



# A Research Agenda for Affective Dimensions in Climate Change Risk Perception and Risk Communication

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There is a growing body of literature that examines the role of affect and emotions in climate change risk perception and risk communication. Conceptions of affect and emotions have differed according to theoretical perspectives and disciplinary orientations (e.g., sociology of risk, psychology of risk, climate science communication), but little has been done to map these differences. This perspective article provides an in-depth analysis of the study of affect and emotions in climate change risk research through a literature review of studies published in the last 20 years. In this perspective, we examined how affect is conceived, what emotions have been considered, and their role in climate change risk perception and risk communication. Early studies in climate risk perception and risk communication included vaguely defined emotions (e.g., negative and positive) in climate risk perception and risk communication studies, more recently turning attention to how different affective dimensions interact with other factors, such as personal experience, knowledge, culture and worldviews, gender, and social norms. Using this review as a mapping exercise of the research landscape on affect and emotions in climate risk perception and communication, we suggest that future research could benefit from more interdisciplinary work that explores the role of different affective responses and their intensities before, during, and after climate-related events.

**Keywords:** affect, climate change, risk communication, risk perception, emotions

## INTRODUCTION

Emotions and feelings—as affective responses to external stimuli or the imagination—reveal truths, create knowledge, and raise awareness about matters of concern to individuals (Furtak, 2018). A growing body of scholarship shows that affective responses—negative or positive—influence how risks are perceived (Finucane et al., 2000; Slovic, 2000, 2010; Mary Kate et al., 2018) as well as the effectiveness of the transmission and reception of the communication of risks (Slovic, 2010). Risk perception and risk communication are deeply connected to emotions and experience. Affective responses are increasingly recognized as an essential part of risk perception and risk communication by interacting with knowledge (Furtak, 2018), personal experience (Van Der Linden, 2014), social norms (Du Bray et al., 2019), and gender, among other factors; however, the specific role of affect in risk perception and risk communication is still not well-understood.

Studying affective responses in risk perception and risk communication is particularly important in climate change action. The impacts of climate change, which are distributed unequally across the planet, have become visible through floods, droughts, wildfires, heat waves, vector-borne diseases, and sea level rise, among other impacts. Scholarship on the role of emotions and feelings has shown that affective responses influence the judgment of risks and decision-making by individuals and communities, which may ultimately influence climate change actions (Slovic, 2000, 2010; Slovic et al., 2004; Finucane and Holup, 2006). The intensity and frequency of climate-related events are predicted to increase in the absence of substantial and transformative climate change mitigation (Mckenna et al., 2020), therefore, it is crucial to understand the role of affective dimensions in climate change risks perception and how to better communicate climate risks with different audiences.

Previous literature reviews have focused on single climate change impacts (e.g., floodings) (Bubeck et al., 2012) or on a single region (e.g., United Kingdom) (Taylor et al., 2014); however, no literature reviews have examined affect in risk perception and communication related to a broader range of climate change impacts. This perspective study presents the results of a review of forty-two articles from the last 20 years that study affective responses to climate change impacts in terms of risk perception and risk communication, guided by the following research questions: How are affective responses studied in climate change risk perception and risk communication research? And what role does affect play in risk perception before, during, and after a climate event? We identify trends, debates, and opportunities to better understand the role of affective responses in risk perception and communication of climate events<sup>1</sup>.

## LITERATURE REVIEW

### Meanings and Understandings of Affect

A variety of theoretical frameworks have been developed to understand the role of affective responses in risk perception and risk communication. We found that emotional responses were mostly studied following a “risk-as-feelings” interpretation (Zaalberg et al., 2009; Van Der Linden, 2014; Vasileiadou and Botzen, 2014). This perspective holds that, in low intensity situations, feelings play a minor role in risk perception, but in highly intense situations, emotions can take priority over cognitive responses to risk. The affect heuristic takes a different view—that emotional responses are immediate and automatic. In climate change research, the affect heuristic was used to explore how positive or negative emotions and feelings guide people when judging risks (Van Der Linden, 2014; Lefevre et al., 2015; Ekholm and Olofsson, 2017; Mol et al., 2020). Fewer studies used “risk information seeking and processing” (RISP) models to explore how affect influences information seeking behaviors in risk perception (Terpstra et al., 2014; Yang and Zhuang, 2020).

<sup>1</sup>The literature review methodology is described in the **Supplementary Material** of this perspective study, and the main insights of the review are presented in **Tables 1, 2**.

