

REVIEW AND SYNTHESIS

Smartphone interactions and nature benefits: How predominant approaches picture social life and ways of advancing this work

Russell Hitchings¹  | Cecily Maller² 

¹Department of Geography, University College London, London, UK

²Centre for Urban Research, RMIT University, Melbourne, VIC, Australia

Correspondence

Russell Hitchings
Email: r.hitchings@ucl.ac.uk

Handling Editor: Davide Geneletti

Abstract

1. Whether new technologies will have a positive impact on how societies experience nature depends on how particular devices and populations come to interact.
2. This paper reviews two bodies of work that have sought to understand and influence these interactions with reference to the smartphone.
3. The first is associated with a group of researchers interested in how smartphone apps might help people to engage with their surroundings in beneficial ways.
4. The second comes from a set of scholars hoping to learn from the analysis of the social media datasets associated with smartphone interactions outdoors.
5. After comparing these how these two bodies commonly see the social world, the paper considers how other approaches might augment these endeavours.
6. We argue for more studies that explore what different social groups have to say about life with the smartphone and how norms of technology use emerge.
7. We also suggest that this area of research might engage more fully with wider academic work on how smartphones are reshaping our societies.

KEYWORDS

apps, flickr, nature experience, qualitative research, smartphones, twitter

1 | INTRODUCTION

In an extensive review of how studies focused on the human benefits of experiencing nature (understood as outdoor environments in which plants, trees and animals are in comparative abundance) could inform public health promotion, Frumkin et al. (2017) discuss how technological advances will likely play into this experience. In considering this prospect, they make what initially seems like an uncontroversial point in claiming that 'smartphone apps may facilitate or inform a connection to nature' (p. 9). Yet, as Coyne (2014) had already noted, this optimistic vision may, for other commentators, go against all that is good about nature experience. For them, the

whole point is to encourage people to put down their devices and benefit from the personal restoration that particularly comes from a less mediated encounter. His whole discussion is, in fact, devoted to fighting the assumption that smartphones are fundamentally antithetical to the right way of experiencing nature.

Smartphones can be attached to some very different visions of how these technologies are influencing the likelihood of future societies benefiting from nature experience. And that should come as no surprise when we are still coming to terms with how fully they have infiltrated so many aspects of everyday life. On the one hand, we may be tempted to paint a dystopian picture in which populations have become so used to staring at their screens that they rarely even notice where they are. On the other hand, we could anticipate a

This is an open access article under the terms of the Creative Commons Attribution License, which permits use, distribution and reproduction in any medium, provided the original work is properly cited.

© 2021 The Authors. *People and Nature* published by John Wiley & Sons Ltd on behalf of British Ecological Society

more positive situation in which smartphones have come to prompt their users to engage with their immediate surroundings various rewarding new ways. Our review starts with the suggestion that which kind of scenario will eventually come to pass rests, in at least some part, on how relevant researchers imagine and influence this relationship through their work. This may be especially the case for this area of scholarship in which a common hope is that the results of individual studies will inform positive interventions in wider society.

With that in mind, this paper takes stock of how the link between smartphone interactions and nature benefits has most often been studied to date. It starts by setting the scene with a short overview of wider work on how smartphones are reshaping societies. Then we describe how we came to focus our review on two bodies of research concerned with the relationship between smartphone interactions and nature experience. The first comes from a group of researchers who hope that smartphone applications (hereafter 'apps') might help people to get more out of their surroundings. The second has been produced by a set of scholars eager to learn from the social media practices that are already supported by smartphones. After evaluating the ways in which both bodies commonly picture social life, we end by considering how some alternative approaches might complement these endeavours. In undertaking this exercise, our aim is not to be overly critical when, instead of worrying about the effects of technological advances on nature experience in more abstract terms, these studies have been getting stuck into the detail of how exactly we should respond to the global spread of smartphones. Our aim is rather to consider how this work commonly imagines social life and what that means for future research in this area.

2 | UNDERSTANDING SMARTPHONE SOCIETIES

In Europe, nine of every 10 adults aged under 35 now own a smartphone that provides internet access in addition to making audio calls (Taylor & Silver, 2019). Globally, adults living in the more 'advanced economies' are more likely to own a smartphone than not, and the market seems far from saturated (ibid). This popularity should not surprise us in view of the very many apps that, once installed onto smartphones, serve to entertain us, provide useful information and present new ways of connecting with others wherever we are. It is easy to see why smartphones have become an increasingly indispensable and ubiquitous feature of modern life when they offer their users such a diversity of benefits.

Inevitably, however, there are also downsides to this situation. One of the most commonly expressed concerns starts with a suggested epidemic of 'smartphone addiction' in which many users are drawn into relatively compulsive patterns of interaction that may negatively impact their well-being (Horvath et al., 2020; Panova & Carbonell, 2018). Young people have been a particular source of concern in this respect as the 'digital natives' who were born into these smartphone societies (Palfrey, 2010). Some see them as the 'head down generation' that is now so often hunched over their screens

that their bodies are already suffering as a result (Bueno et al., 2019). Others point to how young people may be pioneering new conventions of phone use in which they feel compelled to present themselves online positively and often even though doing so might be feeding their private insecurities (Chua & Chang, 2016). However, it is also true that smartphones can provide a relaxing place in which to spend some time (Huang & Su, 2018). In this respect, many owners may now see their smartphones as comforting social 'pacifiers' to which they instinctively turn when they find themselves in contexts that otherwise feel either stressful or insufficiently stimulating (Melumad & Tuan Pham, 2020). Sharing experiences through apps can also provide uplifting sources of inspiration in ways that trigger positive emulation (Meier et al., 2020).

The picture is predictably complicated, which is partly because the situation is changing fast. But it also relates to how different research approaches naturally highlight different aspects. And that leaves us with questions about how existing academic work focused on the human experience of nature connects to this wider discussion. Whilst there is a great deal of evidence to suggest that being in natural environments can provide various human benefits (Fagerholm et al., 2020; Frumkin et al., 2017; Hartig et al., 2014; Maller et al., 2006), how exactly a smartphone focus could help in the promotion of these benefits is another matter. With that in mind, this paper asks: what ways of looking at this connection are currently most common, how do relevant studies picture social life, and what are the implications for future research on this topic?

3 | UNDERTAKING OUR REVIEW

The material for this review was not produced through a systematic examination of academic papers that were identified by following an established procedure. Our interest in this topic developed more organically than that. The seed was sown at some conference sessions in which we learnt of an app aiming to facilitate positive nature experiences in the United Kingdom. As researchers who have studied everyday practices, this piqued our interest in questioning how exactly social life was being imagined in current academic work on smartphones and nature experience. With that in mind, we decided to embark on an iterative process of exploring this work. Relevant terms were typed into academic search engines and then we followed various reference trails. Along the way, we gradually refined and reworked our strategy to understand how this connection has most commonly been studied.

