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The rarity of direct experiences of nature in an urban population

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HIGHLIGHTS

- The most common form of nature experience involves not being present in nature.
- Accumulatively 75% of time in nature was experienced by just 32% of the population.
- People who experience nature regularly are the exception as opposed to the norm.
- Connectedness to nature was positively correlated with spending time in nature.
- Deconstructing nature dose will allow the development of targeted health outcomes.

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ABSTRACT

As people live more urbanised lifestyles there is potential to lose daily contact with nature, diminishing access to the wide range of associated health benefits of interacting with nature. Experiences of nature vary widely across populations, but this variation is poorly understood. We surveyed 1023 residents of an urban population in the UK to measure four distinctly different nature interactions: indirect (viewing nature through a window at work and at home), incidental (spending time outside at work), intentional (time spent in private gardens) and intentional (time spent in public parks). Scaled-up to the whole study population, accumulation curves of the total number of hours per week that people were exposed to each type of nature interaction showed that 75% of nature interactions were experienced by half the population. Moreover, 75% of the interactions of a type where people were actually present in nature were experienced by just 32% of the population. The average hours each individual experienced nature per week varied across interactions: indirect (46.0 ± 27.3 SD), incidental (6.4 ± 12.7 SD), intentional-gardens (2.5 ± 2.9 SD) and intentional-parks (2.3 ± 2.7 SD). Experiencing nature regularly appears to be the exception rather than the norm, with a person's connection to nature being positively associated with incidental and intentional experiences. This novel study provides baseline information regarding how an urban population experiences different types of nature. Deconstructing nature experience will pave the way for developing recommendations for targeted health outcomes.

1. Introduction

With over 70% of the global human population predicted to live in cities within 30 years (WHO, 2016a), urbanisation is considered one of the most significant health issues of the 21st century (WHO, 2016b), tied as it is to growing levels of chronic, non-communicable and mental health conditions (Dye, 2008; Sundquist, Frank, & Sundquist, 2004). Urban nature has the potential to help mitigate many of these health issues (Keniger, Gaston, Irvine, & Fuller, 2013; Shanahan, Lin et al., 2015), with demonstrable links between exposure to nature and health and well-being benefits (Hough, 2014; Keniger et al., 2013; Shanahan, Fuller, Bush, Lin, & Gaston, 2015). These benefits span a remarkable range of health outcomes, with evidence for reduced all-cause mortality and mortality from cardiovascular disease (Donovan et al., 2013; Mitchell & Popham, 2008), reduced allergies (Hanski et al., 2012), enhanced general and self-reported health (e.g. Groenewegen, van den Berg, Maas, Verheij, & de Vries, 2012; Maas, Verheij, Groenewegen, de Vries,

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& Spreeuwenberg, 2006), improved self-reported wellbeing and a reduced risk of poor mental health (e.g. Bratman, Hamilton, & Daily, 2012; Bratman, Hamilton, Hahn, Daily, & Gross, 2015; Fuller, Irvine, Devine-Wright, Warren, & Gaston, 2007; White, Alcock, Wheeler, & Depledge, 2013) and improved cognitive ability (Berman, Jonides, & Kaplan, 2008; Han, 2009).

Within the urban environment, exposure to nature is more complex and versatile than often portrayed; to a greater or lesser extent many people are exposed to components of nature throughout their daily lives. Keniger et al. (2013) identified three types of nature interactions. First, there is robust evidence for the benefits from 'indirect interactions' with nature while not being present in it (e.g. having a view of nature from home or work), including increased psychological well-being (Kaplan, 2001) and reduced stress at work (Kaplan, 1993). Second, people benefit from 'incidental interactions' with nature while carrying out another activity (e.g. walking past street trees during daily activities), which can lead to decreased levels of stress (Kaplan, 1993; Lottrup, Grahn, & Stigsdotter, 2013). Third, there is a broad range of benefits provided by 'intentional interactions' (e.g. where someone intends to interact with nature through visiting parks or gardens), including reduced mortality from cardiovascular disease (Mitchell & Popham, 2008) and improved mental health (Fuller et al., 2007).

Plainly, different people receive different levels of each kind of nature experience. This variation likely results from a combination of orientation and opportunity (Lin, Fuller, Bush, Gaston, & Shanahan, 2014; Soga & Gaston, 2015). Some people are more inclined towards interacting with nature (orientation), and some have greater access to those interactions (opportunity). Orientation and opportunity are themselves shaped by a wide array of factors including location, age, gender, ethnicity, income and education, and potentially complex interactions between them (Lin et al., 2014; McCormack, Rock, Toohey, & Hignell, 2010). The net outcome, combined with the composition of an urban population, will determine the extent to which nature interactions are distributed across that population in a more or less equitable fashion (with interactions being roughly equally distributed or disproportionately experienced by a small number of people). To date, this outcome is poorly understood.