Studies of affective dimensions in risk communication relied on affective imagery to investigate positive and negative emotions triggered by images, sounds, ideas, and stories which evoke judgment of a perceived risk (Lorenzoni et al., 2006; Smith and Leiserowitz, 2012; Thaker et al., 2020). It is notable that many studies did not explicitly follow a specific theory of affect despite the growing number, diversity and contrasts between different theories of affect (Furtak, 2018).

### Polarity, Intensity, and Dimensions of Affect

In recent years, there has been a shift in how studies of climate risk perception have approached the subject of affect. Earlier studies tended to refer only to negative and positive affective responses. Over time, different positive and negative emotions, including fear and anxiety, started to be elicited in studies but were not typically a primary focus. More recently, a small but growing number of studies have focused on disaggregating negative and positive responses into specific emotions and feelings (Graybill, 2013; Jovarauskaite and Böhm, 2020). Fear, anger, worry, and anxiety were among the most studied affective responses in our review. For example, Graybill (2013) found that positive (e.g., bravery) and negative (e.g., confusion, anger, fear, helplessness) emotions were shown in response to climate change threats even when climate skepticism was a factor.

There were similar findings related to risk communication. Meijnders et al. (2001) found that affect can result in positive or negative attitudes toward climate risks, depending on how messages are delivered and what information is provided. Among different affective responses, fear has captured the greatest attention (Meijnders et al., 2001; Wagner, 2007; De Boer et al., 2014; Terpstra et al., 2014; Luís et al., 2016; Lebel et al., 2018). Using qualitative data from a case study of climate change in Norwich, U.K., Langford (2002) argued that risk managers should be aware of fear in individuals so that risk communication strategies allow individuals to understand existing risks and coping mechanisms, although the study does not say how this could be done. Appeals to fear appear to succeed in motivating people to protect themselves from climate risks only when they increase confidence that proposed actions can mitigate the risks of a threat (Luís et al., 2016). By contrast, positive emotions (e.g., hope) achieve better results in conveying clearer messages (Langford, 2002) but only when motivating information-seeking behavior (Terpstra et al., 2014; Van Der Linden, 2014) or providing clear actions to mitigate risks (De Boer et al., 2014).

The intensity of affective responses of perceived climate change risks can result in contradicting behaviors (Taylor et al., 2014). For example, Meijnders et al. (2001) found that fear in a lesser intensity can result in a positive attitude (e.g., a coping response) while more intense fear can produce negative attitudes (e.g., resistance or avoidance). However, others found that stronger negative affective responses could result in positive behavior (e.g., seek information to mitigate risks) (Yang and Zhuang, 2020). Similarly, Terpstra et al. (2014) found that negative affective responses (e.g., fear) can result in information seeking behavior. Other studies indicate that fear could have