Studies focused on citizen science were excluded from our review because our interest was in promoting public health through nature experience more than encouraging civic involvement. This is therefore a review concerned with how studies have thought about promoting well-being through nature experience for different populations by taking the smartphone as their focus. The review did not focus on certain countries or world regions though studies from Europe and North America tended to predominate. By organising the process in this way, we only evaluated academic papers on this topic. And we imagine that all sorts of industry studies will have

shaped the various apps that have been developed in recent years with the intention of encouraging enjoyable engagements with elements of the natural world through activities that range from bird-watching to plant spotting. Whilst an appreciation of how they see the social contexts into which their apps hope to intervene would be welcome that was outside our scope.

Two bodies of work emerged from this exercise as those with the most studies belonging to them and so we focus the rest of our paper on those. In evaluating these two, we were particularly interested in how certain research approaches were associated with certain visions of the societies that the studies involved sought to understand and certain ideas about how those societies are influenced. Our discussion of the results now begins with a sense of excitement about a craze for collecting animated characters that might tempt some people into nature spaces outdoors to which they may never have otherwise gone.

4 | NEW APPLICATIONS FOR ENGAGEMENT: TRIGGERING EXCITEMENT AND IMAGES OF URBAN LIFE

A widely cited consideration of how smartphone apps might foster positive human engagements with nature takes its inspiration from the global popularity of PokemonGO. PokemonGO is an 'augmented reality' game in which animated characters (the 'pokemon') are nominally scattered across physical space such that players who hope to collect them must go to the physical sites that trigger their appearance on their smartphones (Dorwood et al., 2017). If nothing more, the authors argue this game takes those who may otherwise have been inclined to remain indoors into sites that often include parks, gardens and other green spaces. But, beyond that, the parallel between the animated characters dreamt up by game designers and the living species to which societies might otherwise be increasingly oblivious was obvious: If people can be so easily tempted to search for computer-generated creatures outside, surely there is scope for using a similar strategy to get them to notice the real-world equivalents and thereby engage with nature in positive new ways (Preece, 2017)?

This excitement (see also Jepson & Ladle, 2015) hints at the essential rationale for our first body of work. Although anxieties are occasionally expressed (to which we will return), the idea here is that smartphones, in conjunction with imaginatively designed apps, hold great promise in fostering positive human experiences with nature. Indeed, for researchers already focused on 'human-computer interaction' (HCI), encouraging digitally mediated experiences with nature can be straightforwardly seen as a new 'domain of application' in which to apply their ingenuity (Jones et al., 2018). In doing so, one common objective (comparable to the PokemonGO example) centres on engendering a sense of excitement about everyday environments that are otherwise assumed to be found comparatively dull. In Soro et al. (2018), for example, the ambition is to develop an app that encourages children to see (and then care about) the animals that

live around them. In McEwan et al. (2020), users are alerted when they may be 'going through a natural environment' based on the implicit assumption that they might otherwise be unlikely to notice the beauty of nature and receive the associated benefits. Phillips and Kau (2019) in their work on 'nature gaming' similarly see much promise in using apps to augment play in ways that lead to a more empathetic relationship with local birds that are themselves not always around or so easily spotted.

The picture here is generally one of a decidedly active form of engagement that is very different to more passive forms of immersive enjoyment. An intriguing example of how these two formats are potentially bridged is, however, seen in the 'enviropulse' app (Valtchanov & Hancock, 2015). Its ambition was to translate the insights of environmental psychology studies that suggest that contemplating certain arrangements of greenery can provide mental respite into an alert system that tells the user when such arrangements are nearby. In this regard, this project was effectively developing a kind of 'PokemonGO for psychological restoration' in which the app alerts relate to the nearness of green space more than augmented reality creatures. Whilst these studies endeavour to fine tune the ways in which potential users interact with different forms of interface, the social experience with the finished product still suggests a tricky experiential balancing act for the potential user. How easy, in terms of the lived reality, is it to reconcile a sense of excitement about the impending nearness of beneficial green environments and slowing down to a point when the user is sufficiently relaxed to reap the restorative rewards they potentially provide?

The suggestion that app alerts might disrupt the social experience of nature spaces in less than ideal ways is not lost on many of those in this field. For example, in asking people to notice the 'good things' they see in nature, Richardson and Sheffield (2017) consider how the act of noticing might problematically take people out of the moment. And, whilst sharing what has been noticed through social media might feasibly get others to notice the good things too, they are aware that questions remain about whether 'noticing' is the activity that we should aspire to encourage if certain ways of noticing prevent people from more fully immersing themselves in these environments (in ways that are already good for them). In another study from this team, the researchers voice concerns about how, when they asked the participants in their Northern England project to record beneficial encounters with nature, the 'nature' on which they focused was often of a particular type, with certain animal sightings, for example, featuring more than might have otherwise been expected (McEwan et al., 2020). This leads them to wonder whether societies should be educated away from a focus on 'spectacular' moments when part of their intention is to encourage people to see beauty in the more mundane environments that they might otherwise ignore. However, one problem here is that being asked to 'record' their experience naturally leads people to focus on the 'spectacular' scenes that invite recording, especially if photographing with phones is part of the process.

This takes us to our interest in how everyday life is imagined in this work, which, in turn, returns us to the ambivalence that we introduced

at the start of our paper about whether smartphones might feasibly act to undermine the very experiences that these apps hope to encourage. In considering what studies in this field have said about this matter, it is telling that the studies most willing to consider the possibility that the ideal experience is one in which smartphones are comparatively absent are those focused on experiences explicitly apart from 'everyday life'. More specifically, these studies are focused on what some might see as the 'real nature' found away from cities—those who have 'escaped' technology and society to benefit from hiking and other outdoor pursuits (Anderson & Jones, 2018). The assumption now is that the hiker is already well placed to benefit from the environments around them (and might do so more fully if undisturbed by technology). There is less of a perceived need to trigger a sense of excitement here. The few studies that involve speaking with hikers about their smartphone use have led to some interesting suggestions in this regard. Hikers talk of how, though they are inclined to take their phones with them, they also have developed creative strategies to stay connected with others whilst also revelling in the pleasures of comparative isolation (Helms et al., 2019). These include looking at their phones at particular times (rather than constantly interacting with them) and taking a surprising pleasure from staging a temporary social media disappearance. Other hikers also describe their ambivalent relations with navigational apps that are certainly helpful but can also take them out of the moment (Rogers & Leung, 2021). One study on this topic accordingly recommends that hikers are told about how apps can undermine the experience so that they can ration their smartphone engagement accordingly (Amerson et al., 2020). A further study, this time drawing on observational methods, sheds a different light on how smartphone apps and social dynamics intersect by videoing walkers on the moorlands of mid Wales (Smith et al., 2020). This study demonstrates how the interactions that take place around a navigational app can serve to encourage certain social relationships and bonding experiences whilst walking. These walkers are presumably benefiting from their surroundings. But they are also getting to know one another through collaborative discussion around the app. In any case, this work reminds us to be careful not to assume that hikers and walkers are generally enjoying a personally restorative immersive experience in unmediated nature. If they get lost, after all, they might soon relate to 'natural' environments in a very different way (and be quite thankful of having a smartphone at hand to help them get their bearings back).

