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Economic Value of Parks via Human Mental Health: An Analytical Framework

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Exposure to nature yields a wide range of mental health benefits. Improvements in mental health have substantial economic value, through: reduced mental healthcare costs; improved workplace productivity; and reduced costs of antisocial behavior, both public, and private. These economic gains represent an unquantified ecosystem service attributable to conservation. Since most individual people, and hence most politicians and policy-makers, care more about the private good of individual health than the public good of ecosystem and biodiversity conservation, calculating the economic value of nature via its contributions to human mental health could prove influential in achieving conservation goals. Here, we review relevant literature, establish a framework for these calculations, and identify immediate information gaps and research priorities. Current estimates rely on assumptions, but are similar in scale to those from tourism and recreation, which do influence policy.

Keywords: conservation, policy, social-psychology, government-financing, ecosystem-services

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INTRODUCTION

Conserving nature requires human actions and decisions, influenced by political systems. These are driven by human values: intrinsic, ethical, and emotional; and extrinsic, economic, and financial (Buckley, 2016). Economic values of conservation include: those which accrue to individuals whether or not they visit protected areas; and those which accrue only to individuals who use protected areas directly. The former have been analyzed largely as ecosystem services (Costanza et al., 1997; Balmford et al., 2002; De Groot et al., 2012; Fenichel et al., 2016), estimated at US$145 trillion worldwide in 2011 (Costanza et al., 2014). The latter include tourism and recreation (Balmford et al., 2009), estimated at US$600 billion globally (Balmford et al., 2015).

They also include human health benefits, both physiological and psychological, derived from individual use of nature, as opposed to public health gains from off-park ecosystem services such as clean air and water (Parks Canada, 2014; Redford et al., 2014; Romagosa et al., 2015; U.S. Department of the Interior, 2015; Yang et al., 2015). Here, we address the individual direct-use psychological health improvements. We propose that parks have an economic value attributable to visitors' mental health improvements. This is additional to intrinsic values, ecosystem services, and physical health improvements from exercise. Here, we construct an analytical framework to quantify this economic value; review relevant data to identify critical gaps; and propose future research to improve relevant economic estimates.

Practical conservation operates within multiple scientific and social contexts. From a scientific perspective, the role of intact biodiversity in maintaining ecosystem function operates

independently of human perceptions (Wardle et al., 2011; Naeem et al., 2012; Hautier et al., 2015; Isbell et al., 2015). From a social perspective, conservation is embedded within human value systems, of which utilitarian values such as economic measures are only one component (Perrings et al., 2011; Dirzo et al., 2014). Economic valuations can be reached either through market processes, or outside them. They exert considerable influence on political decisions, notably allocation of land and water between competing uses (Morrison, 2015; Newbold et al., 2016).

Economic arguments for conservation are by no means the only arguments, but they are particularly powerful in political contexts (Biermann et al., 2012; Morrison, 2015; Buckley, 2016). Economists have calculated total economic value of conservation land use by aggregating economic values derived from different sources of value and mechanisms of valuation. We recognize the limitations of such approaches, but since they are indeed in common use, we argue that they should include values associated with human mental health.

ANALYTICAL FRAMEWORK AND DATA SOURCES

Overall Approach

We propose a three-step analytical framework. The first is to quantify types of park users and park uses in a manageably small number of categories. The second is to quantify proportional changes in mental health parameters, for different categories of people and experiences. The third step quantifies economic values of mental health outcomes, using national economic statistics for public health. One key issue is estimating the degree to which parks users are representative of national populations. Our framework proposes four alternative pathways to address this. The calculation thus requires three datasets: park use patterns, mental health outcomes, and economic values, respectively. In contrast to the "metro nature" focus of Wolf et al. (2015), our focus here is on parks and other greenspace areas sufficiently large and undisturbed to be significant for conservation.

People and Nature Experiences

Park users and uses may be grouped by type and duration of nature exposure, and individual characteristics. Park experiences may be brief or extended, once-off or repeated, irregular or routine, group or solo, guided or unguided, motorized or unmotorized, individual or commercial. Different activities and experiences are available to different individuals, depending on age, physical capabilities, location, and finance. Some park-based activities also include exercise and social components; others rely solely on immersion and contemplation. Experiences of different types and intensities commonly involve different numbers of participants (**Figure 1**).