**TABLE 1** | Main insights into the role of affective responses in risk perception by sampled studies.

Sampled studies	Main insights into role of affective response in risk perception
Lazo et al. (2000)	The research resulted in negative correlations between goodness (i.e., how good, or bad a risk is in terms of its impacts on ecosystems/natural environments) and emotionality [i.e., negative affective responses (e.g., fear, disgust, hate) respondents felt when thinking about the risk and its effects on ecosystems/natural environments]. Also, they found that a layperson appears to be more emotional than an expert when perceiving risks.
Meijnders et al. (2001)	Fear can result in either positive attitudes (e.g., coping response) or negative attitudes (e.g., resistance to change behavior). This was observed when other factors that influence how risks are perceived exist (e.g., distractions, time pressures, and information overload).
Langford (2002)	The author argues that coping mechanisms could appear in the form fear of loss (i.e., loss of material possessions and life) when climate change risks are perceived and can also be observed in the form of anxiety. Knowledge appears to also play a role—that is, if something is unknown, the judgment of risks perceived could be influenced.
Lorenzoni et al. (2006)	Negative affective responses are associated with images of climate change impacts, such as sea level rise and flooding; this was observed for both people who are skeptical of the science and those who trust the science of climate change. Distance from climate change impacts also appeared to influence the intensity of the affective responses.
Siegrist and Gutscher (2006)	The intensity of affective responses to perceived risks can be justified or not depending on the previous knowledge and understanding of the risks posed by a climate change impact. Past experiences can also have an influence on the affective responses triggered even if the risk is low.
Wagner (2007)	Fear and anxiety are two affective responses observed for people that have previously experience floodings, although how these influence the judgment of perceived risks is not further explored.
Mcfarlane and Witson (2008)	People that had some knowledge about the impacts of the Mountain Pine Beetle (MPB) experienced negative affective responses to the perceived risks. The intensity of affective responses to how risks are judged decreased with increased knowledge (i.e., experts). Affective responses to perceived risks of the impacts of the MPB also had a role in the support for or against control measures.
Smith and Joffe (2009)	Publics react to visual information that triggers positive or negative affective responses of perceived climate change threats, which may influence how publics engage with risks posed by climate change.
Zaalberg et al. (2009)	People who have experienced a flooding event may have stronger negative affective responses (e.g., fear) to future flooding and influence the perceived severity of the consequences. However, the role of past emotions in how risks are perceived and how these influence decisions is not well-understood.
Kellens et al. (2011)	The judgment of perceived risks of storm surges and floodings are influenced by age, gender, personal experience, and that result in different negative affective responses (e.g., worry, concern).
Bubeck et al. (2012)	Past experiences trigger negative affective responses (e.g., fear and worry) to perceived climate change risk that influence how people behave to mitigate risks (e.g., demanding flood insurance); however, if past experiences are distant, the influence of these negative affective responses may be less significant.
Roeser (2012)	No insights into role of affective response in risk perception.
Harries (2012)	Negative affective response (e.g., anxiety) influence the judgment of risks and shape the behavior of people on whether they mitigate perceived climate change risks (e.g., investing in flood protective equipment and having flood insurance) or not and recommends further research exploring the role of anticipated emotions in responses to risk.
Smith and Leiserowitz (2012)	Affective responses can influence how risks are perceived, their severity, and likelihood (e.g., negative association to climate change when learning about potential risks). Affective responses (e.g., emotions) interact with cognition (e.g., reason) before, during, and after a risk has been perceived. The study also suggests that cultural worldviews and other demographic variables also influence how climate change risks are perceived.
Brugger et al. (2013)	Personal experience can trigger different types of affective responses (e.g., worry and anxiety) and influence the degree of concern of climate change risks. The study also suggests that ties to local physical environment (e.g., glaciers), livelihoods, knowledge, and traditions interact together with emotions and that these complex interactions could result in consistent or contradictory risk perceptions and anticipatory affective responses (e.g., concern).
Graybill (2013)	Even when climate skepticism exists within a community, people who have perceived the impacts of climate change still show a range of positive (e.g., bravery) and negative (confusion, anger, fear, helplessness) emotions. The study also highlights that the affective responses to climate change risk perceptions could be different between women and men. The study also argues that community and territorial bonds influence how climate change risks are perceived.
Vasileiadou and Botzen (2014)	The study highlights that affective responses (e.g., fear, anxiety, worry) are tied to personal experiences, which influence how climate change risks are judged. The study also suggests that techniques such as role-playing games can help have a better understanding of the affective responses triggered before, during, and after climate change impacts.
De Boer et al. (2014)	No insights into role of affective response in risk perception.
Van Der Linden (2014)	Van Der Linden (2014) explores the relationship between climate change risk perception, affective responses, and personal experience and presents three hypothesized models on the relationship between these. The study highlights that there is a mutually reinforcing mechanism between affective responses and risk perception. The study also argues that affect can guide the perception of risk and can also be a reaction to a perceived risk.
Taylor et al. (2014)	The study suggests that the degree of affective responses triggered could result in either positive or negative behavior. On the one hand, moderate negative affective responses (e.g., moderate fear) can result in a behavior that seeks to mitigate risks. On the other, intense negative affective responses (e.g., intense fear and anxiety) can result in an avoidant and defensive behavior.

