Received: 18 December 2019 | Accepted: 8 May 2020

DOI: 10.1002/pan3.10118

PERSPECTIVE

PEOPLE AND NATURE | BRITISH ECOLOGICAL SOCIETY

Extinction of experience: The need to be more specific

Kevin J. Gaston[1] | Masashi Soga[2]

[1]Environment and Sustainability Institute, University of Exeter, Cornwall, UK

[2]Department of Ecosystem Studies, Graduate School of Agricultural and Life Sciences, The University of Tokyo, Tokyo, Japan

Correspondence
Kevin J. Gaston
Email: k.j.gaston@exeter.ac.uk

Handling Editor: Leah Gibbs

Abstract

1. Extinction of experience, the progressive loss of human–nature interactions, may prove to be one of the key environmental concepts of our times. Not only does this loss reduce the important benefits that people gain from these interactions, but it may also undermine their support for pro-biodiversity policies and management actions, and thus play an important role in shaping the future of biodiversity.
2. Here, to help improve understanding, encourage a more consistent approach and highlight research gaps, we consider some of the key features of the concept of extinction of experience, contentions that these have caused and propose some solutions.
3. We focus particularly on the importance of (a) the definition of nature employed; (b) whether direct or other human–nature interactions are considered; (c) the differences between the loss and the extinction of experience; (d) the timing of the loss of interactions that is considered and (e) the difference between human–nature interactions and human–nature experiences.
4. Differentiating between narrow and broad senses of nature, between childhood and lifelong timings, and between interactions and experiences leads to a typology of eight different forms of extinction of experience. Such a classification can be useful for targeting research, furthering understanding of the processes and dynamics of the extinction of experience, and developing policies to reduce this phenomenon and minimize its negative consequences.

KEYWORDS

extinction, human–nature interactions, nature, personalized ecology

1 | INTRODUCTION

Much scientific and popular concern has been expressed over the 'extinction of experience', whether directly referred to by that name or otherwise, and its consequences (e.g. Griffiths, 2014; Louv, 2005; Miller, 2005; Nabhan & St. Antoine, 1993; Pyle, 1992, 1993; Soga & Gaston, 2016). Extinction of experience is the progressive loss of the interactions that people have with nature. It remains relatively poorly empirically documented, in part because of the challenges of obtaining baseline data on historical levels of human–nature interactions against which to compare more recent levels (for a review of the evidence see Soga & Gaston, 2016; more recent additions include Imai, Nakashizuka, & Kohsaka, 2018; Imai, Nakashizuka, & Kohsaka, 2019; Soga, Gaston, & Kubo, 2018). Nonetheless, the loss of interactions is thought to be highly significant because of the substantial evidence for positive human

health and well-being effects of such interactions (Hartig, Mitchell, De Vries, & Frumkin, 2014; Keniger, Gaston, Irvine, & Fuller, 2013; Russell et al., 2013), and growing evidence of the possible effects on people's support for pro-biodiversity policies and management actions (Evans, Otto, & Kaiser, 2018; Mackay & Schmitt, 2019; Prévot, Clayton, & Mathevet, 2018; Whitburn, Linklater, & Abrahamse, 2019). Indeed, the restoration particularly of these personal benefits, through reversal of the extinction of experience, is a key motivation for a wide range of proposed nature-based interventions (McCurdy, Winterbottom, Mehta, & Roberts, 2010; Shanahan et al., 2019).

Given the important theoretical and applied role that the concept has attained, it seems timely to examine in more detail what does and does not constitute the extinction of experience. Here we briefly consider some of its key features, contentions that these have caused, and propose some solutions. Following from these considerations, we also present a typology of different forms of extinction of experience. In highlighting these issues we want to encourage development of understanding of the extinction of experience, to increase consistency in how it is defined and also to improve the ease with which research gaps are recognized.