For practical purposes, we can group park experiences into three broad categories: (i) brief visits to natural environments in residential areas, variously known as neighborhood nature, metro nature, or urban greenspace; (ii) single-day visits to parks and other public lands allocated for conservation and/or recreation; and (iii) multi-day programs. These are shown in **Figure 1** as neighborhood nature, park visitors, and immersive multi-day. The multi-day category includes: (a) repeated activities in the same general area, part of organized programs; (b) independent multi-day nature-based activities, such as family camping trips; and (c) organized nature-based experiences, such as outdoor education and commercial nature-based tourism. Mental health research also includes both more and less intensive nature exposures than these three categories (**Figure 1**). Individuals have different patterns and profiles of nature experience and exposure, including different types and categories at different times and frequencies (Wolf et al.,

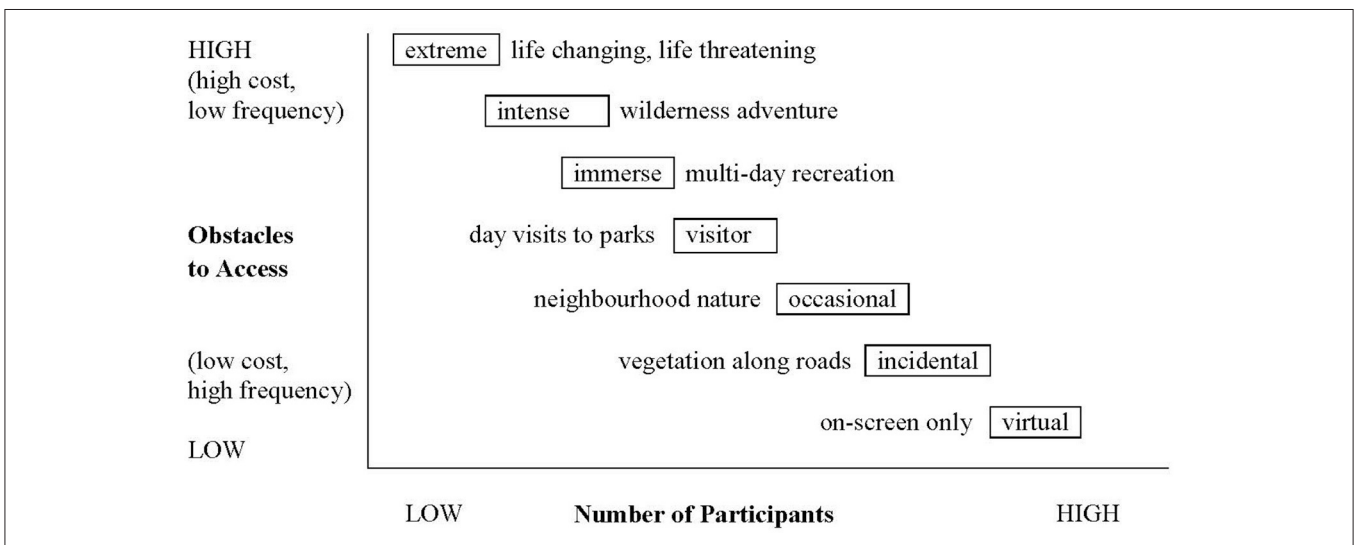

FIGURE 1 | Broad-scale schematic relationship between intensity of experience and number of participants. Individual experiences may differ, e.g., adventure activities in neighborhood nature or urban greenspace.

2015). This is a simple classification to construct a practical framework.

Natural areas include public parks and wilderness, forests and rangelands, foreshores, and urban greenspace. Data on use and visitation for parks and reserves are available for some countries only (Balmford et al., 2009, 2015), and the degree of detail differs greatly between and within nations. Park use varies with attractions, notably biodiversity (Stevens et al., 2014; Siikamäki et al., 2015; proximity and access (Bancroft et al., 2015; Rossi et al., 2015), and wealth (Poudyal et al., 2013). Use of greenspace varies with many local factors (Jones et al., 2009; Lin et al., 2014; McCormack et al., 2014; Veitch et al., 2015). In some cities, these are incorporated in urban planning (Gidlöf-Gunnarsson and Öhrström, 2007; Villeneuve et al., 2012; Alcock et al., 2014; Francis et al., 2015; Giles-Corti et al., 2015; Ulmer et al., 2016).

Urban greenspace, "metro nature," has an economic value attributable to its many parallel and complementary contributions to environmental health (Wolf and Robbins, 2015), including contributions to human physical and mental health over the entire life course (Wolf et al., 2015).

Despite the political significance of economic valuation, however, there has been no framework for financial valuation of nature through human mental health specifically (Wolf and Robbins, 2015). Here, therefore, we review and integrate relevant research, to construct such a framework.

