude, and their interaction on pro-environmental intentions and interest in apps. We tested two models for each dependent variable. In the first step, environmental attitude and the recalled behavior were entered as predictors. In the second step, the interaction term (Recall × Attitude) was added to the model. If adding the interaction term resulted in a statistically significant improvement to the model, we used the Johnson-Neyman conditional analysis (Spiller et al., 2013), made available through the R package jtools (Long, 2018), to identify the range of the environmental attitude for which the simple effect of the recall manipulation was significant. Simple slope analyses were then used to better understand the interactions (Cohen et al., 2003; Spiller et al., 2013).

Interaction effects

To test the prediction that attitude strength would influence the extent of positive and negative spillover, we first explored potential interaction effects. For two (of five) intentions, the effect of the recall manipulation depended on the strength of participants' environmental attitude (**Table 2**).

The first interaction was found when the intention to compost green waste was used as the dependent variable (**Table 2**). Analysis of this interaction with the Johnson-Neyman technique showed that the recall manipulation had an effect only on participants with attitude scores less than 0.16 (i.e., the 53rd percentile; **Figure 2A**).[2] The simple slopes for participants with strong attitudes (75th percentile) showed that these participants were equally motivated to compost regardless of whether they had recalled an environmentally friendly versus unfriendly action ($B = 0.08$, $SE = 0.43$, $p = 0.85$; **Figure 2B**). By contrast, those with medium or weak attitudes less strongly intended to compost when they had recalled an environmentally friendly compared to an environmentally unfriendly action (50th percentile: $B = -0.65$, $SE = 0.32$, $p = 0.04$; 25th percentile: $B = -1.38$, $SE = 0.44$, $p < 0.001$; **Figure 2B**).

The second interaction effect was found when participants indicated whether they intended to turn off the lights when leaving a room (**Table 2**). Using the Johnson-Neyman technique, it was found that recalling either an environmentally friendly or an unfriendly behavior significantly predicted the

[2]The Johnson-Neyman technique suggested that the recall condition would also have an effect on participants with an extremely favorable environmental attitude (i.e., scores larger than 4.08). However, because our sample did not include any participants with such extreme scores, this extrapolated effect should be seen as hypothetical and treated with caution.

TABLE 1 | Descriptive statistics for behavioral intentions (I1–I5) and interest in apps (A1–A3) in the contexts of environment and health, Study 1.

	Mean	*Median*	*SD*	*Range*
Environmental protection				
I1: Composting green waste	4.71	6	2.35	1–7
I2: Using biodegradable cleaning agents	4.56	5	1.84	1–7
I3: Switching off electronic devices on standby completely overnight	4.93	5	1.90	1–7
I4: Buying locally grown vegetables and fruits	5.86	6	1.28	1–7
I5: Switching off lights when leaving a room	6.54	7	0.84	2–7
A1: Saving energy at work	4.38	4	1.78	1–7
A2: Saving energy at home	5.28	6	1.58	1–7
A3: How to reduce my CO_2 emissions	4.71	5	1.79	1–7
Health				
I1: Treating myself with a high-calorie or fatty snack (e.g., chocolate bar or potato chips) (reverse-coded)	2.32	2	1.64	1–7
I2: Taking time to relax	5.51	6	1.42	1–7
I3: Exercising for at least 2 h per week	5.74	7	1.70	1–7
I4: Drinking no more than one glass of alcohol per day	4.62	5	2.24	1–7
I5: Preparing at least one fresh meal per day	5.55	6	1.59	1–7
A1: How to maintain a healthy diet	5.71	6	1.45	1–7
A2: Simple relaxation techniques in your spare moments	5.02	5	1.58	1–7
A3: More physical activity in everyday life	5.28	6	1.73	1–7

intention to turn off lights for participants who scored lower than −0.62 or higher than 1.66 on environmental attitude (**Figure 2C**). More specifically, the simple slopes again show that participants with a weak attitude (25th percentile) less strongly intended to turn off the lights after recalling an environmentally friendly than an environmentally unfriendly behavior (B = −0.33, SE = 0.16, p = 0.04; **Figure 2D**). By contrast, recalling either an environmentally friendly or unfriendly behavior did not have any effect on participants with medium or strong environmental attitudes, respectively (50th percentile: B = −0.05, SE = 0.11, p = 0.65; 75th percentile: B = 0.22, SE = 0.15, p = 0.16; **Figure 2D**). However, for 16 participants with an extremely environmentally friendly attitude (>1.66, 95th percentile), recalling an environmentally friendly behavior increased the intention to turn off lights compared to those who recalled a negative behavior (B = 0.52, SE = 0.25, p = 0.04).

We also tested for possible interactions between the recall manipulation and environmental attitude on participants' interest in using three pro-environmental apps. None were statistically significant.

Direct effects of the recall manipulation and environmental attitude

Because the absence of statistically significant interaction effects implies that direct effects can be meaningfully interpreted, we examined whether the recall manipulation and environmental attitude had a direct influence on the dependent variables where the two predictors did not interact. Of eight dependent variables, there were no direct effects of the recall manipulation significant at the 5% level. However, it was found that the stronger participants' level of environmental attitude, the more they were motivated to protect the environment and the more they were interested

TABLE 2 | Direct and interactive effects of environmental attitude and recalled behavior on intentions and interest in apps, Study 1.

	Step 1			Step 2			
	B	*95% CI*	R^2	*B*	*95% CI*	R^2	ΔR^2
I1: Composting							
Attitude	0.91***	[0.56, 1.26]	0.15	0.47$^{\$}$	[−0.02, 0.96]	0.18	0.03*
Recall manipulation	−0.64$^{\$}$	[−1.28, 0.01]		−0.77*	[−1.42, −0.13]		
Recall × attitude				0.87*	[0.18, 1.56]		
I2: Cleaning agents							
Attitude	0.99***	[0.74, 1.24]	0.27	0.96***	[0.60, 1.32]	0.27	0.00
Recall manipulation	0.09	[−0.37, 0.56]		0.08	[−0.39, 0.56]		
Recall × attitude				0.07	[−0.44, 0.57]		
I3: Switching off electronic devices							
Attitude	0.96***	[0.71, 1.20]	0.26	0.78***	[0.43, 1.14]	0.27	0.01
Recall manipulation	−0.43$^{\$}$	[−0.88, 0.03]		−0.48*	[−0.94, −0.02]		
Recall × attitude				0.33	[−0.16, 0.82]		
I4: Local food							
Attitude	0.54***	[0.38, 0.71]	0.19	0.44***	[0.19, 0.68]	0.19	0.01
Recall manipulation	−0.04	[−0.36, 0.27]		−0.07	[−0.39, 0.25]		
Recall × attitude				0.20	[−0.14, 0.54]		
I5: Switching off lights							
Attitude	0.25***	[0.13, 0.38]	.09	0.09	[−0.09, 0.26]	0.12	0.03*
Recall manipulation	−0.05	[−0.28, 0.18]		−0.10	[−0.33, 0.13]		
Recall × attitude				0.32*	[0.07, 0.56]		
A1: Saving energy at work							
Attitude	0.51***	[0.25, 0.77]	0.10	0.53**	[0.15, 0.90]	0.10	0.00
Recall manipulation	−0.44$^{\$}$	[−0.93, 0.04]		−0.44$^{\$}$	[−0.94, 0.05]		
Recall × attitude				−0.02	[−0.55, 0.50]		
A2: Saving energy at home							
Attitude	0.34**	[0.12, 0.56]	0.06	0.26	[−0.06, 0.58]	0.06	0.00
Recall manipulation	−0.24	[−0.65, 0.17]		−0.27	[−0.69, 0.15]		
Recall × attitude				0.16	[−0.29, 0.60]		
A3: Reduce CO_2							
Attitude	0.61***	[0.37, 0.86]	0.13	0.56**	[0.21, 0.92]	0.13	0.00
Recall manipulation	−0.35	[−0.80, 0.11]		−0.36	[−0.83, 0.10]		
Recall × attitude				0.09	[−0.40, 0.59]		

*Environmentally unfriendly behavior = 0, environmentally friendly behavior = 1. ***$p < 0.001$, **$p < 0.01$, *$p < 0.05$, $^{\$}p < 0.10$.*

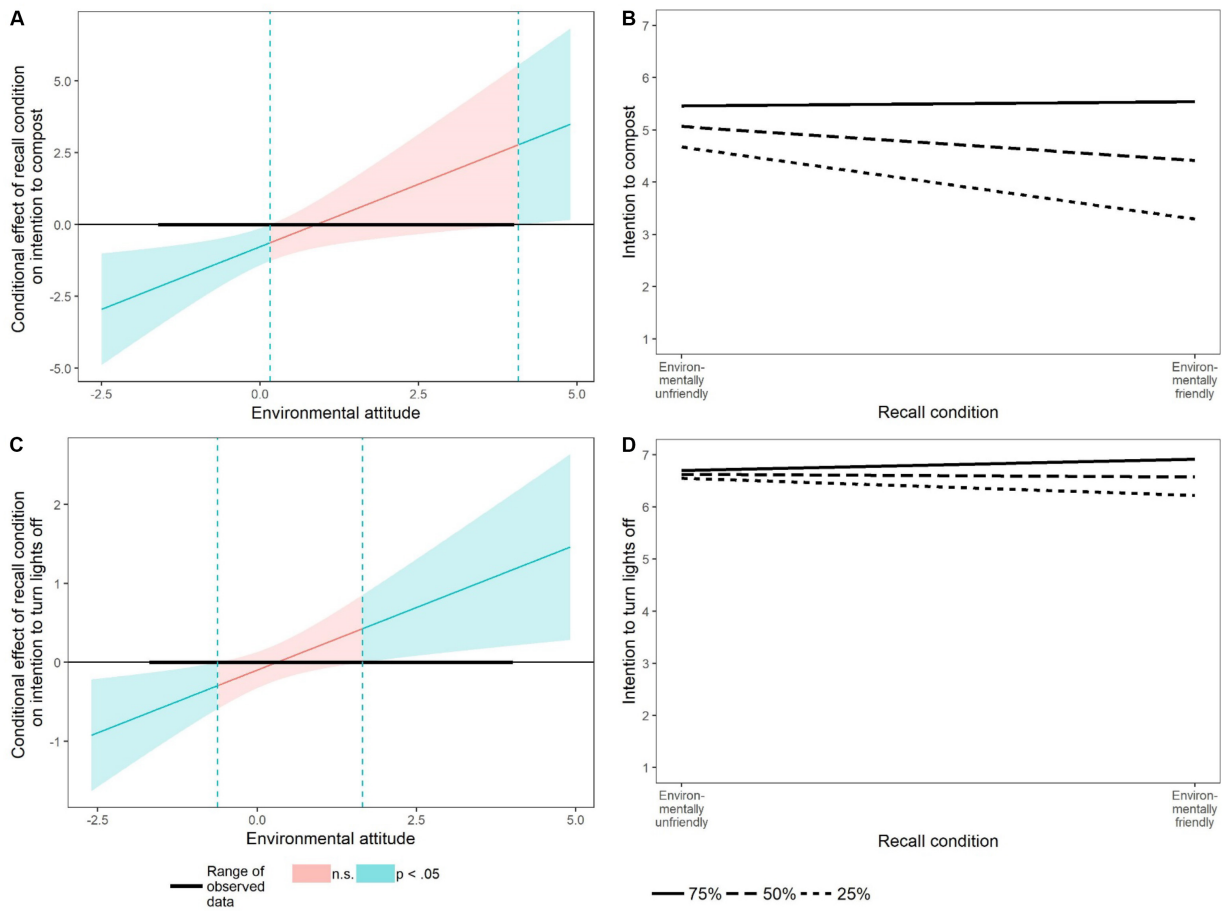

FIGURE 2 | Panels **(A,C)** show the levels of environmental attitude for which recalling an environmentally friendly versus unfriendly behavior had a statistically significant effect on intention (Johnson-Neyman technique). Panels **(B,D)** show simple slopes of the effect of recalling an environmentally friendly versus unfriendly behavior on intentions for the median of the lower, middle, and upper terciles of environmental attitude.

in relevant apps. This direct effect was found for all eight dependent variables.

Taken together, these results provide some support for our hypothesis. The patterns of the interactions are consistent with the prediction that participants with a weak environmental attitude would be affected by the valence of the recalled behavior such that they would be less motivated to engage in environmentally friendly behavior after recalling an environmentally friendly behavior (negative spillover). Among those with an *extremely* positive environmental attitude, the stronger intention to turn lights off after recalling an environmentally friendly action is an example of positive spillover.

Health Attitude Does Not Moderate the Effect of Past Health Behavior

Interaction effects

Following the same analytic approach, the prediction that a strong health attitude would increase the likelihood of positive spillover and reduce the likelihood of negative spillover was not confirmed. Health attitude did not moderate the effect of recalling an healthy or unhealthy behavior with respect to any of the five health intentions or interest in health-related apps (**Table 3**).

Direct effects of the recall manipulation and health attitude

The recall manipulation again did not affect any of the dependent variables at the 5% significance level. Health attitude was, however, positively related to three behavioral intentions and interest in two apps.

Discussion

Study 1 tested the hypothesis that attitude strength would moderate the effect of an initial behavior on subsequent behaviors. We expected that those with a strong (favorable) attitude would be equally motivated to engage in additional goal-conducive behaviors after recalling either a goal-consistent (environmentally friendly/healthy) or a goal-inconsistent past behavior (environmentally unfriendly/unhealthy), whereas those with a weak attitude would be less motivated to engage in further behaviors after recalling a goal-consistent compared to a goal-inconsistent behavior.

The results of Study 1 provided initial support for this prediction in two of five pro-environmental intentions but in none of the health-related intentions. One possible explanation for why the predicted interaction was not found in more dependent variables is that Study 1 did not have sufficient statistical power to detect the interaction effect. To obtain a rough estimate of the power of Study 1, we conducted a power analysis using the special *F*-test assessing the increase in explained variance due to the interaction with three predictors (i.e., attitude, dummy representing the experimental condition, and their interaction) and a significance level of 0.05 (Faul et al., 2009). Based on these assumptions, the sample size of the two regression analyses (*N*s = 185, 193) provided high power ($1 - \beta > 0.98$) for finding a conventional medium-sized effect (i.e., $|B| = 0.30$) but only weak power ($1 - \beta = 0.27/0.28$) for finding a small effect (i.e., $|B| = 0.10$). The power analysis suggests that a larger sample size is necessary to find small interaction effects.

Another limitation of Study 1 was that the control condition was recalling a goal-inconsistent (unhealthy or environmentally unfriendly) behavior rather than a more neutral task. A weakness of this design is that it is impossible to conclude whether effects of the experimental conditions originate uniquely from recalling a goal-consistent behavior, a goal-inconsistent behavior, or from their combined effects (Mullen and Monin, 2016). To illustrate, the finding that 16 participants with an extremely strong pro-environmental attitude were more motivated to turn lights off after recalling a goal-consistent action (environmentally friendly) could stem from an increase in this intention among those who recalled a goal-consistent behavior, from a decrease among those who recalled a goal-inconsistent behavior – or both. Although all three explanations are logically possible, from a theoretical perspective

TABLE 3 | Direct and interactive effects of health attitude and recalled behavior on intentions and interest in apps, Study 1.

	Step 1			Step 2			
	B	**95% CI**	R^2	***B***	**95% CI**	R^2	ΔR^2
I1: Treating myself with a snack							
Attitude	0.35$^{\$}$	[−0.03, 0.74]	0.02	0.11	[−0.46, 0.68]	0.03	0.01
Recall manipulation	0.12	[−0.35, 0.59]		0.06	[−0.42, 0.54]		
Recall × attitude				0.45	[−0.32, 1.22]		
I2: Taking time to relax							
Attitude	0.42*	[0.09, 0.74]	0.03	0.49$^{\$}$	[−0.00, 0.98]	0.03	0.00
Recall manipulation	−0.04	[−0.43, 0.35]		−0.02	[−0.42, 0.38]		
Recall × attitude				−0.13	[−0.78, 0.53]		
I3: Exercising at least 2 h/week							
Attitude	0.95***	[0.58, 1.31]	0.12	0.76**	[0.22, 1.30]	0.13	0.00
Recall manipulation	−0.04	[−0.48, 0.40]		−0.08	[−0.53, 0.37]		
Recall × attitude				0.35	[−0.38, 1.08]		
I4: Drinking less than 1 glass/day							
Attitude	0.26	[−0.29, 0.81]	0.01	0.31	[−0.48, 1.10]	0.01	0.00
Recall manipulation	0.10	[−0.57, 0.76]		0.11	[−0.57, 0.78]		
Recall × attitude				−0.09	[−1.20, 1.02]		
I5: Prepare at least 1 fresh meal/day							
Attitude	0.90***	[0.55, 1.26]	0.12	0.96***	[0.43, 1.49]	0.12	0.00
Recall manipulation	0.31	[−0.13, 0.74]		0.32	[−0.13, 0.76]		
Recall × attitude				−0.10	[−0.83, 0.62]		
A1: How to keep a healthy diet							
Attitude	0.69***	[0.39, 1.00]	0.12	0.63**	[0.19, 1.08]	0.12	0.00
Recall manipulation	−0.36$^{\$}$	[−0.73, 0.01]		−0.37$^{\$}$	[−0.75, 0.00]		
Recall × attitude				0.11	[−0.50, 0.72]		
A2: Relaxation techniques							
Attitude	0.29	[−0.07, 0.66]	0.02	0.35	[−0.19, 0.90]	0.02	0.00
Recall manipulation	0.15	[−0.30, 0.60]		0.16	[−0.30, 0.62]		
Recall × attitude				−0.11	[−0.85, 0.63]		
A3: More physical activity							
Attitude	0.50*	[0.09, 0.90]	0.04	0.34	[−0.26, 0.94]	0.04	0.00
Recall manipulation	−0.31	[−0.80, 0.18]		−0.35	[−0.85, 0.15]		
Recall × attitude				0.30	[−0.51, 1.11]		

Unhealthy behavior = 0, healthy behavior = 1. ***$p < 0.001$, **$p < 0.01$, *$p < 0.05$, $^{\$}p < 0.10$.

it seems somewhat implausible that those with the most extreme pro-environmental attitude would act against their goal after an environmentally friendly action. Ultimately, however, this is an empirical question that requires empirical testing and can best be investigated with an additional neutral condition.

A further limitation of Study 1 is that the sample consisted mainly of female students. Consequently, environmental and health attitudes may have been more homogeneous than in the general adult population. Without a more representative sample, the findings of Study 1 might be limited to well-educated female students.

STUDY 2

Study 2 aimed to replicate the findings of Study 1 and address its shortcomings by adding a neutral control condition and by using a larger and demographically more heterogeneous sample. We used the neutral control condition as a baseline and examined the moderating effect of attitude strength on recalling a goal-inconsistent (environmentally unfriendly/unhealthy) or goal-consistent (environmentally friendly/healthy) behavior.

We expected that participants with a strong attitude would be more motivated to engage in goal-conducive behaviors after recalling either a goal-consistent or goal-inconsistent behavior than after recalling a neutral behavior. The prediction is based on the following assumptions: when such participants carry out a behavior that is relevant to their attitude, it increases (a) the salience of the attitude and (b) the relationships between different attitude-relevant behaviors and how they are relevant to the underlying attitude; and (c) if such participants carry out a behavior inconsistent with their attitude, they experience cognitive dissonance. Regarding participants with weak attitudes, we predicted that they would feel that they had "done enough" and be less motivated to engage in further similar behaviors after recalling a goal-consistent behavior compared to a neutral behavior. For these participants, previous environmentally unfriendly or unhealthy actions are unlikely to lead to cognitive dissonance because they do not conflict with attitudes. We therefore did not expect motivation to differ after recalling a goal-inconsistent behavior relative to recalling a neutral behavior.

Materials and Methods

Procedure

The general procedure was the same as Study 1. Data were again collected through Qualtrics at two points in time in 2018. At time 1, participants answered questions regarding their environmental and health attitudes and socio-demographic questions.

At time 2 (8–12 days later), participants completed one of five recall conditions, to which they were assigned randomly. After answering two sets of questions that are beyond the scope of Study 2 (i.e., relating to possible additional moral processes), participants answered the questions used as dependent variables. Finally, they were thanked and debriefed.

Participants

A power analysis using the special F-test assessing the increase in explained variance due to the interaction with five predictors (i.e., attitude, two dummies representing the experimental conditions, and their interactions; Faul et al., 2009) suggested that to find a small-to-medium effect ($|B| = 0.15$) with 90% power at the 5% level, at least 553 participants are required for an experimental design with three groups. To be able to conduct the analysis in two contexts (environment and health), we increased the target sample size proportionally and aimed for a total sample of $N = 922$.

The United States-based sample was recruited via Amazon Turk. Those who participated in both parts of the survey were paid US $4. In total, 1,208 participants started the survey at time 1. Of those, 26 were removed due to a missing personal identifier. Eighteen were removed because they participated more than once (in which case we discarded the participation that included more missing values, and in case of a similar amount of missing values, the second participation). A further 38 participants were removed because they responded to fewer than 20% of the questions.

Of all participants who finished the survey at time 1, 1,003 accessed the study at time 2. Ten participants participated twice; we again excluded the answers from the participation that included more missing values, and in case of a similar amount of missing values, the second participation. A further 37 participants were removed because they responded to less than 20% of the questions.

Some 174 participants were excluded as they did not take part in both parts of the study. To ensure good data quality, we again retained only participants (a) who passed the seriousness check (Reips, 2002), (b) whose participation time in both surveys lasted at least one third of the sample's median time (10.55 min at time 1, 10.19 min at time 2), (c) who provided a semantically meaningful answer in the recall task (judged by three independent raters), and (d) who passed the attention checks that were included in both parts of the study. Based on these criteria, 25 participants were excluded. The mean age of participants who met the criteria ($N = 929$) was 37.42 ($SD = 12.01$). The proportion of women was approximately 65%. Of participants who revealed their academic background, for 10.1% the highest degree was high school or lower, 20.1% partially completed college, 13.5% fully completed college, 39.6% had a bachelor's degree, and 16.7% a master's or Ph.D. degree.

A comparison of the 199 participants who either did not participate in the survey both times ($N = 174$) or who did participate but were excluded to ensure good data quality and the 929 participants who were retained for the analyses did not reveal any differences in environmental or health attitudes (t-tests, ps = 0.17, 0.60). The proportion of participants who dropped out or were excluded was not associated with experimental condition, $\chi^2(4) = 1.75$, $p = 0.782$.

Manipulation

Participants were randomly assigned to one of five experimental conditions. In addition to the four conditions used in Study 1, a control condition was included in which participants were asked to recall their routine on a typical Tuesday (Jordan et al.,

2011; Cornelissen et al., 2013). In all conditions, participants were instructed to take 5–10 min to write down their action or routine in detail (Jordan et al., 2011; Weibel et al., 2014).

To examine whether the manipulation had the intended effect, three coders blind to condition rated how environmentally friendly and healthy the recalled deeds were (seven-point scale: −3 = very environmentally harmful or unhealthy, +3 = very environmentally friendly or healthy). Interrater reliability was high (intraclass correlation coefficient $[ICC]_{environmentally\ friendly}$ = 0.88, $ICC_{healthy}$ = 0.89). The ratings of the coders were averaged into an environmental friendliness and a healthiness scale.

Moderators

Environmental attitude was measured with 47 items (see **Supplementary Table 1**) from Kaiser and Wilson (2004). Of the 47 items, 30 were presented in a five-point frequency format. The responses to these items were recoded into a dichotomous format by collapsing "never," "seldom," and "occasionally" into "unreliable pro-environmental engagement," and "often" and "always" into "reliable pro-environmental engagement." The remaining 17 items were presented in a yes/no format. Nineteen behaviors represented environmentally unfriendly activities and were recoded prior to analysis. The dichotomization, calibration of the behavior scale, and the estimation of person scores were based on the classical Rasch model and in line with previous calibrations of the same instrument (Kaiser and Wilson, 2004). All behavior items were found to fit the model very well (infit mean square values < 1.29; for reference values, see Bond and Fox, 2007). The Rasch-model-based reliability estimate of the measure was *rel* = 0.74.

Health attitude was measured with 44 items from Byrka and Kaiser (2013) and nine newly developed items (**Supplementary Table 2**). For 27 items, a five-point frequency scale was used; then responses were dichotomized as for the environmental scale. The remaining 24 items were in a yes/no format. Nine items represented unhealthy behaviors and were recoded prior to analysis. All behavior items fit the model very well (infit mean square values < 1.23). The Rasch-model-based reliability estimate was *rel* = 0.77.

Dependent Variables

To assess the extent of positive and negative spillover, we used four types of dependent variables. First, participants indicated on a seven-point scale (1 = very unlikely, 7 = very likely) how likely they are to engage in 17 behaviors in the near future. Of these behavioral intentions, eight were related to the environment and nine to their personal health (**Table 4**).

Second, participants indicated on a seven-point scale (1 = very unlikely, 7 = very likely) how likely they were to sign nine petitions from online sites[3,4]. Of the nine petitions, six were related to environmental protection (**Table 4**) and three to improving health.

[3] change.org

[4] thepetitionsite.com

Third, participants indicated (yes/no) whether they were interested in receiving tips about pro-environmental or healthy behaviors. Fourth, they were given the chance to donate any part of their reimbursement to either an organization for the protection of the environment (**Table 4**) or the promotion of health.

We did not examine any effects on support for health-related petitions or donations. This is because health attitude focuses on people's *personal* health. This makes it difficult or impossible to anticipate any systematic relationship between health attitude and decisions that focus predominantly on promoting *others'* health.

Results

Levels of Environmental and Health Attitudes in the Five Experimental Conditions

The random allocation of participants to the five conditions was successful with respect to the strength of the attitudes: The levels of environmental [$F(4,924) = 1.39$, $p = 0.235$, $\eta^2 = 0.01$] and health attitude [$F(4,924) = 1.59$, $p = 0.175$, $\eta^2 = 0.01$] were not statistically different in the five conditions.

Manipulation Checks

Environmental behavior

The manipulation check showed that the recall manipulation had the intended effect. Coders rated the recalled environmental behaviors in the three conditions differently [$F(2,535) = 1814.00$, $p < 0.001$, $\eta^2 = 0.87$]. *Post hoc* comparisons using the Tukey HSD test indicated that coders rated the recalled action as more positive in the environmentally friendly condition ($M = 1.50$, $SD = 0.56$) than in the control condition ($M = 0.00$, $SD = 0.00$) and the environmentally unfriendly condition ($M = -1.21$, $SD = 0.48$), and as more positive in the control condition than in the environmentally unfriendly condition.

Health behavior

The recall manipulation also had the intended effect with respect to health. Coders rated the recalled behaviors in the three conditions differently [$F(2,532) = 2442.00$, $p < 0.001$, $\eta^2 = 0.90$]. *Post hoc* comparisons using the Tukey HSD test indicated that coders rated the recalled health action as more positive in the healthy condition ($M = 1.43$, $SD = 0.48$) than in the control condition ($M = 0.00$, $SD = 0.00$) and the unhealthy condition ($M = -1.29$, $SD = 0.42$), and as more positive in the control than the unhealthy condition.

Environmental Attitude Moderates the Effect of Past Environmental Actions on One Petition and Has a Direct Positive Effect on All Dependent Variables

To examine the effects of the recall manipulation, environmental attitude, and their interaction on intentions and support for petitions, we used the same multiple linear regression approach as in Study 1. Because of the dichotomous answer format of the pro-environmental information sheet, we used a logistic regression analysis to examine effects on this dependent variable. Furthermore, only 14% of the sample donated to any organization, resulting in a high frequency of zero data points

TABLE 4 | Descriptive statistics for behavioral intentions (I1–I8), petitions (P1–P6), interest in behavior tips, and donations in the contexts of environment and health, Study 2.

	Mean	*Median*	*SD*	*Range*
Environmental protection				
I1: Switching off electronic devices instead of leaving them on stand-by	4.02	4	1.87	1–7
I2: Forego air travel and instead choose a means of transport with less negative effects on the environment	3.85	4	1.92	1–7
I3: Buy ecologically produced food	3.92	4	1.55	1–7
I4: Only eat seasonal produce	3.83	4	1.68	1–7
I5: Boycott products from businesses that harm the environment	3.71	4	1.7	1–7
I6: Buy the environmentally friendly alternative of a product	4.52	5	1.53	1–7
I7: Always recycle plastic bottles (even in public places)	5.35	6	1.61	1–7
I8: Join an environmental group	2.7	2	1.59	1–7
P1: Fee for paper cups	3.41	3	1.96	1–7
P2: Plastic bag tax	4.17	5	2.17	1–7
P3: Ban non-sustainable palm oil	4.32	5	1.97	1–7
P4: Ban plastic dishes	3.87	4	2.07	1–7
P5: Invest in renewable energy	5.2	6	1.92	1–7
P6: No drilling in arctic national wildlife refuge	5.01	6	2.03	1–7
S1: Interest in information sheet	0.6	1	0.49	0–1
D1: Amount environmental donation	0.15	0	0.47	0–4
Health				
I1: Eat four to five servings of fruit/vegetables per day	4.62	5	1.67	1–7
I2: Avoid snacks high in calories (e.g., chips, chocolate)	4.15	4	1.79	1–7
I3: Choose lean over fatty food options	4.81	5	1.58	1–7
I4: Regularly take the stairs instead of the elevator	4.89	5	1.64	1–7
I5: Do 150 min/week of moderate physical activity (gentle swimming, golf, horseback riding)	4.46	5	1.89	1–7
I6: Do 75 min/week of vigorous physical activity (joggin, cycling, aerobics, competitive tennis)	4.33	5	1.91	1–7
I7: Have regular health check-ups (dental hygiene, gynecologist, cancer checks)	4.96	5	1.68	1–7
I8: Drink no more than two beers or similar per week	5.37	7	2.11	1–7
I9: Use sunscreen consistently when exposed to the sun	4.73	5	1.86	1–7
S1: Interest in information sheet	0.61	1	0.49	0–1

and a strongly positively skewed distribution. We therefore used negative binomial regression analyses when donations to a pro-environmental organization was the dependent variable (Carrico et al., 2018).