2 | NATURE

What is and is not nature, and therefore in effect what may or may not constitute a human–nature interaction, has been a topic of debate and discussion for centuries (for recent discussion see Bratman, Hamilton, & Daily, 2012; Hartig et al., 2014; Proctor, 1998; Soga & Gaston, 2020; Wickson, 2008; Wohlwill, 1983). In the context of extinction of experience, nature has commonly remained rather ill-defined (as it has been in work on human–nature connections more widely; Clayton et al., 2017; Ives et al., 2017). In much of the associated literature, there is an explicit or implicit indication that the relevant nature is in some sense 'wild' (e.g. Gaston et al., 2018; Miller, 2005; Nabhan & St. Antoine, 1993; Pyle, 1992, 1993; Soga & Gaston, 2020), which one might usefully define as being free of human interventions such as cultivation or domestication (although grey areas obviously remain as the degree of wildness is characterized along a continuum rather than in binary fashion; Cookson, 2011; Ridder, 2007). However, in discussion of the benefits of interacting with nature the implicit definition often becomes much broader, to include settings (e.g. many domestic gardens and urban greenspaces) in which organisms are essentially cultivated and groups of organisms that would not, even under otherwise quite liberal definitions, be considered wild (e.g. domesticated plants and animals; Bratman et al., 2012; Hartig et al., 2014; Kellert, 2002). Whether the line is drawn so as to focus on wild nature or more broadly is not a trivial consideration as it fundamentally determines the measured levels of, and spatial and temporal changes in, human–nature interactions, and thus the evidence base for extinction of experience, and the suitability of different interventions to respond to that extinction (as opposed to addressing other issues).

It seems unlikely that the different viewpoints on what constitutes nature in the context of extinction of experience can simply be reconciled. This may particularly be the case because with a high and increasing proportion of the world's human population living in urban areas it may be difficult for many people, at least on a daily basis, to have interactions with wild organisms, and much easier for them to do so with cultivated and domesticated ones (e.g. temporary plantings in greenspaces, potted houseplants, household pets). Indeed, several researchers argue that direct experiences with living organisms in botanical gardens and zoos can play an important role in preventing the extinction of experience for urban dwellers (e.g. Stokes, 2006). We therefore propose that explicit distinction is made between 'narrow' and 'broad' sense definitions of nature when considering extinction of experience, and perhaps therefore narrow and broad sense definitions of extinction of experience (no negative connotations should be drawn from our use of the term 'narrow'). A narrow sense definition focuses on engagement with wild organisms and less managed and more pristine or wilderness environments (the limits to all of which can be problematic and will need to be carefully specified); extinction of experience could then be described as the extinction of wild experience. A broad sense definition is more inclusive, and closer to nature comprising any non-human living organisms, whether wild or not.

3 | DIRECT INTERACTIONS

The extinction of experience concerns the loss of human–nature interactions. In the main, this has been thought of in terms of direct sensory, principally visual and acoustic, interactions (contacts) with organisms that are in the same physical space or in close proximity to a person (e.g. Miller, 2005; Nabhan & St. Antoine, 1993; Pyle, 1992, 1993; Samways, 2007; Soga & Gaston, 2020). These interactions can take a wide diversity of forms, including walking in wilderness areas, visiting urban greenspaces, listening to bird song, picking flowers or catching insects, and views of nature from the window of a vehicle or a building.

To confuse matters, the last form (views from windows) has been termed by some as constituting an 'indirect' interaction with nature (e.g. Cox, Hudson, Shanahan, Fuller, & Gaston, 2017; Keniger et al., 2013). Occasionally this terminology has also been extended to include viewing images of nature (Keniger et al., 2013), while others have reserved it for interactions in more 'restricted, programmed and managed contexts', including arboretum, botanical gardens, aquariums, zoos, museums and nature centres (Kellert, 2002). As well as being inconsistent, we are not convinced that such usage is particularly helpful. The first use (views from windows) is really a matter of degrees of how direct (or immediate; Soga & Gaston, 2020) an interaction is (e.g. would it be direct when a window was open, but indirect when it was closed?), the second (views of imagery) is best treated as a separate phenomenon entirely (see below), and the third use (interactions in restricted, programmed and managed contexts) is really more about the definition of nature being employed (see above) than about the interaction per se.

The significance of the interactions between humans and nature being direct has been blurred by the use of media representations (e.g. photographs, video, sound recordings) and virtual imagery of nature to test for effects of direct nature interactions on human health and well-being (e.g. Gao, Zhang, Zhu, Gao, & Qiu, 2019; Laumann, Gärling, & Morten Stormark, 2003; Pretty, Peacock, Sellens, & Griffin, 2005; van den Berg, Koole, & van der Wulp, 2003). Albeit enabling much greater control over experimental treatments, this seems implicitly to suggest some level of substitutability. Indeed, others have argued that nature experiences span a spectrum from direct interactions with organisms to vicarious (or symbolic) interactions, which occur in the absence of sensory contact of a person with nature, including through print media, television, film, video and the internet (e.g. Kellert, 2002; Russell et al., 2013). The logical extension of this position is that for many people the extinction of experience is often not an extinction per se but rather a transformation of one kind of interaction (the direct one) to another (a vicarious one; Clayton et al., 2017).