Mental Health Outcomes

Improvements in mental health and happiness from experiences in nature have been documented widely over the past three decades (Wilson, 1984; Kaplan and Kaplan, 1989; Hartig et al., 1991, 2011, 2014; Ryan et al., 2010; Bailey and Fernando, 2012; Cervinka et al., 2012; Keniger et al., 2013; MacKerron and Mourato, 2013; Russell et al., 2013; Capaldi et al., 2014; Gilovich et al., 2014; James et al., 2015; Sandifer et al., 2015). Even adopting the simplest of these approaches (P1), quantifying mental health outcomes derived from exposure to nature is far from straightforward (Mayer et al., 2008; Bowler, 2010; Hartig et al., 2011, 2014; Thompson Coon et al., 2011; Keniger et al., 2013; Russell et al., 2013; Korpela et al., 2014; Kuo, 2015; Triguero-Mas et al., 2015).

We propose four parallel pathways to estimating mental health outcomes, summarized in **Figure 2**. The first two pathways (P1, P2 in **Figure 2**) rely on existing literature to quantify proportional mental health changes for the general population, and either assume (P1) or test whether (P2) park users are psychologically representative of national populations as a whole. The third pathway (P3) tests experimentally for specific psychological or mental health changes associated with park use, for particular categories of individuals and experiences. The fourth pathway (P4), the most comprehensive and reliable, involves large-scale random sampling of entire national populations to determine simultaneously the mental health parameters, park use patterns, and sociodemographic characteristics, for the same individuals at the same time.

Exposure to and experience of nature differs substantially between climates and cultures. In Scandinavian nations, concepts such as *friluftsliv*, open-air life, are in common use as part of national culture. In Japan and Korea, there is a widespread practice known as *shinrin-yoku*, "forest bathing," as a deliberate measure to improve health (Li, 2010; Shin et al., 2010; Lee et al., 2011; Li et al., 2011; Morita et al., 2011; Craig et al., 2016). In China, there is a longstanding historical precedent for the philosophy of *tian ren he yi*, harmony between people and nature—even if, as in other nations, this may not be practiced in economic development. In many temperate English and Spanish-speaking nations, many urban residents may see nature principally as an outdoor playground, a place to practice outdoor sports or to get a short "nature fix." In some Western nations, the use of "green prescriptions" has recently become an established part of medical practice (Swinburn et al., 1998; Maller et al., 2006; Townsend, 2006; Seltenrich, 2015; Ulmer et al., 2016). However, improvements are not universal (Saw et al., 2015; Townsend et al., 2015), and have rarely been quantified in ways which are generalizable, especially in terms of economic benefits to broad population groups.

The principal types of mental health outcomes reported in previous studies include: improved attention (Tennessen and Cimprich, 1995; Faber and Kuo, 2011); changed attitudes (Weinstein et al., 2009); improved cognition (Berman et al., 2008, 2012; Bratman et al., 2012; Wu et al., 2014; Zedelius and Schooler, 2015); reduced levels of stress, anxiety, and depression (Nutsford et al., 2013; Bratman et al., 2015); reduced use of antidepressants (Hartig et al., 2007; Taylor et al., 2015); improved recovery from stress (Bodin and Hartig, 2001); general improvements in mental health (Nielsen and Hansen, 2007; O'Campo et al., 2009; Bratman et al., 2012; Pearson and Craig, 2014); improved sleep (Grigsby-Toussaint et al., 2015); and improved life satisfaction (García-Mainar et al., 2015). These outcomes are not mutually exclusive: different individuals may experience multiple outcomes simultaneously (Hartig et al., 2011).

Mental health outcomes are reported for both adults and children (Dadvand et al., 2014, 2015; Wu et al., 2014; Zhang et al., 2014), and for both men and women (Teas et al., 2007). Improvements derived from recreation and tourism have received particular attention (Kühnel and Sonnentag, 2011; Dolnicar et al., 2012; Chen and Petrick, 2013; Bimonte and Faralla, 2015; Coghlan, 2015; Zuo et al., 2015; Chen et al., 2016; Uysal et al., 2016). Mental health improvements are commonly coupled with physical and physiological gains (Pretty et al., 2005, 2007; Hughes et al., 2013; Astell-Burt et al., 2014; Haluza et al., 2014); but few studies to date have distinguished these mechanisms experimentally (Mitchell, 2013; Pasanen et al., 2014; Sandifer et al., 2015). Equally, few have considered the complex patterns of nature exposure which individuals experience in practice (Hartig et al., 2011).