With this picture of the lived experience in mind, some of those who focus on time away from cities see themselves as walking the tightrope of creating 'unobtrusive technologies' (Jones et al., 2018) that augment, but do not intervene too greatly into, what is otherwise thought of as a positive experience with the immediate surroundings (Kerber et al., 2018). This is because the users found away from everyday urban life are often presumed to be there precisely because they want temporarily to 'disconnect' from their pressures back home (see also Michael, 2009). If this is so, the app developer must be mindful of the potential for unhelpfully distracting from the feelings of escape that users may already be enjoying. A neat example of how this tension is negotiated comes from the 'anti-social' hiker app (Posti et al., 2014).

This alerts hikers when other smartphone users are nearby on their trails, based on the assumption that seeing them is the last thing that hikers would want when revelling in the solitary pleasures of their walk. The trouble, however, is that time spent dodging other hikers (for which, jumping into bushes is unappealing, but being offered alternative routes is understandably more welcome) might also be less than fully meditative. Indeed, the result could feasibly be more akin to a kind of computer gaming (in which the aim is to dodge the hikers) than nature communing. In any case, the overall picture is quite different to how, in the urban context, a common assumption is that users are pre-occupied such that the challenge faced by the app is to make them stop and notice their surroundings. In this thinking, smartphones should be harnessed because people are assumed to already be using them. Hence, the argument that, if we cannot get them off their phones, we should encourage the patterns of use that stand to yield the greatest health benefits (McEwan et al., 2019).

How different social groups may already be carving out routines that combine significant smartphone use and sufficient beneficial nature experience generally goes unexplored in these accounts. There has been a discussion of how young people might find 'disconnection' especially difficult (understandably so since, as already discussed, they have grown up with the smartphone; Phillips & Kau, 2019). Yet, by contrast, it also seems that those who had seldom engaged with nearby nature in this way before may be especially likely to benefit from being asked to (McEwan et al., 2019). So, there may be significant potential for fostering engagement amongst those who feel new to nature. Either way, the suggestion that particular social groups might already be enjoying plenty of nature experience (and therefore have little need for any well-designed app) is often beyond the scope of this work. This is because a common objective amongst these studies is to collect data on whether their proposed apps will work. This can mean that the aim is to recruit enough people who are willing to take part in trials more than it is to see how smartphone interactions and nature experiences are already being juggled by various social groups in various contexts.

5 | SOCIAL MEDIA SHARING: SUPPLANTING SURVEYS AND PICTURING THE EXPERIENCE

In our second body of work focused on online sharing practices, we see a similar level of excitement about how those interested in fostering positive nature experiences might respond to the widespread embrace of the smartphone. Here, however, the argument generally goes that, by examining the wealth of data that is already being produced by the interactions people have with their smartphones in relevant environments, we put ourselves in a stronger position to ensure that they continue to benefit from these environments. This is either by informing how relevant spaces are managed or by using these data to strengthen the argument for preserving green spaces and encouraging people to go to them. So, unlike the first body of work in which the objective was to influence what different

populations do in relevant nature spaces, the ambition now is to learn from what they are already doing within them. One of the main justifications for this work is that it provides a more cost-effective means of assessing and evaluating the visitor experience when compared to the traditional survey (Donahue et al., 2018; Wu et al., 2017). Pluntz et al. (2019), for example, suggest that these data will likely become essential in green space planning (once their problems have been ironed out).

Before turning to how these studies imagine smartphone interactions in social life, it is again worth considering experiences apart from the everyday. Uploads to the picture sharing site Flickr (which are commonly done from smartphones) have been a popular source of data in this work. This is partly because the images found there are commonly geotagged in a way that allows researchers to examine the relationship between what people take photos of, where they take them, and how they represent the experience in their compositions and captions. Yet the patterns found within these data can also be interpreted quite differently. For example, for those interested in how sensitive people are to the visual quality of their environments, a study of lake water quality in North America (Keeler et al., 2015) uses Flickr uploads to suggest that visitors are indeed quite aesthetically sensitive. In their dataset, they find a direct relationship between the visual quality of water and the likelihood of lake photos being deposited on Flickr. We could use these data to emphasise the importance of taking good care of these lakes. If we do not, those who (potentially because of how smartphones are reshaping our societies more generally) have become especially alive to visual consumption and the aesthetic qualities of their surroundings will be less likely to take photos there and share them afterwards. That might then make others less inclined to visit since they have not been prompted by the pictures to follow suit. However, a rather different story can be extracted from Flickr data in a study by Levin et al. (2015) that partly considers how globally recognised beauty spots are responded to by users of this site. They find that people do not venture too far from the roads before taking the photos that they subsequently share on Flickr. Although the roads could be taking people directly to the most striking spots, we could think quite differently about their desire for visual perfection if they are unwilling to stray very far from their cars. Our point here is that, whilst there are massive amounts of data to be exploited here, these data can be used to paint very different pictures of the social scenarios involved.

Another good example of this ambiguity relates to the finding that positive mentions of 'nature' on Twitter (as the other popular data source for these studies) are associated with countries with higher life satisfaction (such as Iceland and New Zealand; Chang et al., 2020). The authors use this finding to float the suggestion that those living in countries blessed with easy access to 'quality' nature are reaping the well-being rewards that come from having it close to hand. Yet, another interpretation, if we lingered over who is taking the photos, is that these citizens could, in fact, be feeling happy about profiting from the visitors who have come to photograph the views. Building on the idea that we should take care about inferring real-world scenarios from these aggregate data sources (and moving

towards how certain aspects of everyday life are imagined in this work), the same paper by Chang et al. (2020) also notes how, at the global level, there seems to be fairly strong evidence to support the idea that major life events (such as weddings and birthdays) involve photos with vegetation backdrops. This, they wonder, might be a further cause for celebration for those hoping to encourage positive nature experiences. Why? Because they see evidence of a persistent human desire to be in nature (namely the 'biophilia hypothesis' cf. Kellert & Wilson, 1993) since, on important occasions, and whenever they can, people seek out these environments. Yet, an opposing suggestion would be that what we are seeing here is a ritualistic return to environments which many have largely forgotten about and which are only sought out at major life events. There are opportunities for fascinating analysis here. But we should be careful not to jump the interpretative gun.