Interaction effects

For one (of six) petitions, the effect of the environmentally unfriendly recall manipulation depended on the strength of participants' environmental attitude: The significant interaction was found when petition 6 (no drilling in the arctic national wildlife refuge) was used as the dependent variable and the terms that represented the interaction between environmental attitude and participants who either recalled a typical Tuesday (control group) or an environmentally unfriendly behavior were included as predictors (**Table 5**). Analysis of this interaction with the Johnson-Neyman technique showed that the environmentally unfriendly recall manipulation had an effect only on participants with attitude scores less than −1.04 (39th percentile), not for participants whose environmental attitude was equal to or greater than −1.04 (**Figure 3A**). The simple slopes for participants with a weak environmental attitude (25th percentile) showed that they less strongly intended to sign the petition when they had recalled an environmentally unfriendly compared to a neutral behavior ($B = -0.63$, $SE = 0.26$, $p = 0.02$; **Figure 3B**). By contrast, those with a strong or medium attitude were equally motivated to sign the petition after recalling a neutral or an environmentally unfriendly deed (75th percentile: $B = 0.10$, $SE = 0.27$, $p = 0.71$; 50th percentile: $B = -0.28$, $SE = 0.20$, $p = 0.17$; **Figure 3B**).

Similar trends were observed for petition 1 (fee for paper cups), petition 3 (ban unsustainable palm oil) and petition 4 (ban plastic dishes); however, with only marginally significant effects (**Figures 3C–E**). These patterns are not consistent with the prediction that after recalling an environmentally unfriendly versus a neutral behavior, participants with a strong attitude would increase their support for environmental policies, whereas participants with a weak attitude would be relatively unaffected by the two types of memories.

Direct effects of environmental attitude and the recall manipulation

When the valence of the recalled behavior was held constant, participants with a strong environmental attitude acted

TABLE 5 | Direct and interactive effects of environmental attitude and recalled behavior on intentions, willingness to sign petitions, interest in information sheet and amount donated, Study 2.

	Step 1			Step 2			
	B	*95% CI*	R^2	*B*	*95% CI*	R^2	ΔR^2
I1: Switch off electronic devices							
Attitude	0.90***	[0.71, 1.09]	0.16	1.04***	[0.72, 1.36]	0.16	0.00
Recall environmentally Friendly	0.69***	[0.34, 1.03]		0.58*	[0.08, 1.07]		
Recall environmentally Unfriendly	0.11	[−0.24, 0.46]		−0.13	[−0.64, 0.38]		
Recall environmentally Friendly × attitude				−0.15	[−0.61, 0.30]		
Recall environmentally Unfriendly × attitude				−0.30	[−0.76, 0.17]		
I2: Switch from air travel other means of transport							
Attitude	0.63***	[0.43, 0.84]	0.06	0.77***	[0.42, 1.12]	0.07	0.01
Recall environmentally Friendly	0.23	[−0.16, 0.61]		−0.11	[−0.66, 0.43]		
Recall environmentally Unfriendly	0.07	[−0.32, 0.45]		0.11	[−0.46, 0.67]		
Recall environmentally Friendly × attitude				−0.44$^{\$}$	[−0.94, 0.07]		
Recall environmentally Unfriendly × attitude				0.02	[−0.49, 0.53]		
I3: Buy ecologically produced food							
Attitude	0.92***	[0.77, 1.08]	0.21	0.86***	[0.60, 1.11]	0.21	0.01
Recall environmentally Friendly	0.24$^{\$}$	[−0.04, 0.52]		0.18	[−0.22, 0.58]		
Recall environmentally Unfriendly	−0.02	[−0.30, 0.26]		0.22	[−0.19, 0.63]		
Recall environmentally Friendly × attitude				−0.07	[−0.44, 0.30]		
Recall environmentally Unfriendly × attitude				0.29	[−0.09, 0.66]		
I4: Eat seasonal produce							
Attitude	0.66***	[0.49, 0.84]	0.09	0.57***	[0.28, 0.87]	0.09	0.00
Recall environmentally Friendly	0.09	[−0.23, 0.42]		0.15	[−0.31, 0.61]		
Recall environmentally Unfriendly	0.03	[−0.30, 0.36]		0.19	[−0.28, 0.67]		
Recall environmentally Friendly × attitude				0.08	[−0.35, 0.51]		
Recall environmentally Unfriendly × attitude				0.21	[−0.23, 0.64]		
I5: Boycott products							
Attitude	1.09***	[0.92, 1.25]	0.24	1.00***	[0.73, 1.28]	0.24	0.00
Recall environmentally Friendly	0.22	[−0.08, 0.52]		0.20	[−0.22, 0.62]		
Recall environmentally Unfriendly	0.13	[−0.18, 0.43]		0.36	[−0.08, 0.80]		
Recall environmentally Friendly × attitude				−0.02	[−0.41, 0.38]		
Recall environmentally Unfriendly × attitude				0.29	[−0.11, 0.69]		
I6: Buy the environmentally friendly alternative of a product							
Attitude	0.88***	[0.73, 1.03]	0.20	0.96***	[0.70, 1.21]	0.21	0.01*
Recall environmentally Friendly	0.37**	[0.09, 0.65]		0.10	[−0.30, 0.49]		
Recall environmentally Unfriendly	−0.04	[−0.32, 0.24]		0.08	[−0.32, 0.49]		
Recall environmentally Friendly × attitude				−0.35$^{\$}$	[−0.72, 0.01]		
Recall environmentally Unfriendly × attitude				0.13	[−0.24, 0.50]		
I7: Always recycle plastic bottles							
Attitude	0.76***	[0.60, 0.93]	0.19	0.89***	[0.61, 1.16]	0.19	0.00
Recall environmentally Friendly	0.47**	[0.18, 0.77]		0.23	[−0.19, 0.65]		
Recall environmentally Unfriendly	−0.46**	[−0.76, −0.16]		−0.48*	[−0.91, −0.04]		
Recall environmentally Friendly × attitude				−0.32	[−0.71, 0.07]		
Recall environmentally Unfriendly × attitude				−0.04	[−0.44, 0.35]		
I8: Join an environmental group							
Attitude	0.90***	[0.74, 1.06]	0.18	1.01***	[0.73, 1.28]	0.18	0.00
Recall environmentally Friendly	−0.09	[−0.38, 0.21]		−0.29	[−0.71, 0.13]		
Recall environmentally Unfriendly	−0.10	[−0.41, 0.20]		−0.13	[−0.57, 0.30]		
Recall environmentally Friendly × attitude				−0.26	[−0.66, 0.13]		
Recall environmentally Unfriendly × attitude				−0.06	[−0.45, 0.34]		
P1: Fee for paper cups							
Attitude	0.88***	[0.67, 1.08]	0.12	0.69***	[0.35, 1.04]	0.12	0.00
Recall environmentally Friendly	0.12	[−0.26, 0.49]		0.22	[−0.31, 0.76]		
Recall environmentally Unfriendly	−0.18	[−0.56, 0.20]		0.16	[−0.39, 0.72]		
Recall environmentally Friendly × attitude				0.15	[−0.34, 0.65]		
Recall environmentally Unfriendly × attitude				0.43$^{\$}$	[−0.07, 0.93]		

(Continued)

TABLE 5 | Continued

	Step 1			Step 2			
	B	*95% CI*	R^2	*B*	*95% CI*	R^2	ΔR^2
P2: Plastic bag tax							
Attitude	1.00***	[0.78, 1.23]	0.12	0.87***	[0.49, 1.24]	0.13	0.00
Recall environmentally Friendly	0.05	[−0.36, 0.46]		0.06	[−0.52, 0.64]		
Recall environmentally Unfriendly	−0.02	[−0.44, 0.40]		0.31	[−0.29, 0.92]		
Recall environmentally Friendly × attitude				0.03	[−0.51, 0.57]		
Recall environmentally Unfriendly × attitude				0.41	[−0.14, 0.96]		
P3: Ban non-sustainable palm oil							
Attitude	0.86***	[0.65, 1.07]	0.11	0.69***	[0.33, 1.04]	0.12	0.01$^{\$}$
Recall environmentally Friendly	0.15	[−0.23, 0.54]		0.13	[−0.42, 0.67]		
Recall environmentally Unfriendly	−0.19	[−0.58, 0.20]		0.26	[−0.30, 0.83]		
Recall environmentally Friendly × attitude				−0.01	[−0.52, 0.49]		
Recall environmentally Unfriendly × attitude				0.56*	[0.04, 1.07]		
P4: Ban plastic dishes							
Attitude	1.06***	[0.85, 1.27]	0.15	0.90***	[0.55, 1.26]	0.16	0.01
Recall environmentally Friendly	0.04	[−0.35, 0.42]		0.07	[−0.48, 0.61]		
Recall environmentally Unfriendly	−0.04	[−0.44, 0.35]		0.33	[−0.24, 0.89]		
Recall environmentally Friendly × attitude				0.06	[−0.45, 0.56]		
Recall environmentally Unfriendly × attitude				0.45$^{\$}$	[−0.06, 0.97]		
P5: Invest in renewable energy							
Attitude	0.63***	[0.43, 0.84]	0.07	0.55**	[0.21, 0.88]	0.07	0.00
Recall environmentally Friendly	−0.03	[−0.40, 0.34]		−0.06	[−0.58, 0.47]		
Recall environmentally Unfriendly	−0.23	[−0.60, 0.15]		0.02	[−0.52, 0.57]		
Recall environmentally Friendly × attitude				−0.02	[−0.51, 0.47]		
Recall environmentally Unfriendly × attitude				0.31	[−0.19, 0.80]		
P6: No drilling in arctic national wildlife refuge							
Attitude	0.79***	[0.58, 1.01]	0.10	0.68***	[0.32, 1.03]	0.11	0.01*
Recall environmentally Friendly	0.14	[−0.25, 0.53]		−0.02	[−0.57, 0.53]		
Recall environmentally Unfriendly	−0.30	[−0.70, 0.09]		0.17	[−0.40, 0.74]		
Recall environmentally Friendly × attitude				−0.18	[−0.69, 0.33]		
Recall environmentally Unfriendly × attitude				0.57*	[0.06, 1.09]		
S1: Information sheet y/n[a]							
Attitude	0.48***	[0.24, 0.73]	0.03	0.62**	[0.19, 1.09]	0.03	0.00
Recall environmentally Friendly	−0.22	[−0.65, 0.22]		−0.45	[−1.14, 0.21]		
Recall environmentally Unfriendly	−0.44*	[−0.87, −0.01]		−0.53	[−1.23, 0.16]		
Recall environmentally Friendly × attitude				−0.28	[−0.90, 0.32]		
Recall environmentally Unfriendly × attitude				−0.11	[−0.74, 0.50]		
D1: Amount environmental donation[b]							
Attitude	0.84***	[0.57, 1.12]	0.07	0.63**	[0.17, 1.08]	0.07	0.00
Recall environmentally Friendly	0.15	[−0.41, 0.71]		0.28	[−0.30, 0.87]		
Recall environmentally Unfriendly	0.36	[−0.19, 0.92]		0.42	[−0.19, 1.02]		
Recall environmentally Friendly × attitude				0.44	[−0.21, 1.11]		
Recall environmentally Unfriendly × attitude				0.20	[−0.46, 0.87]		

*Environmentally unfriendly behavior = 0, environmentally friendly behavior = 1. ***$p < 0.001$, **$p < 0.01$, *$p < 0.05$, $p < 0.10$. [a]Logistic regression. [b]Negative binomial regression.*

more environmentally friendly than participants with a weak environmental attitude. This direct effect was observed in all 16 dependent variables (**Table 5**) and is evident, for example, in the varying levels of support for petitions in **Figures 3B–E**.

Recalling a neutral versus an environmentally friendly or unfriendly behavior also had some direct effects on the environmental outcome variables: When controlling for the influence of environmental attitude, recalling an environmentally friendly (vs. neutral) behavior increased the motivation to engage in three pro-environmental behaviors (switch off electronic devices, buy eco-friendly products, and recycle plastic bottles). In other words, recalling an environmentally friendly deed promoted positive spillover across all levels of environmental attitude with respect to these intentions. When the intention

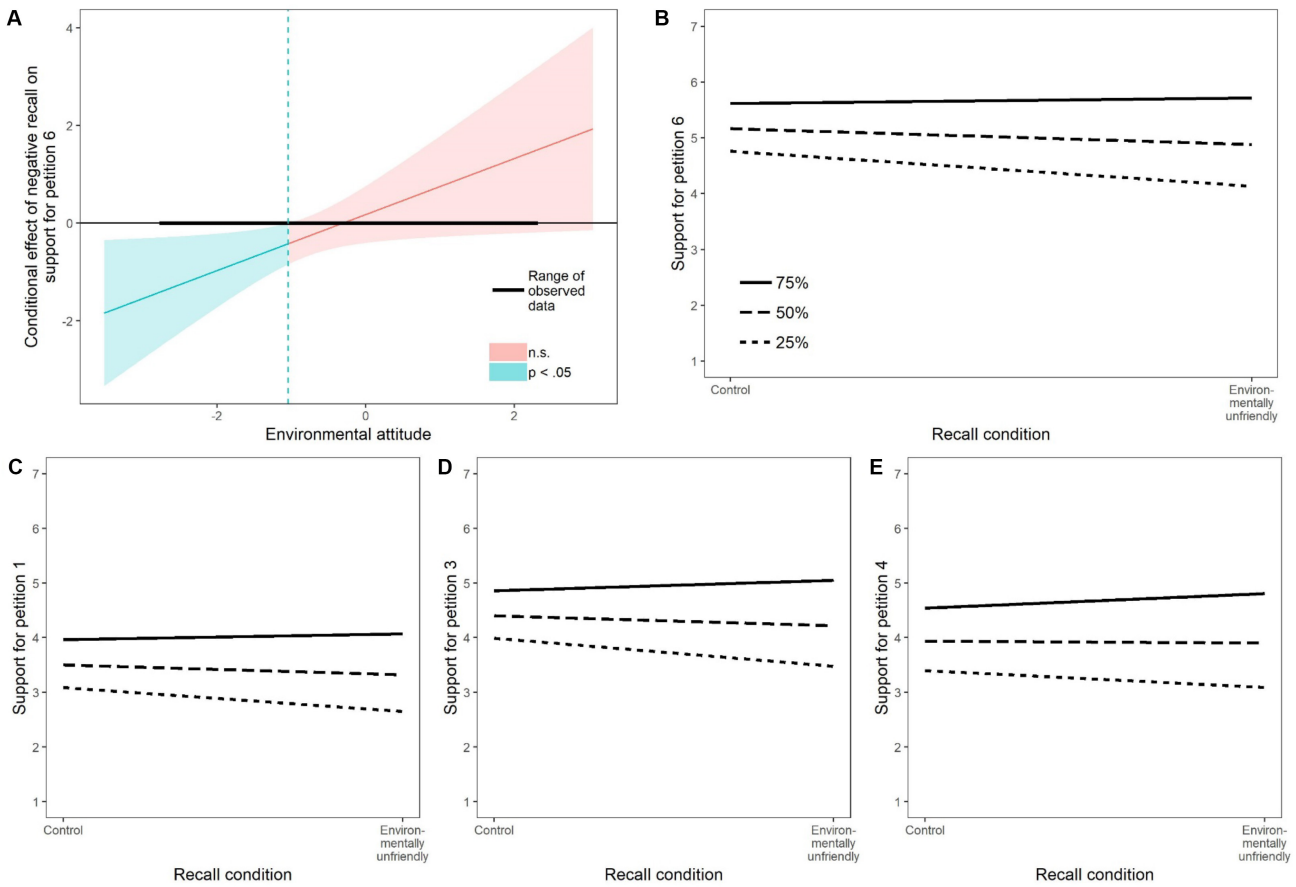

FIGURE 3 | Panel **(A)** shows the level of environmental attitude for which recalling an environmentally unfriendly behavior versus a control condition had a statistically significant effect on petition 6 (Johnson-Neyman technique). Panel **(B)** shows simple slopes of the effect of recalling an environmentally unfriendly behavior versus a control condition on support for petition 6 for the median of the lower, middle, and upper terciles of environmental attitude. Panels **(C–E)** show the same trend (significant at the 10% significance level) as panel **(B)** for three additional petitions.

to recycle plastic bottles was the dependent variable, this behavioral consistency was also observed in the other direction: Recalling an environmentally unfriendly (vs. neutral) behavior decreased the intention to recycle, irrespective of the strength of environmental attitude. Finally, behavioral consistency was found when participants who recalled an environmentally unfriendly behavior were asked if they wanted to receive tips about pro-environmental behavior: Compared to the neutral condition, they were less interested in receiving such information.

Health Attitude Has a Direct Positive Effect on All Dependent Variables

Interaction effects

The prediction that a strong health attitude would increase the likelihood of positive spillover and reduce the likelihood of negative spillover after an initial healthy behavior was not confirmed (**Table 6**). There was even some evidence to suggest a detrimental influence of a strong health attitude. We found a significant interaction when interest in tips for how to live healthily was used as a dependent variable and the healthy (vs. neutral) recall manipulation, health attitude, and their interactions were used as predictors (**Table 6**). A decomposition of this interaction with the Johnson-Neyman technique showed that recalling a healthy behavior had an effect only on participants with attitude scores less than −1.13 (i.e., the 3rd percentile) and more than 0.55 (i.e., the 74th percentile; **Figure 4A**). The simple slopes for participants with strong attitudes (75th percentile) showed that these participants requested the information sheet less frequently when they had recalled a healthy compared to a neutral deed ($B = -0.74$, $SE = 0.32$, $p = 0.02$, **Figure 4B**). By contrast, those with moderate and weak health attitudes did not differ in their interest in the information when they had recalled a healthy or a neutral deed (50th percentile: $B = -0.16$, $SE = 0.22$, $p = 0.46$; 25th percentile: $B = 0.41$, $SE = 0.30$, $p = 0.18$; **Figure 4B**).

Direct effects of health attitude and the recall manipulation

Attitude was positively related to all nine health intentions; that is, the stronger a person's health attitude, the more likely they were to act in a healthy way (**Table 6**). When controlling for the influence of attitude, recalling a healthy (vs. neutral) behavior increased the intention to avoid snacks high in calories

TABLE 6 | Direct and interactive effects of health attitude and recalled behavior on intentions and interest in information sheet 2.

	Step 1			Step 2			
	B	*95% CI*	R^2	*B*	*95% CI*	R^2	ΔR^2
I1: Four to five servings of fruit/vegetables per day							
Attitude	0.95***	[0.76, 1.13]	0.16	1.08***	[0.77, 1.39]	0.16	0.00
Recall healthy	−0.11	[−0.42, 0.20]		−0.07	[−0.39, 0.24]		
Recall unhealthy	−0.24	[−0.55, 0.07]		−0.21	[−0.53, 0.10]		
Recall healthy × attitude				−0.29	[−0.73, 0.16]		
Recall unhealthy × attitude				−0.13	[−0.57, 0.32]		
I2: Avoid snacks high in calories							
Attitude	0.89***	[0.69, 1.08]	0.13	0.81***	[0.49, 1.14]	0.14	0.01$^{\$}$
Recall healthy	0.41*	[0.07, 0.74]		0.42*	[0.08, 0.76]		
Recall unhealthy	0.22	[−0.11, 0.56]		0.17	[-0.17, 0.51]		
Recall healthy × attitude				−0.16	[−0.64, 0.32]		
Recall unhealthy × attitude				0.38	[−0.10, 0.86]		
I3: Choose lean over fatty food options							
Attitude	0.84***	[0.66, 1.01]	0.14	0.81***	[0.52, 1.10]	0.14	0.00
Recall healthy	−0.02	[−0.31, 0.28]		−0.01	[−0.31, 0.29]		
Recall unhealthy	−0.21	[−0.50, 0.08]		−0.24	[−0.53, 0.06]		
Recall healthy × attitude				−0.08	[−0.50, 0.34]		
Recall unhealthy × attitude				0.15	[−0.27, 0.57]		
I4: Take the stairs instead of the elevator							
Attitude	0.80***	[0.61, 0.98]	0.12	0.98***	[0.68, 1.28]	0.13	0.01
Recall healthy	0.08	[−0.22, 0.39]		0.13	[−0.17, 0.44]		
Recall unhealthy	−0.11	[−0.41, 0.20]		−0.08	[−0.39, 0.23]		
Recall healthy × attitude				−0.42$^{\$}$	[−0.86, 0.02]		
Recall unhealthy × attitude				−0.16	[−0.59, 0.28]		
I5: Moderate physical activity							
Attitude	1.08***	[0.87, 1.28]	0.16	0.96***	[0.62, 1.30]	0.16	0.00
Recall healthy	0.17	[−0.18, 0.52]		0.14	[−0.21, 0.49]		
Recall unhealthy	0.27	[−0.07, 0.62]		0.25	[−0.11, 0.61]		
Recall healthy × attitude				0.23	[−0.27, 0.74]		
Recall unhealthy × attitude				0.14	[−0.36, 0.64]		
I6: Vigorous physical activity							
Attitude	1.14***	[0.92, 1.35]	0.17	1.09***	[0.73, 1.44]	0.17	0.00
Recall healthy	−0.02	[−0.38, 0.33]		−0.02	[−0.38, 0.35]		
Recall unhealthy	−0.08	[−0.43, 0.28]		−0.11	[−0.48, 0.25]		
Recall healthy × attitude				−0.09	[−0.61, 0.43]		
Recall unhealthy × attitude				0.25	[−0.27, 0.76]		
I7: Have regular health check-ups							
Attitude	0.69***	[0.50, 0.88]	0.08	0.67***	[0.35, 0.99]	0.08	0.00
Recall healthy	0	[−0.32, 0.33]		0	[−0.33, 0.33]		
Recall unhealthy	0.1	[−0.22, 0.43]		0.1	[−0.23, 0.43]		
Recall healthy × attitude				0.02	[−0.45, 0.48]		
Recall unhealthy × attitude				0.05	[−0.41, 0.52]		
I8: Drink maximum two drinks/week							
Attitude	0.37**	[0.12, 0.62]	0.02	0.61**	[0.20, 1.03]	0.02	0.00
Recall healthy	0.01	[−0.41, 0.43]		0.05	[−0.38, 0.48]		
Recall unhealthy	−0.05	[−0.47, 0.37]		0.02	[−0.41, 0.45]		
Recall healthy × attitude				−0.27	[−0.88, 0.34]		
Recall unhealthy × attitude				−0.48	[−1.09, 0.12]		
I9: Use sunscreen consistently							
Attitude	0.73***	[0.52, 0.95]	0.08	0.70***	[0.34, 1.06]	0.08	0.00
Recall healthy	0.04	[−0.32, 0.41]		0.03	[−0.34, 0.40]		

(Continued)

TABLE 6 | Continued

	Step 1			Step 2			
	B	***95% CI***	R^2	***B***	***95% CI***	R^2	ΔR^2
Recall unhealthy	−0.25	[−0.62, 0.11]		−0.25	[−0.63, 0.12]		
Recall healthy × attitude				0.12	[−0.41, 0.65]		
Recall unhealthy × attitude				−0.01	[−0.53, 0.52]		
S1: Information sheet[a]							
Attitude	0.20	[−0.05, 0.46]	0.00	0.60**	[0.16, 1.06]	0.01	0.01*
Recall healthy	−0.14	[−0.56, 0.28]		−0.06	[−0.49, 0.37]		
Recall unhealthy	−0.13	[−0.55, 0.29]		−0.09	[−0.52, 0.34]		
Recall healthy × attitude				−0.83**	[−1,47, −2.11]		
Recall unhealthy × attitude				−0.36	[−0.99, 0.27]		

*Unhealthy behavior = 0, healthy behavior = 1. ***p < 0.001, **p < 0.01, *p < 0.05, $p< 0.10. [a]Logistic regression.*

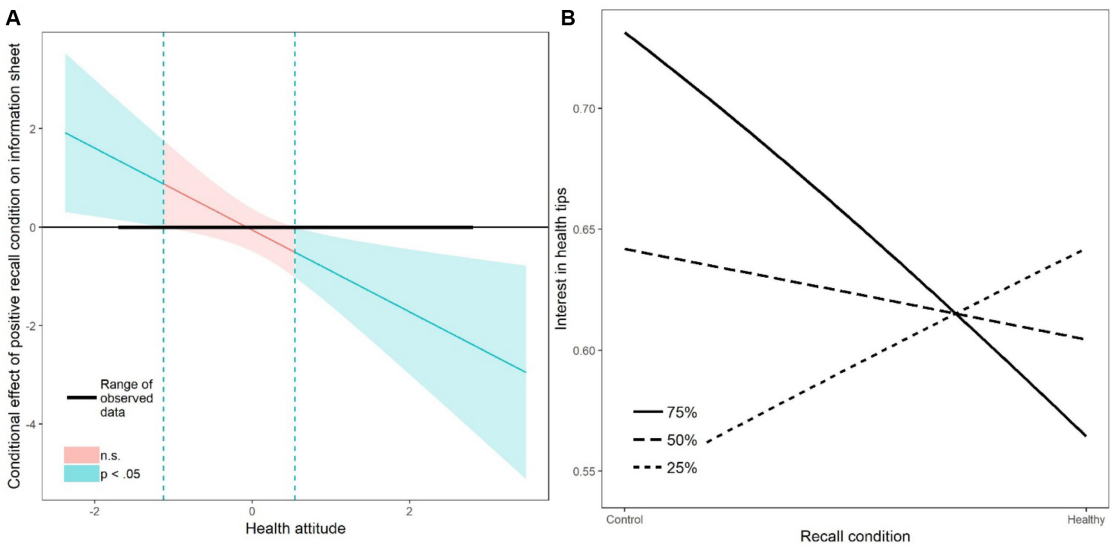

FIGURE 4 | Panel **(A)** shows the level of health attitude for which recalling a healthy behavior versus a control condition had a statistically significant effect on the interest in an information sheet with health tips (Johnson-Neyman technique). Panel **(B)** shows simple slopes of the effect of recalling a healthy behavior versus a control condition on interest in an information sheet with health tips for the median of the lower, middle, and upper terciles of health attitude.

(intention 2, **Table 6**). No other positive or negative spillover effects of the recall manipulation were found.

Discussion

Study 2 provided little evidence for the expected moderating effect of attitude strength: In only two instances – when participants were asked whether they would support a petition against drilling in an arctic wildlife refuge and when they were asked whether they wanted to receive health tips – did the respective attitude moderate the effect of the recalled behavior at the 5% significance level.

What is more, these interactions were not entirely in line with our predictions: We expected that recalling a healthy (vs. a neutral) behavior would increase the interest in receiving health tips among those with a strong health attitude, but found that the recalled behavior decreased their interest in such tips. It is striking that the latter interaction was the only one across both studies in which those with a strong attitude *reduced* their efforts to act in line with their attitude.

To explain this unexpected pattern, we look to the content of the dependent variable: the choice to receive information. It could be argued that participants who have a strong health attitude tend to already know a lot about health. This expertise may have become particularly obvious after recalling a healthy behavior, which might in turn have reduced the subjective need for further information. In other words, this dependent variable may have tapped more into participants' evaluation of whether they require information than their motivation to act healthily. Empirical evidence strengthens the notion that this variable worked differently than questions about behavioral intentions: It was the only variable *not* directly associated with health attitude (**Table 6**).

Adding to the impression that information-related questions might be of only limited use as proxies of behavioral spillover

is the finding that all participants – irrespective of attitude strength – were less interested in receiving tips about pro-environmental behavior after recalling an environmentally unfriendly (vs. neutral) behavior. Moreover, the predictive power of environmental attitude with respect to interest in pro-environmental tips was also considerably smaller than when other dependent variables were used. The diminished influence of attitude strength suggests that additional processes might be in play when participants make decisions about receiving information.

Also contrary to the prediction that recalling an environmentally unfriendly past behavior would increase pro-environmental tendencies among those with a strong attitude and leave those with a weak attitude unaffected, this condition had no discernible effect among those with a strong attitude, but decreased the support for one pro-environmental petition among participants with a weak attitude. One possible explanation for this pattern is that recalling a past environmentally harmful behavior may have increased the salience of participants' existing attitude, which then could have led to behavioral patterns consistent with their respective attitude strength. We will discuss these issues in more detail in the next section.

GENERAL DISCUSSION

This research examined whether attitude strength can explain whether the likelihood of engaging in additional behaviors in the domains of environmental protection and health promotion increases (positive spillover) or decreases (negative spillover) after recalling a goal-conducive behavior in the same domain. We argued that when people who have a strong attitude toward an issue carry out a behavior that benefits the issue, such a behavior is an integral part of a wider network of behaviors that serve a more comprehensive, superordinate goal (Carver and Scheier, 2001). We further argued that this mental structure implies that when people with strong attitudes carry out a goal-conducive behavior, it will increase the salience of related behaviors and the importance of continuing to work toward their attitude (or their superordinate goal), not least because failing to do so would elicit cognitive dissonance and negative feelings (Festinger, 1957; Bargh et al., 1992; Ratneshwar et al., 2001; Thøgersen and Crompton, 2009; Thøgersen and Noblet, 2012; Lanzini and Thøgersen, 2014). In short, we predicted that a strong attitude would promote positive spillover and mitigate the risk of negative spillover after an initial goal-conducive behavior (and vice versa: it would promote negative spillover after an initial goal-inconsistent behavior).

Across two studies, we found limited empirical support for the predicted moderating role of attitude strength. In Study 1, attitude strength moderated the effect of a first behavior in two instances: participants with a weak attitude (25th percentile) less strongly intended to act environmentally friendly after recalling an environmentally friendly versus unfriendly action, while participants with a strong attitude (75th percentile) were similarly motivated regardless of the valence of the recalled action. This pattern is consistent with the prediction that a strong attitude toward an issue should promote positive spillover and mitigate the risk of negative spillover after an initial goal-conducive behavior, while those with a weak attitude should feel that they had done enough and not engage in further behaviors in the same behavioral context. A similar pattern was found in Study 2: Recalling an environmentally unfriendly past behavior again had no discernible effect among those with a strong environmental attitude but decreased support for a pro-environmental petition among participants with a weak attitude.