*(Continued)*

TABLE 1 | Continued

Sampled studies	Main insights into role of affective response in risk perception
Terpstra et al. (2014)	The study reinforces highlights that negative affective response (e.g., fear) to a climate change risk can result in an information seeking behavior.
Panno et al. (2015)	The study highlights that cognitive reappraisal (e.g., moderating negative and positive affective responses) can influence how climate change risks are perceived, and could result in whether a person changes their behavior.
Duinen et al. (2015)	Personal experience of climate change impacts could result in either negative (e.g., worry or dread) or positive (e.g., sense of control) affective responses toward climate change risks. People with a sense of control tend to perceive lower degrees of risks to climate change (e.g., droughts) although the severity of a climate change impact can also result in higher risk perceptions. This has a particular relevance for farmers who rely on both personal experience and affective dimensions to climate change risk perception.
Lefevre et al. (2015)	This study reinforces that personal experience plays a role together with affective responses during heat waves and this results in taking a heat protection behavior or not. This is influenced by the trust in organizations that convey the communication of the risks of heat waves.
Stevenson et al. (2015)	The study found that affective responses to climate change risks tend to be deciding factors when risks appear to be personal. The study also highlights that affective responses to risk perception also interact with personal beliefs and political ideology. Affective responses seemed to have a lesser role in assessing climate change risks to wildlife as opposed to cognitive reasoning (e.g., relying on scientific facts).
Shi et al. (2015)	The study highlights that in climate change risk perception, individualistic and cultural worldviews interact with affective responses (e.g., concern or powerlessness) that could result in whether people are willing or reluctant to mitigate risks.
Luis et al. (2016)	No insights into role of affective response in risk perception.
O'Neill et al. (2016)	Negative affective feelings (e.g., worry) are more likely when a person has personal experience with a climate change risk (e.g., flood). The study also found that distance to a climate change risk (e.g., flood hazard) has a positive relationship with the perceived risks. The study also found that the intensity of negative affective feelings is influenced by gender and education.
Berse (2017)	Age, gender, and affective responses have a role in how risks are perceived. The study found that children's perception of climate change risks (e.g., floods or typhoons) result in creating memories that result in negative affective responses (e.g., fear and sadness). Emotional coping strategies (e.g., denial, distancing) that are common in adults were not common in children.
Ekholm and Olofsson (2017)	The study explores the interactions between parenthood, affective responses (e.g., worry), and climate change risk perception. The study found that the intensity of affective responses as a response to climate change risks is also influenced by gender (i.e., women worried more than men). Ekholm and Olofsson (2017) argue that survey emotion-based questions can result in a better understanding of affective responses to climate risk perception.
Wang et al. (2018)	The study found that stronger affective responses to climate change risks resulted in more interest and action-driven behavior than those that had less intensive affective responses. In case of the latter, the study suggests that material objects, people, and places that are valued by a person could play a stronger role in how climate change risks are perceived.
Lebel and Lebel (2018)	The intensity of negative affective responses (e.g., fear and anxiety) change depending on the severity of risks perceived together with the experience of deterioration of conditions. For example, the study found that fish farmers felt more anxious when then noticed that the quality of water changed over time. The study also found that worry was a key affective response in encouraging that people changed behavior and implemented measures to reduce perceived risks. The intensity of anxiety also changed over time as conditions worsened. The study also found that affective responses to climate change risk perception were relevant in making decisions. Lebel and Lebel (2018) also argue that role-playing games can assist in providing an additional lens to explore affective responses before, during, and after a climate related event.
Gotham et al. (2018)	Gotham et al. (2018) argue that affective responses influence how flood risks are perceived and that risks perceived are also influenced by previous experiences.
Wang and Lin (2018)	The study highlights that anticipated affective responses (e.g., anticipated guilt) are related to both personal and group climate change risk perceptions. Stronger risk perceptions within groups could be explained by how close members of a group could be negatively affected by a climate change related event.
Ejelöv et al. (2018)	No insights into role of affective response in risk perception.
Lebel et al. (2018)	Negative affective responses (e.g., anxiety) had a stronger influence in how climate change risks are perceived, but no influence was found on intention to act.
Kwon et al. (2019)	The study found a strong correlation between negative affective responses and climate change risks perceived. The study also found that affective responses in risk perception also interacted with religion, and norms.
Du Bray et al. (2019)	The study found that different cultures, norms, and gender resulted in different affective responses for similar climate change perceived risks. That means that to fully grasp the affective dimensions in climate change risk perception, it is necessary to understand the interaction between cultural norms and local contexts.
Robinson and Botzen (2019)	Anticipated (e.g., regret) and anticipatory (e.g., worry) emotions in flood risk perception results in different intentions to act (e.g., flood insurance demand).
Thaker et al. (2020)	Less intense affective responses in climate change risk perception could be influenced by low public awareness and understanding of climate change. Thaker et al. (2020) suggest that more studies that consider the role of affective responses in climate change risk perception in the developing world and poor nations is needed.

(Continued)

TABLE 1 | Continued

Sampled studies	Main insights into role of affective response in risk perception
Yang and Zhuang (2020)	The study found that stronger negative affective responses to climate change risks resulted in an information seeking behavior.
Mol et al. (2020)	Anticipatory negative affective responses (e.g., worry) resulted from perceived flooding risks. The intensity of worry may result in overestimated perceived flood risks; however, personal experience and trust in adaptation options may result in a decrease in perceived flood risks.
Kim et al. (2020)	Political leaning may play a role in the affective responses to climate change risk perception (e.g., climate change impacts to health). People with poorer health conditions could perceive stronger emotional responses to perceived climate change risks (e.g., vector borne diseases).
Ekholm (2020)	Women show stronger anticipated affective responses (e.g., worry) to climate change risks than men. Parenthood seems to increase worry about perceived climate change impacts but to a lesser degree than women regardless of whether they are parents or not.
Jovarauskaite and Böhm (2020)	Different types (e.g., contempt, anger, worry, disappointment, sadness, and guilt) and intensities of affective responses to climate change risks were found in experts in climate change and intense affective responses can trigger avoidance instead of a desire to act.
Morss et al. (2020)	An individualist worldview can result in lesser intensities of affective responses (e.g., worry, fear, anxiety, and dread) to climate change risk perceptions and to a desire to act (e.g., avoid evacuating during a hurricane).
You and Ju (2020)	Depending on the climate change risk a range of positive or negative affective responses can be identified and is also influenced by political leaning.