Turning to those who are often thought to live fairly near the nature spaces involved, Twitter has come to predominate as a data source, presumably partly because more familiar places are less likely to be sufficiently spectacular to prompt Flickr deposits. This has led to a different strategy for examining the effects of parks, namely 'sentiment analysis' as a method that considers what the tweets that are produced in particular environments suggest about how people experience them. One particularly arresting example comes from a recent paper in this journal (Schwartz et al., 2019) in which, by comparing the frequency with which Twitter users in San Francisco used phrases that were taken to indicate whether they are feeling positive at the time, the authors not only found that being in a park makes for more positive tweeting but also that this effect can last for some time afterwards. A similar study in New York complicates the picture (Pluntz et al., 2019). This finds green spaces closer to people's homes producing this same kind of positive result. However, this is not the case for green spaces near to workplaces where perhaps the stresses of work are too great for any park experiences to achieve the same intensity of effect. Such analysis could ultimately lead to compelling real-time depictions of changing mental states as people flow into and out of urban green spaces and we can imagine those depictions being particularly effective in encouraging their use. Either way, it would be almost impossible to consider these effects through traditional survey methods that take only snapshots of how people feel about their surroundings. It is with such ideas in mind that the body of work on Twitter and green space is growing fast (Roberts et al., 2018).

This work has, however, for reasons to which we now turn, so far tended to stop short of recommendations. This is partly because, when we get to the detail of how people respond to natural environments, the suggestions that follow on from what can be seen in the Twitter data are intriguing. The presence of tree cover provides a good example. In an analysis of both Flickr and Twitter data from Minnesota parks, Donahue et al. (2018) find that greater tree cover leads to more image sharing but fewer tweets. So some groups are drawn to trees more than others. Or perhaps, trees make for better pictures (whereas tweeters prefer to compose posts on the grass). However, across the Atlantic, in the English city of Birmingham, how

often people tweet about exercising in parks seems to be related to tree cover. These authors speculate that this could be as a result of trees offering the shade that encourages them to stop and tweet or it could be a product of how trees provide a more aesthetic backdrop for pictures (Roberts et al., 2017). So, should more trees be planted? If we want to encourage photography and physical fitness in Birmingham, the suggestion here is that this could be good idea. But, if this happened in Minnesota, it is also possible that some Twitter users might drift away. This kind of more fine-grained analysis in which the specific components of what is sometimes analysed as a more general 'nature experience' for want of greater detail pushes us to think harder about what social media users are really responding to in urban parks. For example, back in the north of England, Brindley et al. (2019) present us with a word cloud based on the captions that most often accompany positive Flickr depictions of local parks. Linking back to the earlier discussion of what was also found in Sheffield about 'spectacular' nature (McEwan et al., 2020) and how we should think about the frequency of tweets about animals, the word 'squirrel' is front and centre in their cloud. We should be cautious about taking positive posts as a viable proxy for what people want, rather than what they find remarkable. In other words, although it might be nice to encourage more squirrels in the park, they are probably not the most important thing to people. Again, this finding invites us to imagine the social situations that produce the tweets and the posts and how different groups may report on their experiences in particular ways for particular reasons.

One of the most intriguing suggestions skirted by Schwartz et al. (2019) is that being in natural environments can make people tweet. This is not only because these are the environments that they may most want to celebrate but also because being there can increase their levels of sociability and positive disposition towards others (Zhang et al., 2014). So, rather than smartphones standing in the way of nature benefits, perhaps people turn to their phones when the benefits have been accrued and their newly acquired well-being encourages them reach out to friends and family. Either way, the processes by which people come to tweet and post through their smartphones in natural environments are still unclear. And though the exploitation of this data source is often justified in terms of being more efficient than a survey, these data are the outcome of a social experience quite unlike that of completing a questionnaire. The understandable interest in this data source should not blind us to how these social processes complicate the picture. For example, in another study that pays particular attention to the sentiments expressed in the tweets that are produced by those who are in green space, Wilkie et al. (2020) are amongst the few to acknowledge that self-promotion might be a motivation. Certainly, these tweets should not be understood as a straightforward and comparatively guileless record of green space experience. Instead, they may often be a rather more strategic means of presenting the user to their social network. In their study, they compare how the sentiments expressed on Twitter square with a popular model of the ways in which natural environments may act to produce psychological restoration. They find that people are tweeting quite a lot about how these environments support particular activities and

less than they expected about their intrinsic beauty. Could this mean that tweeters are turning away from a celebration of natural scenes? Or is it rather that nature provides an attractive backdrop for those who seek validation from those to whom they are linked online? In this way, we could see being in attractive green spaces as a kind of 'nature legitimisation' for the attention-seeking poster. In a more prosaic vein, Roberts et al. (2019) show how, when people tweet positively about urban green space in Birmingham, this is often about events taking place there, rather than offering us a straightforward insight into 'nature experience'. By scrutinising the detail of their data, they show how many tweeting visitors may, in fact, be talking about litter deposits or sports events (perhaps even the squirrels that can tend to catch their eye?).

The social contexts of smartphone use are most often considered in this field with reference to who is more or less likely to post (rather than the social situations that lead them to post in the first place) and how particular demographic groups are more likely to share online than others. This raises the question of what should be done about this inconsistency. If the argument is that this source of data is set to become 'essential' within future green space management, one answer is that we should attempt to get currently under-represented groups to do more tweeting (on that see Roberts et al., 2019). That would make sense if the aim is to make the data more truly representative of the experiences and feelings of the broader population. But, if we put these sampling issues aside for a moment, do we really want to encourage others (ideally nearly everyone?) to interact with their smartphones in this way when doing so might feasibly stop people from benefiting as much as they otherwise might from being there? Returning to some of the concerns expressed in the previous body of work, how should this second body handle the 'non-users' who may benefit more from natural environments precisely because they have disengaged from their smartphones? Furthermore, do planners and green space managers necessarily want to fill these spaces with the features that currently lead to the most positive tweets and posts? In one respect, perhaps they might because, if we allow ourselves to reflect on how social media are shaping societies, that could set off a chain reaction of interest from wider 'follower' populations who have been 'influenced' by those who authored the original tweet. But, if all they are doing when they get there is to seek out a similar form of online approval by emulating that same tweet, are they really getting so much benefit from being in these natural environments (on the relationship between 'selfie' taking and nature 'disconnection', see Richardson et al., 2018)?

6 | DISCUSSION

In the above overview, we have examined what we believe to be the two ways of researching the relationship between smartphone interactions and beneficial nature experience that currently predominate. In undertaking this exercise, we are impressed by how both bodies of work are thinking hard about the detail of how smartphones are, and could be, lived with, instead of worrying about the impacts of new technologies in a more abstract manner. But we also

think it is worth considering the ways in which these bodies of work are, partly by virtue of the ambitions that they have for their studies and partly because of the data on which they draw, encouraged to see the issue. Acknowledging that there are exceptions, Table 1. attempts to provide a summary of some of these ways.

We see many questions being prompted by this table. The studies from the first group, for example, can tend to reproduce a vision of people busily rushing around their cities to the extent that, if we do not disrupt them, they may never notice the nearby nature. By contrast, the work of the second hints at how even short bursts of park experience are already proving very restorative to people. One can be anxious about the implications of how people have come to use their smartphones. The other occasionally skirts the suggestion that they should ideally use them more so that researchers have a more complete sense of how populations are benefitting from nature spaces. Comparing these two bodies of work also encourages us to reflect on how 'nature' is being defined within this developing field of research. What, for example, are the implications of the resolutions at which we explore it in our studies (from individual creatures and features to greenery more generally)?