Taken together, these results suggest that a strong attitude can work as a "behavioral stabilizer" that protects against self-complacency and goal disengagement – it keeps people on track. By contrast, a weak attitude can fuel two tendencies that threaten pro-environmental and healthy behavior: First, it can, as suggested by Study 1, make people susceptible to the kind of behavioral fluctuations that are described in the literature as "moral licensing" (Merritt et al., 2010) or the tendency to "rest on one's laurels" (Amir and Ariely, 2008). Second, a weak attitude can, as suggested by Study 2, increase the susceptibility to disengage entirely from environmental or health goals after an initial setback (i.e., the recall of a goal-inconsistent behavior), a tendency that has been referred to as the "what-the-hell effect" (Cochran and Tesser, 1996; see also Dolan and Galizzi, 2015).

A possible explanation for why participants with a weak environmental attitude acted in line with "moral licensing" (inconsistent behavior or negative spillover) in Study 1 but in line with the "what-the-hell effect" (consistently goal-inconsistent behavior or positive spillover) in Study 2 is that the two samples differed in terms of absolute attitude strength. To examine whether environmental attitude differed across studies, we pooled participants from both studies and recalibrated the Rasch scale (including all items from both studies), so that attitude scores were on the same metric and directly comparable. Participants in Study 1 were more environmentally friendly ($M = 0.06$, $SD = 0.77$) than participants in Study 2 [$M = -0.91$, $SD = 0.73$; $t(663.84) = 20.87$, $p < 0.001$]. Because we defined attitude strength *relative* to other participants in the respective samples, participants with a weak environmental attitude in Study 2 were less environmentally friendly in absolute terms than participants with a weak attitude in Study 1. In other words, participants with a weak attitude in Study 1 probably still cared at least somewhat about the environment and might therefore have displayed the kinds of self-regulation processes well known from research on moral licensing (e.g., Merritt et al., 2010; Jordan et al., 2011; Mullen and Monin, 2016). By contrast, participants with a weak attitude in Study 2 might have felt indifferent or even hostile toward the idea of environmental protection. Recalling an environmentally unfriendly behavior could therefore have highlighted the latter group's anti-environmental attitude and motivated them to engage in further attitude-consistent behaviors, accounting for the observed consistency in their behavior.

In addition to some interaction effects, this research also found compelling evidence for a direct effect of attitude: Across two studies and in both domains, a stronger attitude was associated

with an increased likelihood of engaging in corresponding goal-conducive behaviors. In short, in the context of behavioral spillover, attitude strength assumed two roles – that of a direct predictor and that of a moderator. The direct effect was much more consistent across different dependent variables and contexts than the moderator effect.

In sum, this research provides limited evidence for the idea that attitude strength (as one possible operationalization of relatively stable individual differences in how relevant an issue is to a person) can moderate the extent to which engaging in pro-environmental or healthy behaviors leads to positive or negative spillover.

This finding has implications for theory and practice. First, it provides limited empirical support for plausible but rarely tested assumptions about the role of attitude strength (and similar concepts tapping into personal relevance) in the context of spillover (for notable exceptions, see Effron et al., 2009; Meijers, 2014). As such, our findings improve the field's understanding for *whom* engaging in a goal-conducive behavior leads to positive or negative spillover.

The findings also contribute to a refined theoretical understanding of the conditions under which recalling past behavior affects subsequent behaviors. Based on Bem's (1972) self-perception theory, various spillover researchers have argued that reminding people of past goal-consistent behavior (e.g., pro-environmental actions) could lead to or make salient a corresponding identity and thereby increase the tendency to engage in positive spillover (Van der Werff et al., 2014b; Lacasse, 2015, 2016; Truelove et al., 2016). This line of reasoning points to a relatively malleable conceptualization of identity that is best understood as a *mediator* between recalled and subsequent behavior (Van der Werff et al., 2014a,b). Our findings complement this view by suggesting that when conceptualized and measured as traits, identity – and other similar conceptualizations of relatively stable individual differences such as attitude, superordinate goal, or values – can influence how thinking about past behaviors affects spillover. People who have a firm identity or who hold a very favorable or unfavorable attitude about an issue have few doubts about who they are and what they appreciate. It is therefore unlikely that reminders about what they did or failed to do in the past influence how they see themselves, nor should such reminders have much effect on subsequent behaviors. By contrast – and consistent with Bem's (1972) proposition that people use their behavior to infer information about themselves only "to the extent that internal cues are weak, ambiguous, or uninterpretable" (p. 2) – those with a less firm identity or attitude may find diagnostic value in reminders of past behavior, and adjust subsequent behavior accordingly.

The findings also have implications for practice. It can be assumed that reminding people of past pro-environmental or healthy behaviors (Van der Werff et al., 2014a,b) or labeling them as "environmentalists" or "health-conscious" (Cornelissen et al., 2007; Lacasse, 2016) is an effective strategy to increase positive spillover (after an initial goal-conducive behavior) among those with moderate attitude levels. However, using the same approach is bound to be less effective among those with a firm attitude or identity. A better understanding of how different levels of attitude strength affect spillover can also help campaigners use their resources more efficiently. For instance, our findings suggest that people with a strong attitude are unlikely to display negative spillover. Thus, when trying to reduce negative spillover effects, campaign designers could economize by focusing their efforts on people with moderate and weak attitudes.

A limitation of the research is that attitude strength accounted for positive and negative spillover for only some of the dependent variables. This raises two major questions. First, why did attitude strength moderate the effect of recalling a goal-consistent versus a goal-inconsistent behavior for some but not for other variables? Previous research suggests that when the second behavior is either extremely difficult or extremely easy, it could attenuate or even override the generally positive relationship between attitude strength and the likelihood of engaging in further goal-conducive behaviors (Kaiser and Schultz, 2009; see also Truelove et al., 2014). If this explanation is valid, the anticipated moderating effect of attitude strength should be more likely for intentions that are neither extremely difficult nor easy. However, if the popularity of the dependent variables (see the arithmetic means in **Tables 1**, **4**) is an indication of their difficulty (Kaiser et al., 2007), it can be seen that there is no systematic relationship between item difficulty and whether attitude strength moderated the effect of the recalled behavior. This suggests that the effect of attitude strength on spillover probably did not depend on the difficulty or costs of the behaviors.

On a more speculative note, the fact that the expected moderation was found for only some of the dependent variables could also have to do with the subjective meaning that participants attributed to the respective behaviors. For example, it is possible that participants may have perceived the behaviors as environmentally relevant to different extents (Truelove and Gillis, 2018), and that those with a strong attitude were most likely to engage in behaviors they perceived as impactful. To test this explanation, future research could assess the perceived environmental impact of different behaviors for each participant and examine whether this additional information can help to understand when attitude strength works as a moderator.

The second major question is why did we not find any of the predicted attitude moderations in the health domain. It is striking that much spillover research focuses directly or indirectly on morality, for example, by examining the extent to which engaging in morally relevant behaviors affects people's self-perceptions and subsequent behaviors (Merritt et al., 2010; Jordan et al., 2011; Mullen and Monin, 2016). A possible mechanism through which morality could affect spillover is by highlighting the violation of personal norms after goal-inconsistent behaviors. That is, the stronger people's moral norm regarding the relevant behavior, the more would behaving inconsistently induce cognitive dissonance and threaten their self-perception as a moral person. Thus, people with strong moral norms are likely to behave consistently with their norms and goals and thereby avoid these negative cognitions (Thøgersen, 2004).

This raises the question to what extent moral processes are relevant for the two domains examined here. There is evidence that people understand behaviors that affect the environment to be morally relevant (Stern, 2000; Feinberg and Willer, 2013; Van der Werff et al., 2013; Jia et al., 2017), but the extent to which the same applies to caring for one's own health is less clear. Whereas environmentally harmful actions can negatively affect both the natural environment and other people, eating unhealthily or failing to exercise do not have immediately obvious negative consequences for others, and therefore lack a critical quality of prototypical moral violations (Rottman et al., 2015). It therefore seems plausible that people perceive environmental behavior as more morally charged than health behavior (the comparisons of self-assessed morality of the recalled behaviors support this line of reasoning, see **Supplementary Tables 3**, **4**). In short, to the extent that moral processes play a key role in behavioral spillover, it is possible that such effects – and the corresponding moderation by attitude strength – are more likely to occur in the context of environmental behavior. Future research could test this possibility by comparing the extent to which moral processes are triggered when people engage in environmental versus health behaviors.

One last critical point is that we used several dependent variables, which increased the probability to detect (interaction) effects that do not in fact exist (false positives). This research is exploratory in the sense that it is one of the first to investigate the role of attitude as a moderator of spillover effects and does therefore not necessarily require statistical procedures to correct for false positives (Rothman, 1990; Rubin, 2017). However, to be able to assess the extent to which the rate of false positives might challenge our findings, we used the false discovery rate method (FDR; Benjamini and Hochberg, 1995) to adjust the *p*-values of the interaction terms (i.e., the focal interest of this paper).[5] Applying the FDR method shifted the two relevant interactions of Study 1 just beyond the 5% significance level ($ps = 0.056$); the two relevant interactions of Study 2 were no longer statistically significant ($ps \geq 0.18$). Thus, while the FDR adjustments do not completely challenge our findings, they further qualify the already limited moderating effect of attitude strength.

CONCLUSION

Overall, the two studies showed that the importance of an issue to a person – in our study operationalized as behavior-based attitude (Kaiser et al., 2007, 2010) – had a direct and positive effect on decisions and behaviors. Additionally, we found limited evidence for the prediction that a strong (favorable) attitude increases the consistency of goal-conducive behavior, whereas a weak attitude was associated with less predictable behavioral patterns. This lends some support to the theoretical considerations derived from goal-theoretical perspectives and self-perception theory (for more details, see Höchli et al., 2018). The findings are relevant for theory because they point to a possible boundary condition of positive and negative spillover. Practically they matter because they enable those seeking to effect change to more accurately anticipate the effects of campaigns and interventions on different groups of people, which should help to allocate resources more efficiently and render campaigns more effective.

[5]Note that limiting the FDR adjustment to the interaction terms results in their *p*-values being larger as compared to when the *p*s of all predictors are corrected.

ETHICS STATEMENT

At the time these studies were conducted (spring 2013 and summer 2018), our faculty had no Internal Review Board to grant ethical approval. However, we certify that the research adhered to the ethical principles of the American Psychological Association [APA] (2010). Informed consent was attained by asking participants to continue only if they were willing to participate and if they had read and understood the instructions and information provided. Participants were told that participation was voluntary and that they had the right to withdraw from the study at any time. Upon completion of the study, participants were fully debriefed. The data were anonymized and treated confidentially.

AUTHOR CONTRIBUTIONS

AB conceived and designed Study 1, analyzed the data, and wrote the first draft of the manuscript. BH and AB conceived, designed, and analyzed the data from Study 2. BH contributed to the editing process of the first draft and added additional content. Both authors contributed to manuscript revision, and read and approved the submitted version.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyg.2019.01018/full#supplementary-material

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Looking at Spillovers in the Mirror: Making a Case for "Behavioral Spillunders"

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Behavioral spillovers refer to the influence that a given intervention targeting behavior 1 exerts on a subsequent, non-targeted, behavior 2, which may or may not be in the same domain (health, finance, etc.) as one another. So, a nudge to exercise more, for example, could lead people to eat more or less, or possibly even to give more or less to charity depending on the nature of the spillover. But what if spillovers also operate backward; that is, if the expectation of behavior 1 influences behavior 0 that precedes it? For example, a person may form an intention to exercise prompted by a policy intervention but overeat at present as a result. We define such a possibility as a "spillunder." In the proposed article, we critically review the few papers that we have identified through a narrative literature review which have demonstrated spillunder effects to date, and we propose a conceptual framework. Based on evidence about the human mind and behavior from psychology and economics, we argue that spillunder effects may be more common than the limited empirical findings suggest. We propose six representative mechanisms through which the prospect of behavior 1 may impact behavior 0: executive functions, moral licensing and moral cleansing, emotion regulation, energization, construal level, and savoring and dread. We further discuss the policy and practical implications of spillunder effects and examine methodological issues that need to be considered when empirically testing these effects. As with our earlier paper on spillovers, we aim to motivate other behavioral scientists to research behavioral spillunders more systematically and extensively, and to prompt decision makers to consider these effects when designing behavioral interventions.

Keywords: spillover, spillunder, policy, intervention, nudging, decision-making

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INTRODUCTION

Policy makers have increasingly started adopting behavioral science insights to "nudge" behaviors ranging from energy conservation and sustainable food consumption to tax collection (Dolan et al., 2012; Ölander and Thøgersen, 2014; Halpern, 2015). Dolan and Galizzi (2015) have argued that transitioning to a second generation of behaviorally informed policy-making will require moving beyond immediate behavioral effects and investigating "behavioral spillovers" from one behavior to the next (Truelove et al., 2014; Nash et al., 2017). For example, an intervention that encourages people to donate blood may license them to subsequently display actions that are not as moral, thus donating less to environmental charities (Blanken et al., 2015).

But what if behavioral spillovers also operate backward; that is, if aiming to undertake a behavior at some point in the future influences another preceding behavior? For example, expecting to donate blood next week may license someone to behave less morally at present and discriminate a job candidate on a racial basis (Cascio and Plant, 2015). We label such a "mirror image" of behavioral spillovers as "spillunders." This paper aims to establish behavioral spillunders as a construct that policy makers need to consider if they are to avoid unintended behavioral consequences when designing policy interventions. We start by defining spillunders, after which we propose a conceptual framework, and we overview the spillunder effects that we have identified via a narrative literature review. By examining evidence about the human mind and behavior from the field of behavioral science, we then argue that spillunder effects are likely to be more pervasive than what is suggested by the limited empirical evidence encountered through our narrative literature review. We further discuss the relevant policy implications and examine methodological considerations behind testing and measuring spillunder effects.

BEHAVIORAL SPILLUNDERS

Definition

Before proposing a definition of spillunders, it is useful to recall the definition of spillovers. According to Dolan and Galizzi (2015), the starting point of any behavioral spillover is an intervention, which they broadly define as any policy intervention or experimental manipulation aimed at changing or inducing a behavior. For example, an intervention can involve a nudge that changes behavior at an automatic level, a financial incentive, a persuasion technique, an experimental instruction that informs participants to engage in certain actions, etc. Each spillover involves an "intervention—behavior 1—behavior 2" triplet, where behavior 1 and behavior 2 are two different and sequential behaviors, and where the intervention is directed at influencing the targeted behavior 1. Behavioral spillover refers to the effect of the intervention on the subsequent, non-targeted behavior 2 (**Figure 1**). The occurrence of a behavioral spillover is assessed experimentally by comparing the quantity of behavior 2 in a group randomly assigned to the intervention relative to a control group with no intervention (Galizzi and Whitmarsh, 2019). For example, Dolan and Galizzi (2014a) investigated how the effect of a financial incentive (intervention) on a physical activity (behavior 1)—stepping on a 6-inch high stepper—spills onto subsequent eating (behavior 2). Compared to the control condition, both high incentives (£0.10 per step) and low incentives (£0.02 per step) significantly increased the number of steps participants performed. However, whereas low incentives (vs. control) did not impact subsequent eating behavior, high incentives increased calorie intake, thus resulting in people consuming more calories than they burned.

In line with this conceptualization of spillovers, each spillunder involves an "intervention—behavior 0—behavior 1" triplet. That is, the intervention is directed at targeted behavior 1 as in the context of spillovers. The non-targeted behavior, however, is a different behavior 0 which *precedes* (rather than follows) behavior 1.[1] Behavioral spillunder therefore refers to the impact of the intervention on this preceding behavior 0 (**Figure 1**). For example, in Masicampo and Baumeister (2011), all participants were told that they would need to undertake a brainstorming task that would require them to generate as many different examples of a given category as possible (behavior 1). The intervention consisted of providing participants with different instructions concerning behavior 1: in the unfulfilled goal group, they were told that they would need to list as many examples of sea creatures as they could; in the fulfilled goal group, they were given the same instructions about the sea creatures but were also asked to form a more precise plan of how they would accomplish the task (e.g., "When I get to the final task, I will write down the letters of the alphabet and will list sea creatures for each one," Masicampo and Baumeister, 2011, p. 676); in the control condition, they were given broad instructions about having to undertake a category generation task without any reference to the specifics. Before undertaking behavior 1, all participants were administered an anagram task (behavior 0) and asked to solve as many as they could. The results showed that participants in the unfulfilled goal group solved fewer anagrams than those in the other two groups, presumably because the prospect of having to generate examples of sea creatures but without having a specific strategy that makes the task easy produced intrusive thought that

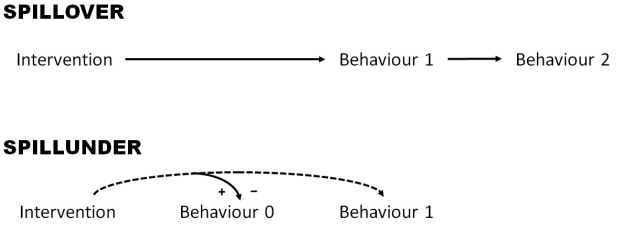

FIGURE 1 | A conceptual diagram of spillover and spillunder effects. A behavioral spillover involves an "intervention—behavior 1—behavior 2" triplet, where behavior 1 and behavior 2 are two different and sequential behaviors, and the intervention is directed at behavior 1. The spillover therefore refers to the effect of the intervention on the subsequent, non-targeted behavior 2. Similarly, each spillunder involves an "intervention—behavior 0—behavior 1" triplet. As for the spillovers, the intervention is directed at targeted behavior 1. The non-targeted behavior, however, is a different behavior 0 which precedes (rather than follows) behavior 1. Behavioral spillunders thus comprise the effects that the anticipation of some behavior 1 that was induced by the intervention has on the preceding behavior 0. From this perspective, it is of a lesser importance whether or not behavior 1 ever takes place after behavior 0: what really matters is the anticipation of behavior 1 generated by different instructions about this behavior. In that sense, it is not behavior 1 itself that influences behavior 0, but the prospect of this behavior instigated by the intervention. Signs + and – refer to "enhancing" and "extinguishing" spillunders respectively, thus indicating that the prospect of some behavior 1 can either increase (+) or decrease (–) the quantity of behavior 0 or its likelihood of occurrence.

[1]It is important to point out that, conceptually speaking, behavior 0 can refer to various different behaviors that precede behavior 1 (e.g., behavior 0a, behavior 0b, etc.). Because we have, however, failed to identify any such more complex spillunders in the literature, we refrain from further addressing them in the present article.

clashed with the present anagram solving. As with behavioral spillovers, participants do not need to be consciously aware of what links behavior 0 and behavior 1 for spillunders to take place.

Therefore, as with spillovers, our conceptualization of spillunders naturally lends itself to imagining a longitudinal between-subject experimental setting where participants are randomly allocated to either a control or (at least) a treatment group. Participants in both groups are asked to perform exactly the same task (behavior 0). Before this task, however, they are given different sets of instructions (intervention) for a subsequent behavior 1 that will take place only after behavior 0. Behavioral spillunders thus refer to the effects that the anticipation of different behaviors 1 has on the preceding behavior 0. From this perspective, it is of a lesser importance whether or not behavior 1 ever takes place after behavior 0 (and how exactly it takes place): what really matters is the *anticipation* of behavior 1 generated by different instructions about this behavior. An alternative, but substantially corresponding, way of conceptualizing spillunders is by imagining the same longitudinal between-subject experimental setting described above, but where the intervention is behavior 1 itself: participants are randomly allocated to either the control or the treatment group; participants in both groups perform the same task (behavior 0); before performing the task for behavior 0, those in the treatment group are told that another task (behavior 1) will take place after behavior 0, whereas those in the control group are told nothing. In such a case behavioral spillunders refer to the fact that merely knowing that behavior 1 will follow can alter the preceding behavior 0.

Conceptual Framework and Overview of the Literature

Compared to the state of research on spillovers, spillunders have been largely neglected. After conducting an extensive narrative review of the literature over the course of 2 years, we have identified only eight research articles that fall under the above definition of spillunders.[2] Considering this limited empirical evidence, and the potentially different psychological mechanisms that account for spillover relative to spillunder effects, it would be difficult to classify spillunders using the same conceptual framework that Dolan and Galizzi (2015) developed for spillovers.

According to this framework, spillovers are divided into "promoting," "permitting," and "purging" (Dolan and Galizzi, 2015). Promoting spillovers refer to all behavioral sequences in which the first behavior leads to another behavior that works in the same direction. For example, if the first behavior (e.g., biking to work) is positive, which means it is consistent with an underlying motive (e.g., protecting the environment), the second behavior (e.g., recycling) is also consistent with this motive (Evans et al., 2013). Also, if the first behavior (e.g., resting) is inconsistent with a motive (e.g., losing weight) and thus has a negative sign, the second behavior follows the same direction (e.g., eating a slice of cake; Cochran and Tesser, 1996). Permitting spillovers occur when undertaking a behavior 1 (e.g., lowering water use) consistent with a motive (e.g., protecting the environment) entitles the person to undertake behavior 2 (e.g., increasing electricity consumption) that pushes back against that same motive (Tiefenbeck et al., 2013). Finally, purging spillovers occur when a person undertakes behavior 2 (e.g., donating to charity) that is driven by the motive to repair the self-image damaged by behavior 1 (e.g., being selfish; Sachdeva et al., 2009).

There are two obstacles to implementing this classification system to spillunders. First, whereas for some spillunder effects behaviors 0 and 1 are clearly linked through an underlying motive, for other spillunders a different mechanism may be at play. For example, when people expect to engage in a confrontational situation that involves warning a tenant s/he has to pay the rent (behavior 1), they are more likely to listen to music that makes them feel angry in advance (behavior 0) because this prepares them for the confrontation (Tamir and Ford, 2012). This spillunder could be categorized as promoting because the motive to collect the rent drives both behaviors to work in the same direction. In another representative spillunder research that we previously described (Masicampo and Baumeister, 2011), however, the prospect of behavior 1 may impact behavior 0 through a different mechanism: expecting to generate names of sea creatures with vs. without a plan (behavior 1) impaired anagram solving (behavior 0) due to creating intrusive thoughts rather than due to strengthening or weakening a specific motive. This spillunder, therefore, can hardly be categorized as promoting, permitting, or purging, because an underlying motive linking behavior 0 and behavior 1 may not exist, or may be difficult to identify. Another obstacle is that, even if certain spillunder effects can be classified under the categories that Dolan and Galizzi (2015) established, available evidence is not yet sufficient to support the existence of all the categories.

We therefore propose a simpler classification system that is appropriate for the current state of research on spillunders and can be expanded into greater detail as the number of relevant research increases. It organizes spillunders into two categories

[2]Considering that "spillunder" is a novel conceptualization that can be used to describe a variety of different behavioral phenomena (see **Table 1**), we could not undertake a systematic review of the literature to detect all the articles that contain the word 'spillunder' effects. Our approach was therefore less systematic, and we used a variety of different strategies that led us to identify the eight research articles that involve "spillunders." First, using Google Scholar as well as the PsycINFO, RepEC, and EconLit databases, we searched for keywords that refer to phenomena from psychology and economics under which we thought that spillunders may occur. These involve behavioral mechanisms such as energization, intrusive thoughts, planning, goal activation, goal shielding, procrastination, intentions, psychological distance, commitment, future orientation, anticipatory regret, future thinking, savoring, dread, and similar. Then we used specific keywords which refer to the link between present and future actions, such as "influence of future behavior on present behavior," "future into present," "future impacts present," "future influences on present behavior," "how future impacts present," and similar. Finally, we explained the concept of spillunders to our close colleagues and collaborators and asked them to notify us if they encounter a paper that involves research related to this or similar constructs, and we ourselves closely followed representative psychology (e.g., Journal of Personality and Social Psychology, Psychological Science, Social Cognition, etc.) and economics (e.g., Journal of Economic Behavior and Organization, Journal of Economic Psychology, Journal of Behavioral and Experimental Economics) journals to uncover spillunder studies that may have been published in the previous issues or occurred in the most recent issues.

TABLE 1 | Overview of empirical findings on behavioral spillunders.

Study	Behavior 0	Behavior 1	Finding	Spillunder Type
Masicampo and Baumeister, 2011	Solving anagrams	Generating names of sea creatures without forming a plan (unfulfilled goal) vs. generating names of sea creatures with forming a plan (fulfilled goal) vs. generating names of sea creatures with vague description of the generation task (control)	Participants expecting to generate names of sea creatures without forming a plan (unfulfilled goal group) solved fewer anagrams than those in the control group and in the fulfilled goal group	Extinguishing
Tamir and Ford, 2012	Listening to angry music clips	Confronting a tenant about paying the rent vs. nurturing a healthy relationship with the tenant (control)	Expecting to confront a tenant about paying the rent makes people more likely to listen to angry music than in the control group	Enhancing
Polivy et al., 1994	Eating cookies	Engaging in an anxiety inducing behavior (delivering a 2-min speech) vs. rating fabrics on tactile dimensions (control)	Expecting to give a 2-min speech vs. control increases cookie consumption, but only for restrained eaters	Enhancing
Morsella et al., 2010	Meditation	Generating names of all the states of the United States	Expecting to write down the names of all US states made people less able to meditate due to experiencing intrusive thoughts	Extinguishing
Urbszat et al., 2002	Eating cookies	Diet vs. no diet	Expecting to start a diet immediately after the experiment increased cookie consumption, but only for restrained eaters	Enhancing
Kopp et al., 2015	Assessment of reading comprehension of a scientific text	Focusing on behaviors that participants need to undertake after the experiment vs. removing attention from those behaviors (e.g., by making a list of the components of an automobile)	Participants who were thinking about the short-term plans they aimed to accomplish after the experiment (vs. control) performed worse on reading comprehension of a scientific text	Extinguishing
Cascio and Plant, 2015	Deciding on whether to endorse a black or a white candidate for the position of a new police officer	Engaging in a moral behavior (e.g., taking part in a fundraiser or donating blood) vs. absence of anticipated moral behavior (control)	Participants who anticipated performing a moral action in the future were more likely to reveal their racial prejudices and to discriminate a job candidate on a racial basis	Enhancing
Cody et al., 2015	Word recall task	Anticipating to undertake an anxiety inducing behavior (delivering a 5-min speech in front of the experimenter and a video camera) vs. no expectations to engage in anxiety inducing behaviors (control)	Participants with social anxiety who anticipated giving a 5-min speech falsely recalled more anxiety-related words compared to those in the control group	Enhancing

based on the direction of effect that the expectation of behavior 1 has on behavior 0: "enhancing" spillunders are those in which the prospect of behavior 1 increases the quantity of behavior 0 or its likelihood of occurrence; "extinguishing" spillunders are those in which the prospect of behavior 1 reduces the quantity of behavior 0 or its likelihood of occurrence.

Table 1 provides an overview of all the spillunder effects we identified in the behavioral science literature to date. Of the eight spillunder effects identified, three effects can be classified as extinguishing, and five as enhancing spillunders. As it can be seen from the table, the spillunder effects are spread across many different behavioral domains, including mental performance—e.g., anagram solving (Masicampo and Baumeister, 2011), reading comprehension (Kopp et al., 2015), and word recall (Cody et al., 2015); health—e.g., food consumption (Polivy et al., 1994; Urbszat et al., 2002) and meditation (Morsella et al., 2010); morality—e.g., displaying racial prejudice (Cascio and Plant, 2015); and leisure—e.g., music choice (Tamir and Ford, 2012). This variability indicates that spillunders could be relevant to many different policy domains if they are shown to be an integral component of day to day activities.

To illustrate that spillunders can be more common than the limited evidence up to date suggests, in the next section we overview a broad range of psychological and behavioral mechanisms that may account for spillunder effects across diverse situations and environments. Three of these mechanisms were selected both because they can convincingly explain some of the spillunder effects from **Table 1** (as it will be discussed in section "Making the Case for Spillunders: Overview of Core Mechanisms Through Which the Prospect of Behavior 1 Could Impact Behavior 0"), and because they typically control a wide range of everyday behaviors, thus allowing us to make speculations about the occurrence of spillunders in everyday life. These mechanisms involve executive functions (plausible mechanisms that are likely behind the spillunder effects documented by Polivy et al., 1994; Morsella et al., 2010; Masicampo and Baumeister, 2011; Kopp et al., 2015); moral licensing and moral cleansing (plausible mechanisms that can explain the spillunder effects in Urbszat et al., 2002; Cascio and Plant, 2015); and emotion regulation (which can accounts for the spillunder effect in Tamir and Ford, 2012).[3] The remaining three mechanisms—energization, construal level, and savoring and dread—were

[3]For the spillunder effect in Cody et al. (2015) (see **Table 1** in the present article), we did not identify a mechanism that would convincingly explain it and could be extended to a wide range of everyday activities. This is why in Section "Making the Case for Spillunders: Overview of Core Mechanisms Through Which the Prospect

selected because of their implications for a variety of everyday actions, and because the link between the present and the future is inherently ingrained in their theorizing, thus allowing us to make convincing arguments for their involvement in spillunder effects, even if these effects have not yet been identified within their domains.

MAKING THE CASE FOR SPILLUNDERS: OVERVIEW OF CORE MECHANISMS THROUGH WHICH THE PROSPECT OF BEHAVIOR 1 COULD IMPACT BEHAVIOR 0

Executive Functions

Executive functions refer to three broad categories of cognitive processes—inhibition, working memory, and cognitive flexibility (Diamond, 2013)—that are at the core of any behavior that is effortful and does not come spontaneously, ranging from exercise (Hagger et al., 2010) to healthy eating (Hofmann et al., 2012), and solving intellectual tasks (Mrazek et al., 2013). Inhibition comprises functions such as self-control that regulate control of attention, thoughts, behavior, or emotions, and are necessary for resisting temptations, maintaining the focus of attention, overcoming habits, and persisting on any effortful physical or intellectual tasks (Diamond, 2013). Working memory is the capacity to hold information in one's consciousness and actively work with the information during problem solving (Engle, 2002). Cognitive flexibility allows one to look at a problem from many different perspectives, using different strategies to solve the problem, and adjusting to new situational demands and requirements to find the solution (Diamond, 2013). Without executive functions, humans would be at the mercy of their impulses and habits and would not be able to undertake any activities that require focus and effort.