different forms (e.g., loss of life, loss of material possessions) and that different coping mechanisms can result from these affective responses (Langford, 2002).

A few studies disaggregated affective responses according to temporal characteristics (i.e., anticipatory and anticipated affective responses) (Robinson and Botzen, 2019; Mol et al., 2020). Robinson and Botzen (2019) argued that actions to mitigate risks (e.g., acquiring flood insurance) can be influenced by either anticipated (e.g., to avoid regretting future uninsured flood losses) or anticipatory (e.g., worrying about flooding) emotions. Similarly, Harries (2012) found that anticipatory affective responses to climate risks, such as worrying about flooding, influences intentions to mitigate perceived risks (e.g., investing in flood protective equipment).

## Individual-Level Factors

### Personal Experience With Climate Impacts

Experience appears to play a significant role in the intersection of risk perception and affect. Personal experience may result in negative (e.g., worry or dread) or positive (e.g., sense of control) affective responses toward climate change risks, which also influence the degree to which a risk is perceived (e.g., severity and chances of a flooding) (Duinen et al., 2015). Fear, worry, and anxiety were found to be common responses of people who have had personal experience with climate change impacts (e.g., flooding, heat waves) (e.g., Wagner, 2007; Zaalberg et al., 2009; Kellens et al., 2011; Vasileiadou and Botzen, 2014; Lefevre et al., 2015). Bubeck et al. (2012) review of flood risk literature highlighted that the amount of time passed since a climate event was an important factor in how affect relates to risk perception. The negative emotional influence of flooding events on risk perceptions diminishes over time, implying that emotional responses are likely to be less significant for events in the distant past.

Van Der Linden (2014) highlighted that there is a mutually reinforcing mechanism between personal experience, risk perception, and affective responses; affect can guide the

perception of risks but can also be a reaction to risk. Only one study highlighted that personal experience of children with typhoons or floods created memories that shaped affective responses (e.g., fear, sadness) and guided risk perceptions (i.e., coping mechanisms) (Berse, 2017). However, most studies did not explore whether affective responses were guiding, or reacting to, the perception of climate change risks.

### Lay People vs. Experts

The intensity of affective responses in risk perception have been observed to differ between climate change experts and laypeople. Lazo et al. (2000) found that laypeople showed more intense emotions than experts when perceiving climate change risks. Contrastingly, Jovarauskaite and Böhm (2020) found that experts tended to show more intense negative emotions (e.g., disappointment, sadness, guilt) to climate change impacts than laypeople. Experts experience diverse negative affective responses to perceived climate change risks including contempt, anger, worry, disappointment, guilt, and sadness (Jovarauskaite and Böhm, 2020). Negative affective responses (e.g., fear) were common in laypeople, who, in some cases, tended to overestimate the potential risks (e.g., flooding) (Siegrist et al., 2006). Siegrist et al. (2006) argued that lay risk perceptions depend on personal experiences, which could explain why affect plays a prominent role. Others found that personal experiences also interact with the affective responses to perceived risks, which could explain these contrasting findings (Van Der Linden, 2014). Mcfarlane and Witson (2008) suggested that increased knowledge may decrease the intensity of affective responses when judging risks, as knowledge reflects a better understanding of the risks.

## Societal-Level Factors

### Culture and Worldview

Affective responses to risk perception and communication can be shaped by different cultures and worldviews. For instance, belief in the inevitability of climate events, or about the role of individuals in addressing climate change result in different emotions: fear that harm will come to oneself,