Deconstructing people's daily nature experience is the first step towards better integrating science with planning and policy for improved health outcomes (Shanahan, Lin et al., 2015). Modelling how, where and what type of nature people experience will allow a clearer understanding of how targeted green planning can be better incorporated into the daily lives of urban dwellers. For example, what kind of environments encourage walking (Middleton, 2010), with the implications for behavioural change, advocacy, design and policy to create better urban environments.

In an urban population we examine four common nature interactions for which there is tangible evidence for pathways of benefit delivery: indirect interactions (time spent at home and at work in a room with a view of nearby nature); incidental interactions (time spent outside as part of job); intentional interactions (time spent in private gardens) and intentional interactions (time spent in public parks). We explore three questions: (1) How are experiences of nature distributed across different nature interactions? (2) How does this vary across the population? (3) How are these experiences distributed across socio-demographic groups?

2. Material and methods

This study was conducted within the urban limits of the 'Cranfield triangle' (52°07′N, 0°61′W), a region in southern England, U.K., comprising three adjacent towns of Milton Keynes, Luton and Bedford. These have a human population of c. 609,501 (2011 Census, UK), and occupy 166 km^2. An urban lifestyle survey, delivered online through a market research company (Shape the Future Ltd.), was completed in May 2014 by 1023 adults enrolled in their survey database. Participants were self-selecting and were compensated with a nominal fee. Within the questionnaire, we collected several socio-demographic covariates that could influence nature interactions including age, gender, the primary language spoken at home, personal annual income, highest formal qualification, self-assessment of health and nature orientation (Table S1 shows the variables and classifications for analysis purposes).

Respondents provided self-reported information on four types of common nature interaction that they experience in an average week:

(i) *Indirect interactions*: Time spent at home and at work in a room with a view of nearby nature (within 500m; defined as no view, trees, parks, countryside, lake, canal or river). Respondents were asked how many days a week they worked, before selecting how much time they spent in a room with a view of nature at home on an average workday and an average non-workday, and at work on an average working day. In each case respondents selected from the categories: Less than an hour; 1–2 h; >2–4 h; >4–6 h; >6–8 h; >8–10 h; >10–12 h; >12 h. The mid-points of the selected categories were chosen (where 12 or more hours was treated as '12′) and then the total time per week was calculated by summing the number of hours on a work day by the number of days worked, and adding the sum of the number of hours on a non-work day by the number of days not worked.

(ii) *Incidental interactions:* Time spent working outdoors in an average week. Respondents selected from the categories: No time; 5 h or less; 6–10 h; 11–20 h; 21–30 h; 31–40 h; 41–50 h; 51–60 h; 61–70 h; 71 or more hours; Most of the time (in a separate question respondents were asked how many hours they spend at work). The mid-points of selected categories were chosen (where 71 or more hours was treated as '71').

(iii) *Intentional interactions (gardens):* Time spent in private gardens. Respondents selected the total time spent in their private gardens in the last week from the categories; I don't have a garden/no time (these answers were combined, because both responses indicate no experiences of nature in private gardens), 1–30 min, 31 min to 1 h, >1–3 h, >3–5 h; >5–7 h, >7–9 h, >9 h. The mid-points of the selected categories were used for analysis purposes (where 9 or more hours was treated as '9').

(iv) *Intentional interactions (parks):* Time spent in up to seven public parks. Respondents selected from the categories; 1–29 min; 30 min −1 h; >1–2 h, >2–3 h, >3–4 h, >4 h. The mid-points of the selected categories were identified (where 4 or more hours was treated as '4') and then the total time was summed across all public parks visited.

2.1. Statistical analysis

We built a generalised linear mixed model with a Gaussian error distribution to model the total time spent experiencing each type of nature interaction (dependent variable), with each respondent as a random effect, against the type of nature interaction, nature orientation, self-assessment of health, age, income, gender, education and ethnicity. We log-transformed the dependent variable so that it was approximately normally distributed, before testing for the effects of covariates and paired interactions (nature interaction*nature orientation, nature interaction*age, nature interaction*income). We used the 'MuMIn' package (Bartoń, 2015) to produce all subsets of models based on the global model and rank them based on AICc. Following Richards (2005) we retained all models where $\Delta AIC_c < 6$. We then used model-averaging to produce the coefficients with standard errors and 95%