Executive functions are highly susceptible to situational influences, and can be disrupted or enhanced by a variety of factors—including stress, anxiety, intrusive thoughts, cognitive load, mood, stereotype threat, mindfulness, mortality salience, and so on—which can in turn impair or enhance a variety of everyday behaviors (Sorg and Whitney, 1992; Ashcraft and Kirk, 2001; Klein and Boals, 2001; Hofmann et al., 2008, 2012; Johns et al., 2008; Stawarczyk et al., 2011; Mrazek et al., 2013). Based on this notion, it would be expected that a large proportion of spillunder effects occur via the influence of a prospective behavior 1 on executive functioning. In fact, the largest number of spillunders we identified in **Table 1** can be explained by the impairment of executive functions caused by the expectation of behavior 1. For example, in Polivy et al. (1994), restrained eaters ate more cookies when anticipating an anxiety-inducing (vs. neutral) behavior because anxiety undermined their self-control, and the impulsive tendencies to indulge took over as a result. Moreover, in Kopp et al. (2015), focusing on behaviors participants were aiming to undertake after the experiment (vs. removing attention from these behaviors) likely evoked intrusive thoughts which interfered with their reading comprehension. A similar mechanism was at play in Masicampo and Baumeister (2011). Finally, in Morsella et al. (2010), intrusive thoughts activated by the prospect of having to recall the names of all US states interfered with their ability to meditate.

Moral Licensing and Moral Cleansing

Moral licensing refers to people's propensity to undertake an action that is less virtuous or less beneficial for their health after they have previously engaged in a morally desirable or a healthy behavior (Merritt et al., 2010). For example, purchasing an electric car may influence people to feel less obliged to act environmentally friendly compared to purchasing a conventional gas car (Klöckner et al., 2013). In contrast, moral cleansing is the propensity to engage in a morally desirable or a healthy behavior after undertaking actions that are less virtuous or healthy to restore the moral balance (West and Zhong, 2015). For example, when people think of the negative aspects of their personality or recall immoral actions from the past, they are more likely to donate money to charity (Sachdeva et al., 2009). Moral licensing and cleansing have been identified in a variety of domains ranging from pro-environmentalism (e.g., Tiefenbeck et al., 2013; Truelove et al., 2014) to health (Chiou et al., 2011), and research has established they are pervasive in everyday life (Merritt et al., 2010; Hofmann et al., 2014; Truelove et al., 2014; Blanken et al., 2015).

Moral licensing and cleansing are considered examples of "permitting" and "purging" behavioral spillovers, respectively, because their definition implies that some morally relevant behavior 1 increases or decreases the likelihood of a subsequent moral action (Dolan and Galizzi, 2015). Research has, however, shown that moral licensing and cleansing can also operate backward in accordance with our definition of spillunders. As can be seen in **Table 1**, the research on the influence of expecting to undertake a moral action in the future (behavior 1) on present racial discrimination (behavior 0; Cascio and Plant, 2015) is an example of a moral licensing spillunder. Another example of this spillunder from **Table 1** is the impact of expected future dieting (behavior 1) on present cookie consumption (behavior 0; Urbszat et al., 2002). These findings indicate that moral licensing and cleaning may be one of the mechanisms that account for spillunder effects. Future research will need to establish whether spillunders of moral behavior are as common as their spillover counterparts.

Emotion Regulation

Emotion regulation comprises different strategies through which people "influence which emotions they have, when they have them, and how they experience and express them" (Gross, 1998, p. 272). People regulate their emotions for a variety of reasons and in a variety of situations they encounter on a daily basis, and they generally try to regulate negative emotions more frequently than positive ones (Gross et al., 2006; Gross, 2014, 2015). Examples of emotion regulation include trying to calm

of Behavior 1 Could Impact Behavior 0" we do not discuss this effect in relation to one of the mechanisms.

oneself down when feeling angry, firing oneself up before a competitive event, or suppressing crying at a funeral (Gross and John, 2003; Gross, 2015).

There are 5 different strategies people use to regulate their emotions: (i) selection of the situation; (ii) modification of the situation; (iii) deployment of attention; (iv) change of cognitions; and (v) modulation of responses (Gross, 1998). The first two strategies are of particular interest here because of their compatibility with spillunder effects. Selection of the situation refers to "approaching or avoiding certain people, places, or objects in order to regulate emotions," whereas modification of the situation comprises "active efforts to directly modify the situation so as to alter its emotional impact" (Gross, 1998, p. 283). An example of situation selection would be avoiding places where one is likely to meet a person one dislikes, whereas skipping a sad scene in a movie to avoid feeling negative is an example of situation modification (Aspinwall and Taylor, 1997; Gross, 2015; Livingstone and Isaacowitz, 2015).

Research showed that situational strategies of emotion regulation can result in spillunder effects: expecting to undertake some behavior 1 that can benefit from a specific emotional state may influence the person to undertake actions that potentiate that state at present. In an example outlined in **Table 1**, participants chose to listen to angry music (behavior 0) before confronting a tenant about paying the rent (behavior 1) because being angry makes confronting other people easier and less intimidating (Tamir and Ford, 2012). Such emotion regulation strategies in which behavior 0 is used to create or modify a situation to evoke emotions that benefit behavior 1 may be common in performance-related or confrontational contexts (e.g., sports, stock trading, or debt collection) that involve intense emotional states (Sutton, 1991; Fenton-O'Creevy et al., 2012; Lane et al., 2012).

Energization

Energization, which is a synonym for physiological activation of the body, is typically used as an objective measure of motivation in behavioral literature and is assessed via cardiovascular reactivity indicators such as systolic blood pressure or heart rate (Brehm and Self, 1989; Wright and Kirby, 2001; Wright, 2008; Gendolla et al., 2012). Cardiovascular processes are controlled by the sympathetic and parasympathetic nervous systems and therefore encompass motivational states directed at either physical or intellectual endeavors (Obrist, 1976, 1981; Wright and Kirby, 2001; Segerstrom and Nes, 2007; Gendolla and Richter, 2010). Energization levels usually increase when people perform challenging but feasible activities (Gendolla and Richter, 2010). For example, people's systolic blood pressure rose as the difficulty of a task that required them to memorize random letter strings increased, but systolic blood pressure dropped when the task became impossible (Richter et al., 2008). Energy levels are, however, not elevated only while people are undertaking challenging activities, but even when they anticipate engaging in such activities (Wright et al., 1986). For example, when people merely anticipated undertaking a memory task, their systolic blood pressure decreased if the task was easy compared to difficult (Contrada et al., 1984; Wright et al., 1986).

Important for spillunders, research evidence suggests that energization incited by one activity can influence behavior toward other unrelated activities, given that increased energy levels generally make a person more likely to act and more capable of pursuing demanding physical and intellectual endeavors (Wright, 2008). For example, Sevincer et al. (2014) told participants they would need to perform an intellectually demanding task (e.g., solving an IQ test) and instructed them to mentally contrast their desired performance on this task with the obstacles to achieving the desired performance level (vs. control: absence of mental contrasting). The intervention increased their systolic blood pressure. As a result, when all participants were eventually told they would not need to perform the intellectual task and were given a replacement task instead (e.g., squeezing a handgrip or writing a letter to a friend who is recovering from a car injury in the hospital), those in the mental contrasting (vs. control) condition did better on the replacement tasks.

These insights suggest that expecting to perform some effortful behavior 1 may elevate people's energy levels and thus create various spillunder effects, depending on the context in which behavior 0 is taking place. If people are in the presence of "positive" opportunities for action (e.g., exercising or donating to charity), these spillunders may have desirable consequences (e.g., burning more calories while exercising or increased charitable donations). In contrast, if people are in the presence of negative opportunities for action (e.g., eating hedonic foods, spending electricity), the outcomes of spillunders may be undesirable (e.g., consuming more calories, increased energy use).

Construal Level

According to construal level theory, humans can mentally represent the physical world and situations in two ways—using abstract (e.g., seeing the forest) and concrete (e.g., seeing the trees) construals (Trope and Liberman, 2010). For example, one can think of a vacation very concretely, in terms of specific activities, or abstractly, in terms of having a good time but without focusing on the details. The abstract construal is also known as high construal level, and the concrete construal as low construal level. Evidence indicates that the level of construal people use to mentally represent a stimulus (e.g., a situation or a physical object) is determined by psychological distance of the stimulus—the degree to which it is physically, socially, temporally, or probabilistically distant (Bar-Anan et al., 2006; Liberman et al., 2007; Trope and Liberman, 2010). For example, people automatically think about a place that is far away, a situation that will happen in a distant future, a person who is not close to them, or an event that has a low chance of occurring using abstract language (high construal level). In contrast, they think about a place that is nearby, a situation expected to happen soon, a person who is close to them, or an event highly likely to occur using concrete language (low construal level).

Importantly for spillunders, a high or low construal level mindset can be situationally induced and influence a variety of different behaviors: findings generally show that low (vs. high) construals potentiate impulsive behaviors by triggering present bias (Trope et al., 2007). For example, in Fujita and Han (2009) people were presented with a list of 40 words (e.g., dog) and asked

to either generate exemplars of these words (e.g., poodle), which induced low construal level, or categories to which the words belong (e.g., animal), which induced high construal level. People in the state of low construal level were subsequently more likely to choose a chocolate bar over an apple. Inducing low (vs. high) construal level had a similar effect on other related behaviors such as smoking (Chiou et al., 2013), or preference for immediate over delayed outcomes (Fujita et al., 2006).

Although researchers have not yet investigated construal level theory in the context of spillunders, the research we reviewed in relation to the theory suggests that different interventions directed at behavior 1 could induce a low or high construal level mindset, thus impacting behavior 0 in accordance with this mindset. For example, if an intervention influences the person to think about behavior 1 using concrete construals, this could evoke a low construal level mindset and make the person less likely to avoid temptations at present. Moreover, if a behavior 1 is temporally close or an intervention makes it seem close, this can as well instigate a low construal level mindset and make the person more likely to act impulsively at present. Overall, each behavior 1 involves a certain element of psychological distance and can therefore incite low or high construal level (Trope and Liberman, 2010), which could in turn impact numerous behaviors relevant to health and wellbeing.

Savoring and Dread

A small literature to date in behavioral economics has focused on accounting for instances where decision-making violates the standard assumption of positive discounting. Loewenstein (1987) is arguably the first behavioral economist to explicitly posit that the "anticipation of the future has an impact on immediate well-being" (p. 666). Earlier arguments in this direction were made by Wolf (1970), who discussed utility from memory and its implications for intertemporal choice, and by Pope (1983), who discussed the role of anticipation in risk aversion. Actually, Loewenstein (1987) traces back this same idea to Bentham (1789), for whom "anticipation, like consumption itself, was an important source of pleasure and pain" (p. 666); and to Jevons (1905), who argued that "three distinct ways are recognizable in which pleasurable or painful feelings are caused: (i) by the memory of past events; (ii) by the sensation of present events; (iii) by the anticipation of future events" (p. 3). Loewenstein (1987) shows some evidence from undergraduates (n = 30) who were asked their maximum willingness to pay to obtain a kiss from the movie star of their choices, or to avoid receiving a (non-lethal) 110 volts shock, with five different time delays, spanning from immediately (no delay) to 10 years in the future. Participants were willing to pay, on average, more to experience a kiss delayed by 3 days than an immediate kiss or one kiss delayed by 3 h or 1 day. The same participants were willing to pay, on average, more to avoid a shock that was delayed for 3 h to 3 days than to avoid an immediate shock. Loewenstein (1987) call "savoring" the first effect, that is the "anticipal pleasure" and positive utility derived from the anticipation of future consumption; and "dread" the second effect, that is the "anticipal pain" and negative utility derived from the contemplation of the future. Both effects cannot be explained by positive discounting, which postulates that people would prefer to consume desired outcomes as soon as possible and would prefer to delay undesirable outcomes as late as possible.

Loewenstein and Prelec (1991, 1993) relate the discussion on negative time preferences to the parallel literature on evaluating sequences of outcomes versus evaluating single outcomes. Kahneman et al. (1993), for example, found that participants strongly preferred brief sequences of decreasing discomfort even at the cost of experiencing more discomfort overall. Further evidence of preferences for improving sequences has been provided by Hsee et al. (1991) for improving sequences of relative satisfaction; Loewenstein and Sicherman (1991) for increasing 5-year salary profiles; Ross and Simonson (1991) for happy-ending experiences; Frank and Hutchens (1993) for rising wages and consumption; Loewenstein and Prelec (1993) for increasing sequences of outcomes; and Chapman (2000) for improving sequences of health outcomes. Loewenstein and Prelec (1991) observe that preferences for improving sequences can be explained in part by savoring and dread: for gains, improving sequences allow the decision maker to savor the best outcome until the end of the sequence, while for losses, getting the worst outcome immediately quickly eliminates dread. Loss aversion and adaptation can also in part explain preferences for improving sequences: over time, in fact, people tend to assimilate to ongoing stimuli and to evaluate new stimuli relative to their assimilation level so that changes in consumption, rather than levels of consumption, are the key driver of utility. While declining sequences provide a series of relative losses, improving sequences allow the decision makers to experience a continual series of positive gains from their adaptation levels. Sequences of outcomes which decline in value would thus be disliked, which indicates negative time preferences.

Frederick and Loewenstein (2008) discuss nine reasons why people may care about the profile of a sequence of events. Three reasons justify preferences for increasing sequences; three reasons justify preferences for declining sequences; and three reasons justify preferences for flat sequences which spread consumption equally across time. The three reasons for preferring improving sequences are: (i) *anticipatory utility*: delaying good outcomes extends the period over which those outcomes can be pleasurably savored, while accelerating bad outcomes reduces the period of dread; (ii) *contrast effects*: delaying consumption to future periods allows the decision makers to enjoy a series of gains relative to their "adaptation level"; (iii) *extrapolation*: people may consciously or unconsciously transform the presented sequence into corresponding longer sequences (for example, the sequence 2, 3, 4 can be preferred to 4, 3, 2 because those sequences are reinterpreted as 2, 3, 4, 5…and 4, 3, 2, 1…, respectively). The three reasons for preferring declining sequences are the same reasons for showing positive discounting and are: (i) *uncertainty* about future outcomes; (ii) *opportunity costs* from delaying outcomes which could have been profitably invested; and (iii) *pure time preferences*: genuinely caring less about utility from later periods. Finally, the three reasons for preferring flat sequences are: (i) *diminishing marginal utility* from consumption; (ii) *desire for equality among temporal "selves"* (Frederick, 2003); and (iii) "*divide-equally" heuristic*: allocating

consumption among multiple periods could, consciously or unconsciously, evoke the idea of distributional equity and thus favor flat sequences (Harris and Joyce, 1980; Allison and Messick, 1990; Messick, 1993; Roch et al., 2000).

The possibility of savoring and dread is highly relevant for spillunders, since it implies that people derive utility not just from the current consumption of outcomes (behavior 0), but also from the anticipation of future outcomes (behavior 1): in many instances, the mere expectation of future outcomes (behavior 1) can affect the current behavior (behavior 0) through savoring or dread channels.

How Widespread Are Spillunders? Summing Up "the Big Picture"

Our overview of the six widely prevalent behavioral mechanisms—executive functions, moral licensing or cleansing, emotion regulation, energization, construal level, and savoring and dread—indicates that the prospect of behavior 1 could potentially influence behavior 0 through many different routes to create spillunders. Indeed, these mechanisms shape a large proportion of everyday actions, ranging from exercise and healthy eating to pro-environmental behavior and various intellectual and moral pursuits. In fact, it would be difficult to identify more than a few activities that are not at least to some degree controlled by one or more of these mechanisms. Given the lack of research evidence on spillunders, we cannot currently determine with certainty how frequently spillunder effects occur in everyday life via these mechanisms. Our argumentation, however, suggests that even if the six overviewed mechanisms create spillunder effects in few instances, these effects may be more prevalent in day to day living than the limited evidence we identified suggests. Their under-representation in the literature therefore likely reflects the lack of effort to systematically study the phenomenon rather than its irrelevance in shaping human actions.

FROM PSYCHOLOGICAL MECHANISMS TO POLICY IMPLICATIONS

Spillunders have implications for any policy directed at behaviors that involve future anticipation. Whereas some policy interventions primarily concern one-off decisions that will not require any future input from the person (e.g., making decision about organ donation while acquiring the driving license; Johnson and Goldstein, 2003), other interventions affect more complex behaviors that require planning. For example, when people who have not yet paid their taxes receive a government letter that nudges them to pay the tax (Halpern, 2015), they need to decide when in the future to make the payment (e.g., on the same day, in the upcoming week, etc.). Other examples involve policies that encourage healthy lifestyle (e.g., people need to plan when to exercise or eat the healthy foods they purchased in the supermarket; Kahn et al., 2002; Story et al., 2008), or pro-environmental behavior (e.g., people need to plan time of the day when they will reduce their energy use; Schultz et al., 2007), and many others.

Any policy intervention directed at behaviors that are not undertaken immediately when the person encounters the intervention can therefore create spillunder effects. In this section, we discuss policy implications of each of the six main behavioral mechanisms that drive the impact of some anticipated behavior 1 on behavior 0. We start with moral licensing (Merritt et al., 2010). Spillunders that propagate through this mechanism are relevant to policy interventions that encourage morally responsible or healthy behaviors (Blanken et al., 2015). As can be inferred from previous research (e.g., Chiou et al., 2011; Tiefenbeck et al., 2013; Hofmann et al., 2014; Cascio and Plant, 2015), influencing people to commit to blood donation, volunteering, energy saving, healthy eating, exercising, and similar behaviors 1 in the future can backfire at present and have an undesirable impact on behaviors 0 linked to health, pro-environmentalism, charitable giving, prejudice, and so on. For example, a policy intervention that makes people more likely to plan a gym visit might also make them more likely to eat unhealthy products at present (Werle et al., 2011). To create effective policies, policy makers will therefore need to test which interventions can change behaviors 1 in the moral domain without instigating moral licensing spillunders.

Two spillunder mechanisms—executive functions (Diamond, 2013) and energization (Wright, 2008)—are relevant to any policy interventions linked to effortful behaviors that require persistence and self-control. A policy that provokes affective reactions to behavior 1 (e.g., overexcitement, anxiety, etc.) can impair executive functions and thus hinder positive behaviors 0 such as intellectual problem solving or energy saving (Hagger et al., 2010; Diamond, 2013), even if it eventually impacts the targeted behavior 1 as planned. For example, Fryer et al. (2012) showed that incentivizing teachers in advance to increase student achievement, assuming they would need to return the money if the students do not eventually improve ("loss incentive"), increased math scores compared to the traditional incentives paid upon the improved performance. Regardless of this encouraging outcome, psychology research showed that motivational strategies based on avoidance of losses can evoke anxiety and impair executive functions (Roskes et al., 2014). It is therefore a realistic possibility the loss incentive not only motivated teachers to increase student achievement (Fryer et al., 2012), but also backfired in other domains not evaluated in the experiment. In contrast to policy interventions that impair executive functions, the interventions that lead to energization—for example, by making the person committed to pursue some activating behavior 1 such as exercising or studying for school exams—can produce either desirable or undesirable spillunders, depending on which behaviors 0 the environment affords (Wright, 2008). This spillunder mechanism poses a future challenge that policy makers will need to resolve: How to build interventions that propel effortful future activities but without backfiring in a present environment regardless of the action opportunities it provides?

Construal level has implications for any policies targeting future actions because any future behavior that a person considers or anticipates can be mentally construed either concretely (low construal level) or abstractly (high construal level;

Trope and Liberman, 2010). People are more likely to eventually undertake a future behavior construed concretely rather than abstractly (Liberman et al., 2007), and some of the most effective intervention strategies rely on making a targeted behavior as concrete as possible. For example, forming an implementation intention to exercise, save energy, study, or eat healthily involves formulating a plan concerning how, where, and when to undertake these activities, which eventually increases their likelihood (Gollwitzer and Sheeran, 2006; Prestwich et al., 2015). In another related line of research, participants who were shown a computer-generated older version of themselves were more likely to save for pension because the intervention made the old age more concrete (Hershfield et al., 2011). Although low construal level can be beneficial when building effective interventions that target behavior 1, it may also backfire for behavior 0, considering that concrete mind-sets increase the likelihood of acting impulsively (Fujita et al., 2006; Fujita and Han, 2009). It is therefore crucial to investigate more comprehensively how policy interventions that change construal level impact different behaviors 0 and explore how such interventions could be designed to avoid propelling impulsive present actions.

Similarly, savoring and dread imply that people derive utility not only from the current consumption of outcomes, but also from the anticipation of future outcomes. Because the overall utility at any point in time is the sum of the utility from current consumption, plus the utility from the anticipation of future consumption, it may be the case that the mere expectation of future outcomes (behavior 1) would affect the current behavior (behavior 0), for example by reducing the current consumption. Therefore, any policy which aims at influencing future behavior needs to factor in all the ramifications and the changes in the current behavior triggered by the anticipation of the future, for example in terms of savoring the future positive outcomes or dreading the future negative outcomes. This can have major consequences for the assessment of the overall impact of an envisaged policy intervention, especially if the ultimate goal of a policy intervention is the overall individual wellbeing or social welfare, rather than a narrowly defined behavioral outcomes. Given that the overall individual wellbeing is the integral over time of the instantaneous wellbeing experiences (Dolan, 2014), it is imperative that the design of behavioral interventions systematically and comprehensively capture all the spillunder effects associated to the present anticipation of future outcomes.

The final spillunder mechanism—emotion regulation—is relevant to policy contexts where the choice of some behavior 0 may be used as a strategy to propel emotional states that prepare people for behavior 1 (Tamir and Ford, 2012; Gross, 2014, 2015). For example, if behavior 1 involves using less electricity during a particular time of the day, people may undertake a behavior 0 that will make them calm and serene, so they are subsequently not tempted to engage in activities that require energy consumption. Or, if behavior 1 involves donating blood, people may undertake behaviors 0 that make them feel more powerful and less fearful, so they do not experience the act of donating blood as highly unpleasant. In this regard, the extent to which a policy directed at behavior 1 will prompt undesirable or desirable spillunders will depend on whether it propels positive or negative emotion regulation strategies. Positive emotion regulation strategies may involve activities such as mindfulness, listening to music one enjoys, socializing with friends, etc., whereas negative emotion regulation strategies may involve unhealthy eating, impulsive shopping behavior, etc. (Tugade and Fredrickson, 2007; Aldao et al., 2010; Webb et al., 2012; Gross, 2014). Understanding how to design policies that are grounded upon positive emotion regulation strategies will require researchers to dig beyond the existing knowledge on the role of emotion regulation in spillunder effects.

METHODOLOGICAL CHALLENGES

All research that has looked at behavioral spillunders so far (see **Table 1**) has been conducted in artificial lab settings. This may be one of the primary limitations of applying the concept of spillunder in policy making contexts: even if human behavior in the lab and in the field sometimes tend to be aligned, what happens in the lab does not always correspond to what happens in the real world (Mitchell, 2012; Alm et al., 2015; Galizzi and Navarro-Martínez, 2018). Moreover, lab experiments typically suffer from the limitation that participants know that they are part of an experiment, which in itself can alter the very behavior one is interested to investigate. An alternative is to test behavioral spillunders in "natural field experiments," that is, in field settings where participants are not even aware that they are part of an experiment (Harrison and List, 2004). Investigating behavioral spillunders in the field, however, poses several challenges. First, whereas field experiments are designed to test the impact of an intervention on behavior 1, measuring some other preceding behavior 0 may be difficult because the experimenter does not always know whether and where the person may engage in that behavior. Second, even if the experimenter is aware where the behavior would take place, recording it may not be possible in practice.

To overcome these limitations, here we propose some suggestions for how spillunders could be measured in a more ecologically valid way to inform policy making. The first solution is to conduct "lab-field experiments" (Dolan and Galizzi, 2014b; Galizzi, 2017), that, as the name suggests, contain the elements of both lab and natural field experiments because they combine a stage where participants are observed in the lab and another stage where they are followed up over time in a natural setting while they are not aware of being observed. For example, Galizzi and Navarro-Martínez (2018) elicited social preferences in a variety of experimental games that participants completed in the lab. Participants were then invited to the lab on the next day to do a task that was not related to social preferences. After they exited the lab, they were faced with a natural field situation where they could demonstrate prosocial behavior (e.g., donating to charity, helping people), and, unbeknownst to them, their behavior was recorded.

Similar paradigms could be implemented to study spillunders. For example, imagine that one wants to investigate whether an intervention directed at physical activity (behavior 1) influences

people's donation to environmental charity (behavior 0). In that case, participants could first be invited to the lab to fill in a survey about their exercise behavior, and subsequently half of participants could receive an intervention that encourages them to behave physically active in the upcoming week (e.g., going to the gym, outdoor running). Then, after they exit the lab, all participants could encounter a natural situation where an environmental charity collects money—the amount of money donated would then be used as the dependent variable to test the spillunder effect. Additionally, researchers could also assess participants' physical activity behavior in the upcoming week either through self-reports or through a more objective measure (e.g., Fitbit activity monitor; Takacs et al., 2014). This would allow examining not only whether intervention directed at behavior 1 impacts behavior 0, but also whether the two behaviors are eventually related.

An alternative approach could allow for the integration of behavioral science experiments with other longitudinal data. In particular, the Internet of Things (IoT; Swan, 2012) refers to the ecosystem that consists of all objects that can be connected to the Internet and generate data (Swan, 2012; Madakam et al., 2015). Some of the most obvious such objects are smartphones, laptops, and tablets, but in today's digital age an enormous number of other objects also constitute IoT, including cars, household appliances, speakers such as Amazon Echo or Google Home, watches, etc. (Swan, 2012; Hiremath et al., 2014; Zanella et al., 2014). Almost everything can be potentially connected, and in principle people's behavior can be continuously tracked and measured in many ways through the devices they use, their social media activities, and other online, mobile, and offline data sources (e.g., Kosinski et al., 2015).

In fact, in policy domains like health, which are typically data-rich, there is a growing interest in "behavioral data linking," that is, in the linkage and integration of behavioral experiments with all sources of longitudinal smart data, such as hospital and electronic medical records, administrative registers, biomarkers banks, mobile devices, apps, scan data, and online panels (Galizzi et al., 2017; Galizzi and Wiesen, 2018). These same technological advances for the first time in history afford the measurement of complex behavioral patterns, such as the long-term effects or spillover and spillunder effects of behavioral interventions. For example, if all administrative records were linked together for the same individual, when policy makers send letters with different intervention messages that encourage tax payment to people (e.g., Halpern, 2015), they could potentially track the behavior of these same people in other policy contexts between the times they receive the letter and the time they submit the payment (e.g., Alzantot and Youssef, 2012; Wilson et al., 2012; Wang et al., 2014). Using this approach, it would be possible to determine which behaviors 0 participants are more likely to change as a result of the messages targeting behavior 1, as well as the direction and the magnitude of these behavioral changes.

The main obstacle to this approach is an ethical one: it is imperative to ensure that companies and organizations providing the data have obtained the general consent from participants for these data to be used for research purposes, and that the data are securely protected to avoid misuse by third parties (Sugiura et al., 2017; Baldini et al., 2018). Current developments in data protection regulation, however, such as the General Data Protection Regulation (GDPR) developed by the European Union, for example, have made the process of providing consent in such circumstances more compelling and transparent (Chassang, 2017). These and other similar developments in the legal and institutional framework may potentially increase the privacy, confidentiality, safety, and ethicality of sharing data for research purposes, and therefore enhance the potential opportunities to link online, mobile, and other longitudinal data to behavioral experiments in order to systematically investigate phenomena such as long-term effects, spillovers, and spillunders of behavioral interventions (Galizzi, 2017; Alter and Gonzalez, 2018). We therefore encourage researchers and practitioners to examine different legal, logistical, and organizational solutions and share best practices to design and implement ethically sound experiments linked with smart data when systematically testing real-world spillunder effects and their policy implications.

CONCLUSION

We have proposed a definition of spillunders as the mirror image of behavioral spillovers. Spillunders are spillovers operating backward: the expectation of behavior 1 influences behavior 0 that precedes it. We have critically reviewed the few papers identified via the narrative literature review that have demonstrated spillunder effects to date and we have proposed a simple conceptual framework. Based on the evidence about moral licensing and moral cleansing, emotion regulation, energization, executive functions, construal level, and negative time preferences, we have argued that spillunder effects are likely to be more widespread than the examples that we have uncovered via our narrative literature review indicate. We have discussed their policy and practical implications. We have also examined methodological challenges that need to be considered when empirically testing for spillunder effects. As with our earlier paper on spillovers, we aim to motivate other behavioral scientists to research behavioral spillunders more systematically and extensively, and to prompt decision makers to consider these effects when designing behavioral interventions.

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DK initiated and led the writing. MG contributed to the writing, in particular on the definition and methodological challenges of behavioral spillunders, and on savoring and dread. PD contributed to the writing.