**TABLE 2 |** Main insights into the role of affective responses in risk communication by sampled studies.

Sampled studies	Main insights into role of affective response in risk communication
Lazo et al. (2000)	No insights into role of affective response in risk communication.
Meijnders et al. (2001)	Feelings of fear in climate change risk communication can result in both positive and negative attitudes, depending on how the message is transmitted, its clarity, and if recommendations are provided.
Langford (2002)	Risk communication could be more effective if positive emotions (e.g., hope) are considered and risk communication strategies should recognize the effects of negative affective responses in the form of helplessness and fear.
Lorenzoni et al. (2006)	Effective risk communication requires a better understanding of the negative affective responses that are associated with images of climate change impacts, such as sea level rise and flooding.
Siegrist and Gutscher (2006)	The communication of climate change risks should consider if the audience had previous experiences, as this could trigger memories and affective responses. Risk communication should also consider including messages of potential solutions.
Wagner (2007)	Personal experience and knowledge about climate change risks are two significant elements that should be considered during the communication of climate change risks. Along the same lines, it appears that when the communication of climate change risks considers images or messages of areas that are familiar to the audience. Affective responses such as fear also appears to have a role, but this is not further explored in the study.
Mcfarlane and Witson (2008)	No insights into role of affective response in risk communication.
Smith and Joffe (2009)	Images used to communicate climate change risks in newspapers result in affective responses, and the strength may be influenced by memories.
Zaalberg et al. (2009)	The communication of flooding risks could be more effective if emotionally arousing experiences are considered, for example, in the simulation of virtual environments. The study also suggests that the communication of risks could be more effective when threats and coping appraisal of people are considered.
Kellens et al. (2011)	No insights into role of affective response in risk communication.
Bubeck et al. (2012)	No insights into role of affective response in risk communication.
Roeser (2012)	Emotions in the communication of climate change risks could produce a reflective behavior in people. The communication of risks should go beyond using alarmist images that cause negative affective responses and should produce emotional responses that are aimed at motivating behavior change.
Harries (2012)	No insights into role of affective response in risk communication.
Smith and Leiserowitz (2012)	Images that trigger an affective response influence the effectiveness of the communication of climate change risks and enable a way forward to further understand how public perceptions of risk change over time. Affective imagery used in climate change risk communication also interacts with political, social, and cultural dynamics that may result in positive or negative behavior individually and collectively.
Brugger et al. (2013)	The study highlights the importance of emotions in an effective communication of climate change risks and that that there is a significant possibility of failing to promote action if the importance of emotions is not recognized (i.e., consider people as only rational actors).
Graybill (2013)	No insights into role of affective response in risk communication.
Vasileiadou and Botzen (2014)	The study highlights that climate change risk communication can be more effective if the role of emotions and personal circumstances are considered through personal stories of life-threatening experiences (e.g., personal stories during climate change adaptation workshops could trigger other participant's personal experiences and emotions).
De Boer et al. (2014)	The study suggests that the communication of climate change risks (e.g., flood risks) could be more effective if it is framed beyond reducing fear responses and considers prevention measures.
Van Der Linden (2014)	The study highlights that effective climate change risk communication should recognize the interaction between perceived risks, affective responses, and personal experience. The study also argues that risk communication that considers affective responses can result in an information-seeking behavior.
Taylor et al. (2014)	The study suggests that climate change risk communication strategies that focus on producing negative affective responses (e.g., anxiety) could result in triggering avoidant behavior.
Terpstra et al. (2014)	The study suggests that positive affective responses in climate change risk communication could be ineffective in reducing negative affective responses (e.g., fear). The study also suggests that climate change risk communication should seek to convey messages that result in an information seeking behavior, typically considering negative affective responses.
Panno et al. (2015)	The study suggests that risk communication strategies should also consider that people may have cognitive appraisal strategies that would influence how climate change risks are perceived.
Duinen et al. (2015)	No insights into role of affective response in risk communication.
Lefevre et al. (2015)	The communication of climate change risks could be more effective if these evoke negative affective responses. For example, the study suggests that the communication of the risks of heat wave can be more effective if the messages evoke negative affective responses (e.g., unpleasant feelings caused by the heat). During heatwaves, positive affective responses in risk communication could also be less effective if these trigger positive memories of heat (e.g., positive memories during hot summers).
Stevenson et al. (2015)	Affective responses in climate change risk communication could be more effective when addressing threats to society as opposed to subjects that are more distant to people (e.g., wildlife). The study also highlights that the communication of climate change risks could be more effective when appealing to emotions and recognize differing worldviews and political ideologies.
Shi et al. (2015)	No insights into role of affective response in risk communication.