This confounding of direct and vicarious interactions with nature is not what was originally intended when the notion of extinction of experience was introduced. We argue that indeed, it is unhelpful, and that extinction of experience should be reserved for the loss of direct interactions with nature. In much the same way, there are clear distinctions between actually walking on the moon and watching television imagery of an astronaut doing this, between attending a live sporting event and watching it being live streamed, and between attending a live concert and listening to a recording. There may, of course, be important benefits to people from having vicarious experiences of nature (e.g. Nadkarni, Hasbach, Thys, Crockett, & Schnacker, 2017; White et al., 2018), but the consequences are not strictly the same as those obtained from interaction with the real thing (in some cases, for the individual people the benefits of vicarious interactions may exceed those from direct ones—especially if their direct interactions are very limited (see Section 4) and their vicarious ones very rich). As has been much discussed, there may also be important differences between the impacts of direct and vicarious experiences of nature for people's understanding of, and their emotions and attitudes towards, nature (e.g. Arendt & Matthes, 2016; Bousé, 2003; Nabhan & St. Antoine, 1993).

4 | EXTINCTION

While eye-catching, the term 'extinction of experience' is in many instances strictly a misnomer, as what is argued to be occurring is a reduction in experiences not their total loss (e.g. Pergams & Zaradic, 2008; Pyle, 1993; Soga & Gaston, 2016; Soga, Gaston, et al., 2018). Its appropriateness could thus be argued to rest on whether this process is likely to extend eventually to such total loss, or at least whether there are instances of total loss. Certainly, it is possible to envisage unusual circumstances under which people may have no or virtually no direct nature interactions, such as in some forms of social withdrawal due to depression, confinement in prisons or mental hospitals and service on submarines. We suspect, however, that