More thought might be given to these matters before reaching for policy recommendations. Otherwise, some less than ideal scenarios could be inadvertently encouraged by studies that individually seek to have only positive impacts. Do those in charge of nature spaces, for example, want to end up creating the most attractive environments for the users of social media who might not be benefitting all that much if they are only looking to find the most attractive environment for their post before leaving? Equally, we could picture the roll out of various nature apps that hope to trigger new forms beneficial engagement with the immediate physical environment but end up meaning that people go back down some of their more familiar online rabbit holes as soon as their smartphones come out of their pockets.

7 | FURTHER WORK ON NATURE BENEFITS AND SMARTPHONE INTERACTIONS

With the above reflections in mind, we now consider how some less common approaches might help to round out this picture and build a sturdier platform for future intervention. In this respect, it is worth noting how the broader discussion of 'smartphone societies' presented at the start of our paper is quite different to the two pictures associated with our two prevailing bodies of work. To explore these differences in practice, we might consider:

7.1 | More qualitative studies

In the above discussion, we admittedly looked for instances in which the 'user experience' was imagined in rather different ways. Our thinking was that doing so might bring to the fore assumptions about lived experience that can end up being pushed into the background when we trade in aggregate datasets or focus on the detail of specific interactions instead of the broader social contexts of smartphone use. Other research approaches, however, are comparatively well suited to exploring these contexts in ways that would add some useful detail to the picture provided by the above two bodies of work. If part of our argument is that we should be careful about how certain assumptions can end up being baked into certain ways of studying smartphone use in natural spaces, qualitative methods can, for example, be particularly good (by virtue of being open to the hitherto unknown perspectives of the people involved) at critically engaging with how well some of these assumptions square with the actuality of their lived experience.

In the above discussion, the studies of how hikers spoke of social media and navigational apps were amongst the minority of papers

	Application developers	Online sharing analysts
How do they see the smartphone	A tool to increase positive engagement with the natural environment	A data source for understanding the current use of natural spaces
Is smartphone usage a good thing?	Ambivalent—'we need to take care with this'	Indifferent—'this is just what people do now'
The 'nature' with which they most commonly work	Specific features of the immediate environment	Categories of place to which people already go
What is the essential objective of the work?	Improve technology to foster well-being	Improve environments in response to new insights
To whom are they catering?	Smartphone users	Societies more broadly
How should we think about non-users?	A problem because we cannot really reach them	A problem because they mean the data are unrepresentative
How do they picture everyday urban life?	A busy condition that requires intervention	Full of nature interactions from which we can learn

TABLE 1 Comparing how the 'application developers' and the 'online sharing analysts' commonly picture smartphone interactions, nature benefits and social life

we found that used these methods. These studies alone invited many questions about whether similar strategies were likely to be shared by others when they encounter natural spaces. So what happens when phones are taken out of people's pockets in a range of natural environments? Can the passive relaxation that feasibly comes from comparatively natural spaces and the active engagement that apps demand be easily combined for people? How do they see their tweets and their environments as linked and what might they say about the intriguing results of some of sentiment analysis studies discussed above? Qualitative studies would help us to learn from people's responses to such questions. The illuminating accounts of how people are already managing these matters for themselves (despite being crucial in knowing how, when and whether to influence their actions) are currently often tantalisingly out of reach in the above two bodies of work because these methods are not that popular. Drawing on them more often could help us to understand how online and offline lives are being choreographed (rather than looking at engagements with identified apps in comparative isolation). In the above second body of work in particular, quantitative methods greatly predominate. Within it, Egarter Vigle et al. (2021) are rare in noting the value of interviews in exploring the social scenarios suggested by the patterns seen in their datasets. In a broader discussion of what apps say about the mood effects of nature experience, MacKerron and Mourato (2013) note how the process could go in different directions. In other words, people may go to nature spaces when they are happy instead of these spaces making them happy after they have arrived. Finding out about how these sorts of processes play out for people could be done by talking with them. Thinking beyond the interview, observational studies of smartphone interaction in natural environments could also help us to dig even further into the social dynamics involved.

7.2 | Different social groups

Both the approaches outlined above sometimes downplayed social diversity. The aim of the app developers, after all, was often to understand how apps could benefit users more generally. Meanwhile, the online sharing analysts can be tempted to overlook demographic variation in pursuit of more general conclusions about what broader populations may want or need. But different groups will have very different relationships with their smartphones (in ways that have implications for how and whether they benefit from time spent in natural spaces). They are much more than 'people' who may or may not be smartphone 'users'. So, which groups could be most useful to study? One obvious axis to explore here is age. Younger people, in particular, have been singled out as those who may be particularly tempted by computer-mediated experiences and therefore be less interested in spending time in nature outdoors. This was one of the justifications for arguments about how nature advocates should work with the grain of how younger generations may be especially attracted to technologies or keen on apps (Ballouard et al., 2011; Pergams & Zaradic, 2006) And, going back to the contextual discussion that we presented at the start, many are concerned about the challenges being faced by these

so-called 'digital natives'. There is certainly evidence to suggest that young people are creatively absorbing smartphones into their lives in ways that allow them to deliver on various social imperatives in new ways (Thulin et al., 2020). But they may still be mindful of the mental health benefits of nature spaces (Birch et al., 2020) in ways that might make them put their phones away (or even leave them behind) when going to the park or the countryside. Either way, they are subject to specific pressures and expectations in terms of phone use that will likely make their responses to nature distinct.

Another strategy would be to start with those who have particular smartphone relations. Going back to our table, what could be learnt from the non-users? Or those who do a great deal of posting online compared to those who rarely do? Although the understandable ambition of the online sharing analysts is often to speak on behalf of broader populations, embedded within the datasets involved are posting patterns that could be explored in these terms. Are those who post a lot in the park doing so because the environment has filled them with a sense of positive sociability or because the environment is insufficiently interesting to distract them from their phones? The latter situation, of course, is not necessarily a bad thing if the enhanced mood and mental restoration results are the same. It could, in fact, lead us to encourage people to do their tweets outdoors. Either way, a more explicit focus on identified groups would help to explore these options. Going beyond the above focus on hikers who have set off to explore places outside the city, what about runners—when and in what ways might their smartphones augment experiences with the natural environment (Bamberg et al., 2018)? Turning to other groups, Gray et al. (2018), for example, have explored how gender serves to shape the depiction of outdoor experiences on Instagram, which takes us back to some of the important self-presentation issues with which we began. Here, Truong and Clayton (2020), for example, point to the value of speaking with 'content creators' about how they depict the natural world. They note how the most popular posts involving natural scenes are often curated by, for example, taking photos at the most visually attractive times of the day. So, is Instagram making people stay for the perfect shot in ways that could bring them extra well-being from the environment as they wait? Or might other potential posters soon leave relevant sites when they discover they do not match up to the idealised images that increasingly predominate on social media? Either way, it may be worth more fully exploring how, for the first of our two bodies of work, different social groups will engage differently with apps and, for the second, the social situations that produce the posts will likely be different for different sets of posters.