*(Continued)*

TABLE 2 | Continued

Sampled studies	Main insights into role of affective response in risk communication
Luis et al. (2016)	Fear appeals in climate change risk communication (e.g., communicating risks of coastal risks) may be effective only when it results in increasing the confidence of reducing or avoiding a threat and it involves the affected public.
O'Neill et al. (2016)	The communication of climate change risks (e.g., flooding) should consider the degree of negative affective responses (e.g., worry) and the perception that people have on how close or distant they are to a risk.
Berse (2017)	No insights into role of affective response in risk communication.
Ekholm and Olofsson (2017)	No insights into role of affective response in risk communication.
Wang et al. (2018)	Climate change risk communication could be more effective when the messages appeal to the objects of care (e.g., material objects, people, and places) of people, which may result in different affective responses.
Lebel and Lebel (2018)	The communication of risks posed by climate change related events could be more effective if the messages considered affective responses to prior climate related events and address the personal experience of the target audience.
Gotham et al. (2018)	Climate change risk communication could be more effective if the messages conveyed considered emotions and stories that are directly related to the target audience.
Wang and Lin (2018)	No insights into role of affective response in risk communication.
Ejelöv et al. (2018)	The study found that affective responses (e.g., self-conscious emotions) are evoked during climate change risk communication when abstract messages about the consequences of climate change are sent. The study also found that no influence in the intensity of affective responses was found when risk communication considered spatial distance of climate change risks.
Lebel et al. (2018)	The study found no influence in changing behavior when climate change risk communication included messages that inserted negative emotions (e.g., fear, guilt, and anxiety); however, the study suggests that affective imagery may have a stronger influence.
Kwon et al. (2019)	No insights into role of affective response in risk communication.
Du Bray et al. (2019)	No insights into role of affective response in risk communication.
Robinson and Botzen (2019)	Considering affective dimensions (e.g., anticipated and anticipatory emotions) in the communication of flood risks can motivate intentions to act to increase resilience and mitigate risks (e.g., demanding flood insurance).
Thaker et al. (2020)	The study found that affective images did not result in an effective risk communication strategy, as public awareness and knowledge about climate change can also play a role.
Yang and Zhuang (2020)	No insights into role of affective response in risk communication.
Mol et al. (2020)	No insights into role of affective response in risk communication.
Kim et al. (2020)	Political leaning can result in different affective responses in climate change risk communication (e.g., climate change impacts to health).
Ekholm (2020)	No insights into role of affective response in risk communication.
Jovarauskaite and Böhm (2020)	No insights into role of affective response in risk communication.
Morss et al. (2020)	No insights into role of affective response in risk communication.
You and Ju (2020)	No insights into role of affective response in risk communication.

anxiety about the future, helplessness, or anger are tied to what individuals believe the situation to be and socially appropriate emotional responses are. Shi et al. (2015) found that individualistic and cultural worldviews interact with affective responses (e.g., concern or powerlessness). Similarly, Morss et al. (2020) found individualistic worldviews resulted in lower intensities of affective dimensions to climate change risks and decreased desire to act (e.g., evacuate during a hurricane). People who are close to a person or community (i.e., collectivist cultures) impacted by a climate change-related event tended to show stronger affective responses and risk perceptions (Wang and Lin, 2018). Territorial and community bonds have also been shown to influence people's affective responses to perceived climate change risks and their desire to act (i.e., social resilience) (Graybill, 2013). These studies show that individualistic and collectivist worldviews influence affective responses to the perceived climate change risks and intentions to act but do not articulate how findings can be applied to risk communication strategies.

## Gender and Family Norms

Gender is a recurring focus in literature on affective dimensions of climate risk perception (e.g., Kellens et al., 2011; Berse, 2017; Ekholm and Olofsson, 2017; Lebel and Lebel, 2018; Du Bray et al., 2019). One study found that men tend to express different emotions than women (e.g., anger instead of sadness) (Du Bray et al., 2019). Du Bray et al. (2019) also found that cultural gender norms influence which affective responses are evoked against the same climate change risk (e.g., men from Cyprus tend to express emotions of anger whilst men in Fiji did not) as this can be driven by gendered expectations of what is acceptable for men and women. O'Neill et al. (2016) found that women tend to show more negative anticipatory affective responses (e.g., worry) to floods than men. Gotham et al. (2018) argued that climate change risk communication strategies should consider gender dimensions as they may influence the transmission and reception of the information.

Two studies focused on exploring the role of parenthood in risk perception (Ekholm and Olofsson, 2017; Ekholm, 2020).

Ekholm and Olofsson (2017) found a close tie between affective responses, parenthood, and risk perception. Ekholm (2020) added a gender lens to parenthood, finding that the intensity of negative affective responses (e.g., worry) in men, changed depending on whether they were parents or not; however, this difference was not observed in women. Studies that focused on gender, culture, and social expectations show that these can result in different affective responses to climate risk perception; however, most studies did not provide how this should be considered in risk communication strategies.