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Compensatory and Catalyzing Beliefs: Their Relationship to Pro-environmental Behavior and Behavioral Spillover in Seven Countries

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There is growing research interest in behavioral spillover and its potential for enabling more widespread lifestyle change than has typically been achieved through discrete behavioral interventions. There are some routes by which spillover could take place without conscious attention or explicit recognition of the connections between separate behaviors. However, in many cases there is an expectation that an individual will perceive behaviors to be conceptually related, specifically in terms of their compensatory (suppressing further action) or catalyzing (promoting further action) properties, as a prerequisite for both negative and positive spillover. Despite this, relatively little research has been carried out to assess the beliefs that may underpin spillover processes as held by individuals themselves, or to measure these directly. We develop and evaluate a survey-based instrument for this purpose, doing so in a sample of seven countries worldwide: Brazil, China, Denmark, India, Poland, South Africa, and the United Kingdom (approx. 1,000 respondents per country). This approach allows us to assess these measures and to compare findings between countries. As part of this, we consider the connections between beliefs about behavioral relationships, and other key variables such as pro-environmental identity and personal preferences. We observe higher levels of endorsement of compensatory beliefs than previous research, and even higher levels of endorsement of novel items assessing catalyzing beliefs. For the first time, we present evidence of the validity of such measures with respect to comparable constructs, and in relation to people's consistency across different types of behaviors. We reflect on the implications of considering the relationships between behaviors in the context of people's subjective beliefs and offer recommendations for developing this line of research in the broader context of spillover research and within a cross-cultural framework.

Keywords: behavioral spillover, compensatory beliefs, pro-environmental behavior, pro-environmental identity, survey methods

INTRODUCTION

Recent years have seen a growth in research that has set out to promote, understand, and test behavioral spillover in the environmental domain. Behavioral spillover is broadly defined as an observable and causal effect one behavior has on another (Nash et al., 2017). Research in this area has been founded on an appreciation of the limited capacity for piecemeal behavior change to address urgent environmental problems (Maniates, 2001), especially through simple, low-effort individual action (Thøgersen and Crompton, 2009). The prospect that such behaviors might nevertheless prompt or catalyze more widespread behavior change has generated interest in the relationship between environmentally significant behaviors, and the conditions under which one action might "spill over" to another (Defra, 2008). Similarly, evidence that interventions to promote pro-environmental behavior (PEB) may be undermined by rebound effects (e.g., installing domestic insulation leading to greater energy use) highlights a need to understand how and why these apparently inconsistent behaviors may occur and ultimately to reduce their occurrence.

While there are various proposed mechanisms for how spillover works, most assume that they require some degree of conscious reflection – for example, justifying inconsistent behaviors (e.g., eating cake after exercising) or motivating consistent ones (e.g., giving money to charity leading to volunteering). Yet, while patterns of compensatory and catalyzing behaviors have been explored – a central objective of spillover research – individuals' own beliefs about these behaviors have received relatively lesser attention. In the present study, we consider how compensatory and catalyzing beliefs relate to PEBs, as well as to underlying psychological constructs. In order to examine these beliefs in light of the types of behavioral patterns that would be anticipated as a result of spillover processes, we also examine whether and how they are linked to consistency across self-reported behaviors.

SPILLOVER MECHANISMS AND THE ROLE OF BELIEFS ABOUT BEHAVIOR

Recent reviews focusing specifically on spillover of pro-environmental behavior have highlighted several mechanisms by which the process might occur, as well as different perspectives on what is encompassed or excluded from the concept of spillover itself (Truelove et al., 2014; Nash et al., 2017; Nilsson et al., 2017). While there is the potential for spillover to occur automatically or outside of a person's awareness, much research indicates that conscious emotional, self-perception, or mental accounting processes are activated in triggering spillover. The types of conscious reasoning and justifications typical to spillover are neatly articulated by Dolan and Galizzi's (2015) explanation of the processes by which one type of healthy or unhealthy behavior (running or sofa-sitting) can lead to another (eating more or less healthily). The concept of "*promoting*" (positive) spillover occurs when behaviors work together; for example, "*I ran an hour, let's keep up the good work.*" In "*permitting*" (negative) spillover, behaviors work against each other; for example, "*I ran an hour, I deserve a big slice of cake.*" Similarly, permitting spillover might also be triggered by the sofa-sitter concluding that "*I've been lazy today, let's have a big slice of cake.*" "Purging" spillover (moral cleansing) occurs when an actor attempts to reduce negative feelings after indulging, taking the view that "*I've been lazy today, best not eat so much tonight.*"

Of particular relevance to the present study, Nash et al. (2017) point to the potential for self-perception to underpin spillover: the idea that reflecting on past behavior provides cues to people for how to act subsequently. In a related manner, though drawing on a different strand of theory, it has also been argued that spillover may be underpinned by people's desire for consistency in their actions and with their values, not least because the perception of inconsistency – or dissonance – can be psychologically uncomfortable (Sapiains et al., 2015).

While people's awareness of the links between behaviors can promote positive spillover (i.e., one "good" behavior leading to another) equivalent processes may operate that could undermine this, or operate in a reverse manner. For example, Nilsson et al. (2017) outline in some detail the types of reasoning or rationalization that might underpin negative spillover, with the notion of "moral licensing" held to be central. This entails a person balancing the "good" of one action with the "bad" of another: having carried out one PEB they may consider that they have earned the right (or "licence") to act in another, less pro-environmental manner (Khan and Dhar, 2006; Merritt et al., 2010; Blanken et al., 2015); or they may simply be of the view that having now done their share, they have reduced their obligation to take further action.

THE ROLE OF PSYCHOLOGICAL AND CULTURAL FACTORS AS INFLUENCES ON SPILLOVER AND BEHAVIORAL CONSISTENCY

Pro-environmental action is influenced by a range of factors including people's values, general beliefs, and identity (Hornsey et al., 2016). In relation to spillover in particular, as well as consistency across behaviors, a person's pro-environmental identity has been argued to be critical. From a theoretical perspective, it is a person's "self-identity" – their concept of themselves – that is used to guide actions. In the environmental domain, this manner of self-identity has been shown both to be a significant predictor of PEB (Sparks and Shepherd, 1992), and been proposed as a factor that promotes behavioral consistency (Whitmarsh and O'Neill, 2010). Several studies have furthermore assumed a central role for pro-environmental identity in enabling spillover processes. For example, experimental work has shown that drawing attention to the environmental impacts of choices can lead to a heightened sense of one's pro-environmental self-identity, which in turn can promote subsequent actions in line with this self-perception (Cornelissen et al., 2008; Poortinga et al., 2013; Van der Werff et al., 2013; though see Truelove et al., 2016, for contradictory findings). More generally, research has shown that the potential exists for people to evaluate their behaviors in the context of their identity: for example, Gneezy et al. (2012)

argue that high-cost behaviors in particular may be perceived by a person to reflect a pro-social identity, and consequently to raise the likelihood of further pro-social action. Given the centrality of identity to spillover research, and to PEB more generally, we seek to understand its relationship to the types of beliefs that are a focus of the present study. We conceptualize pro-environmental identity in terms of the self-concept, which stresses how a person sees themselves, in the context of their environmental concerns and behaviors. In this we draw on research by Whitmarsh and O'Neill (2010) who developed the identity scale we apply in the present study.

Although less considered in the environmental psychology literature, a separate strand of research has also highlighted how people's preference for consistency (PFC) is related to patterns of behavior. PFC refers to the idea that people value behavioral characteristics that are stable, predictable, and reliable (Guadagno and Cialdini, 2010). Whereas more general theoretical frameworks have tended to assume by default that people are motivated to be consistent to an equivalent degree, the PFC framework proposes that, instead, there are individual differences in the extent to which people's actions are congruent with past and similar behavior (Guadagno and Cialdini, 2010). For example, Cialdini et al. (1995) found that PFC moderated how susceptible people were to the "foot-in-the-door" effect, in which the request to carry out a small action allows for a subsequent, larger request to be met; this effect has itself been used often as an analog of spillover (Nash et al., 2017). Given the demonstrated utility of PFC as a construct that underpins behavioral consistency in general terms, we are interested to understand the extent to which it is related to the types of beliefs considered in the present study.

As we outline above, there is evidence for individual differences in behavioral consistency and PFC. In a related manner, cross-cultural research has indicated that there are differences in the extent to which societies tolerate ambiguity; this has been linked to cultural variability in uncertainty avoidance (the degree to which a society challenges or is accepting of unpredictability: Hofstede, 2011). Variation in tolerance of ambiguity, in turn, has direct implications for how a person's underlying values influence their behavior (Furnham and Ribchester, 1995; Boer and Fischer, 2013). In particular, and in a manner analogous to the individual-level need to manage cognitive dissonance, individual and societal differences in this area may affect the extent to which people accept and manage personal (in)consistency (Boer and Fischer, 2013).

In line with the expectation that behavioral consistency – and by implication, spillover processes – is likely to vary across cultures and countries, in the present study we assess the endorsement, and implications, of compensatory and catalyzing beliefs across several different nations, including non-Western contexts. This builds on prior work which has addressed spillover in research primarily carried out in Europe and North America, as well as on prior work examining pro-environmental behaviour across nations and cultures (Oreg and Katz-Gerro, 2006). Given the almost complete absence of cross-national comparative work on spillover in general – and the role of underlying beliefs in particular – we are interested to ascertain the extent to which our findings are obtained consistently across countries.

MEASUREMENT AND PREDICTIVE ABILITY OF COMPENSATORY AND CATALYZING BELIEFS

Despite conceptual and theoretical reasons to expect that the types of catalyzing and compensatory beliefs outlined above might be related to a person's PEB, there has been surprisingly little research that has directly addressed this.

One study that did set out to assess beliefs of this kind was work by Kaklamanou et al. (2015), who devised a 16-item measure of "compensatory green beliefs." This was designed to assess the extent to which people endorsed beliefs about one type of PEB compensating for another. As these authors pointed out, such compensatory beliefs have been more widely considered in the health domain, with some research finding a relationship with health risk behaviors and dietary temptations (Knäuper et al., 2004; Albarracin et al., 2009). Indeed, these and other studies have found compensatory health beliefs are related to intentions to quit smoking (Radtke et al., 2011) and other health risk behaviors such as drinking alcohol and unhealthy eating (Knäuper et al., 2004).

The compensatory beliefs scale devised by Kaklamanou et al. (2015) covered a range of behaviors and posited relationships between them. For example, items included the proposition that "If you have a low flush toilet, then it is okay to use more water in other ways" and "Composting food waste can make up for buying imported food," each referring to trade-offs within domains (water and food, respectively). Behavior pairs were also proposed that were cross-domain, such as "Walking to the supermarket can compensate for buying highly packaged food" and "Having a water butt can compensate for using the oven."

The study by Kaklamanou et al. (2015) found that the compensatory beliefs scale was negatively associated with ecological worldview and pro-environmental identity; and that the scale also negatively predicted self-reported PEB over and above these variables. This suggests these beliefs tended to be connected to relatively less pro-environmental views and actions, in line with the exculpatory tone of the phrasing used. For the most part, the items used tended to have low levels of agreement. In all but five cases, participant agreement with the statements presented was lower than 10%, with the highest level of agreement being for a travel-related proposition, "not driving a car compensates for flying on holiday" (16.2% agreement); this particular statement may also have chimed with Barr et al.'s (2010) finding that holiday-related behaviors were seen as particularly distinct from everyday domestic choices in the home.

Overall, the low levels of agreement found by Kaklamanou et al. (2015) may have reflected that such compensatory green beliefs are relatively uncommon, or that the particular examples used were not endorsed. There is also the possibility that people's willingness to equate their own views with compensatory beliefs may have been affected

by social desirability, whereby such beliefs could be considered disagreeable. Nevertheless, these findings parallel an earlier study by Bratt (1999) in which levels of endorsement of three compensatory statements were also found to be low: indeed, in that study the item presenting a trade-off between not driving and flying on holiday was agreed with by a similar proportion of respondents, at 17.1%.

Building on this earlier work, Byrka and Kaminska (2015) argued that a useful avenue to develop an understanding of compensatory beliefs was to consider them in terms of their relative similarity and difficulty. In particular, these authors suggested that compensatory behaviors are more likely to operate as such if they fall under the same category of behavior (similarity of domain) than if they are dissimilar. As such, it might be expected that an item referring to compensating for buying imported food by composting would be seen as more plausible than compensating for using an oven by using a water butt – to use examples taken from the work by Kaklamanou et al. (2015). Indeed, Byrka and Kaminska (2015) made the argument that across the items developed for that earlier study, the most-endorsed did indeed tend to be those that reflected within-domain trade-offs.

The study by Byrka and Kaminska (2015) proposed, in addition, that behaviors which were easier than the preceding "target" behaviors would be more likely to be endorsed in terms of a compensatory process than would a more difficult choice. For example, the reuse of a carrier bag obtained from a store would be seen as a plausible compensatory act, in part due to its being a simple action to perform; in contrast to using environmentally friendly cleaning products to compensate for using an insecticide. Across their analyses, these authors found that endorsement of compensatory beliefs was higher where target and compensatory behaviors were in the same domain, and where the compensatory behavior was easier than the target behavior.

Other research by Seebauer (2018) has used measures designed to test rebound effects of acquiring an electric car or carrying out home insulation; as well as items that presented these actions in terms of compensatory behaviors for other environmentally significant choices (for example: "I use an electric car, so it doesn't matter much if I fly on a holiday every now and then"). As in the studies described above, this research found that compensatory beliefs were negatively associated with pro-environmental values. In addition, some evidence was presented that rebound behaviors – for example, reporting that one covered more miles with an electric vehicle than before – were also associated with compensatory beliefs.

In addition to survey-based work that has assessed the prevalence and measurement of compensatory beliefs, recent qualitative research by Hope et al. (2018) has shed light on their nature – as well as the ends to which they might be put. These authors suggest that compensatory beliefs can serve important functions in terms of enabling people to affirm their own environmental credentials (even though they may be aware of other actions that are less desirable), to justify some (harmful) actions, and to reduce their negative feelings about their impact on the environment.

AIMS OF THE PRESENT STUDY

The studies considered above have shed light on the prevalence of certain types of belief of relevance to spillover processes and behavioral consistency. However, there are a number of limitations to the research carried out to date that we seek to address.

First, the focus of prior work has been almost exclusively upon people's justification for *inconsistency* across PEBs. In all cases, the measures described above are framed in terms of a "negative" behavior balanced against a "positive" one – either being presented in terms of negative action that is permitted on account of taking other, positive behavior; or in terms of a positive action compensating for other, negative action (hence, the use of the term "compensatory" beliefs). However, prior work has not reflected the potential for equivalent processes whereby one positive action might give rise to another. In the present study, we therefore develop a new measure of "catalyzing" beliefs, intended to complement this former construct. Our concept of a catalyzing belief is one that views behaviors as positively related, whereby action in one area is understood as a trigger for action in another. Given the conceptual linkages between "compensatory" and "catalyzing" beliefs and spillover, we refer in places to both of these as constituting "spillover-related" beliefs.

Second, previous work has set out to measure compensatory beliefs exclusively in terms of trade-offs between defined PEBs: for example, between use of a car and donating to an environmental organization. Although this approach enables a comparison between types of PEBs, such as similarity and difficulty as in Byrka and Kaminska (2015)'s study, these measures have not allowed for an examination of more generalized compensatory beliefs. In the present study, we build on this prior work through an assessment of more general beliefs about the relationships between behaviors, as well as between specified behavior pairs.

Third, although the measures used to date have been considered in the context of other environmentally significant measures, such as pro-environmental identity, ecological worldview, and personal norms, there has not yet been an attempt to validate scales or items with reference to conceptually related constructs. As well as assessing a link with pro-environmental identity in the present study, we also consider our measures of spillover-related beliefs in relation to Cialdini et al.'s (1995) notion of personal consistency and their PFC scale, in order to address the convergent validity of the scales we present. We consider these relationships separately across countries, and for the dataset as a whole, in order to offer an extension of previous research that has occurred in the context of a single country.

Fourth, while previous work has been able to assess compensatory belief measures in relation to several indicators of PEB, there has to date been no analysis of whether and how the scales and items used actually reflect *relationships* between behaviors. It remains unclear, for example, whether those who endorse compensatory beliefs show related *patterns* of behavior in line with this. We are interested here to assess the linkages between different types of behavior, rather than cross-national

differences. For this reason we use aggregated data and analyses from participants across countries to assess this study aim.

Finally, the research assessing these types of beliefs has, to date, been able to do so only in homogenous settings and primarily in European or other "Western" nations. In the present study, we consider the application of measures across diverse cultures, extending our survey research to Brazil, China, India, and South Africa, as well as the European countries of Denmark, Poland, and the United Kingdom. We approach this in an exploratory manner, without a pre-specified hypothesis, in order to characterize similarities or differences in the presence of such beliefs across different national contexts.

Our research questions are as follows:

(1) To what extent are compensatory and catalyzing behavioral beliefs endorsed in different national contexts?
(2) To what extent are compensatory and catalyzing beliefs related to pro-environmental identity and PFC?
(3) To what extent are compensatory and cataylzing beliefs related to self-reported PEB?
(4) To what extent are compensatory and catalyzing beliefs related to consistency across different self-reported PEBs?

Based on previous work which has found correlations between compensatory beliefs, pro-environmental identity, and PEB, we anticipate that the measures used here will demonstrate similar associations. We also offer additional predictions based on further novel components to this study. Our hypotheses are as follows:

H1. Pro-environmental identity will negatively predict compensatory beliefs (H1a), and pro-environmental identity will positively predict catalyzing beliefs (H1b).
H2. Preference for consistency will negatively predict compensatory beliefs (H2a), and preference for consistency will positively predict catalyzing beliefs (H2b).
H3. Compensatory beliefs will negatively predict PEB (H3a), and catalyzing beliefs will positively predict PEB (H3b).
H4. Compensatory beliefs will negatively predict consistency across different behaviors (H4a), and catalyzing beliefs will positively predict consistency across different behaviors (H4b).

Hypotheses H1 and H2 assess aspects of the second research question (links between psychological constructs and spillover-related beliefs). Hypotheses H3 and H4 are derived from research questions 3 and 4, respectively (levels and patterns of self-reported behavior).

MATERIALS AND METHODS

Participants and Design

Participants were recruited through the research panel provider Qualtrics. We used quota sampling in order to ensure the participant pools in each of the surveyed countries were representative by age, gender, and income, based on publicly available national statistics. In selecting for age, we used bands (e.g., 18–24, 25–34, 35–44, etc.) which we matched to national demographics (e.g., in the United Kingdom to that provided by the Office for National Statistics). For all countries, the median age band was 35–44 years of age; with the exception of the United Kingdom and Denmark where this was 45–54 years of age. We quota sampled for personal income, based on a country's income quintiles, such that the samples obtained reflected a range of income brackets. We sought to obtain a 50:50 split for gender, while allowing respondents to self-identify in another way than male or female. While we did not quota sample for education, this information was obtained through a survey item. There was a reasonable spread of levels of education, although this may have been skewed somewhat toward those with a higher level of education: while it is problematic to compare across countries given different systems, around two-thirds (63%) of the sample had a graduate-level qualification.

Participants completed survey questionnaires online between March and November 2016, receiving a small compensation for participating (credits administered by the panel provider). The median time taken to complete the survey was 29 min 50 s. The full sample of respondents comprised 6,969 individuals, approximately 1,000 people per country surveyed (although due to problems with obtaining a full sample in Poland, numbers were lower here at $n = 658$; in India we obtained a sample $n = 985$, with just over $n = 1{,}000$ in other countries).

For each of the surveyed countries, items were translated by professional translators, and subsequently double-checked by a second professional translator. In addition, collaborators based in academic institutions in each of the countries surveyed were involved in checking for meaning and transferability to that country's context.

Measures

Items were administered in blocks of questions, using the online survey randomization feature to preclude ordering effects.

The survey incorporated a range of measures, not all reported or analyzed here. The following items and scales are those considered in the present study.

Compensatory Beliefs

We measured compensatory beliefs using nine items, developed in part to build on earlier work by Kaklamanou et al. (2015). The items were designed to reflect specific behavior pair trade-offs as well as more general compensatory beliefs. Items included statements such as "If I save electricity through switching off appliances, I am entitled to use it in other ways such as by turning up the heating" and "Doing some things that are positive for the environment means I am allowed to do other things that are less environmentally friendly." Participants were asked the extent to which they agreed or disagreed with each statement, on a scale from "1" (entirely disagree) to "7" (entirely agree). The full list of items is given in **Table 1**, together with descriptive statistics for overall levels of agreement.

TABLE 1 | Items and descriptive statistics for compensatory and catalyzing beliefs scales (all countries).

		Compensatory beliefs		
Item	**Mean (SD)**	**% Agree (cross-national)**	**Highest % agree (country)**	**Lowest % agree (country)**
Doing some things that are positive for the environment means I am allowed to do other things that are less environmentally friendly	3.25 (1.92)	26.2%	42.4% (India)	14.6% (Denmark)
As long as I take a few simple actions to protect the environment then that is enough	4.24 (1.63)	47.6%	67.0% (Poland)	29.8% (Denmark)
I already try to help out on environmental issues; I am not prepared to change my lifestyle any further	3.95 (1.59)	36.7%	45.7% (Poland)	27.9% (South Africa)
If I save electricity through switching off appliances, I am entitled to use it in other ways such as by turning up the heating	3.40 (1.95)	29.4%	51.4% (China)	6.6% (Denmark)
As long as I "do my bit" to help the environment at home, there is no need to worry about doing this at work or in other situations	2.84 (1.75)	18.4%	46.2% (India)	8.5% (Denmark)
The environmental impact of flying on holiday can be made up for by reducing one's car use at other times	4.13 (1.61)	39.5%	66.8% (India)	16.2% (Denmark)
Reducing my environmental impact at home (e.g., by recycling) helps to compensate for any environmental impacts I have at work or elsewhere	3.92 (1.84)	41.4%	62.2% (India)	26.0% (Denmark)
It doesn't matter how much energy I use when I'm at work or out of the house, as long as I try to be "green" at home	2.68 (1.69)	15.9%	38.6% (India)	4.9% (Denmark)
If a person has a diet that is environmentally friendly, this compensates for any environmental harm from them burning petrol/diesel in cars	3.03 (1.76)	20.7%	41.7% (India)	3.6% (Denmark)
Full scale;	31.43 (10.25)			
Equivalent per item	3.49 (1.14)			
		Catalyzing beliefs		
Being environmentally friendly is not about taking small actions, it is a complete approach to life	5.43 (1.58)	77.0%	92.8% (China)	59.7% (Denmark)
Doing something positive for the environment in my everyday life makes me want to do other similar things	5.33 (1.28)	76.7%	91.8% (India)	58.8% (Denmark)
If I manage to do one small thing for the environment, it gives me the sense that bigger changes in my lifestyle are possible	5.30 (1.35)	75.9%	91.5% (India)	44.8% (Denmark)
If I act in a manner that benefits the environment, it makes me more aware of other similar actions I can take	5.44 (1.24)	81.8%	93.3% (India)	66.6% (United Kingdom)
Full scale;	21.53 (4.22);			
Equivalent per item	5.38 (1.06)			

The compensatory beliefs items formed a reliable scale in all countries; alpha scores obtained were as follows: Brazil (α = 0.76), China (α = 0.84), Denmark (α = 0.78), India (α = 0.87), Poland (α = 0.73), South Africa (α = 0.81), and United Kingdom (α = 0.86).

Catalyzing Beliefs

We measured what we term "catalyzing" beliefs using four novel items. These were designed to mirror the types of statements used to reflect compensatory beliefs, but in contrast to convey the belief that undertaking positive PEB was associated with taking further action in that vein. The items used in all cases were intended to convey a generalized belief in this catalyzing property of PEB. Items included the statements "Doing something positive for the environment in my everyday life makes me want to do other similar things" and "If I manage to do one small thing for the environment, it gives me the sense that bigger changes in my lifestyle are possible." Participants were asked the extent to which they agreed or disagreed with each statement, on a scale from "1" (entirely disagree) to "7" (entirely agree). The full list of items is given in **Table 1**, together with descriptive statistics for overall levels of agreement. The catalyzing beliefs items formed a reliable scale (fair to excellent alpha scores) in all countries; alpha scores obtained were as follows: Brazil (α = 0.71), China (α = 0.77), Denmark (α = 0.66), India (α = 0.71), Poland (α = 0.69), South Africa (α = 0.71), and United Kingdom (α = 0.81).

Pro-environmental Identity

Seven items were used to measure pro-environmental identity, using items adapted from previous research (Whitmarsh and O'Neill, 2010) as follows: "Taking action to protect the environment is an important part of who I am," "I would describe myself as an environmentalist," "I would not want anyone to think of me as someone who is concerned about reducing waste" (reverse-scored), "I would not want my family or friends to think of me as someone who is concerned about environmental issues" (reverse-scored), "I am the type of person who tries not to be wasteful," "I think of myself as an environmentally friendly person," and "I would be embarrassed to be considered a 'waste-conscious' person" (reverse-scored). Participants were asked the extent to which they agreed or disagreed with each statement, on a scale from "1" (entirely disagree) to "7" (entirely agree). The pro-environmental identity items formed a fairly reliable scale across countries, though with somewhat lower alpha scores than those obtained for other scales; alpha scores obtained were as follows: Brazil ($\alpha = 0.59$), China ($\alpha = 0.70$), Denmark ($\alpha = 0.72$), India ($\alpha = 0.53$), Poland ($\alpha = 0.58$), South Africa ($\alpha = 0.65$), and United Kingdom ($\alpha = 0.75$).

Preference for Consistency

We used seven items taken or adapted from Cialdini et al.'s (1995) PFC scale, as follows: "It is important to me that my actions are consistent with my beliefs," "Admirable people are consistent and predictable," "I get uncomfortable when I find my behaviour contradicts my beliefs," "I'm uncomfortable holding two beliefs that are inconsistent," "It doesn't bother me much if my actions are inconsistent" (reverse-scored), "It is important to me that those who know me can anticipate what I will do," and "I want to be described by others as a stable, predictable person." Participants were asked the extent to which they agreed or disagreed with each statement, on a scale from "1" (entirely disagree) to "7" (entirely agree). The PFC items formed a reliable scale in all countries; alpha scores obtained were as follows: Brazil ($\alpha = 0.64$), China ($\alpha = 0.62$), Denmark ($\alpha = 0.72$), India ($\alpha = 0.62$), Poland ($\alpha = 0.70$), South Africa ($\alpha = 0.70$), and United Kingdom ($\alpha = 0.77$).

Pro-environmental Behavior

We used a battery of 20 items designed to measure self-reported incidence of carrying out a range of PEBs. These items were derived in part from previous studies of PEBs (e.g., Whitmarsh and O'Neill, 2010) and from qualitative research previously carried out in six of seven of the surveyed countries (Nash et al., under review). Participants were asked to state the frequency with which they had carried out these behaviors, on a scale from "0" (not at all in the past year) to "10" (at least once a day). The full list of items is given in **Table 2**, together with descriptive statistics. PEBs included in the battery include those relating to "private-sphere" (i.e., consumer or domestic) action (see Stern, 2000), including "avoided wasting food (e.g., by using leftovers)" and "bought environmentally friendly products" as well as "public-sphere" (i.e., political or social) action, including "encouraged other people to save energy" and "donated money to an environmental campaign group." Due to ethical and practical considerations, Chinese respondents were asked four items in substitution for the more politically sensitive items.

In order to assess the latent structure – and hence behavior "types" – across the PEB items, we carried out a principal components analysis. Given the use of several alternative or modified items in the China survey (e.g., relating to "voting" or "protest"), we carried out this analysis on data from the remaining six countries: Brazil, Denmark, India, Poland, South Africa, and the United Kingdom. Principal components analysis was undertaken based on eigenvalues >1 and using Varimax rotation. We used a Varimax (orthogonal) rotation in order to derive distinct (uncorrelated) principal components; this enables us to compare consistency across different types of PEB, as we describe below. An alternative approach using oblique rotation (in which principal components are permitted to correlate) reveals a similar latent structure to that described below. We did not apply this approach, however, given our particular interest in the extent to which people varied in their consistency across different types of behavior; we consider it would have been problematic to calculate differences between factor scores – our approach to operationalizing "consistency" – had those factors been known to be substantially correlated.

The factor structure of the PEB items for the six-country dataset is shown in **Table 2**, with factor loadings above 0.4 shown in bold. The types of PEB obtained fall under three fairly neatly delineated categories. Factor 1 encompasses public-sphere behavior (e.g., signing a petition, donating money) incorporating one behavior relating to finding out more about climate change; factor 2 encompasses resource-use and waste-avoidance behaviors, including limiting water and energy usage, as well as recycling; factor 3 encompasses purchasing as well as food-related behaviors (e.g., buying environmentally-friendly products). For subsequent analyses we name the factors accordingly. As we discuss below, we use factor scores in our analyses; however, we also note that measures of alpha corresponding to each of the three factors indicate acceptable to excellent reliability (assuming items with loadings >0.4, factor 1 $\alpha = 0.90$, factor 2 $\alpha = 0.66$, factor 3 $\alpha = 0.74$).

Analytic Approach

We adopt several, related approaches in order to address the study's research questions and hypotheses. In the first instance, we describe the distributional properties of the compensatory and catalyzing beliefs scales. This enables us to compare the extent to which they are endorsed across the seven countries. Next, we carry out correlation analyses to assess the extent to which pro-environmental identity is predictive of compensatory and catalyzing beliefs. We examine the relationship between these beliefs and PFC in a similar manner.

In order to consider the relationships between the spillover-related constructs and PEB, we first assess the extent to which compensatory and catalyzing beliefs relate to different types of PEB, based on the factor analysis of behaviors. Having done so, we then examine consistency *between* behavior types and whether this is related to compensatory and catalyzing beliefs.

TABLE 2 | Component structure and descriptive statistics of PEBs across six countries (Brazil, Denmark, India, Poland, South Africa, and United Kingdom).