7.3 | Social anxieties and expectations

Building on the issue of how to handle social diversity, we might equally structure our samples around particular feelings about the natural world that are abroad in wider society. The motivation for this research, after all, is that there is something special about environments that contain plants, trees and other living creatures from which

people can benefit. But do different social groups share these beliefs? And, if they do, how do they go about reconciling them with their other preoccupations and priorities? This takes us to how different groups negotiate what we might call the everyday ethics of nature experience and smartphones use. The trend that immediately springs to mind here is that of the 'digital detox' which suggests that the anxieties with which this paper began are not harboured by those who study this topic alone. Dickinson et al. (2016), for example, consider the tensions involved in keeping devices at arm's length for families when they hope to enjoy quality time together during camping holidays in the United Kingdom. But even when these technologies first became popular, there was a degree of cultural nervousness about staying 'connected' whilst also 'getting away from it all' in the 'countryside' (Michael, 2009). It seems that teachers are also ambivalent about how much smartphones should feature in their outdoor education work (Bolliger et al., 2020), but interestingly that younger teachers are more positive about this. Are the younger teachers more resigned to the presence of smartphones in all aspects of young lives today? Or are they more optimistic about what the technology can do?

This final suggestion points to how what people feel they should do with their smartphones is as much a social as an individual process—an outcome of how situated norms of action are established in particular contexts. Another way of thinking about what the smartphone does is to provide a social licence to be there. In other words, interacting with smartphones may give people who feel that they should be demonstrably occupied a legitimation for lingering in environments they might feasibly get even more out of if they had the confidence to put the phone away (Hitchings, 2021; Ward Thompson, 2002). How do these conventions spread through different societies and how can innovatively designed studies capture that? We might equally turn to some of the other emotions that could be involved: When is it embarrassing to use (or not use) smartphones in natural environments, when it is a source of pride, and for whom? Linking back for one final time to our starting contextual discussion, it is notable that one of the most commonly expressed concerns about the societal impact of smartphones seen in the wider literature, that of the potential for smartphone 'addiction', goes largely without mention in the above two bodies of work on nature experience. The first likely pulls back because of the implication that nature apps could make matters worse by providing yet another reason for looking at phones. The second avoids it because it commonly works on the basis that frequent smartphone engagement is the reality of modern life rather than an obstacle standing in the way of deriving nature benefits. But these issues are probably crucial in understanding the 'paths' that take social groups either towards a fuller nature engagement outdoors or into online worlds accessed through their smartphones (Wang et al., 2021).

8 | CONCLUSION

This journal seeks to encourage interdisciplinary exchange in pursuit of the fullest sense of how people and nature interact and fresh ideas

about how to positively influence these interactions. In line with this ambition, our review has explored how the smartphone currently is, and potentially could be, studied by those who are interested in fostering beneficial human experiences in natural environments outdoors. Our discussion started with two very different views on whether smartphones should be seen a good thing by those who hope to encourage these experiences. However, this is probably not the right time to be thinking in such abstract terms about whether smartphones are 'good' or 'bad' for nature experience. They are here now. And so it probably makes more sense to turn to the detail of how they are already being lived with.

In so doing, we focused on two prevailing ways of studying how smartphones might help to foster beneficial nature experiences. Both bodies of work are revealing important insights when smartphones seem set to stay. But, as research on this topic develops, we also think that it is worth reflecting on how certain images of social life can end up serving as unquestioned foundations for particular research strategies along with the extent to which they hold true in practice. More specifically, we think that future studies should be careful about glossing over variation in how different social groups engage with smartphones either because they are hopeful that certain apps might have a broad appeal or because of an understandable excitement about new data sources. We would also argue for further reflection on how 'nature' is handled by different bodies of work and the implications of seeing it as a container for stimulating experiences or a restorative backdrop to activities.

But, as we said, our aim is not to be overly critical when there is much fascinating and valuable work being done here. Our argument is more that some of the above suggestions warrant further examination at this point in its development. As part of this, further qualitative studies could help us to know whether and when they hold true for people. Some creative sampling might also be beneficial. So too might a fuller engagement with changing conventions of phone use more broadly and the feelings that accompany them.

ACKNOWLEDGEMENTS

We thank Robert Fish, the Associate Editor, and the two external reviewers for this paper. We appreciate their constructive engagement, and we feel that responding to their comments has definitely improved our paper. We also want to thank all the authors who are discussed in this review. It was great to learn about all the exciting work that is happening here.

CONFLICT OF INTEREST

Although both authors are editors for *People and Nature*, neither of them was involved in the peer review and decision-making process for this paper.

AUTHORS' CONTRIBUTIONS

R.H. and C.M. conceived of the idea for this review paper; R.H. reviewed the literature and wrote the original manuscript; C.M. edited this before submission; R.H. and C.M. discussed how to adapt

the paper in response to the review and R.H. revised the paper accordingly.

DATA AVAILABILITY STATEMENT

This manuscript draws only on already published sources and it does not therefore include the examination of any of our own datasets.