In particular, mental health outcomes are dose-dependent (Barton and Pretty, 2010; Shanahan et al., 2015); but for exposure to nature, dose and response are both difficult to quantify (Hartig et al., 2014). Even relatively low-key exposure to nature in urban greenspace can generate measurable changes (Groenewegen et al., 2006, 2012; Maas et al., 2006; Bowler et al., 2010; Lee and Maheswaran, 2011; Lachowycz and Jones, 2013; Nutsford et al., 2013; Astell-Burt et al., 2014; Carter and Horwitz, 2014; Krekel

et al., 2016). In at least some cases, this seems to apply especially if these areas are relatively high in biodiversity (Fuller et al., 2007; Thompson et al., 2012). Indeed, even views of nature from an office or hospital window can yield some improvements (Ulrich, 1984; Kaplan, 2001; Lee et al., 2015). More intense and extended nature experiences generate greater changes, but it is not yet clear whether the marginal returns increase or diminish, nor how different individuals may be affected by more complex patterns in nature exposure.

Economic Values

The third step (**Figure 2**) involves the estimation of economic values of mental health outcomes through multiple parallel additive pathways. As noted earlier, these are related respectively to: avoided costs of mental healthcare and treatment; improved workplace productivity; and avoided costs of antisocial behaviors, both public (e.g., vandalism) and private (e.g., domestic violence). Each of these mechanisms or pathways may be applied either for: overall general measures of mental health and wellbeing; broad categories such as mood and anxiety (ISCA/CEBR, 2015); or specific mental health parameters, if data are available.

Improvements in psychological health, and consequent economic gains, are dependent on the demographic, socioeconomic, and psychological characteristics of the individuals involved. As summarized above, recent research has demonstrated positive associations between individual subjective health evaluations and regular exposure to nature, but there are three caveats. Firstly, many of these studies are based on individuals who have purposefully chosen to exercise in parks or other greenspace, and who may not be representative of national populations as a whole. Secondly, there may be less opportunity for improvement for those individuals whose psychological health is functionally normal, than for those where it is not, and we do not currently know the prior mental health status of parks and greenspace users, or the degree to which current mental health profiles at population level may reflect existing patterns in park use. Thirdly, some psychological health conditions may respond much more readily than others, to nature-based prevention or treatment options. For practical purposes in calculating economic values, therefore, we can usefully differentiate three broad groups: healthy adults; healthy children; and individuals with known prior mental health conditions. Again, this is a simplification in order to construct a practical analytical framework.

Reductions in relevant mental healthcare costs have been estimated, at coarse scale, in a number of countries (Medibank Private, 2008; Myers and Patz, 2009; Myers et al., 2013; McKenzie et al., 2013; Australian Medical Association, 2014; National Heart Foundation of Australia, 2014; Hosie et al., 2015; ISCA/CEBR, 2015; Lambert et al., 2015). Improvements in workplace productivity (Korpela and Kinnunen, 2010; Ghermandi, 2015) may also include extensions to working life through reduced early mortality (Halonen et al., 2015), and reductions in youth unemployment payments (Hosie et al., 2015). Reductions in antisocial behavior for children and young adults carry forward into working life (Scott et al., 2001; D'Amico et al., 2014).