	Component/Factor			
	1	2	3	Mean (SD)
Took part in a protest about an environmental issue	**0.807**	−0.068	0.141	0.84 (1.83)
Got involved in conservation work to protect natural environments (e.g., national parks, coastline)	**0.802**	0.059	0.162	1.43 (2.37)
Offered support (e.g., by voting) for political action to protect the environment	**0.797**	0.047	0.142	2.40 (2.24)
Contacted a politician about an environmental issue	**0.779**	−0.105	0.091	0.66 (1.64)
Signed a petition about an environmental issue	**0.770**	0.041	0.111	1.37 (2.17)
Donated money to an environmental campaign group	**0.741**	−0.022	0.207	1.16 (1.88)
Done something together with neighbors, people at work or friends to address an environmental issue	**0.686**	0.081	0.301	1.77 (2.40)
Found out more about environmental issues (e.g., learning more about climate change)	**0.575**	0.244	0.344	3.33 (2.71)
Avoided buying new things (e.g., clothes, luxury items)	0.338	0.269	0.237	3.60 (2.79)
Avoided wasting food (e.g., by using leftovers)	0.054	**0.712**	0.129	7.36 (2.09)
Avoided littering (throwing rubbish on the street)	−0.116	**0.684**	−0.015	8.10 (1.92)
Turned off the tap when brushing teeth	−0.028	**0.669**	0.061	8.07 (2.21)
Turned off lights when not in use	−0.140	**0.630**	0.130	8.25 (1.76)
Taken short showers (less than 3 min long) or infrequent baths	0.172	**0.536**	0.182	6.12 (3.08)
Recycled household waste (e.g., glass, plastic, food waste)	0.134	**0.408**	0.161	5.82 (3.14)
Encouraged other people to save energy	0.378	0.394	0.339	4.40 (2.93)
Eaten organic, locally grown or in season food	0.131	0.160	**0.787**	4.96 (2.80)
Bought environmentally friendly products	0.227	0.158	**0.769**	4.50 (2.48)
Bought products with less packaging	0.229	0.261	**0.694**	4.50 (2.59)
Avoided eating meat	0.204	0.066	**0.529**	3.10 (3.29)

We adopt the approach of using factor scores for each of the three principal components (factors), which in each case represents a score weighted to reflect the relative loading of items within the factor. In this, we follow the "weighted sum scores" approach described by DiStefano et al. (2009). The use of factor scores enables us to obtain a participant score for each behavior type, which can be treated as an outcome variable in linear regression analyses.

In order to develop an indicator of consistency between behavior types, we calculate the positive difference between factor scores for each participant, across the three factors. For example, to calculate the difference between factors 2 and 3, we use the following equation, where D is the positive value of the difference between the two factor scores and where FAC2 and FAC3 represent scores for factors 2 and 3:

$$D = \sqrt{((FAC2 - FAC3)^2)}$$

This enables us to quantify the extent to which each participant's PEB is relatively consistent across behavior types (a small positive value for D) or relatively inconsistent (a large positive value for D). We carry out this assessment of difference for each of the pairs of factors (i.e., factor 1 vs. factor 2; factor 1 vs. factor 3; and factor 2 vs. factor 3).

In the first stage of our linear regression analyses, we include compensatory or catalyzing beliefs only, as predictors; at the next stage, we also include pro-environmental identity and PFC as predictor variables. In this, we mirror the approach used by Kaklamanou et al. (2015) who sought to assess the extent to which such beliefs were uniquely predictive of PEB (as opposed to only reflecting more general pro-environmental tendencies) while also considering the role of PFC. Given the previously observed relationship between spillover-related beliefs and pro-environmental identity, we also examine collinearity across these analyses; we do not find any evidence that this is problematic (VIF < 1.5 in all cases).

TABLE 3 | Relationship between green identity and compensatory beliefs.

Country	Correlation (Pearson's *r*)	R^2
Brazil	−0.29***	0.09
China	−0.44***	0.19
Denmark	−0.41***	0.16
India	−0.46***	0.21
Poland	−0.23***	0.05
South Africa	−0.39***	0.15
United Kingdom	−0.42***	0.17
Full dataset	−0.36***	0.13

***$p < 0.001$.

RESULTS

Endorsement of Compensatory and Catalyzing Beliefs

As can be seen in **Table 1**, average levels of endorsement – where a participant stated they "entirely," "mostly," or "somewhat" agreed with the statement – varied from 15.9% ("It doesn't matter how much energy I use when I'm at work or out of the house, as long as I try to be 'green' at home") to 81.8% ("If I act in a manner that benefits the environment,

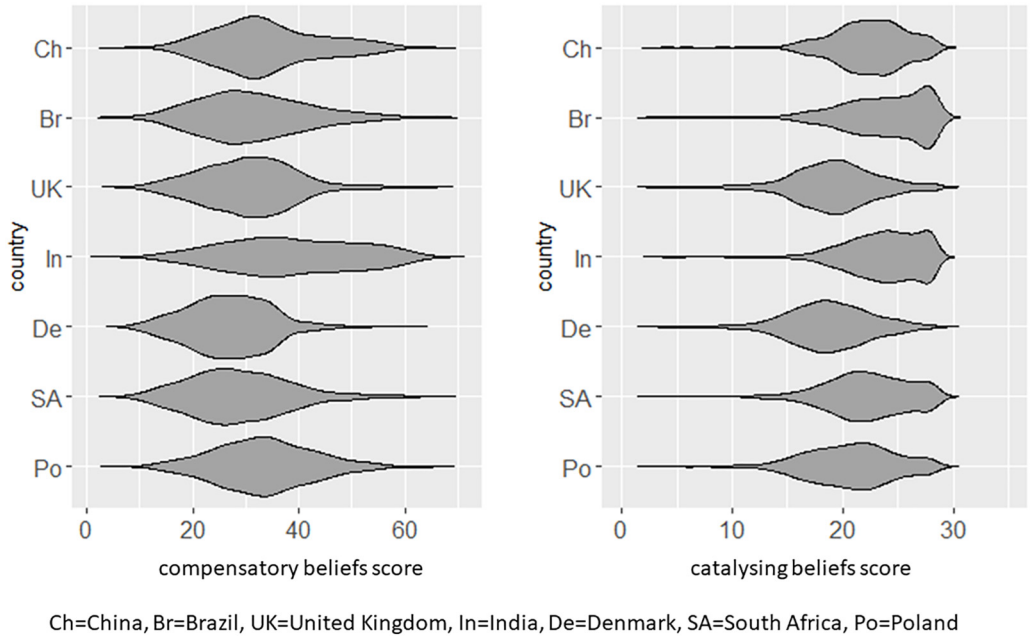

FIGURE 1 | Distribution of Compensatory and Catalyzing beliefs scores across surveyed countries.

it makes me more aware of other similar actions I can take") across the full seven-country sample. **Table 1** also shows the countries for which the lowest and highest levels of agreement were obtained.

The overall distributional properties of both scales are shown in **Figure 1**. As can be seen here, relative to the other surveyed countries, responses are skewed and/or flattened in the case of India (compensatory beliefs), and Brazil and India (catalyzing beliefs).

Relationship of Belief Types to Pro-environmental Identity and Preference for Consistency

Correlation tests were used to assess whether, and to what extent, pro-environmental identity predicts compensatory beliefs. This was undertaken separately for each of the seven countries. **Table 3** shows Pearson's r and R^2 scores for the associations between pro-environmental identity and the compensatory beliefs scale across countries.

In all cases, the analysis supports the H1a prediction that identity and compensatory beliefs are inversely related. Pro-environmental identity explains between 5 and 21% of the variance in compensatory beliefs (adjusted R^2 values), as shown in **Table 3**.

We carried out a similar set of correlation tests to assess whether, and to what extent, pro-environmental identity predicts catalyzing beliefs. In all cases, the analysis supports the H1b prediction that identity and catalyzing beliefs are positively related. Pro-environmental identity explains between 15 and 37% of the variance in catalyzing beliefs (adjusted R^2 values), as shown in **Table 4**.

TABLE 4 | Relationship between green identity and catalyzing beliefs.

Country	Correlation (Pearson's *r*)	R^2
Brazil	0.53***	0.28
China	0.61***	0.37
Denmark	0.49***	0.24
India	0.39***	0.15
Poland	0.53***	0.28
South Africa	0.54***	0.29
United Kingdom	0.60***	0.36
Full dataset		0.27

****p < 0.001.*

TABLE 5 | Relationship between PFC and compensatory beliefs.

Country	Correlation (Pearson's *r*)	R^2
Brazil	0.19***	0.04
China	−0.04 (ns)	0.00
Denmark	0.02 (ns)	0.00
India	0.13***	0.02
Poland	−0.06 (ns)	0.00
South Africa	0.02 (ns)	0.00
United Kingdom	0.04 (ns)	0.00
Full dataset	0.12***	0.01

****p < 0.001.*

We next carried out correlation tests to assess whether, and to what extent, PFC predicts compensatory beliefs. **Table 5** shows results obtained.

Our prediction of a negative relationship between these two constructs, H2a, was not supported. In only two of seven countries was a significant relationship obtained, and with only small amounts of variance explained.

Further analysis supports the prediction, H2b, that PFC and catalyzing beliefs are positively related. PFC explains between 7 and 28% of the variance in catalyzing beliefs (adjusted R^2 values), as shown in **Table 6**.

Relationship Between Pro-environmental Behavior and Belief Types

We next assess the extent to which the different types of PEB described above are related to compensatory and catalyzing beliefs, using linear regression analyses.

As can be seen from **Table 7**, although a significant relationship is observed in all cases between compensatory beliefs and PEB, there is a divergence between the direction in which compensatory beliefs are predictive of PEB. In the case of resource/waste PEB and purchasing/food PEB the expected negative relationship is found; however, in the case of public-sphere PEB, a positive relationship is observed. Our hypothesis that compensatory beliefs would be inversely related to PEB, H3a, is therefore not supported.

In the case of the relationship between PEB and catalyzing beliefs (**Table 8**), our hypothesis, H3b, is more clearly supported: catalyzing beliefs are predictive of each of the three PEB types, and this relationship holds where pro-environmental identity is also included in the regressions. An unexpected negative relationship is observed between pro-environmental identity and one of the factors at Step 2. It is not clear why this result is obtained, given that pro-environmental identity is, on its own, positively associated with each factor. As we note above, we do not identify any concerns with collinearity in our regression analyses. Nevertheless, the relatively strong overall association between identity and catalyzing beliefs, as illustrated in **Table 4**, may indicate that this finding is an anomaly due to a relatively large degree of variance being shared between identity and catalyzing beliefs, in predicting PEB.

As shown in **Table 9**, our analyses confirm our prediction, H4a, that compensatory beliefs are related to behavioral inconsistency. In each case, compensatory beliefs significantly and positively predict the degree of divergence between different types of PEB. The relationship is strongest for inconsistency between public-sphere and resource/waste PEBs.

As shown in **Table 10**, our analyses do not support the prediction, H4b, that catalyzing beliefs are inversely related to behavioral inconsistency. We find a mix of divergent results here, as well as very low R^2 values attributable to catalyzing beliefs, suggesting either a null or non-predicted relationship between these two variables.

TABLE 6 | Relationship between PFC and catalyzing beliefs.

Country	Correlation (Pearson's *r*)	R^2
Brazil	0.26***	0.07
China	0.53***	0.28
Denmark	0.27***	0.07
India	0.38***	0.15
Poland	0.31***	0.10
South Africa	0.34***	0.11
United Kingdom	0.40***	0.16
Full dataset	0.41***	0.16

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

DISCUSSION

The present study considers individuals' beliefs in relation to how certain behaviors are thought of as triggering, justifying, or compensating for other behaviors. Our research is the most detailed exploration to date of the content, measurement, and relationships with other key indicators, of such spillover-related beliefs.

Our compensatory beliefs scale was found to have acceptable to good internal consistency (reliability) across the seven countries in which we were able to administer it; as did the 4-item catalyzing beliefs scale we devised. In the case of some specific measures used, we observed similar levels of endorsement as comparable previous research: for example, 16.2% of respondents in the Danish sample endorsed the view that reduced car use can compensate for flying on holiday, an identical figure to that obtained for an equivalent item used by Kaklamanou et al. (2015) with a United Kingdom sample. However, in contrast to previous research, for the most part we obtained substantially

TABLE 7 | Relationships between PEB factors and compensatory beliefs.

	Dependent variable: public-sphere PEB (factor 1)			Dependent variable: resource/waste PEB (factor 2)			Dependent variable: purchasing/food (factor 3)		
	B (*SE*)	Beta	R^2 (ΔR^2)	*B* (*SE*)	Beta	ΔR^2 (ΔR^2)	*B* (*SE*)	Beta	ΔR^2 (ΔR^2)
Step 1			0.16			0.05			0.003
Compensatory beliefs	0.04 (0.001)	0.39***		−0.02 (0.001)	−0.21***		−0.005 (0.001)	−0.05***	
Step 2			0.19 (0.04)			0.17 (0.12)			0.06 (0.06)
Compensatory beliefs	0.05 (0.001)	0.46***		−0.01 (0.001)	−0.09*		0.004 (0.001)	0.04**	
Green identity	0.03 (0.002)	0.21***		0.06 (0.002)	0.37***		0.04 (0.002)	0.26***	

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

TABLE 8 | Relationships between PEB factors and catalyzing beliefs.

	Dependent variable: public-sphere PEB (factor 1)			Dependent variable: resource/waste PEB (factor 2)			Dependent variable: purchasing/food (factor 3)		
	***B* (*SE*)**	**Beta**	**R^2 (ΔR^2)**	***B* (*SE*)**	**Beta**	**ΔR^2 (ΔR^2)**	***B* (*SE*)**	**Beta**	**ΔR^2 (ΔR^2)**
Step 1			0.10			0.08			0.06
Catalyzing beliefs	0.07 (0.003)	0.31***		0.06 (0.003)	0.28***		0.06 (0.003)	0.24***	
Step 2			0.11 (0.02)			0.17 (0.09)			0.08 (0.02)
Catalyzing beliefs	0.09 (0.003)	0.39***		0.02 (0.003)	0.10***		0.03 (0.003)	0.15***	
Green identity	−0.02 (0.002)	−0.15***		0.06 (0.002)	0.35***		0.03 (0.002)	0.17***	

***$p < 0.001$.

TABLE 9 | Relationships between PEB inconsistency and compensatory beliefs.

	Dependent variable: factor 1 vs. factor 2 scores			Dependent variable: factor 2 vs. factor 3 scores			Dependent variable: factor 1 vs. factor 3 scores		
	***B* (*SE*)**	**Beta**	**ΔR^2 (ΔR^2)**	***B* (*SE*)**	**Beta**	**ΔR^2 (ΔR^2)**	***B* (*SE*)**	**Beta**	**ΔR^2 (ΔR^2)**
Step 1			0.11			0.02			0.04
Compensatory beliefs	0.03 (0.001)	0.33***		0.01 (0.001)	0.12***		0.02 (0.001)	0.19***	
Step 2			0.11 (0.003)			0.03 (0.02)			0.04 (0.002)
Compensatory beliefs	0.03 (0.001)	0.31***		0.01 (0.001)	0.08***		0.02 (0.001)	0.20***	
Green identity	−0.01 (0.002)	−0.06***		−0.02 (0.002)	−0.13***		0.004 (0.002)	0.03*	
Pref. for consistency	0.00 (0.002)	−0.001 (ns)		−0.004 (0.002)	−0.03 (ns)		0.005 (0.002)	0.03*	

*Factor 1, public-sphere PEB; factor 2, resource/waste PEB; factor 3, purchasing/food PEB. *$p < 0.05$, ***$p < 0.001$.*

TABLE 10 | Relationships between PEB inconsistency and catalyzing beliefs.

	Dependent variable: factor 1 vs. factor 2 scores			Dependent variable: factor 2 vs. factor 3 scores			Dependent variable: factor 1 vs. factor 3 scores		
	***B* (*SE*)**	**Beta**	**ΔR^2 (ΔR^2)**	***B* (*SE*)**	**Beta**	**ΔR^2 (ΔR^2)**	***B* (*SE*)**	**Beta**	**ΔR^2 (ΔR^2)**
Step 1			0.002			0.01			0.01
Catalyzing beliefs	0.01 (0.003)	0.04**		−0.02 (0.003)	−0.10***		0.02 (0.003)	0.09***	
Step 2			0.05 (0.05)			0.02 (0.02)			0.02 (0.01)
Catalyzing beliefs	0.04 (0.003)	0.17***		−0.003 (0.003)	−0.02 (ns)		0.03 (0.003)	0.14***	
Green identity	−0.04 (0.002)	−0.26***		−0.02 (0.002)	−0.15***		−0.02 (0.002)	−0.11***	
Pref. for consistency	0.003 (0.002)	0.02 (ns)		−0.001 (0.002)	−0.003 (ns)		0.001 (0.002)	0.03*	

*Factor 1, public-sphere PEB; factor 2, resource/waste PEB; factor 3, purchasing/food PEB. *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.*

higher levels of agreement with the compensatory scale as a whole, as well as for specific items. We suggest there are two main reasons for this.

First, this was likely related to the use of items which did not exclusively affirm specific relations between predetermined behaviors or contexts. Whereas other research has tended to present specific behavior pairs in relation (or opposition) to one another, in the present study we also framed this in terms of more general statements. We also note the important caveat that the items used in the compensatory beliefs scale used some behavior-specific items, whereas the catalyzing beliefs scale used wording that reflected more general behavioral relations. This is likely to have influenced the overall higher levels of endorsement of the catalyzing beliefs scale, compared to the compensatory scale.

While we used several belief items that imply a more general relation between behaviors, in this, the statements we propose may well reflect an overlooked aspect of how compensatory beliefs operate in practice; rather than being rigidly tied to specific choices, a person's beliefs may instead constitute an adaptable and generalized perspective on one's own behavior in aggregate. This is in line with qualitative research by Hope et al. (2018), which argued that participants saw behavioral compensation on a cumulative and holistic level rather than in relation to distinct behavioral relations; these researchers likewise suggested that participant perspectives were at odds with survey items in which "single, predefined compensatory actions are pitted against one another."

A second reason for the relatively higher levels of agreement with the compensatory scale used in the present study is likely to relate to our use of cross-national samples, and variability in country-level response distributions. While differences were not especially pronounced across the seven countries as a

whole, it is noteworthy that Indian respondents in particular were more inclined to agree with these items, whereas those from Denmark were least likely to endorse them (Danish respondents were, indeed, also relatively less likely to endorse catalyzing beliefs). Some aspect of this is likely to relate to cross-cultural differences in survey responding, including the tendency for "acquiescent responding" (i.e., tendency to agree with statements) to vary cross-nationally (Johnson et al., 2005). It is worth noting in this regard that many of the seminal and influential studies of spillover have in fact been undertaken in Denmark (e.g., Thøgersen and Ölander, 2003; Lanzini and Thøgersen, 2014); which, from our research at least, would seem to comprise a population that is strongly inclined to reject compensatory beliefs.

Our use of a catalyzing belief scale revealed surprisingly high endorsement of the items proposed. While cross-country variability in patterns of responding is again evident – in particular, the scale distribution is skewed for the India and Brazil country samples – nevertheless participants across all countries appeared far more inclined to endorse catalyzing than compensatory beliefs. The wording of items could have reflected some aspect of people's general pro-environmental attitudes or tendencies, as we note above, but it is of interest that the most-endorsed catalyzing beliefs item was one that most clearly presented the idea that one's personal actions are linked in a positive manner. As with the compensatory beliefs scale, there may have been some sense in which these items were influenced by acquiescent responding, with this in turn varying on a cross-national basis. It is of note, however, that there does not appear to be a straightforward equivalence in responding by country, between the two belief types. In particular, whereas relatively high levels of agreement are found for this scale in Brazil and India, an equivalent pattern – whether in the same direction or inverse – is not shown for these countries for the compensatory beliefs scale.

We suggest that pursuing a deeper understanding of catalyzing beliefs – and similar constructs – offers a promising, and potentially constructive approach, to considering the ways in which people perceive their PEB as a whole. A large majority of people (around 90%) in Europe now report that they personally take action on climate change (Eurobarometer, 2017); where opportunities exist to make positive connections between such current, future, or recent action, particularly in relation to beliefs to which people widely subscribe, this could facilitate more widespread behavior change. The research literature already recognizes that there are multiple processes by which positive spillover can in principle occur – whether through a "foot in the door" approach (Thøgersen and Noblet, 2012), through self-identity (Van der Werff et al., 2014), or promoting self-efficacy (Lauren et al., 2016). However, our research suggests that one under-appreciated feature may be people's own beliefs about the ways in which their own behaviors can be considered mutually reinforcing across choices and contexts.

In line with previous research, we have examined the extent to which spillover-related beliefs relate to pro-environmental (or "green") identity, which is known to be both a precursor to action and relevant to behavioral spillover (Whitmarsh and O'Neill, 2010; Poortinga et al., 2013; Van der Werff et al., 2014; Nash et al., 2017). As in prior work, we also observe a negative association between identity and compensatory beliefs; conversely, we find a positive association between catalyzing beliefs and identity.

An advance offered through the present research, moreover, is an assessment of a link between our measures of spillover-related beliefs and PFC (Cialdini et al., 1995). In doing so, we consider whether these beliefs are correlated with a related and comparable construct which is not so straightforwardly associated with environmental concern and action. This enables us to assess the construct validity of spillover-related beliefs, in a way that has not previously been addressed.

We do observe a strong association between PFC and catalyzing beliefs, across the countries surveyed. This enables us to have some confidence in this novel measure, given that our view of catalyzing beliefs encompasses the idea of consistency across behaviors. Conversely, we do not find that PFC is inversely related to compensatory beliefs, as predicted. In this latter case, we speculate that where people subscribe to compensatory beliefs, this may not be as straightforwardly related to a lack of personal "consistency." In particular, the characterizations of behavior across the compensatory items arguably do not preclude the idea of a logical pattern in one's choices, albeit that this would be one that views one behavior as allowing for, or offsetting another. In this sense, to report that one favors "consistency," as in the PFC items, may not be at odds with a view of behaviors counterbalancing each other.

We did observe a positive relationship between catalyzing beliefs and each of three types of PEB. However, our hypothesis that compensatory beliefs would inversely predict PEB was not supported. While this held in the case of private sphere (resource and waste) behavior, there was no clear or strong relationship with private sphere (purchasing and food) behavior and we unexpectedly observed a positive relationship with the cluster of public sphere behaviors, such as protesting or donating money.

One possible explanation for this may relate to the relatively high effort nature of the public sphere behaviors used, and their potential to allow a person to consider themselves to have "done their bit" had they carried them out. In line with a compensatory view, where people had taken such effortful action as contacting a politician or volunteering, this may be linked to feeling less obligated to take PEB in other areas. Although we did not anticipate such a finding, it would be in line with other research that has linked negative spillover to "single action bias" (Weber, 2010). Other work has found that people who carry out more private-sphere PEB may in turn be less inclined to offer support for environmental policy (Werfel, 2017); in the present research, our results hint at a relationship that might operate in the reverse direction also.

A direct assessment of how spillover-related beliefs might relate to behavioral (in)consistency was carried out in further analyses in the present study. This we argue is important to address, given that these spillover-related beliefs are, in essence, concerned with relations between behaviors as much as with PEBs in aggregate.

In support of our hypothesis, we observed a consistent finding across the three types of PEB, whereby endorsement of compensatory beliefs predicts inconsistency between different

types of behaviors. The most pronounced effect observed was for inconsistency between public sphere behavior and private sphere resource/waste choices, suggesting that those holding compensatory beliefs are more likely to be inconsistent across these domains; this may be in terms either of relatively high levels of private sphere choices combined with lower levels of public sphere action, or vice versa.

We did not, however, find an association between catalyzing beliefs and behavioral (in)consistency; across the series of regressions carried out, this relationship was variously non-significant, negative, or positive. Moreover, the amount of variance explained by the catalyzing beliefs scale in these cases was relatively small, suggesting that this construct did not have a great deal of explanatory power here. One reason for this may be that the characterizations of behavior in the catalyzing beliefs scale would be more applicable across very similar types of behaviors, and rather less predictive of consistency between the distinct categories we assessed (e.g., in our case, between public sphere action and resource use behaviors). This would seem to be in line with the notion that spillover is more likely to occur between very similar types of behavior, than between ones perceived to be different (Littleford et al., 2014; Nash et al., 2017). Given the lack of a clear pattern here, we cannot in any case be confident that the catalyzing beliefs scale we developed is related to behavioral patterns, despite that we have found that it does convincingly predict overall levels of PEB. In relation to this, we recommend further developing the idea of "catalyzing" beliefs in more detail and depth, as this construct has received little attention outside the present study; as part of this, there may be opportunities to devise additional or complementary measures beyond the four items that we developed.

STUDY LIMITATIONS AND FUTURE RESEARCH

The present study has obtained some support for the validity and reliability of spillover-related beliefs, as well as considering findings in the context of seven country samples. There are nevertheless some limitations to the research and areas for future development.

First, we are limited in our ability to make strong claims about the construct validity of the compensatory beliefs scale, given that this was not found to be related to PFC as expected. Nevertheless, compensatory items were found to predict both overall levels of behavior as well as behavioral inconsistency, suggesting their potential usefulness in future work. Conversely, while we did observe that catalyzing beliefs were related to PFC and overall levels of PEB – supporting the construct validity and predictive ability of this novel scale – this was nevertheless unrelated to behavioral (in)consistency. The lack of an association in this latter case raises questions over the ability of our novel catalyzing belief scale to explain patterns or linkages between behaviors, this being the aim of much spillover-related research.

We have considered the use of the compensatory and catalyzing beliefs measures in different cultural contexts, and observe some distinct differences in how people respond in these locations. It is not clear from our research whether this is linked to cross-cultural differences in response styles, fundamental differences in the extent to which people in different settings endorse such beliefs, or a combination of both. To date, there has been very little cross-cultural research concerning spillover and related topics, particularly outside of a developed country context. We therefore suggest that further attention is given as to whether these phenomena are generalizable and equivalent across different populations.

As in the case of much research in environmental psychology and related fields, we are limited by the use of self-report measures derived from a survey instrument. It would therefore be of value for these spillover-related beliefs to be tested in relation to observed behavior – and patterns of behavior – including in experimental contexts. In future research, it will be of value to link patterns of beliefs to more objective measures, such as home energy use or the recording of dietary choices.

Further testing and development of these types of measures in relation to comparable constructs would be valuable, in order to develop their validity. There are a range of theoretical models of relevance to behavioral consistency (e.g., see Mullen and Monin (2016) for an overview of approaches), which may have bearing on the ways in which people hold such beliefs, or are inclined to act upon them.

CONCLUSION

The present study has progressed the understanding of spillover-related beliefs in several novel directions, providing one of the most detailed explorations to date of this topic area. Our research is, to our knowledge, the first to develop and assess a role for "catalyzing" beliefs, as well as considering those that are "compensatory." In the case of both belief types, we have developed measures that portray generalized beliefs about patterns of behavior, in contrast to prior research which has relied on presenting linkages between specific types of action.

Our measures have been found to be reliable and to be associated with key psychological and behavioral measures, although our hypotheses were only partially supported in some cases: in particular, while we found support for our prediction that compensatory beliefs would be related to a lack of consistency between behavior types, the relationship was less straightforward in the case of catalyzing beliefs. The present research is the first, as far as we are aware, to consider spillover-related beliefs in the light of convergent constructs, through a comparison with a person's preference for consistency and the degree to which they report (in)consistency across different types of behavior. We have also examined spillover-related beliefs for the first time in a cross-cultural context, including outside of a developed country setting. While we observe similar relationships between our key measures across cultures, divergence in the degree to which they are endorsed warrants further attention.

A priority for future research will be to assess how patterns of behavior and behavioral consistency are connected to spillover-related beliefs, as well as considering compensatory and catalyzing beliefs in more detail in the context of theoretically related constructs.

ETHICS STATEMENT

This study was carried out in accordance with the recommendations of the British Psychological Society, with written informed consent from all subjects. All subjects gave written informed consent in accordance with the Declaration of Helsinki. The protocol was approved by the Ethics Committee, School of Psychology, Cardiff University.

AUTHOR CONTRIBUTIONS

The study was designed by SC, LW, and NN. The analysis was carried out by SC with assistance from LW. The manuscript writing was led by SC, with assistance and contributions from LW, NN, PH, and JL.

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Reflecting on Behavioral Spillover in Context: How Do Behavioral Motivations and Awareness Catalyze Other Environmentally Responsible Actions in Brazil, China, and Denmark?

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Responding to serious environmental problems, requires urgent and fundamental shifts in our day-to-day lifestyles. This paper employs a qualitative, cross-cultural approach to explore people's subjective self-reflections on their experiences of pro-environmental behavioral spillover in three countries; Brazil, China, and Denmark. Behavioral spillover is an appealing yet elusive phenomenon, but offers a potential way of encouraging wider, voluntary lifestyle shifts beyond the scope of single behavior change interventions. Behavioral spillover theory proposes that engaging in one pro-environmental action can catalyze the performance of others. To date, evidence for the phenomenon has been mixed, and the causal processes governing relationships between behaviors appear complex, inconsistent and only partly understood. This paper addresses a gap in the literature by investigating accounts of behavioral spillover in three diverse cultural settings using qualitative semi-structured interviews. The analysis shows that while around half of participants overall who were questioned recalled spillover effects, the other half had not consciously experienced spillover. There were few significant differences across cultures, though some forms of spillover effects were reported more in some cultures than others. More environmentally engaged participants across all three countries were significantly more likely to experience spillover than those who were less engaged. Accounts of within-domain spillovers were most commonly reported, mainly comprising waste, resource conservation and consumption-related actions. Accounts of between-domain spillover were very rare. Recollection of contextual and interpersonal spillover effects also emerged from the interviews. Our findings suggest that more conscious behavioral spillover pathways may be limited to those with

pre-existing environmental values. Behavioral spillover may comprise multiple pathways incorporating conscious and unconscious processes. We conclude that targeting behavioral catalysts that generate more socially diffuse spillover effects could offer more potential than conventional spillover involving a single individual.

Keywords: behavioral spillover, pro-environmental behaviour, cross-cultural, Brazil, China, Denmark, qualitative

INTRODUCTION

Pro-environmental behavioral spillover has received renewed interest in the social sciences in recent years as a potential way of initiating voluntary environmentally responsible lifestyle change beyond that of piecemeal behavioral interventions. Behavioral spillover has an intuitive logic and appeal, yet the academic research has been limited (Thøgersen and Crompton, 2009). The majority of research comes from quantitative experiments and field studies; where spillover effects have been observed they are typically conditional (Thøgersen, 1999) with modest effect sizes (Thomas et al., 2016). Nonetheless, they may still be important, especially if they persist over an extended time period (Juhl et al., 2017), promote important behaviors (Lauren et al., 2016) or generate attitude change, such as increased acceptance of environmental policy (Thøgersen and Noblet, 2012).