ORCID

Russell Hitchings  <https://orcid.org/0000-0002-1171-8064>

Cecily Maller  <https://orcid.org/0000-0001-8322-2124>

REFERENCES

- Amerson, K., Rose, J., Lepp, A., & Dustin, D. (2020). Time on the trail, smartphone use, and place attachment among Pacific Crest Trail thru-hikers. *Journal of Leisure Research*, 51, 308–324. <https://doi.org/10.1080/00222216.2019.1680264>
- Anderson, Z., & Jones, M. (2018). *Envisioning outdoor recreation in HCI*. Workshop on HCI outdoors: Understanding human-computer interaction in the outdoors CHI 2018, 21 April 2018, Montréal, Canada.
- Ballouard, J., Brisichoux, F., & Bonnet, X. (2011). Children prioritize virtual exotic biodiversity over local biodiversity. *PLoS ONE*, 6(8), e23152. <https://doi.org/10.1371/journal.pone.0023152>
- Bamberg, J., Hitchings, R., & Latham, A. (2018). Enriching green exercise research. *Landscape and Urban Planning*, 178, 270–275. <https://doi.org/10.1016/j.landurbplan.2018.06.005>
- Birch, J., Rishbeth, C., & Payne, S. (2020). Nature doesn't judge you – How urban nature supports young people's mental health and well-being in a diverse UK city. *Health and Place*, 62, 102296. <https://doi.org/10.1016/j.healthplace.2020.102296>
- Bolliger, D., McCoy, D., Kilty, T., & Shepherd, C. (2020). Smartphone use in outdoor education: A question of activity progression and place. *Journal of Adventure Education and Outdoor Learning*, 21(1), 53–66. <https://doi.org/10.1080/14729679.2020.1730204>
- Brindley, P., Cameron, R., Ersoy, E., Jorgensen, A., & Maheswaran, R. (2019). Is more always better? Exploring field survey and social media indicators of quality of urban greenspace, in relation to health. *Urban Forestry & Urban Greening*, 39, 45–54. <https://doi.org/10.1016/j.ufug.2019.01.015>
- Bueno, G., Garcia, L., Bertolini, S., & Lucena, T. (2019). The head down generation: Musculoskeletal symptoms and the use of smartphones among young university students. *Telemedicine and e-Health*, 25, 1049–1056. <https://doi.org/10.1089/tmj.2018.0231>
- Chang, C.-C., Cheng, G., Nghiem, T., Song, X.-P., Oh, R., Richards, D., & Carrasco, R. (2020). Social media, nature, and life satisfaction: Global evidence of the biophilia hypothesis. *Nature Scientific Reports*, 10, 4125. <https://doi.org/10.1038/s41598-020-60902-w>
- Chua, T., & Chang, L. (2016). Follow me and like my beautiful selfies: Singapore teenage girls' engagement in self-presentation and peer comparison on social media. *Computers in Human Behavior*, 55, 190–197. <https://doi.org/10.1016/j.chb.2015.09.011>
- Coyne, R. (2014). Nature vs. smartphones. *Interactions*, 11(5), 1–24. <https://doi.org/10.1145/2656933>
- Dickinson, J., Hibbert, J., & Filimonau, V. (2016). Mobile technology and the tourist experience: (Dis)connection at the campsite. *Tourism Management*, 57, 193–201. <https://doi.org/10.1016/j.tourman.2016.06.005>
- Donahue, M., Keeler, B., Wood, S., Fisher, D., Hamstead, Z., & McPhearson, T. (2018). Using social media to understand drivers of urban park visitation in the Twin Cities, MN. *Landscape and Urban Planning*, 175, 1–10. <https://doi.org/10.1016/j.landurbplan.2018.02.006>
- Dorwood, L., Mittermeier, J., Sandbrook, C., & Spooner, F. (2017). Pokémon go: Benefits, costs, and lessons for the conservation movement. *Conservation Letters*, 10(1), 160–165. <https://doi.org/10.1111/conl.12326>
- Egarter Vigil, L., Marsoner, T., Giombini, V., Pecher, C., Simion, H., Stemle, E., Tasser, E., & Depellegrin, D. (2021). Harnessing artificial intelligence technology and social media data to support Cultural Ecosystem Service assessments. *People and Nature*, 3(3), 673–685. <https://doi.org/10.1002/pan3.10199>
- Fagerholm, N., Martín-López, B., Torralba, M., Oteros-Rozas, E., Lechner, A., Bieling, C., Olafsson, A., Albert, C., Raymond, C., Garcia-Martin, M., Gulsrud, N., & Plieninger, T. (2020). Perceived contributions of multifunctional landscapes to human well-being: Evidence from 13 European sites. *People and Nature*, 2(1), 217–234. <https://doi.org/10.1002/pan3.10067>
- Frumkin, H., Bratman, G., Breslow, S.-J., Cochran, B., Kahn Jr, P., Lawler, J., Levin, P., Tandon, P., Varanasi, U., Wolf, K., & Wood, S. (2017). Nature contact and human health: A research agenda. *Environmental Health Perspectives*, 125(7), 1018. <https://doi.org/10.1289/EHP1663>
- Gray, T., Norton, C., Breault-Hood, J., Christie, B., & Taylor, N. (2018). Curating a public self: Exploring social media images of women in the outdoors. *Journal of Outdoor Recreation, Education, and Leadership*, 10, 153–170. <https://doi.org/10.18666/JOEL-2018-V10-I2-8191>
- 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>
- Helms, K., Ferreira, P., Brown, B., & Lampinen, A. (2019). Away and (dis)connection: Reconsidering the use of digital technologies in light of long-term outdoor activities. *Proceedings of the ACM on Human-Computer Interaction*, 3, 1–20. <https://doi.org/10.1145/3361111>
- Hitchings, R. (2021). *The unsettling outdoors: Environmental estrangement in everyday life*. Wiley Blackwell.
- Horvath, J., Munding, C., Schmitgen, M., Wolf, N., Sambataro, F., Hirjak, D., Kubera, K., Koenig, J., & Wolf, R. (2020). Structural and functional correlates of smartphone addiction. *Addictive Behaviors*, 105, 106334. <https://doi.org/10.1016/j.addbeh.2020.106334>
- Huang, Y.-T., & Su, S.-F. (2018). Motives for instagram use and topics of interest among young adults. *Future Internet*, 10(8), 77. <https://doi.org/10.3390/fi10080077>
- Jepson, P., & Ladle, R. (2015). Nature apps: Waiting for the revolution. *Ambio*, 44, 827–832. <https://doi.org/10.1007/s13280-015-0712-2>
- Jones, M., Cheverst, K., Anderson, Z., Dalber, F., & Häkkinen, J. (2018). *HCI outdoors: Understanding human-computer interaction in outdoor recreation CHI 2018*, April 21–26, 2018, Montréal, QC, Canada.
- Keeler, B., Wood, S., Polasky, S., Kling, C., Filstrup, C., & Downing, J. (2015). Recreational demand for clean water: Evidence from geo-tagged photographs by visitors to lakes. *Frontiers in Ecology and the Environment*, 13, 76–81. <https://doi.org/10.1890/140124>
- Kellert, S., & Wilson, E. O. (1993). *The biophilia hypothesis*. Island Press.
- Kerber, F., Daiber, F., & Krüger, A. (2018). *HCI outdoors: How smart wearables can help to promote a better lifestyle workshop on HCI Outdoors: Understanding human-computer interaction in the outdoors at CHI 2018*. April 21, 2018, Montréal, Canada.
- Levin, N., Kark, S., & Crandall, D. (2015). Where have all the people gone? Enhancing global conservation using night lights and social media. *Ecological Applications*, 25(8), 2153–2167. <https://doi.org/10.1890/15-0113.1>
- MacKerron, G., & Mourato, S. (2013). Happiness is greater in natural environments. *Global Environmental Change*, 23, 992–1000. <https://doi.org/10.1016/j.gloenvcha.2013.03.010>
- Maller, C., Townsend, M., Pryor, A., Brown, P., & St Leger, L. (2006). Healthy parks healthy people: 'Contact with nature' as an upstream health promotion intervention for populations. *Health Promotion International*, 21, 45–54.