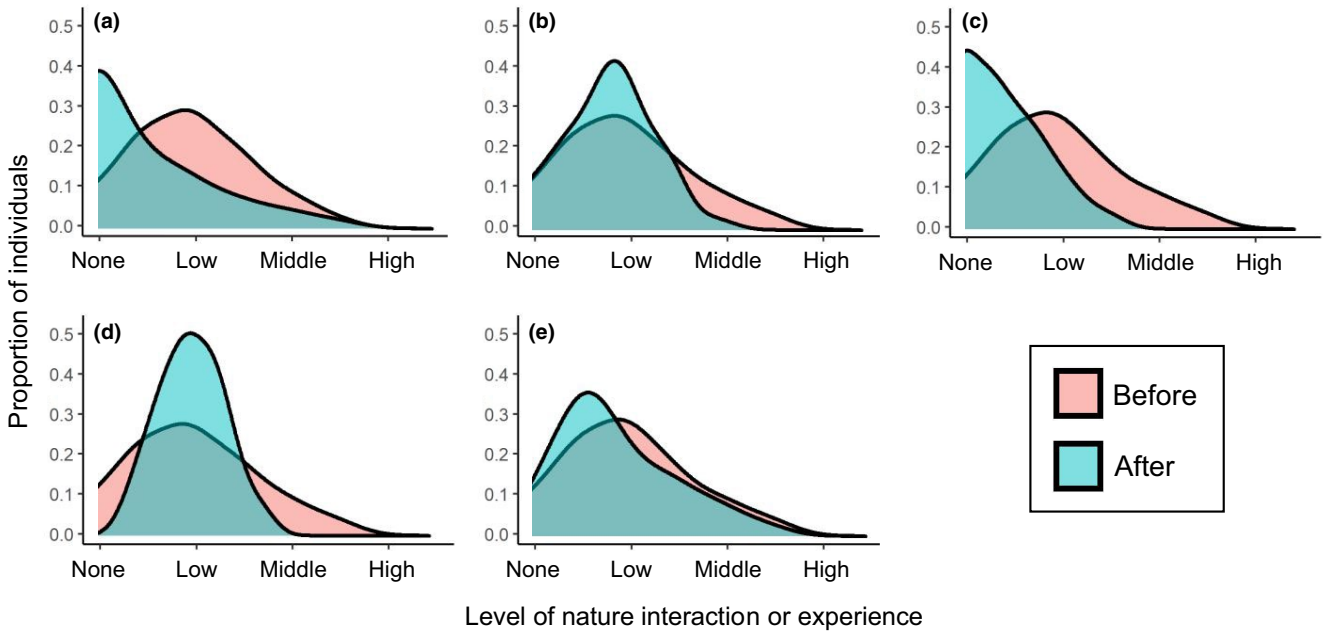

FIGURE 1 Some simple ways in which the frequency of nature interactions or experiences might change in a population: (a) increase in the proportion of people having no interactions or experiences (i.e. increase in the absolute extinction of experience); (b) decrease in the proportion of people with high levels of interactions or experiences; (c) both an increase in the proportion of people having no interactions or experiences and a decrease in the proportion of people having high levels of interactions or experiences; (d) both a decrease in the proportion of people having no interactions or experiences and a decrease in the proportion of people having high levels of interactions or experiences (with the mean level of interactions or experiences staying the same); and (e) decrease in the mean level of interactions or experiences (with the proportion of people having no interactions or experiences and those having high levels of interactions or experiences staying the same)

a genuine extinction of experience may be much more widespread, including some people who live highly urbanized existences in essentially built environments (e.g. central Tokyo), those who are house- or bed-bound in environments that provide no nature views, and those who have very little or no motivation to interact with nature.

Discussion of the extinction of experience has focussed foremost on how average or typical levels of human–nature interactions are declining within groups of people (e.g. Imai et al., 2018; Soga & Gaston, 2016; Soga, Gaston, et al., 2018). However, we suggest that it will be just as important to determine both how the frequency of the absolute extinction of experience and the shape of the frequency distribution of levels of these interactions in populations (local, regional or global) are changing. Very little is known about the latter. One study of people within the urban limits of the 'Cranfield triangle', United Kingdom found that a very high proportion of direct human–nature interactions involved a small proportion of the human population (Cox et al., 2017). That seems likely to generalize widely. This begs questions of the relative significance to extinction of experience, as reflected in declines in average numbers of human–nature interactions, of reductions in the proportion of people experiencing high levels of interactions (i.e. a narrowing of the range), of increases in the proportion having no interactions, and of a shifting or narrowing of the variance in the levels of interactions (Figure 1).

5 | TIMING

Much of the literature associated with the extinction of experience and its consequences has focussed on people's loss of interactions with nature during their childhood (e.g. Hand et al., 2018; Hughes, Richardson, & Lumber, 2018; Kahn & Kellert, 2002; Pyle, 1993; Rosa, Profice, & Collado, 2018; Samways, 2007; Soga et al., 2020; Soga, Gaston, et al., 2018; Soga, Yamanoi, Tsuchiya, Koyanagi, & Kanai, 2018). Implicitly or explicitly, this stems from a belief that interactions during this period are particularly significant. Indeed, there is a growing body of evidence showing that childhood nature interactions have marked impacts on physical and mental health (e.g. Dadvand et al., 2015; Engemann et al., 2019; Feng & Astell-Burt, 2017; McCormick, 2017; Ruokolainen et al., 2015), and attitudes towards nature and support for pro-nature policies in childhood and later in life (e.g. Dopko, Capaldi, & Zelenski, 2019; Evans et al., 2018; Soga et al., 2020; Zhang, Goodale, & Chen, 2014). We thus suggest that it is important to distinguish carefully between childhood and lifetime extinction of experience (one could potentially also consider adult separately from lifetime extinction of experience, but that may often be challenging). The two could have rather different effects and implications, depending on how fundamental childhood experiences are, and the consequences of shifts in experiences through the life course. Understanding the relative importance of the childhood and lifetime extinction of experience is crucial to determine whether and to what extent the loss of nature experiences during childhood can be compensated for by those in later life stages (Cleary, Fielding, Murray, & Roiko, 2018).

6 | INTERACTIONS AND EXPERIENCES

Extinction of experience is commonly framed, as we have done here, in terms of the loss of human–nature interactions. But, interactions and experiences are not the same thing. Interactions are the occurrence of sensory contacts by people (e.g. visual, auditory, olfactory) with components of nature. Interactions are a necessary prerequisite for experiences, but experiences are more than just interactions. Experiences are defined situations in which a person is engaged with an interaction on an emotional, physical, spiritual or intellectual level, including in terms of knowledge, skills, attitudes and behaviour, and are heavily dependent on social context (Clayton et al., 2017); scales such as the Nature Relatedness Index (Nisbet, Zelenski, & Murphy, 2009) and the Connection to Nature index (Cheng & Monroe, 2012) are attempts to capture elements of such responses. To date, interactions have proven much easier to quantify than have experiences, but a full understanding of the consequences of the loss of interactions will require more insight into how these translate into experiences.