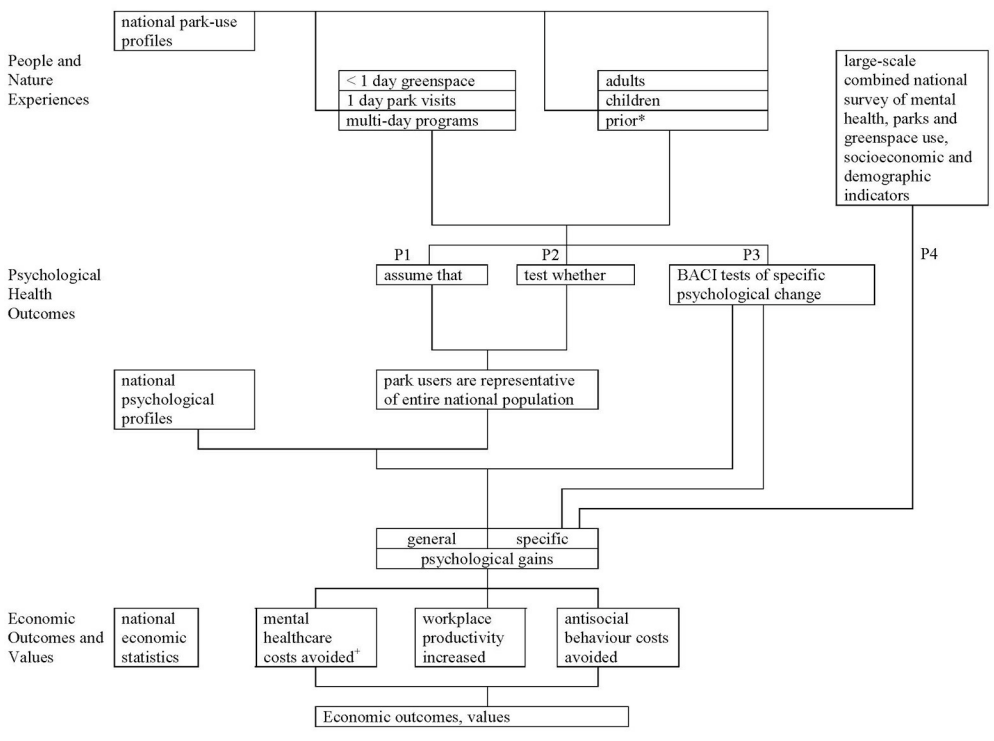

FIGURE 2 | Steps, pathways and information requirements to calculate economic value of parks attributable to improved human mental health.

Relevant statistics for each of these sources are available at national or subnational scale for some countries, but not others.

No country yet has all the data needed to calculate the economic value of its parks via human mental health, via any of the pathways outlined in **Figure 2**. Until the additional research identified here is undertaken, we can make only the broadest order-of-magnitudes estimates. Such estimates are large enough to be significant politically, indicating that additional research to provide accurate figures will indeed be worthwhile. For example, ∼75% of the Australian population of ∼24 million visit public national parks at least once each year, and 90% visit public urban greenspace (Veal, 2007; Zuo et al., 2015). Each year, >20% of Australians experience mental health problems, and 8% use mental health services (Whiteford et al., 2014; Hosie et al., 2015). Current costs of poor mental health in Australia are estimated at over AUD 200 billion (US$150 billion) annually (Medibank Private, 2008, 2013; Lancy and Gruen, 2013; Wade, 2016).

We can compare these figures with corresponding data from tourism and recreation, which form one major consideration in parks policy. Tourism in Australia is worth around AUD 93 billion p.a., of which around AUD 23 billion is broadly nature-based, and perhaps AUD 8–10 billion is derived from parks (Hooper and van Zyl, 2011; Balmford et al., 2015; Tourism Research Australia, 2015; Buckley, 2004, 2009). If conservation policy and parks agency budgets reflect the economic importance of tourism and recreation, therefore, then the same should surely apply to the economic value of mental health, happiness, and wellbeing.

CONCLUSIONS

In the longer term, human survival depends far more fundamentally on the health of ecosystems than the health of individual humans. In the short term, however, those individual humans value their own health and happiness much more highly than the natural environment, and government budget allocations for public health are far higher than those for conservation. It is for this reason that parks agencies and conservation organizations promote recreation and tourism in protected areas, as a mechanism to gain financial and political support.

Most individual people, and government economists, value recreational opportunities and associated expenditure more than the broader public good of conservation. The same applies even more strongly for human health, which individuals value highly, and which attracts a far larger total budget allocation through private insurance and public health programs, than the budgets provided for parks agencies and greenspace planning. The framework provided here, and summarized in **Figure 2**, could be used to calculate financial gains from the mental health benefits of conservation, accruing specifically to health insurers, employers, and to taxpayer-funded health care systems.

New empirical data, however, are required before this framework can be applied. Most critically, we need information on the mental health profile of park users; and on the mental health outcomes, for different individuals, from different patterns in short and long-term nature exposure at low and high intensities, over their entire life course. To obtain finer-scale calibration, such research could also include: nature experiences with higher or lower biodiversity; differences between park visitors with different cultural backgrounds; the benefits of volunteer or stewardship roles, as compared to leisure and tourism; and the relative durability of benefits derived from occasional or frequent visits, respectively. From a public health perspective, these could be used to construct optimal program of experience, from the nearby and familiar, to the distant and wild.

If we can quantify the links from nature to human mental health, and design mechanisms to maximize those links, we will create a new and powerful tool in favor of conservation. This requires not only the broad framework presented here, but the additional quantitative data outlined above, to demonstrate the effectiveness of nature-based experiences for individual psychological health, the financial gains for employers and health insurers, and the large-scale economic significance for public health policy.

AUTHOR CONTRIBUTIONS

RB, PB: Devised the research, conducted the review, wrote the manuscript.

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