- McEwan, K., Ferguson, F., Richardson, M., & Cameron, R. (2020). The good things in urban nature: A thematic framework for optimising urban planning for nature connectedness. *Landscape and Urban Planning*, 194, 103687. <https://doi.org/10.1016/j.landurbplan.2019.103687>
- McEwan, K., Richardson, M., Sheffield, D., Ferguson, F., & Brindley, P. (2019). A smartphone app for improving mental health through connecting with urban nature. *International Journal of Environmental Research and Public Health*, 16, 3373. <https://doi.org/10.3390/ijerp16183373>
- Meier, A., Gilbert, A., Borner, S., & Possler, D. (2020). Instagram inspiration: How upward comparison on social network sites can contribute to well-being. *Journal of Communication*, 70, 721–743. <https://doi.org/10.1093/joc/jqaa025>
- Melumad, S., & Tuan Pham, M. (2020). The smartphone as a pacifying technology. *Journal of Consumer Research*, 47, 237–255. <https://doi.org/10.1093/jcr/ucaa005>
- Michael, M. (2009). The cellphone-in-the-countryside: On some of the ironic spatialities of technonature. In D. F. White & C. Wilbert (Eds.), *Technonatures: Environments, technologies, spaces, and places in the twenty-first century* (pp. 85–104). Wilfrid Laurier University Press.
- Palfrey, J. (2010). *Born digital: Understanding the first generation of digital natives*. Basic Books.
- Panova, T., & Carbonell, X. (2018). Is smartphone addiction really an addiction? *Journal of Behavioral Addictions*, 7(2), 252–259. <https://doi.org/10.1556/2006.7.2018.49>
- Pergams, O., & Zaradic, P. (2006). Is love of nature in the US becoming love of electronic media? 16-year downtrend in national park visits explained by watching movies, playing video games, internet use, and oil prices. *Journal of Environmental Management*, 80, 387–393. <https://doi.org/10.1016/j.jenvman.2006.02.001>
- Phillips, R., & Kau, K. (2019). Gaming for active nature engagement. Animal Diplomacy Bureau: Designing games to engage and create player agency in urban nature. *The Design Journal*, 22, 1587–1602. <https://doi.org/10.1080/14606925.2019.1594993>
- Pluntz, R., Zhou, Y., Vintimilla, M., McKeown, K., Yu, T., Ugocioni, L., & Sutto, M. (2019). Twitter sentiment in New York City parks as measure of well-being. *Landscape and Urban Planning*, 189, 235–246. <https://doi.org/10.1016/j.landurbplan.2019.04.024>
- Posti, M., Schöning, J., & Häkkinen, J. (2014). *Unexpected Journeys with the HOBbit - The Design and Evaluation of an A-social Hiking App DIS 2014*, June 21–25, 2014, Vancouver, Canada.
- Preece, J. (2017). How two billion smartphone users can save species! *Interactions*, 24(2), 26–33. <https://doi.org/10.1145/3043702>
- Richardson, M., Hussain, Z., & Griffiths, M. (2018). Problematic smartphone use, nature connectedness, and anxiety. *Journal of Behavioral Addictions*, 7(1), 109–116. <https://doi.org/10.1556/2006.7.2018.10>
- Richardson, M., & Sheffield, D. (2017). Three good things in nature: Noticing nearby nature brings sustained increases in connection with nature. *Psychology*, 8, 1–32.
- Roberts, H., Resch, B., Sadler, J., Chapman, L., Petutschnig, A., & Zimmer, S. (2018). Investigating the emotional responses of individuals to urban green space using twitter data: A critical comparison of three different methods of sentiment analysis urban. *Planning*, 3(1), 21–33. <https://doi.org/10.17645/up.v3i1.1231>
- Roberts, H., Sadler, J., & Chapman, L. (2017). Using Twitter to investigate seasonal variation in physical activity in urban green space. *Geo: Geography and Environment*, 4(2), 1–14. <https://doi.org/10.1002/geo2.41>
- Roberts, H., Sadler, J., & Chapman, L. (2019). The value of Twitter data for determining the emotional responses of people to urban green spaces: A case study and critical evaluation. *Urban Studies*, 56(4), 818–835. <https://doi.org/10.1177/0042098017748544>
- Rogers, A., & Leung, Y.-F. (2021). 'More helpful than hurtful'? Information, technology, and uncertainty in outdoor recreation. *Leisure Sciences*. <https://doi.org/10.1080/01490400.2020.1871132>
- Schwartz, A., Dodds, P., O'Neil-Dunne, J., Danforth, C., & Ricketts, T. (2019). Visitors to urban greenspace have higher sentiment and lower negativity on Twitter. *People and Nature*, 1, 476–485. <https://doi.org/10.1002/pan3.10045>
- Smith, T., Laurier, E., Reeves, S., & Dunkley, R. (2020). 'Off the beaten map': Navigating with digital maps on moorland. *Transactions of the Institute of British Geographers*, 45(1), 223–240. <https://doi.org/10.1111/tran.12336>
- Soro, A., Brereton, M., Dema, T., Oliver, J., Chai, M., & Ambe, A. (2018). The ambient birdhouse: An IoT device to discover birds and engage with nature CHI 2018, April 21–26, 2018, Montréal, QC, Canada.
- Taylor, K., & Silver, L. (2019). Smartphone ownership is growing rapidly around the world, but not always equally. *Pew Research Center*, 46, 1–46.
- Thulin, E., Vilhelmson, B., & Schwanen, T. (2020). Absent friends? Smartphones, mediated presence, and the recoupling of online social contact in everyday life. *Annals of the American Association of Geographers*, 110(1), 166–183. <https://doi.org/10.1080/24694452.2019.1629868>
- Truong, M.-X., & Clayton, S. (2020). Technologically transformed experiences of nature: A challenge for environmental conservation? *Biological Conservation*, 244, 108532. <https://doi.org/10.1016/j.biocon.2020.108532>
- Valtchanov, D., & Hancock, M. (2015). *EnviroPulse: Providing feedback about the expected affective valence of the environment CHI 2015*, Crossings, Seoul, Korea.
- Wang, C., Geng, L., & Rodriguez-Casallas, J. (2021). The role of nature-deficit disorder in the associations between mobile phone overuse and well-being and mindfulness. *Current Psychology*. <https://doi.org/10.1007/s12144-021-01453-9>
- Ward Thompson, C. (2002). Urban open spaces in the 21st century. *Landscape and Urban Planning*, 60, 59–72.
- Wilkie, S., Thompson, E., Cranner, P., & Ginty, K. (2020). Attention restoration theory as a framework for analysis of Tweets about urban green space: A case study. *Landscape Research*, 45, 777–788. <https://doi.org/10.1080/01426397.2020.17383>
- Wu, X., Lindsey, G., Fisher, D., & Wood, S. (2017). Photos, tweets, and trails: Are social media proxies for urban trail use? *The Journal of Transport and Land Use*, 10(1), 789–804. <https://doi.org/10.5198/jtlu.2017.1130>
- Zhang, J., Piff, P., Iyer, R., Koleva, S., & Keltner, D. (2014). An occasion for unselfing: Beautiful nature leads to prosociality. *Journal of Environmental Psychology*, 37, 61–72. <https://doi.org/10.1016/j.jenvp.2013.11.008>

SUPPORTING INFORMATION

Additional Supporting Information may be found in the online version of the article at the publisher's website.

How to cite this article: Hitchings, R., & Maller, C. (2022).

Smartphone interactions and nature benefits: How predominant approaches picture social life and ways of advancing this work. *People and Nature*, 4, 4–14. <https://doi.org/10.1002/pan3.10263>