7 | TYPOLOGY

Differentiating between narrow and broad senses of nature, between childhood and lifelong timings, and between interactions and experiences leads to a usefully sized typology of eight different forms of extinction of experience (Table 1). While each of

TABLE 1 A typology of different forms of extinction of experience, based on three characteristics: the breadth of the definition of nature, the timing of the loss of experience and whether the focus is on nature interactions or on experience

Nature		Narrow		Broad	
Timing		**Childhood**	**Lifetime**	**Childhood**	**Lifetime**
Interaction or experience	Interaction	*Type 1* Loss of childhood interactions with wild nature	*Type 2* Loss of lifetime interactions with wild nature	*Type 3* Loss of childhood interactions with living organisms	*Type 4* Loss of lifetime interactions with living organisms
	Experience	*Type 5* Loss of childhood experiences with wild nature	*Type 6* Loss of lifetime experiences with wild nature	*Type 7* Loss of childhood experiences with living organisms	*Type 8* Loss of lifetime experiences with living organisms

these three binary distinctions is inevitably a huge simplification the scheme does capture much of the most important variation in the ways in which extinction of experience has been considered, although this has not previously been explicitly recognized. In particular, this highlights the paucity of empirical studies of the occurrence of extinction of experience (see Soga & Gaston, 2016 and additions cited in Section 1 of this paper) that have thus far been conducted given the apparent richness and complexity of the phenomenon. We suggest that in future researchers are very clear about which components of this typology their studies are addressing, and that there is some focus on those that have been less well-explored.

Deconstructing types of extinction of experience, as done here, is critical for guiding recommendations and policies to reduce this phenomenon in an effective manner. This is particularly true given that each of the eight forms of extinction of experience we have proposed can have different causes and consequences, and therefore different measures and actions may be required to deal with them. For example, planting roadside trees in a business district can contribute to the reduction of the loss of lifetime interactions or experiences with domesticated nature (Types 4 and 8 in Table 1), but its contributions to that of other types of extinction of experience will be limited or non-existent. A much improved understanding of the patterns, drivers and consequences of the eight types of extinction of experience will have important practical implications for minimizing the negative consequences of this phenomenon.

8 | IN CONCLUSION

Extinction of experience may prove to be one of the key environmental concepts of our times. This is particularly because of the personal health and well-being consequences, but possibly yet more significantly because of the implications for people's support for activities that will redress the global loss of biodiversity and broader environmental degradation. However, if this is to be the case the concept needs to be made somewhat more robust, such that even when not entirely consistently applied it is evident what the differences are. Here we have suggested some steps to help that process.

ACKNOWLEDGEMENTS

We are grateful to S. Gaston for discussion, and to J. Hughes and an anonymous reviewer for helpful comments.

CONFLICT OF INTEREST

K.J.G. is Editor-in-Chief of *People and Nature*, but took no part in the peer review and decision-making processes for this paper.

AUTHORS' CONTRIBUTIONS

K.J.G. and M.S. conceived the ideas and wrote the manuscript.

DATA AVAILABILITY STATEMENT

This paper does not include any data.

ORCID

Kevin J. Gaston https://orcid.org/0000-0002-7235-7928
Masashi Soga https://orcid.org/0000-0003-1758-4199

REFERENCES

Arendt, F., & Matthes, J. (2016). Nature documentaries, connectedness to nature, and pro-environmental behavior. *Environmental Communication*, *10*, 453–472. https://doi.org/10.1080/17524032.2014.993415

Bousé, D. (2003). False intimacy: Close-ups and viewer involvement in films. *Visual Studies*, *18*, 123–132.

Bratman, G. N., Hamilton, J. P., & Daily, G. C. (2012). The impacts of nature experience on human cognitive function and mental health. *Annals of the New York Academy of Sciences*, *1249*, 118–136. https://doi.org/10.1111/j.1749-6632.2011.06400.x

Cheng, J.-C.-H., & Monroe, M. C. (2012). Connection to nature: Children's affective attitude toward nature. *Environment and Behavior*, *44*, 31–49. https://doi.org/10.1177/0013916510385082

Clayton, S., Colléony, A., Conversy, P., Maclouf, E., Martin, L., Torres, A.-C., … Prévot, A.-C. (2017). Transformation of experience: Toward a new relationship with nature. *Conservation Letters*, *10*, 645–651. https://doi.org/10.1111/conl.12337