A substantial volume of research has investigated behavioral spillover from the perspective of behavioral outcomes following an intervention, yet very little attention has been given to individual perceptions in the context of everyday lifestyles. There may be multiple pathways to generating observable spillover effects. While some of these processes may occur more or less unconsciously, for example, through identity change (Lauren et al., 2018), very little work has examined individuals' conscious perspectives on the spillover phenomenon in the context of their pro-environmental behavioral motivations. Moreover, few studies have investigated behavioral spillover from a cross-cultural perspective. In this paper, we look at individual accounts of behavioral spillover in three culturally diverse nations (Brazil, China, and Denmark). In Brazil and China, factors such as rapid economic development and population growth predict a significant rise in carbon emissions in the near future (Hallding et al., 2013), while, in contrast, Denmark has made some progress in preventing further damage to its natural ecosystems and has set out a strategy to become fossil-fuel independent by 2050 (Wu, 2015). This article is one of the first to explore citizens' experiences of spillover from a detailed, qualitative perspective. We include reflections from both environmentally engaged and less engaged citizens and evaluate the potential for spillover as a means of catalyzing wider sustainable lifestyle shifts.

Within psychology, most studies of pro-environmental behavior change apply a reasoned action model of individual behavior based on the broad assumption that individuals negotiate behavioral decision-making in rational ways. For example, the Theory of Planned Behavior (TPB) (Ajzen, 1991) asserts that behavior is driven by beliefs about the likely consequences of an action, perceived social norms, and perceived behavioral control over a given situation. Likewise, Stern's (2000) Value Belief Norm (VBN) theory states that when behavior is not strongly constrained by contextual factors, personal norms (internalized rules or obligations to act in a certain way), become activated when valued objects (including the environment), are threatened. With reference to the wider social context in which behaviors occur, Cialdini has pioneered research on the importance of social norms in pro-environmental behavior change (for example, Cialdini et al., 1990; Cialdini and Goldstein, 2004). More recently, Community-Based Social Marketing (CBSM) has also been applied to pro-environmental behavior (McKenzie-Mohr et al., 2011). CBSM goes beyond changing individual cognitions by removing the barriers to pro-environmental actions and enhancing the benefits of engaging in order to make acting in an environmentally responsible way the rational choice. Conversely, behavioral spillover research draws mainly on "non-reasoned" theories, especially consistency theories such as Festinger's (1957) Theory of Cognitive Dissonance and Bem's (1972) self-perception theory. Consistency theories assume that behavior change is the outcome of people's post-rationalization of behavior, triggered by feelings of discomfort (Thøgersen, 2004) or the increased salience of a pro-environmental self-identity (Scott, 1977; Lanzini and Thøgersen, 2014).

Behavioral spillover research is concerned with the possibility of voluntary, wider lifestyle shifts beyond piecemeal behavior change. Research on spillover builds on the idea that engaging in a behavior can, under certain circumstances, affect engagement in other actions aligned with the same goal. Spillover effects have been observed in several disciplines, including psychology, economics, sociology, and health studies from the gray literature (Austin et al., 2011). Evidence for behavioral spillover effects has emerged from research into moral self-regulation (Sachdeva et al., 2009), safety (Ludwig and Geller, 2000), and health (Devine et al., 2003), in addition to pro-environmental behavior (Lauren et al., 2018). The literature on pro-environmental spillover includes studies of *positive* and *negative* spillover effects, with a number of reviews drawing on both literatures having been published (Truelove et al., 2014; Dolan and Galizzi, 2015; Nash et al., 2017; Nilsson et al., 2017), as well as a notable review in the gray literature (Austin et al., 2011).

Positive behavioral spillover concerns the idea that engaging in one environmentally responsible action (and therefore an intervention targeting a specific behavior), can catalyze engagement in other behaviors (untargeted by the intervention) (Truelove et al., 2014). Engaging in one pro-environmental behavior can lead to the adoption of others (Lanzini and Thøgersen, 2014; Juhl et al., 2017; Lauren et al., 2018), including behavioral catalysts that increase engagement in

more committed behaviors (Lauren et al., 2016) and increased support for environmental policy (Thøgersen and Noblet, 2012; Lacasse, 2017).

Negative behavioral spillover asserts that an intervention targeting one pro-environmental behavior can limit engagement in other, untargeted actions (Thøgersen, 1999; Nilsson et al., 2017). Negative relationships between pro-environmental behaviors are further suggested by studies into allied phenomena such as moral licensing (Blanken et al., 2015), and economic rebound effects (Chitnis et al., 2013). While acknowledging the complexity and ambivalence inherent in behavioral relationships, for the remainder of the paper we focus on *positive* behavioral spillover (henceforth, behavioral spillover). This is because the plurality of approaches, constructs and pathways, both between, and, indeed, within the literatures on positive and negative spillover effects, cannot be covered in sufficient depth in a single study.

There is some evidence cross-nationally to support the theory that the chance of adopting a novel pro-environmental behavior increases when behaviors are conceptually related in a Danish study (Thøgersen and Ölander, 2003; Thøgersen, 2004), share similar routines or resources in an Australian context (Margetts and Kashima, 2017) and the United Kingdom (Littleford et al., 2014). Uptake of a new behavior may also be facilitated if an individual has previously engaged in a more difficult action (Xu et al., 2018), comparable to the "*Foot-In-The-Door*" effect, in which compliance with a task performance request increases following compliance with a more difficult initial request (Scott, 1977; Truelove et al., 2014). While such findings are encouraging, they also imply that spillover effects may be limited. Other studies have observed broader behavioral shifts across different behavioral clusters, such as driving fuel efficiently and intention to reduce meat consumption in the Netherlands (Van der Werff et al., 2014), and green purchasing and increases in multiple actions including use of public transport, recycling, water and energy conservation, and volunteering for a green cause in Denmark (Lanzini and Thøgersen, 2014).

Despite such support, some of the evidence for behavioral spillover comes from self-reported intentions rather than observed behavior change (Xu et al., 2018), and from correlational study designs that cannot rule out reverse causality or the influence of common factors (Thøgersen, 2012). Longitudinal studies offer more reliable support. Thøgersen and Ölander (2003) reported on a Danish study that found associations between increased engagement in recycling and subsequent increases in organic food purchasing and public transport use measured at three time points. More recently, in a Chinese study, Xu et al. (2018) observed that engagement in household waste separation catalyzed a subsequent reduction in domestic energy consumption over a three-year period, mediated by changes in self-perception. In another study extracting purchasing behavior from supermarket scanner data covering 8000 Danish households over 20 months, Juhl et al. (2017) found that consumers who started to buy organic items in one product category subsequently purchased organic items in more and more categories over time. In addition to the adoption of new behaviors or changes in the frequency of existing environmentally responsible practices, spillover effects may occur whereby pro-environmental behavior is transferred from one context to another, such as from work to home (Rashid and Mohammad, 2011; Nilsson et al., 2017), or, in the gray literature, from one individual to another in different contexts (Austin et al., 2011). From the literature review so far, it appears that while some evidence comes from laboratory studies, behavioral spillover can also occur in natural settings comprising a variety of behavioral catalysts and effects; but it is not a consistent phenomenon, is difficult to detect and it does not appear to operate in a uniform way.

As well as documenting behavioral outcomes following an intervention, research has sought to understand the processes underpinning observed catalytic relationships. Prospective pathways to spillover include desire for behavioral consistency (Thøgersen, 2004), change in self-identity (Lauren et al., 2018), increased knowledge and self-efficacy (Thøgersen, 2012), heightened environmental concern (Carrico et al., 2018), and strength of felt responsibility to act (Lacasse, 2017).

Identity-based approaches have gained traction and are based on the idea that people infer how to act in a given situation through perceived self-identity and past behavior (Bem, 1972). Engaging in pro-environmental behavior can generate a 'greener' sense of self, which increases the likelihood of acting in ways consistent with this identity in future (Lauren et al., 2018). Increasing green self-perceptions can increase intentions to act environmentally responsibly, as found in a Dutch study (Van der Werff et al., 2014; see also Cornelissen et al., 2008) as well as increase environmental concern and boost support for environmental policy as found in a US study (Lacasse, 2016). Following the introduction of a single-use plastic bag charge in Wales, people's environmental self-perceptions were stronger than before the charge (Poortinga et al., 2013). In the United States, Carrico et al. (2018) failed to detect a change in green self-perception following pro-environmental behavior change. They suggest that the way in which green identity is manipulated may be critical in whether spillover is produced.

Unsurprisingly, engaging in pro-environmental behavior can increase relevant knowledge, skills and experience in ways that facilitate the adoption of other behaviors, as found in Denmark and the United Kingdom (Hutton, 1982; Thøgersen, 1999). Familiarity with eco product labels also predicted subsequent increased purchasing of ecological products in a Danish supermarket study (Thøgersen et al., 2010). Enhancing citizens' pro-environmental literacy and skills can therefore increase the potential for wider pro-environmental engagement (Thøgersen, 2012). Related to knowledge and experience, self-efficacy (a subjective perception of one's capacity to act in a given situation; Bandura, 1977), offers another pathway to behavioral spillover. An intervention designed to promote energy conservation by a German energy provider was associated with a range of behavioral spillovers (including reducing meat consumption, reducing car use, and donating to an environmental cause), in which spillover was mediated by change in self-efficacy (Steinhorst et al., 2015). Self-efficacy has also been observed to mediate behavioral spillover from less committed to more committed water conservation actions in Australia (Lauren et al.,

2016). However, in a subsequent study looking at different behavioral relationships (Lauren et al., 2018), it was green self-identity rather than self-efficacy that mediated spillover between green household actions.

Spillover effects may be more consistently measured when individuals hold pre-existing pro-environmental values. Priming pro-environmental values increases the likelihood of engagement in environmentally responsible behavior (Schultz and Zelezny, 1998) and increases the strength of spillover relationships (Thøgersen and Ölander, 2003). Thøgersen and Crompton (2009) note that prioritizing or valuing the environment may be a necessary prerequisite for behavioral spillover, therefore spillover may be limited to more environmentally engaged citizens. The phenomenon is rendered even more complex by variation in individual behavioral engagement in different contexts. For example, pro-environmental commitments may be relaxed when on vacation (Barr et al., 2010), or when roles and responsibilities between one context and another are perceived to differ (Maki et al., 2016).

Little research has utilized qualitative approaches in studying spillover. Schütte and Gregory-Smith (2015) and Barr et al. (2010) interviewed German and British holidaymakers, respectively, concluding there was little evidence for spillover of domestic pro-environmental actions between home and holiday contexts. In the gray literature, Austin et al. (2011) conducted 20 interviews with behavior change practitioners in the United Kingdom and provide anecdotal evidence that engagement in green behaviours catalyzes other actions. Wonneck and Hobson (2017) also used interviews, concluding that participation in a municipal food-waste recycling program in Canada increased engagement in recycling and environmentally responsible food shopping practices. Finally, Dumitru et al. (2016) analyzed interviews, focus groups and evidence from text documents in Italy and Spain, reporting contextual spillover of pro-environmental values from the workplace (a green energy company) to its employees.

We are unaware of any papers taking a qualitative, cross-cultural approach to behavioral spillover and this paper addresses a significant gap in the literature. Our approach situates accounts of behavioral spillover in the wider sociocultural context, to linked factors beyond the ecological (Howell, 2013). CBSM theory highlights the importance of wider psychological and structural barriers constraining the adoption of pro-environmental behavior, therefore attending to perceived barriers to spillover might offer windows of opportunity for intervention (McKenzie-Mohr et al., 2011). We investigate whether citizens are conscious of behavioral spillover effects as significant motivators of their environmentally responsible practices. Culture exerts a powerful effect on pro-environmental behavior (Adger et al., 2013), shaping people's value emphasis (Leonard et al., 2013; Schwartz, 2014), and the patterns and routines of everyday life (Sztompka, 2008; Gram-Hanssen, 2011).

We evaluate the potential for behavioral spillover as a pathway to more environmentally sustainable societies, pointing out that understanding behavioral spillover in culturally diverse settings is crucial for designing effective interventions to bring about wider lifestyle shifts, especially in countries where environmental policy and infrastructure are less developed and where behavioral catalysts could be better tailored to optimize urgently needed lifestyle change. Encouraging even modest lifestyle shifts could significantly reduce a nation's environmental impacts (Dietz et al., 2009). While behavioral spillover effects have been observed in Europe (Thøgersen and Ölander, 2003), the United States (Truelove et al., 2016), Asia (Rashid and Mohammad, 2011) and Australia (Lauren et al., 2016), Spillover might be more common in nations where external factors such as cultural values, education, environmental infrastructure, and environmental services are more supportive of sustainable lifestyle choices, as found in a piece of research comparing differences between Mexico, United States, Spain and Brazil (Vicente-Molina et al., 2013). As self-identity appears germane to spillover processes, cultural differences in self-construal (English and Chen, 2007) may affect the transfer of pro-environmental behavior through identity channels. While individual personal values may vary within a given setting, cultural values, such as those linked to identity, express the integration of ideas, norms, beliefs and values within a society that contribute to individual perspectives and underpin behavior (Oreg and Katz-Gerro, 2006). A qualitative cross-cultural approach to behavioral spillover can also serve to identify gaps between scientific definitions of behavioral spillover and the more experiential perspectives of citizens (Lowe et al., 2006), in line with the active, functional ways that individuals construct their worlds (Potter, 1996), and in which theoretical delineations and boundaries are blurred and do not necessarily match conventional behavioral schematics (Rudiak-Gould, 2012).

Following our review of the literature, 5 research questions are set out as follows:

1. Do citizens in diverse cultural contexts recollect personal experience of positive behavioral spillover?
2. If so, do recollections of behavioral spillover differ between these cultures?
3. Does degree of environmental engagement influence experience of positive behavioral spillover?
4. What kinds of behavioral spillover effects emerge in citizens' accounts and which behaviors are involved?
5. Are there any reported barriers to spillover?

MATERIALS AND METHODS

This section details the design and procedure used in the study, which was approved by the Cardiff University's School of Psychology Research Ethics Committee. The design was based on a set of 96 semi-structured qualitative interviews with more and less environmentally engaged citizens in each of the three countries. Interviews were designed to elicit perceptions of green lifestyles and behavior, including recollections of behavioral spillover as a reason for engaging in pro-environmental actions.

Participants

Interviews were conducted between March 2015 and April 2016. A purposive sampling strategy (Silverman, 2015) was

utilized to ensure that each country sample included a range of environmental values and socio-demographic characteristics (including gender and age). All participants were aged 18+ and comprised two distinct groups. To generate a range of environmental perspectives we recruited in two ways; first of all, we approached potential academic collaborators to help recruit citizens whose environmental values were broadly reflective of the "average" citizen. To do so, we advertised the study as a "*behavior and lifestyle perceptions*" study and avoided explicitly mentioning "*the environment*." In addition, we also approached environmental organizations to recruit another subsample of citizens who were more environmentally engaged.

In Brazil, fieldwork took place in the capital Brasília (population 2.481 million), and João Pessoa, on the North East coast in the State of Paraíba (population 720,000), during March/April 2015. In total, 35 citizens participated. The less environmentally engaged group comprised residents of João Pessoa, who were recruited by collaborators at the Federal University of Paraíba. The study was advertised locally asking interested residents to get in touch. Participants were subject to a brief screening procedure to ensure they were 18+ and did not work in the environmental sector or have any heightened pro-environmental commitments or values, and to ensure we had some variation in terms of factors such as gender[1] and age (n = 17). The environmentally engaged group were recruited by collaborators at the offices of the World Wildlife Fund for Nature (WWF) office in Brasília. An advert for the study explicitly mentioning an interest in employees who were environmentally engaged was circulated internally (n = 18). This group were also screened to ensure that participants were environmentally committed in their lifestyles (as some employees worked for WWF in a more technical capacity and might lack such commitment), as well as to ensure some variation in terms of gender and age. See **Table 1** for participant demographics.

The city of Aarhus on the East coast of the Jutland Peninsula (population 336,000), was the setting for the Danish fieldwork in August/September 2015 (n = 31). The less environmentally engaged group were recruited by collaborators at Aarhus University who advertised the study online (n = 14). After initially approaching WWF Denmark (who were unable to collaborate), collaborators at Aarhus University also recruited the more environmentally engaged group by posting an advert on the Aarhus Sustainable Initiatives Network (n = 17) Participants constituted volunteers, employees and freelance consultants working locally in the environmental sector (see **Table 1**).

In China, interviews were conducted in and around Shanghai (population 24.18 million), during March 2016 (n = 30). The less environmentally engaged group were recruited through an online advert, by an ethnographic research collaborator who was familiar with the city and collaborators at Fudan University (n = 15). The environmentally engaged group were recruited by the ethnographic collaborator who advertised the study on the "Shanghai Green Initiatives" network on the "WeChat" social media app (n = 15). Participants comprised volunteers, employees and freelance environmental consultants working locally in the environmental sector (see **Table 1**).

[1]Response options for gender comprised "Female," "Male" and "Other/Prefer not to say."

Procedure

Following recruitment, individuals were invited to participate in an interview to discuss aspects of their day-to-day behaviors and lifestyle. As a rule, interviews in all countries were held at the collaborating academic institution or organization; however, for some participants who were unable to make the journey but wanted to participate, the interview team agreed to hold interviews elsewhere, including cafes, workplaces or participants' homes, whichever was most convenient.

In Brazil, all interviews with the less engaged group were held in a private interview room at the University of Paraíba in João Pessoa. All interviews with more engaged participants took place in a private meeting room at WWF in Brasília. In China, 13 of the interviews with less engaged participants were held in a rented meeting room in the center of Shanghai and the remaining 2 took place elsewhere (one in a café and one in the participant's home). For the more engaged group, 9 interviews took place in the rented meeting room or in a meeting room at Fudan University, while 6 were held in participants' workplaces. In Denmark, all interviews with the less engaged group took place at Aarhus University. For the more engaged group. 7 interviews were held at the university, while the other 10 interviews took place in participants' workplaces.

Ethical Considerations for Working Across Three Countries

While interviews are commonly used in social research, the methodology carries its own important procedural and ethical implications. Inequitable power relations are unavoidable in academic research where the interaction is primarily directed by the researcher (King et al., 2018). Interactional identities are compounded by factors such as gender, ethnicity, socioeconomic status and education, which may be overt or covert (Anyan, 2013). Cultural assumptions imposed through interview protocols, questioning and instrumentation can potentially cause offense and discomfort to participants situated in other cultures; such inequitable dynamics can also diminish the value of the information obtained (Brinkmann and Kvale, 2008). It is critical that cross-cultural research teams consider ethical issues not only in terms of the interview interaction itself, but to procedural issues prior to the interview interaction (including protocol design, question wording and recruitment), and ongoing reflections following the interview (including analysis, reporting findings and dissemination of research) (Hoover et al., 2018).

In designing the interview protocol, we worked closely with in-country collaborators to ensure not only that the protocol and question wording were designed to elicit the topics in which we were interested, but to address issues of culturally imposed bias (such as making assumptions about environmental conditions, values and lifestyle practices of those within a given culture). All interview materials were double-translated into the local language(s). For balance and to reduce potential cultural and gender imbalance that might otherwise constrain trust

and disclosure, particularly for female participants (Campbell and Wasco, 2000; Sikes, 2018), the interview team comprised the same male researcher (lead author) and a different female translator in each country. The female translator played an active part in the interaction as opposed to simply translating questions and responses, introducing additional questions, checking understanding and elaborating on culturally relevant issues for clarification. Having a cultural "insider" as part of the team helped facilitate trust and disclosure, while the presence of a cultural "outsider" generated greater insight into the participant's world by rendering the familiar strange (Dwyer and Buckle, 2009). The presence of a researcher from another culture also occasionally led to a richer exploration of perspectives linked to economic globalization, resource inequities and sources of environmental harms beyond geographical borders. While a translator was present, some participants expressed a willingness to conduct interviews in English or switched between English and their native language (for example, if they were unable to explain a point in English). We acknowledge that translation imposes an additional level of interpretation on an utterance (Caretta, 2015), therefore we have tried insofar as possible, to analyze accounts based on participants' direct speech rather than the translator's interpretation.

As mentioned, for practical reasons it was not always possible to interview participants at the collaborating institutions. In such cases we took the pragmatic decision to stage interviews in other locations, such as workplaces and homes. In doing so, we acknowledge that space and place are active and influential factors in negotiation interactions between researcher and research participant (Gagnon et al., 2015). Before conducting an interview in an alternative location, we ensured that spaces were available in which participants could discuss issues confidentially without being in the direct gaze of, overheard by, or interrupted by others. We also applied this rubric to interviews that took place in collaborating academic institutions. Allowing participants greater flexibility to choose their preferred location also served to engender a more equitable relationship with participants (Gagnon et al., 2015). We noted that when conducting interviews in participants' homes, the home itself sometimes served as an exemplar of lifestyle discussions in which participants illustrated their accounts with reference to their home interiors, gardens and wider surroundings. We also noted that in workplace interviews, participants sometimes referred to documents and other office procedures or apparatus (such as air conditioning systems or office recycling systems), in discussions. This enriched fieldnote records and would not have been possible if held in more neutral academic institutions.

Analytic Approach

Written, informed consent (in the local language) was sought from all participants prior to interview. Interviews took approximately 1–1.5 h to complete, in which the interview team

TABLE 1 | Participant demographics for all subsamples.

		Less environmentally engaged		More environmentally engaged		Subsamples combined	
Brazil							
Gender	*Female*	10	58.8%	9	50%	19	54.3%
	Male	7	41.2%	9	50%	16	45.7%
Age group	*18–24*	4	23.5%	0	0%	4	11.4%
	25–34	3	17.6%	5	27.8%	8	22.9%
	35–44	2	11.8%	10	55.6%	12	34.3%
	45–54	4	23.5%	3	16.7%	7	20%
	55–64	0	0%	0	0%	0	0%
	65+	4	23.5%	0	0%	4	11.4%
Denmark							
Gender	*Female*	9	64.3%	12	70.6%	10	32.3%
	Male	5	35.7%	5	29.4%	21	67.7%
Age group	*18–24*	4	28.6%	4	23.5%	8	25.8%
	25–34	7	50%	8	47.1%	15	48.4%
	35–44	2	14.3%	0	0%	2	6.5%
	45–54	1	7.1%	3	17.6%	4	12.9%
	55–64	0	0%	0	0%	0	0%
	65+	0	0%	2	11.8%	2	6.5%
China							
Gender	*Female*	9	60%	7	46.7%	16	53.3%
	Male	6	40%	8	53.3%	14	46.7%
Age group	*18–24*	0	0%	3	20%	3	10%
	25–34	12	80%	7	46.7%	19	63.3%
	35–44	1	6.7%	5	33.3%	6	20%
	45–54	1	6.7%	0	0%	1	3.3%
	55–64	0	0%	0	0%	0	0%
	65+	1	6.7%	0	0%	1	3.3%

covered a set protocol of basic questions in all three countries for meaningful comparison, but also allowing for follow-up questions and the exploration of issues that were more culturally specific to each country. Therefore, the flexibility of the semi-structured interview method was advantageous in that it could be applied to multisited cross-cultural contexts (Hagaman and Wutich, 2017), as well as allowing the generation of more detailed, culturally specific context (McIntosh and Morse, 2015). At the end of each interview, participants were provided with a verbal and written debrief (in the local language), along with researcher contact details in case of further questions.

An episodic narrative approach was used to explore participants' lifestyles, which seeks to ground perceptions and experiences as lived narratives within the wider society and culture (Flick, 2000; Jovchelovitch and Bauer, 2000). The episodic interview method is a form of narrative interviewing that elicits snapshot descriptions of particular episodes or features in a person's life as a way of making sense of the world. The questions in the interview protocol sought to contextualize accounts rather than to generate more abstract responses, as this risked neglecting wider socioculturally relevant issues. The preset interview question list appears in **Supplementary Appendix A**. While the protocol explored a range of environmentally salient issues, this paper is primarily focused on responses elicited by the question, "*Can you remember in the past whether doing something that was good for the environment caused you to then do another environmentally-friendly behavior*?," though we looked for examples of spillover throughout each transcript.

Interviews were audio-recorded and subsequently translated and transcribed. Written field notes were also recorded throughout the interaction. An "*in-interview*" system of translation was employed in which questions and responses were translated to and from English by the translator (except where participants preferred to speak in English). Another layer of translation was imposed at the transcription stage. In the analysis section, quotes are labeled "*Direct*" if spoken in English, or "*Transl.*" if translated from another language (either by the translator in the interview or during transcription).

TABLE 2 | Frequencies of reports of spillover reported by participants in Brazil, China, and Denmark.

Sample *Less engaged (–) More engaged (+)*	*N*	Directly questioned[a]	Not questioned	Recalling spillover	Recalling spillover (% of those questioned)	Not recalling spillover	Not recalling spillover (% of those questioned)
Brazil (–)	17	14 (82.35%)	3 (17.65%)	4 (23.53%)	28.57%	10 (58.82%)	71.43%
Brazil (+)	18	13 (72.23%)	5 (27.77%)	10 (55.56%)	76.92%	3 (16.67%)	23.08%
Brazil All	35	27 (77.14%)	8 (22.86%)	14 (40.0%)	51.86%	13 (37.14%)	48.14%
China (–)	15	13 (86.67%)	2 (13.33%)	4 (26.67%)	30.77%	9 (60.0%)	69.23%
China (+)	15	13 (86.67%)	2 (13.33%)	11 (73.34%)	84.62%	2 (13.33%)	15.38%
China All	30	26 (86.67%)	4 (13.33%)	15 (50.0%)	57.69%	11 (36.67%)	42.31%
Denmark (–)	14	14 (100%)	0 (0%)	2 (14.29%)	14.29%	12 (85.71%)	85.71%
Denmark (+)	17	17 (100%)	0 (0%)	11 (64.71%)	64.71%	6 (35.29%)	35.29%
Denmark All	31	31 (100%)	0 (0%)	13 (41.94%)	41.94%	18 (58.06%)	58.06%
All countries	96	84 (87.5%)	12 (12.5%)	42 (43.75%)	50.00%	42 (43.75%)	50.00%
All countries (–)	46	41 (89.13%)	5 (10.87%)	10 (21.74%)	24.39%	31 (67.39%)	75.61%
All countries (+)	50	43 (86.0%)	7 (14.0%)	32 (64.0%)	74.42%	11 (22.0%)	25.58%

[a]*Refers to whether a participant was explicitly asked "Can you remember in the past whether doing something that was good for the environment caused you to then do another environmental behavior?"*

TABLE 3 | Categorization of subjective spillover effects reported in the interviews.

Sample *Less engaged (–) More engaged (+)*	*N* (recalling spillover)	Positive spillover (within-domain)	Positive spillover (between-domain)	Positive spillover (behaviors unspecified)	Contextual spillover	Interpersonal spillover	Other
Brazil (–)	4	0	0	0	0	0	4
Brazil (+)	10	2	0	1	2	4	1
Brazil All	14	2	0	1	2	4	5
China (–)	4	2	0	1	1	0	0
China (+)	11	5	1	2	3	0	0
China All	15	7	1	3	4	0	0
Denmark (–)	2	1	0	0	0	0	1
Denmark (+)	12	6	1	0	1	0	4
Denmark All	14	7	1	0	1	0	5
All countries	43	16	2	4	7	4	10
All countries (–)	10	3	0	1	1	0	5
All countries (+)	33	13	2	3	6	4	5

The interview audio and texts were analyzed using NVivo 11, supplemented by written field notes. We then used a system of template analysis to code the texts, as template analysis is particularly suited to identifying themes in both essentialist and constructionist analyses (Brooks et al., 2015).

RESULTS

In the following analysis, where a feature of interest is applicable across more than one country, for brevity we have illustrated this feature using a single extract and alluded to its occurrence in other cultural settings within the text. The analysis proceeds by summarizing the proportions of participant responses relating to spillover across the three countries. We then move on to categorize the different kinds of behavioral spillover emerging from elicited discussions about experience of spillover. As mentioned above, our questions focused on a range of conscious positive spillover effects and potential barriers to spillover.

Personal Accounts of Positive Behavioral Spillover

In anticipation (based upon conclusions from prior studies) that spillover effects appear ephemeral and difficult to detect, we expected that participants would be unlikely to initiate talk of behavioral spillover themselves (particularly as at least some spillover processes are unselfconscious, therefore people may not necessarily be aware that an initial behavior led to a heightened environmental goal salience or a change in self-identity which then led to other environmentally responsible actions), the analysis is focused on responses to a single question in the interview designed to elicit recollection of spillover. It is therefore important to note that the analysis captures more subjective self-reports of spillover effects and not the less conscious processes that are also of relevance to spillover pathways.

Participants Recall Experiences of Behavioral Spillover

To address our first research question we aggregated and compared responses to the question of whether spillover had ever occurred, across countries. **Table 2** summarizes the proportions of participants who were directly questioned about spillover (some were not asked due to time constraints) and the proportions of those recalling and not recalling spillover. As discussed in the previous section, accounts of spillover did not emerge spontaneously from the interviews. The majority of participants were directly questioned about spillover. Among those who were directly asked, exactly half recalled an experience they considered to be analogous to spillover.

Table 3 breaks down reports positive spillover effects into discrete categorizations based on the academic literature. Overall, the most commonly reported type of spillover effects reported were within behavioral domains (i.e., between behaviors within the same cluster). The second most commonly reported effects were those that did not fall within conventional academic definitions of spillover. The category refers to responses citing other behavioral motivations (for example, formative experiences when young, changes in personal circumstances and other experiences) as catalysts, rather than engagement in a specific behavior. A range of other spillover effects were also found but these were less commonly reported than within-domain effects. These included contextual, interpersonal and between-domain spillover effects. Finally, 4 reports of positive behavioral spillover were unclear in terms of the behaviors involved and were counted separately.