## Communication Strategies

There was widespread recognition in the literature that better understanding the role of affect can improve communication about the risks of climate change impacts (Meijnders et al., 2001; Lorenzoni et al., 2006; Zaalberg et al., 2009; Smith and Leiserowitz, 2012; Brugger et al., 2013). Risk communication strategies could be more effective in educating the public on hazards when messages trigger memories of negative emotions from personal experiences of target audiences (e.g., communities, students, vulnerable groups) (Wagner, 2007; Vasileiadou and Botzen, 2014). Gotham et al. (2018) found including stories directly related to the target audience helps in spreading knowledge about climate risks. Similarly, Lebel and Lebel (2018) found that messages were more effective when personal experiences of target audiences were considered alongside affective responses to previous climate events.

Another body of scholarship has shown that using images to elicit emotional responses on climate change impacts could increase the influence of risk communication on behaviors (Lebel et al., 2018). Visual information can trigger both positive and negative responses to perceived climate threats by creating and prompting memory responses, which could be useful when studying decision-making and designing communication strategies (Smith and Joffe, 2009; Lebel et al., 2018). One study found that people had negative responses when shown images of flooding and sea level rise, regardless of whether they were skeptical about the causes of climate change (Lorenzoni et al., 2006). Another study found respondents in India had lesser negative emotional responses to climate change affective imagery; a lack of knowledge and awareness of climate change risks could potentially explain these findings (Thaker et al., 2020). Affective imagery used in climate change risk communication can also trigger memories that result in preventive behavior (Siegrist and Gutscher, 2006; Smith and Joffe, 2009; Lefevre et al., 2015).

## DISCUSSION

Two decades of research have shown that affective responses influence the judgment of risk perception to and communication of climate change risks. Our review suggests that a wide range of positive and negative affective responses play an important role in climate risks' perception and can enhance or hinder communication of climate risks. The research reviewed also shed light on the different dimensions of affect. For example, negative affective responses can take a wide variety of forms

including fear, anger, anxiety, regret, guilt, sadness, helplessness, and each can result in different behaviors toward perceived climate risks and the communication of climate risks. Research in this area has also shown that beyond identifying the positive and negative affective responses, the intensity of emotional responses influences the judgment of risks and reception of climate risk communication.

There are complex interactions occurring between multiple factors influencing climate risk perception and risk communication, including personal experience, knowledge, gender, worldviews, social norms and time. Following the thoughts of Finucane et al. (2003), there is indeed a complex *dance* between affect, risk perception and risk communication, and these factors. Ignoring these complex interactions can impair efforts to protect people from climate change impacts. Given the importance of affective dimensions in risk perception and communication, future research should continue to develop more nuanced analyses of affective responses in how individuals and communities respond to climate risks.

There remain several critical gaps in the literature that warrant reflection and further research. That most of the studies we reviewed focus on the Global North is problematic in generating theory on affect and climate risk perception and communication. For example, Thaker et al. (2020) found that existing frameworks developed in the Global North could not adequately explain affective responses in India. This is particularly important, as people in the Global South are disproportionately experiencing the impacts of climate change. Studies of affect have shown emotions and feelings assist in the judgement of risks and in anticipatory action, thus, we suggest future research focus greater attention on the Global South.

Whilst studies recognize different emotions, the relative weight and intensity of these emotions in risk perception is still not well-understood, nor is it clear how factors such as gender and culture should be accounted for in risk communication. There is also some ambiguity in what it means for communication to be effective in the context of climate risk assessments. Future research could explore how different affective responses influence risk communication strategies and what happens when the intensity of positive and negative affective responses change.

The influence of time in affective responses for both risk perception and risk communication is also not well-understood. Individuals and communities that have had previous experiences with climate-related events could perceive different affective dimensions—and intensities of affective responses—at one point in time, but whether these change over time is not well-established. A valuable area for future research could involve exploring the role of affective responses in risk perception before, during, and after a climate-related event. Similarly, to what extent affect is mediated by proximity in social relations and geography to people and places that have experienced severe climate events is an open question.

The landscape of affective research on climate risk perception and communication is evolving, particularly as climate risks become a reality. We propose these preliminary



research questions as important gaps to address in future studies of the affective dimensions of climate risk perception and communication.

## DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/**Supplementary Material**, further inquiries can be directed to the corresponding author.

## AUTHOR CONTRIBUTIONS

NK and RS contributed to conception and design of the study. RS performed the literature review, data analysis, and wrote the first draft of the manuscript. RS, NK, and VB wrote sections of the manuscript. All authors contributed to regular discussion

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## SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fclim.2021.751310/full#supplementary-material>

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