Cleary, A., Fielding, K. S., Murray, Z., & Roiko, A. (2018). Predictors of nature connection among urban residents: Assessing the role of childhood and adult nature experiences. *Environment and Behavior*, *52*(6), 579–610. https://doi.org/10.1177/0013916518811431

Cookson, L. J. (2011). A definition for wildness. *Ecopsychology*, *3*, 187–193. https://doi.org/10.1089/eco.2011.0028

Cox, D. T. C., Hudson, H. L., Shanahan, D. F., Fuller, R. A., & Gaston, K. J. (2017). The rarity of direct experiences of nature in an urban population. *Landscape and Urban Planning*, *160*, 79–84. https://doi.org/10.1016/j.landurbplan.2016.12.006

Dadvand, P., Nieuwenhuijsen, M. J., Esnaola, M., Forns, J., Basagaña, X., Alvarez-Pedrerol, M., … Sunyer, J. (2015). Green spaces and cognitive development in primary schoolchildren. *Proceedings of the National Academy of Sciences of the United States of America*, *112*, 7937–7942. https://doi.org/10.1073/pnas.1503402112

Dopko, R. L., Capaldi, C. A., & Zelenski, J. M. (2019). The psychological and social benefits of a nature experience for children: A preliminary investigation. *Journal of Environmental Psychology*, *63*, 134–138. https://doi.org/10.1016/j.jenvp.2019.05.002

Engemann, K., Pedersen, C. B., Arge, L., Tsirogiannis, C., Mortensen, P. B., & Svenning, J. C. (2019). Residential green space in childhood is associated with lower risk of psychiatric disorders from adolescence into adulthood. *Proceedings of the National Academy of Science of the United States of America*, *116*, 5188–5193. https://doi.org/10.1073/pnas.1807504116

Evans, G. W., Otto, S., & Kaiser, F. G. (2018). Childhood origins of young adult environmental behavior. *Psychological Science*, *29*, 679–687. https://doi.org/10.1177/0956797617741894

Feng, X., & Astell-Burt, T. (2017). The relationship between neighbourhood green space and child mental wellbeing depends upon whom you ask: Multilevel evidence from 3083 children aged 12–13 years. *International Journal of Environmental Research and Public Health*, *14*, 235. https://doi.org/10.3390/ijerph14030235

Gao, T., Zhang, T., Zhu, L., Gao, Y., & Qiu, L. (2019). Exploring psychophysiological restoration and individual preference in the different environments based on virtual reality. *International Journal of Environmental Research and Public Health*, *16*, 3102. https://doi.org/10.3390/ijerph16173102

Gaston, K. J., Soga, M., Duffy, J. P., Garrett, J. K., Gaston, S., & Cox, D. T. C. (2018). Personalised ecology. *Trends in Ecology & Evolution*, *33*, 916–925. https://doi.org/10.1016/j.tree.2018.09.012

Griffiths, J. (2014). *Kith: The riddle of the childscape*. London, UK: Penguin Books.

Hand, K. L., Freeman, C., Seddon, P. J., Recio, M. R., Stein, A., & van Heezik, Y. (2018). Restricted home ranges reduce children's opportunities to connect to nature: Demographic, environmental and parental influences. *Landscape and Urban Planning*, *172*, 69–77. https://doi.org/10.1016/j.landurbplan.2017.12.004

Hartig, T., Mitchell, R., De Vries, S., & Frumkin, H. (2014). Nature and health. *Annual Review of Public Health*, *35*, 207–228. https://doi.org/10.1146/annurev-publhealth-032013-182443

Hughes, J., Richardson, M., & Lumber, R. (2018). Evaluating connection to nature and the relationship with conservation behaviour in children. *Journal for Nature Conservation*, *45*, 11–19. https://doi.org/10.1016/j.jnc.2018.07.004

Imai, H., Nakashizuka, T., & Kohsaka, R. (2018). An analysis of 15 years of trends in children's connection with nature and its relationship with residential environment. *Ecosystem Health and Sustainability*, *4*, 177–187. https://doi.org/10.1080/20964129.2018.1511225

Imai, H., Nakashizuka, T., & Kohsaka, R. (2019). A multi-year investigation of the factors underlying decreasing interactions of children and adults with natural environments in Japan. *Human Ecology*, *47*(5), 717–731. https://doi.org/10.1007/s10745-019-00108-5

Ives, C. D., Giusti, M., Fischer, J., Abson, D. J., Klaniecki, K., Dorning, C., … von Wehrden, H. (2017). Human-nature connection: A multidisciplinary review. *Current Opinion in Environmental Sustainability*, *26–27*, 106–113. https://doi.org/10.1016/j.cosust.2017.05.005

Kahn Jr., P. H., & Kellert, S. R. (Eds.). (2002). *Children and nature: Psychological, sociocultural, and evolutionary investigations*. Cambridge, MA: MIT Press.