Differences in Recall of Positive Behavioral Spillover Across Cultures

We found both differences and similarities in reports of spillover across cultures. **Table 2** shows that in Brazil and China the majority of participants were directly questioned about spillover, while all participants in Denmark were directly questioned. Of these, over half of participants in China and Brazil recalled having experienced positive spillover, though less than half of Danish participants recollected spillover having happened to them. The largest proportion of spillover accounts came from China and the smallest came from Denmark.

Table 3 shows that despite the differences in sample sizes and the proportions of participants directly questioned about spillover, frequencies of recollections of within-domain spillover in each country were almost identical. Within-domain spillover effects were the most commonly reported categories in China and Denmark while in Brazil the most common type of account related to "other" motivations. Recollections of between-domain spillover were so infrequent that meaningful cultural comparisons cannot be drawn, other than to say that catalytic effects from one behavioral cluster to another were extremely rare in all three countries. Similarly, reports of other spillover effects were too uncommon to infer cultural differences. However, contextual spillovers were more frequently reported in China than in Brazil and Denmark, while interpersonal spillover effects were only reported in Brazil. In addition, while Chinese participants did not report other behavioral motivations as spillover effects, those in Brazil and Denmark reported the same numbers of accounts in which behavior was catalyzed by non-behaviors. More detailed discussion of the different types of spillover and further examples of cultural differences, along with quotes can be found in the section on "Personal Accounts of Different Types of Positive Spillover Effects".

Behavioral Spillover Effects Are More Common Among the Environmentally Engaged

As shown in **Table 2**, accounts of behavioral spillover were far more common among environmentally engaged participants than those who were less engaged, regardless of cultural context. For both more and less engaged groups, the majority were directly questioned about spillover. Of those questioned, the highest proportion of accounts of spillover effects came from more engaged participants in China, followed by their counterparts in Brazil and Denmark, respectively. With reference to those less environmentally engaged, fewer accounts emerged from Danish participants than those in Brazil and China.

Between-domain spillovers were reported mainly by more environmentally engaged groups, while the rare examples of between-domain spillover came exclusively from the more engaged groups (in China and Denmark). All but one example of contextual spillover came from more engaged groups; similarly, all examples of interpersonal spillover came from the more engaged group in Brazil (**Table 3**). Of course, while the pathways to spillover bore some similarity across cultures, these accounts were also grounded within their specific cultural contexts. We now move on to discuss accounts of behavioral spillover effects in more detail.

Personal Accounts of Different Types of Positive Spillover Effects

In the following sections we provide a more detailed qualitative analysis of accounts of positive behavioral spillover, illustrated with examples from the interviews.

Recollections of Within-Domain Spillover Effects Involving Common Domestic Actions

Reports of positive spillover in the interviews emerged from participants in all three countries studied. Where spillover effects were reported, they most commonly involved relationships between two *related* actions, or an increase in the *frequency* or *range* of a single behavior. Behaviors reported in accounts of spillover in the interviews were mainly in the private sphere and drew on a limited range of behavioral clusters. In all three countries, spillover relationships principally drew on clusters comprising *waste* (for example, littering, recycling and composting) and *resource conservation* (such as reducing energy or water use) practices practiced domestically. In Denmark, in addition to waste and resource conservation, some participants also referred to spillovers involving organic consumption and the occasional public-sphere action, such as volunteering for an environmental organization or community litter-pick (see below). These spillover effects typically involved an extension of the initial behavior, such as buying more organic products, reusing more items or picking up litter elsewhere, as opposed to catalyzing different behaviors. The following extract gives a flavor of within-domain spillover from Brazil. In the account the participant describes how consciously reflecting on existing efforts to limit paper towel use was attributed to a motivation to subsequently reduce paper waste by storing documents on the computer rather than printing them:

Researcher: *Can you remember if, say, doing one environmental behavior – could be any of them – caused you to then later do another? Do you think that ever happened?*

Participant [*Direct*]: *Yeah. The waste of towels. For me it was important. So I started to think of each paper that I threw, each paper that I used, not to use – not to print things that – just for printing. Use more the computer storage in the computer, not printing documents. As you can see I don't have things. Everything is in my computer.*

(B18 more engaged group; Brasilia).

In reflecting on the shift from saving paper towels to avoiding printing on the computer, the speaker explains that the initial behavior was *personally important*. The account also suggests that the initial behavior was consciously (as opposed to habitually) performed, which is used to explain the process by which they came to adopt a new behavior with the same goal. Stating that it was possible to use an alternative form of storage (i.e., storing documents on the computer rather than as hard copies), suggests that aligning behavior consistently depends to some degree on the availability of viable alternatives in switching to more sustainable practices.

As mentioned above, in addition to the adoption of a new behavior, within-domain spillover effects not only involved situations where engaging in one action catalyzed another discrete behavior within the same cluster, but also an increase in the frequency or range of an existing behavior over time. In the next extract from Denmark, the speaker talks about organic shopping practices and a spillover effect in which organic consumption had expanded over time to include an increasing array of products:

Researcher: *Can you remember a time in the past where you did one environmental behavior and as a result of doing that it caused you to do another environmental behavior? So one behavior leading to another?*

Participant [*Direct*]: *Maybe perhaps as I said in the beginning, that – being more aware of, for example, in the beginning buying organic eggs, for example. I think that was the first thing I was aware of, or was aware of and quite – it was important for me to buy organic eggs. Then after that it was like dairy products, milk and so on. Then I'm starting to look at other products as well. I don't know – also that there's a bigger – there's a lot more products – you're able to buy a lot more products that are organic than two or three years ago. Then I started to look at clothes . . . But at least the awareness of buying like environmentally responsible products had led to also buying socially responsible products. So maybe I have made a shift toward that as well, that had led to that.* (B2 more engaged group; Aarhus).

Like the previous account, the speaker constructs organic purchasing as a *conscious* and *deliberate* activity that centers on a personally salient goal. Accounting for the spillover effect relies on both awareness and the increasing availability of viable organic alternatives to conventional products.

In addition to reports of spillover effects from one behavior to another within the same cluster, examples emerged where performing a behavior catalyzed the motivation to engage with others and discuss environmental issues or encourage other people to engage in actions with the same goal. However, such examples were limited and came only from participants in Brazil and China and only from the more environmentally engaged groups in those countries. In the following example from Brazil, the speaker explains how engaging in a collection of

unspecified pro-environmental actions had led them to engage more with others:

Researcher: *So I guess doing those behaviors has affected other areas of your life, as you've said. Has it led to you doing other things? Maybe being involved in things or other behaviors?*

Participant [*Direct*]: *Yeah. I think I talk more about the topic with other people. Not trying to be a teacher but trying to understand how – why people don't think on their impact. This is one point. Yeah. I think talking to other people not in a way that you are teaching them is the way that you bring people to the discussion*. (B2 more engaged group; Brasília).

Within the above account, in discussing engaging others on environmental issues, the speaker stresses that they do not wish to instruct other people, but to gain an insight into why other people are less conscious in reflecting on the environmental relevance of their behavioral decision-making. This is linked to a concern that trying to teach others will drive them away from the issue rather than draw them in. We highlight this type of example because this type of spillover effect offers significant potential as a means of generating wider engagement beyond that of the adoption of one behavior on the strength of another, for a single given individual. We now move on to discuss some rarer examples of behavioral spillover *between* different behavioral clusters.

Recollections of Between-Domain Spillover Effects

If behavioral spillover generates wider lifestyle shifts through spreading activation, one might expect to observe catalytic effects between environmentally responsible actions in different behavioral clusters. However, only a couple of examples of between-domain spillover were recorded in the interviews. Both came from more environmentally engaged participants in China and Denmark (see **Table 3**). In the first extract from Shanghai, the speaker explains how walking catalyzed the motivation to increase consumption of vegetables; though both actions were driven not by pro-environmental goals, but by goals linked to health outcomes:

Researcher: *Can you ever remember a time in the past where you did a behavior that was good for the environment, and because of doing that it led you on to do another thing that was good for the environment?*

Participant [*Transl.*]: *. . .So one example he gave is when he was walking. . .Yeah, just walking, and he will think a lot of things, such as the health. So when he thinks about health, he eats more. vegetables to be a vegetarian. When he is healthy, then he thinks probably more exercise. He's pursuing a comfortable life now*. (B10 more engaged group; Shanghai).

In trying to become a healthier person, engagement in an initial action aligned with a personally salient goal is constructed as generating a greater conscious awareness of other health-related actions while engaged in that behavior. This, in turn, motivated the intention to make dietary changes. In addition, toward the end the speaker explains that progress toward the desired goal (becoming healthier) increases motivations to think about doing more (exercise). The extract shows how pro-environmental behaviors can have co-benefits such as improving health. Essentially, consciously focusing on a non-environmental goal (with environmental co-benefits) may lead to between-domain spillover effects in pursuing that goal.

The other example of between-domain spillover bore a similarity to the previous example in that the manifest process governing the spillover effect was attributed to a non-environmental goal; having a simpler and less expensive lifestyle:

Researcher: *Can you remember a time where – in the past where you did one behavior that was good for the environment, and as a result of doing that behavior you did another behavior that was good for the environment?*

Interviewee [*Direct*]: *Yeah. I cannot tell a concrete example, but it's – I think all the things with (energy-efficient) houses and electronic cars and – I think that's – they had influenced each other. So because of – and the goal with having the easy life without lust, but having like a house who is cheap to run, having a car who is like easy to run, and there was a guarantee and everything is just easy*. (B1 more engaged group; Aarhus).

The environmentally friendly behaviors that formed the focus of the spillover relationship (an energy-efficient home and an electric vehicle) remain undefined in terms of their causal direction (i.e., which behavior was the catalyst, and which behavior was catalyzed), though the speaker acknowledges the difficulty in recollecting a clear example in line with the expressed difficulty in recalling spillover more generally.

Recollections of Contextual Spillover Effects Between Work and Home

Another variant of behavioral spillover, termed contextual (Nilsson et al., 2017), or situational spillover in the gray literature (Austin et al., 2011), was reported in all three countries, albeit rarely. We found limited evidence for two kinds of contextual spillover in the interviews (where a behavior is performed by an individual in one context and then another, and where a behavior is transfered between different individuals across contexts). The few examples of contextual spillover that came up in the interviews were reported almost exclusively by more environmentally engaged participants. Two types of context came up in these accounts. One involved the transfer of behavior between work and home. Here a Danish participant explains how working in the environmental transportation sector had influenced more sustainable travel decisions outside of work:

Participant [*Direct*]: *I'm starting also to think about how you transport yourself.*

Researcher: *Transport, yeah?*

Participant: *Yeah. But that has something to do with my work, where we are quite involved in the whole transport sector thing, because we know how great a deal that counts for CO_2 emissions. So in my professional – or in my job I work with how we can make intelligent transport systems to save energy and let out less CO_2 emissions. So I'm starting to think – or include that in my like private life as well. So now I see the sense of – I see why I can – why there's that advantage of taking the bus, for example. Or using car sharing. Yeah, car sharing transportation instead of like – I don't have a car myself.* (B11 more engaged group; Aarhus).

The speaker describes how working on projects to reduce carbon emissions from transportation at work, had crossed a focal boundary between work and private life, leading to them questioning their private-sphere travel-mode choices and being more aware of the merits of using more "*intelligent*" travel modes such as public transport, car-pooling schemes, as well as not owning a car. Central to the account is the idea of consistency in behavior between one context and another.

Recollections of Spillover Effects Between Different Cultural Contexts

Another type of contextual spillover involved exposure to wider cultural contexts beyond the workplace where pro-environmental behaviors were more socially normative than at home. With reference to contextual spillover effects from exposure to other cultures with contrasting pro-environmental behavioral norms, participants who had traveled, studied or worked overseas in countries with higher standards of environmentally responsible behavior reported a need to act consistently after returning home:

Researcher: *Was there a particular reason why you chose to start waste sorting?*

Participant [*Direct*]: *I started in Germany. In Germany the garbage sorting is a very natural thing. So, they have a very good sorting system. When I – actually I got used to garbage sorting when I was in Germany. I feel that's something we can do everywhere. Every citizen can participate basically. When I live in Shanghai I just feel not comfortable I mixed up things.*

Researcher: *When you came back?*

Participant: *If I – yeah. If we put organic waste in the same garbage bin, I don't know, it just made me very disgusted when I saw things mixed together. I don't know why. I just feel they should be separate...Then six years ago when we started the organic farm I realized that we have the opportunity to sort the garbage, and that we can separate – treat the compost, the organics. So I think this is one thing we can do, and that we just do it.* (B4 more engaged group; Shanghai).

Perhaps unsurprisingly, examples of this kind of contextual spillover were only found in Brazil and China, where infrastructure conducive to facilitating behaviors such as recycling was less widespread than in countries such as Denmark. This kind of example suggests that exposure to supportive pro-environmental norms and infrastructure for engagement can, at least in some cases, be internalized in ways that predispose an individual to perform that behavior in other cultural contexts, including those contexts where engagement is markedly more difficult. Processes related to behavioral consistency are central to the contextual spillover effects described in the second extract. The speaker explains how reverting to a system where waste was not recycled sparked a visceral sensation of cognitive dissonance that underpinned the spillover effect. Therefore, if behavior is internalized then it may persist in contexts where it is neither the norm, nor easy to do.

Recollections of Spillover Effects Between Individuals in Different Contexts

There was also very limited evidence for the second type of contextual spillover involving the transfer of behavior between different individuals across contexts. This type of spillover was reported exclusively by participants in the more environmentally engaged group in Brazil. Such accounts constructed the spillover of behaviors through social diffusion. For example, participants discussed how making changes to their homes to make them more energy-efficient had served as an exemplar for friends and neighbors, who borrowed ideas for making changes to their own homes. In addition, participants who worked in the environmental sector also spoke of how their work influenced people outside of work to become more pro-environmental as a result. In the following extract the speaker illustrates the latter kind by discussing the way in which their work potentially caused their partner to make substantial lifestyle changes without being directly influenced:

Researcher: *Do you feel like you've changed as a person since you started doing those (pro-environmental) behaviors?*

Participant [*Direct*]: *Yeah, I have. For example, my partner that lives with me, he changed his lifestyle. But I don't know if I stimulated him. I think only because I work in WWF and he start to be interested about what I was – were doing and something. I think his behavior is more sustainable than mine today.* (more engaged group; Brasília).

While the partner's motivation to change their lifestyle is not unequivocally attributed to the speaker's influence, an interest in the *identity* and *role* of the speaker as a WWF employee constitute the catalyst rather than behavior. The idea that the effect was not catalyzed in other ways (for example by the partner observing the speaker) is questioned in the account where the speaker suggests that it is "*only*" because of the speaker's role and that their behavior was more sustainable than their own.

Perceived Barriers to Behavioral Spillover

While we have focused on examples of positive behavioral spillover from the interviews, we also recognize the need to acknowledge that half of participants overall did not recall experiencing behavioral spillover. By asking participants to recall episodes of spillover verbally, there is a likelihood that some people could not recall motivation for engaging in certain actions. While little could be gleaned from responses in terms of the reasons *why* participants did not recall spillover, there were occasional utterances that offer some clues as to why behavioral spillover effects were fairly uncommon. These primarily came from interviews with less engaged participants and relate to a lack of conscious reflection on environmentally relevant practices, limited behavioral repertoires and a lack of intrinsic motivation to adopt other actions.

Narrow Pro-Environmental Behavioral Repertoires Inhibit Spillover Effects

There was some evidence that narrow pro-environmental behavioral repertoires may be another reason for limited spillover effects, as a scarcity of potential catalyzing actions reduces the chance of one behavior leading to another. In the following extract with a less engaged participant in Brazil, the speaker attributes their inability to recollect behavioral spillover to a lack of experience of performing pro-environmental behaviors and a lack of intrinsic motivation:

Researcher: *Can you remember a time in the past where you did one environmental behavior and it caused you to then do another environmental behavior because of the first one?*

Participant [*Transl.*]: *He thinks that a specific behavior has not led him to do another behavior, because he hasn't done anything in a large range. So he thinks that small things make him feel good, but it's not like the things are leading him to do other things, because he was never stimulated to, for example, get something, a reward or something like that, because he never has done anything really big, or only specifically small actions* (A1 less engaged group; João Pessoa).

In addition to having a very narrow range of simple behaviors that, nonetheless confer a positive sense of wellbeing, the kinds of behaviors performed do not lead to others because they lack the necessary "*stimulation*" or "*reward*." This suggests a lack of intrinsic motivation, which precludes the possibility of adopting more committed actions.

Lack of Reflection on Pro-environmental Behavior Inhibits Spillover Effects

When asked about whether they could recall any personal experience of spillover, participants also spoke about how they never consciously reflected on their behaviors, nor discussed them with others. Instead pro-environmental behaviors were constructed as having a routine, habitual character:

Researcher: *Can you ever remember a time in the past where you did a behavior that was good for the environment, and as a result of doing that behavior it caused you to do another behavior that was good for the environment? So one behavior leading onto another?*

Participant [*Direct*]: *Like a chain reaction?*

Researcher: *Yeah, yeah*

Participant: *No, I don't think so because it's just habit I never actually talk about it, or think about, it's just things that I do*... (A9 less engaged group; Aarhus).

Whereas accounts of behavioral spillover tended to highlight the salience of conscious awareness of behavior (including environmental impacts, alignment with broader goals and consistency with other behaviors), accounts such as the above that attempt to account for a lack of recollection of spillover provide a counterpoint. In contrast, they describe how spillover may have been impeded by a lack of conscious reflection on the perfunctory action being performed, particularly in terms of that action's relationship to other behaviors. This is also suggested in terms of the character of the behavior itself, in which pro-environmental actions are "*just things that I* do" as opposed to practices with the intention of reducing one's environmental impact.

DISCUSSION

This paper offers an original qualitative analysis of subjective accounts of behavioral spillover in three diverse cultural contexts. Our research questions set out to address 5 research questions; whether citizens in different countries reported experiencing behavioral spillover; whether there were any differences in reports of spillover between different cultures; whether there were any differences based on level of environmental engagement; what kinds of spillover effects were reported; and whether any potential barriers to spillover existed.

Evidence for Positive Behavioral Spillover in Personal Accounts Across Cultures

Reflecting previous (mainly quantitative) work on behavioral spillover (Truelove et al., 2014; Nash et al., 2017), behavioral spillover effects were found in all three cultural contexts. In line with our first research question, overall, our analysis showed that half of participants who were directly questioned recalled an experience they considered analogous to positive behavioral spillover. However, these accounts did not arise spontaneously in interviews but were elicited through direct questioning. Furthermore, not all accounts of behavioral spillover could be defined as such, as a proportion did not involve one behavior being catalyzed by another behavior. Instead, alternative behavioral motivations that did not match conventional definitions of spillover (such as formative experience and

significant life changing events) came up in some responses, reflecting lay conceptions that are less clearly defined and do not map precisely onto conventional scholarly schematics (Rudiak-Gould, 2012).

Differences in Personal Accounts of Positive Behavioral Spillover Between Cultures

Across the three cultures we found relatively few clear differences in accounts of spillover experience, which may at least partly reflect the relative infrequency of clear and detailed accounts of behavioral spillover and a methodological approach that relied on participant recall. In addition, this may also be a function of the rather narrow pro-environmental behavioral repertoires practiced by many participants. Perhaps surprisingly, participants in Denmark were less likely to recall spillover than those in China and Brazil. However, given the relatively low frequencies of spillover effects, further investigation with larger sample sizes would be useful to draw out cultural differences.

In all three countries, within-domain spillovers were the most commonly reported effects, involving the transfer of household practices within the same behavioral cluster (mainly limited to clusters involving waste or resource conservation), or an increase in the frequency or range of existing actions. In addition to catalyzing similar behaviors, wider engagement on sustainability issues with other people was also catalyzed.

While between-domain, contextual and interpersonal spillover effects were also reported, their relative infrequency made it difficult to judge whether cultural differences existed; though there were indications that contextual spillovers were more common in China, while interpersonal spillover effects were only reported in Brazil. This could reflect cultural differences in terms of construal. Work on cultural values (Markus and Kitayama, 1991) asserts that differences in cultural self-construal affect the way in which individuals understand the self in relation to others. While individuals in North American and Northern European cultures see the self as more independent from others, in Asian and African cultures the self is more interdependent with others. Studies have found interdependent self-construal to be predictive of greater ecological cooperation than independent self-construal (Arnocky et al., 2007). Therefore, in promoting forms of spillover involving social diffusion, it may be necessary to take cultural barriers into consideration. Additional work with larger sample sizes is needed to elaborate on these potential cultural differences and address existing gaps.

In line with research question 2, such indications suggest, but do not in themselves confirm the presence of cultural differences. With reference to our methodological approach, there is also the potential that the phrasing of the question designed to elicit spillover was unclear and potentially culturally biased, generating a narrow range of responses (Shiraev and Levy, 2016). A more culturally sensitive approach might have done more to tailor questions more sensitively to each cultural context, though this would have made comparability more problematic. Further exploration and more careful follow-up questioning might have also uncovered more culturally specific nuance.

Differences in Personal Accounts of Positive Behavioral Spillover and Environmental Engagement

The clearest differences in reports of spillover were linked to environmental engagement rather than culture. Following research question 3, participants who were more environmentally engaged were far more likely to recall spillover regardless of country. This was also the case regardless of the type of spillover reported. Based on consistent observed differences, pre-existing pro-environmental values appear to facilitate spillover (see also Thøgersen and Crompton, 2009). Those who prioritize the environment to some degree appeared to reflect upon behaviors with a more environmental focus, in contrast to those who were less engaged and viewed the things they did as simply part of the everyday routine. It may be that more environmentally engaged citizens are more consciously aware of the impacts of the behaviors they perform (Kollmuss and Agyeman, 2002), more consistent in their behavior in line with perceived self-identity (Cialdini et al., 1995), or more driven by concern to do something to address environmental problems (Steg and Vlek, 2009).

Differences in Reported Positive Behavioral Spillover Effects

Within the interviews across cultures an array of positive spillover effects were reported. We now reflect on the nature of these effects separately.

Within-Domain Behavioral Spillover Effects

The relative frequency of within-domain spillover supports previous work proposing that behavioral spillover is likelier when behaviors are similar (Thøgersen, 2004), or share the same routines or resources (Littleford et al., 2014; Margetts and Kashima, 2017). Within-domain spillovers may also require less effort. This parallels other research measuring a gradual expansion of organic food purchasing using supermarket loyalty card and scanner data (as opposed to less robust self-report measures) (Juhl et al., 2017).

While there was some commonality of behavioral clusters leading to reported spillover effects, there was little clarity as to which specific behaviors catalyzed others. It appears unlikely that specific behaviors function as entry points to adopting other actions. There was also little evidence that easier behaviors lead to more committed ones. While unsupported by our analysis, this may be due to a lack of self-efficacy. Increased self-efficacy has been demonstrated not only as a motivator of environmentally responsible action, but as a mediator of further engagement in wider behaviors (Lauren et al., 2018) and warrants further study. There was also some evidence that engaging in one behavior catalyzed wider interpersonal engagement. This might be more effective in generating wider culture change than focusing on spillovers involving the adoption of individual behaviors. This also parallels other work in which it is argued that engagement in green behavior catalyzing pro-environmental policy support

has greater potential impact than conventional spillovers between behaviors (Thøgersen and Noblet, 2012).

Between-Domain Behavioral Spillover Effects

Behavioral interventions potentially risk marginal returns if behavioral repertoires are limited to "simple and painless" actions (Thøgersen and Crompton, 2009). It is also evident from everyday life that if we engage in one environmentally responsible action then this does not guarantee that we will then engage in other behaviors, akin to ascending a "*virtuous escalator*" (Thøgersen and Crompton, 2009). We found very little evidence across cultures where a behavior from one cluster catalyzed another behavior from a different cluster. If spillover is to fulfill its potential in generating wider lifestyle change, interventions must find ways to transcend these boundaries and catalyze the voluntary adoption of wider, more committed practices beyond existing behavioral repertoires.

From our isolated examples of between-domain spillover, an initial step could lie in highlighting the co-benefits of pro-environmental engagement (such as promoting health or voluntary simplicity). This is not to say that environmental justifications for engagement are less important, as without some degree of intrinsic pro-environmental motivation, spillover may be undermined if a perceived benefit or incentive disappears (Evans et al., 2013). Nonetheless, some individuals will value the environment more than others and so strengthening pro-environmental salience in decision-making across the board is likely to be extremely difficult. Research has shown that certain types of co-benefits (for example, the creation of more benevolent and caring communities) can motivate sustainable behavior change for those who are environmentally committed to varying degrees (Bain et al., 2016). This could create the initial momentum for change. Further to the above, catalyzing wider interpersonal engagement might also be an effective way of generating wider culture change.

Contextual Behavioral Spillover Effects

We also found evidence for contextual spillover effects. Previous studies have also documented the transfer of behavior between different contexts including work and home (Lee et al., 1995; Tudor et al., 2007; Andersson et al., 2012). This opens the possibility that promoting pro-environmental practices at work could be spread to other life spheres. However, as the examples from the interviews came from participants who worked in the environmental sector, it is possible that pre-existing values could have facilitated consistency (Thøgersen, 2012). Other work has found contextual spillover mediated via identification with the pro-environmental ethos or values within non-environmental organizations (Rashid and Mohammad, 2011; Loverock et al., 2015). Workplace coercion might also lead to behavioral transfer from the workplace to the home, which could influence less environmentally engaged employees. Andersson et al. (2012) report increases in home waste separation practices following the introduction of an environmental management system at work.

Interpersonal spillover effects were also reported that operated along processes of *social diffusion* (McKenzie-Mohr and Schultz, 2014). Taken together, the evidence suggests that if behavior can be transferred between contexts then it might also then be spread via social diffusion to multiple people within the household under the right conditions. There is also the possibility of a reversal of direction from home to work, though differences in roles, levels of responsibility and control in the workplace might constrain the degree to which household practices could transfer to the workplace (Maki et al., 2016).

Following the lead of CBSM, rather than attempting to identify and promote the adoption of what are judged to be the most potent behavioral catalysts, it may be more productive to tailor interventions based on the receptiveness of different audiences. It may be that in some situations different kinds of spillover pathways will be open or closed. A better understanding of the ways in which different types of spillover operate would be a suitable target for CBSM interventions. In particular, CBSM strategies could utilize community connections and block leaders to create small-scale cultural shifts that can grow and spread through society (McKenzie-Mohr et al., 2011). Small-scale community approaches might also be more successful in reaching those who feel that they lack the capacity to engage in more committed pro-environmental actions, as indicated in the interviews. Community initiatives that foster supportive environments in which more sustainable behaviors can develop, may also be more impactful than individual private-sphere initiatives that ignore the relevance of the social context.

Barriers to Positive Behavioral Spillover

Conscious awareness and personal importance of the initial behavior catalyzing spillover was significant in multiple accounts of spillover, which came from more engaged participants. Much of our day-to-day behavior is not consciously performed (Carden and Wood, 2018), which suggests that behavioral spillover may be impeded by a lack of conscious attention to routinized behavioral decisions, especially for those who were less engaged. Environmental considerations may also be subjugated by more pressing day-to-day concerns and responsibilities that characterize the life of the average citizen. Behaviors like recycling can blend into everyday routines over time, losing their environmental significance (Cornelissen et al., 2008; Thomas and Sharp, 2013), thereby reducing the possibility of spillover. Generating greater conscious awareness of the environmental significance of behavior could therefore strengthen an action's catalyzing potential. Barbaro and Pickett (2016) report positive associations between mindfulness, sense of connectedness to nature, and engagement in a range of pro-environmental behaviors. In line with the habit discontinuity hypothesis (Verplanken et al., 2008), interrupting behavioral routines can reinvigorate awareness and promote more sustainable behavioral choices.

Study Limitations and Future Research

Like all other studies, there are limitations of the methods applied here. The use of a single qualitative method alone can provide only a partial picture of spillover, which rests on subjective self-report and not actual behavior over time. Recollection of motivations *after* behavior has taken place may be subject to distortion and post-rationalization as individuals try to piece

together their motives, especially if behavior occurred sometime in the past (Broemer et al., 2008). Clearly establishing causal links between behaviors is especially problematic due to the many factors governing decision-making, not all of which an individual will be conscious of. The reasons for maintaining a behavior may also be different from the reasons for beginning a behavior.

The rather limited evidence for behavioral spillover found not only in this study but across much of the literature brings into question how to proceed in future research into spillover. The core assumption of spillover as a means of initiating voluntary and cumulative behavior change has given way to a more complex and contingent perspective, in which spillover takes multiple forms, in which certain behaviors may be catalyzed for certain individuals in certain contexts. As previously discussed, interventions that target spillover processes aiming to catalyze wider social engagement may offer greater potential than interventions targeting narrower changes to individual practices. Mixed method approaches should also be employed to measure behavioral outcomes utilizing rigorous quantitative methods longitudinally and capturing the richness and detail of more qualitative techniques (Verfuerth and Gregory-Smith, 2018). We also encourage the application of qualitative approaches (for example, focus group discussions) with more and less environmentally engaged groups to identify obstacles and facilitators of behavior change for different groups across cultural contexts, including spillover processes. Approaches involving groups could incorporate a wider repertoire of CBSM steps and tools tailored to the individual characteristics of those groups. Future research might also examine reflections on behavior change processes *as they occur*, rather than *after* they have occurred. In addition, to shedding light on factors that create conditions favorable to spillover, greater attention to cases where behavioral engagement does not lead to other actions might also uncover processes hitherto concealed from the attention of social scientists.

ETHICS STATEMENT

This study was carried out in accordance with the recommendations of "name of guidelines, name of committee" with written informed consent from all subjects. All subjects gave written informed consent in accordance with the Declaration of Helsinki. The protocol was approved by the Ethics Committee, School of Psychology, Cardiff University.

AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct and intellectual contribution to the work, and approved it for publication.

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SUPPLEMENTARY MATERIAL

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