Kellert, S. R. (2002). Experiencing nature: Affective, cognitive, and evaluative development in children. In P. H. Kahn & S. R. Kellert (Eds.), *Children and nature: Psychological, sociocultural, and evolutionary investigations* (pp. 117–151). Cambridge, MA: MIT Press.

Keniger, L. E., Gaston, K. J., Irvine, K. N., & Fuller, R. A. (2013). What are the benefits of interacting with nature? *International Journal of Environmental Research and Public Health*, *10*, 913–935. https://doi.org/10.3390/ijerph10030913

Laumann, K., Gärling, T., & Morten Stormark, K. (2003). Selective attention and heart rate responses to natural and urban environments. *Journal of Environmental Psychology*, *23*, 125–134. https://doi.org/10.1016/S0272-4944(02)00110-X

Louv, R. (2005). *Last child in the woods: Saving our children from nature-deficit disorder*. London, UK: Atlantic Books.

Mackay, C. M. L., & Schmitt, M. T. (2019). Do people who feel connected to nature do more to protect it? A meta-analysis. *Journal of Environmental Psychology*, *65*, 101323. https://doi.org/10.1016/j.jenvp.2019.101323

McCormick, R. (2017). Does access to green space impact the mental well-being of children: A systematic review. *Journal of Pediatric Nursing*, *37*, 3–7. https://doi.org/10.1016/j.pedn.2017.08.027

McCurdy, L. E., Winterbottom, K. E., Mehta, S. S., & Roberts, J. R. (2010). Using nature and outdoor activity to improve children's health. *Current Problems in Pediatric and Adolescent Health Care*, *40*, 102–117. https://doi.org/10.1016/j.cppeds.2010.02.003

Miller, J. R. (2005). Biodiversity conservation and the extinction of experience. *Trends in Ecology & Evolution*, *20*, 430–434.

Nabhan, G. P., & St. Antoine, S.(1993). The loss of floral and faunal story: The extinction of experience. In S. R. Kellert & E. O. Wilson (Eds.), *The biophilia hypothesis* (pp. 229–250). Washington, DC: Island Press.

Nadkarni, N. M., Hasbach, P. H., Thys, T., Crockett, E. G., & Schnacker, L. (2017). Impacts of nature imagery on people in severely nature-deprived environments. *Frontiers in Ecology and the Environment*, *15*, 395–403. https://doi.org/10.1002/fee.1518

Nisbet, E. K., Zelenski, J. M., & Murphy, S. A. (2009). The nature relatedness scale linking individuals' connection with nature to environmental concern and behavior. *Environment and Behavior*, *41*, 715–740. https://doi.org/10.1177/0013916508318748

Pergams, O. R., & Zaradic, P. A. (2008). Evidence for a fundamental and pervasive shift away from nature-based recreation. *Proceedings of the National Academy of Science of the United States of America*, *105*, 2295–2300. https://doi.org/10.1073/pnas.0709893105

Pretty, J., Peacock, J., Sellens, M., & Griffin, M. (2005). The mental and physical health outcomes of green exercise. *International Journal of Environmental Health Research*, *15*, 319–337. https://doi.org/10.1080/09603120500155963

Prévot, A.-C., Clayton, S., & Mathevet, R. (2018). The relationship of childhood upbringing and university degree program to environmental identity: Experience in nature matter. *Environmental Education Research*, *24*, 263–279.

Proctor, J. D. (1998). The social construction of nature: Relativist accusations, pragmatist and critical realist responses. *Annals of the Association of American Geographers*, *88*, 352–376. https://doi.org/10.1111/0004-5608.00105

Pyle, R. M. (1992). Intimate relations and the extinction of experience. In L. Stovall (Ed.), *Left bank #2 extinction* (pp. 61–69). Hillsboro, OR: Blue Heron Publishing.

Pyle, R. M. (1993). *The thunder tree: Lessons from an urban wildland*. Boston, MA: Houghton Mifflin.

Ridder, B. (2007). An exploration of the value of naturalness and wild nature. *Journal of Agricultural and Environmental Ethics*, *20*, 195–213. https://doi.org/10.1007/s10806-006-9025-6

Rosa, C. D., Profice, C. C., & Collado, S. (2018). Nature experiences and adults' self-reported pro-environmental behaviors: The role of connectedness to nature and childhood nature experiences. *Frontiers in Psychology*, *9*, 1055. https://doi.org/10.3389/fpsyg.2018.01055

Ruokolainen, L., von Hertzen, L., Fyhrquist, N., Laatikainen, T., Lehtomäki, J., Auvinen, P., … Hanski, I. (2015). Green areas around homes reduce atopic sensitization in children. *Allergy*, *70*, 195–202. https://doi.org/10.1111/all.12545

Russell, R., Guerry, A. D., Balvanera, P., Gould, R. K., Basurto, X., Chan, K. M. A., … Tam, J. (2013). Humans and nature: How knowing and experiencing nature affect well-being. *Annual Review of Environment and Resources*, *38*, 473–502. https://doi.org/10.1146/annurev-environ-012312-110838

Samways, M. J. (2007). Rescuing the extinction of experience. *Biodiversity and Conservation*, *16*, 1995–1997. https://doi.org/10.1007/s10531-006-9144-4

Shanahan, D. F., Astell-Burt, T., Barber, E. A., Brymer, E., Cox, D. T. C., Dean, J., … Gaston, K. J. (2019). Nature-based interventions for improving health and wellbeing: The purpose, the people and the outcomes. *Sports*, *7*, 141. https://doi.org/10.3390/sports7060141

Soga, M., Evans, M. J., Yamanoi, T., Fukano, Y., Tsuchiya, K., Koyanagi, T. F., & Kanai, T. (2020). How can we mitigate against increasing biophobia among children during the extinction of experience? *Biological Conservation*, *242*, 108420. https://doi.org/10.1016/j.biocon.2020.108420

Soga, M., & Gaston, K. J. (2016). Extinction of experience: The loss of human-nature interactions. *Frontiers in Ecology and Environment*, *14*, 94–101. https://doi.org/10.1002/fee.1225

Soga, M., & Gaston, K. J. (2020). The ecology of human–nature interactions. *Proceedings of the Royal Society B: Biological Sciences*, *287*(1918), 20191882. https://doi.org/10.1098/rspb.2019.1882

Soga, M., Gaston, K. J., & Kubo, T. (2018). Cross-generational decline in childhood experiences of neighborhood flowering plants in Japan. *Landscape and Urban Planning*, *174*, 55–62. https://doi.org/10.1016/j.landurbplan.2018.02.009

Soga, M., Yamanoi, T., Tsuchiya, K., Koyanagi, T. F., & Kanai, T. (2018). What are the drivers of and barriers to children's direct experiences of nature? *Landscape and Urban Planning*, *180*, 114–120. https://doi.org/10.1016/j.landurbplan.2018.08.015

Stokes, D. L. (2006). Conservators of experience. *BioScience*, *56*, 6–7. https://doi.org/10.1641/0006-3568(2006)056[0007:COE]2.0.CO;2

van den Berg, A. E., Koole, S. L., & van der Wulp, N. Y. (2003). Environmental preference and restoration: (How) are they related? *Journal of Environmental Psychology*, *23*, 135–146. https://doi.org/10.1016/S0272-4944(02)00111-1

Whitburn, J., Linklater, W., & Abrahamse, W. (2019). Meta-analysis of human connection to nature and proenvironmental behavior. *Conservation Biology*, *50*, 179–214.

White, M. P., Yeo, N. L., Vassiljev, P., Lundstedt, R., Wallergård, M., Albin, M., & Lõhmus, M. (2018). A prescription for 'nature'—The potential of using virtual nature in therapeutics. *Neuropsychiatric Disease and Treatment*, *14*, 3001–3013.

Wickson, F. (2008). What is nature, if it's more than just a place without people? *Nature*, *456*, 29. https://doi.org/10.1038/456029b

Wohlwill, J. F. (1983). The concept of nature. In J. F. Wohlwill (Ed.), *Behavior and the natural environment* (pp. 5–37). Boston, MA: Springer.

Zhang, W., Goodale, E., & Chen, J. (2014). How contact with nature affects children's biophilia, biophobia and conservation attitude in China. *Biological Conservation*, *177*, 109–116. https://doi.org/10.1016/j.biocon.2014.06.011

SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section.

How to cite this article: Gaston KJ, Soga M. Extinction of experience: The need to be more specific. *People Nat*. 2020;2:575–581. https://doi.org/10.1002/pan3.10118