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Research Paper

The benefits of nature experience: Improved affect and cognition

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HIGHLIGHTS

- Nature experience produced clear benefits for affect (e.g., decrease in anxiety and rumination).
- Nature experience produced some benefits for cognition (complex working memory span task).
- Supports the idea that exposure to natural greenspace can improve affect and cognition.

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ABSTRACT

This study investigated the impact of nature experience on affect and cognition. We randomly assigned sixty participants to a 50-min walk in either a natural or an urban environment in and around Stanford, California. Before and after their walk, participants completed a series of psychological assessments of affective and cognitive functioning. Compared to the urban walk, the nature walk resulted in affective benefits (decreased anxiety, rumination, and negative affect, and preservation of positive affect) as well as cognitive benefits (increased working memory performance). This study extends previous research by demonstrating additional benefits of nature experience on affect and cognition through assessments of anxiety, rumination, and a complex measure of working memory (operation span task). These findings further our understanding of the influence of relatively brief nature experiences on affect and cognition, and help to lay the foundation for future research on the mechanisms underlying these effects.

1. Introduction

Urbanization is progressing at a rapid rate around the globe. Over half of humanity now lives in urban areas. By 2050 this proportion is expected to exceed 70% (Heilig, 2012). This unprecedented shift from rural to urban living is associated with a significant decrease in exposure to natural environments (Skár & Krogh, 2009; Turner, Nakamura, & Dinetti, 2004). Coincident with urbanization, there is also evidence of an increase in the worldwide prevalence of mental disorders (Patel, Flisher, Hetrick, & McGorry, 2007; Whiteford et al., 2013). Growing evidence suggests that these two trends may be linked, with decreased exposure to nature causing changes in psychological functioning (Bronzaft, 2002; Hartig, Evans, Jamner, Davis, & Garling, 2003; Kaplan, 1995; Kuo & Sullivan, 2001; Lederbogen et al., 2011; Lorenc et al., 2012; Stansfeld, Haines, & Brown, 2000; Ulrich et al., 1991; for a review see Bratman, Hamilton, & Daily, 2012).

As the world urbanizes and people spend less time in regular contact with natural environments, urban planners and other public policy decision-makers are turning to research in environmental psychology to help inform them of the relationship between exposure to nature and mental health (Beil & Hanes, 2013; Bell, Greene, Fisher, & Baum, 2001; Gifford, Steg, & Reser, 2011; Hartig, Mitchell, de Vries, & Frumkin, 2014; Health Council of the Netherlands, 2004; Keniger, Gaston, Irvine, & Fuller, 2013; Parsons & Daniel, 2002; Spencer & Woolley, 2000; Taylor & Kuo, 2006; Van Dillen, de Vries, Groenewegen, & Spreeuwenberg, 2012). This study aims to contribute to the literature concerned with the examination of this relationship.

1.1. Prior studies

A wide variety of research findings suggest that exposure to nature may have an impact on psychological functioning. For

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example, Leather, Pyrgas, Beale and Lawrence (1998) and Kaplan (2001) found that window views of nature from the office and home were associated with higher degrees of well-being and life satisfaction. Taylor, Kuo and Sullivan (2002) showed that among children living in urban environments, those who had everyday views of nature (e.g., a tree outside their apartment window, instead of a view of concrete) performed better on tasks that measured working memory (backward digit span, backward alphabet span), impulse inhibition (matching familiar figures task), selective attention (Stroop color-word task), and concentration (Necker Cube pattern control task). These findings suggest that greater exposure to natural environments may be associated with a range of important benefits.

Such benefits from nature exposure have now been found across a wide range of different types of contact (e.g., photographs, everyday window views, physical presence in natural environments) as assessed using a variety of different research approaches, including cross-sectional, longitudinal, and experimental designs. Benefits from nature exposure have also been observed across varying durations of exposure; from a few minutes of viewing images, to hour-long or multi-day wilderness experiences, up to life-long proximity to greenspace. The diversity of findings suggests that the impact of nature experience on psychological functioning may be both widespread and robust.

Two major theories have been proposed to explain nature's restorative benefits. They suggest that one useful way to categorize the empirical findings in the literature is to distinguish between the affective and cognitive benefits of nature experience. Each of these two theories is described briefly below, under the type of impact (affective or cognitive) with which it is most directly associated.

1.1.1. The affective impact of nature experience

Stress reduction theory (SRT) provides an explanation for the impact of nature experience on affect. This theory posits that natural environments have a restorative advantage over artificial environments due to the role that they played in our evolution as a species (Ulrich, 1981). More specifically, according to this view, nature scenes activate our parasympathetic nervous system in ways that reduce stress and autonomic arousal, because of our innate connection to the natural world. Particular natural landscapes (especially grasslands with clusters of trees) tended to provide human beings with "opportunities" for gain, and places of "refuge" for safety. According to Ulrich et al. (1991), viewing these types of landscapes activates our physiology in affectively beneficial ways, as we have evolved to have an innate preference for these types of environments. Ulrich's theory provides a set of testable hypotheses regarding nature's impact on the autonomic nervous system, and these have been tested via the use of physiological measurements of individuals during their exposure to various environments.

In support of SRT, viewing photographic images and videos of natural scenery has been shown to reduce skin conductance, heart rate, and other physiological indicators of stress (Gladwell et al., 2012; Laumann, Gärling & Stormark, 2003; Ulrich et al., 1991). Similarly, walking through forests and other natural landscapes reduces cortisol levels (Park, Tsunetsugu, Kasetani, Kagawa, & Miyazaki, 2009; Tyrväinen et al., 2014). In addition to these improvements on physiological measures of stress, a 50-min walk through a natural environment can increase positive affect (Berman, Jonides, & Kaplan, 2008; Berman et al., 2012; Hartig et al., 2003). In other cross-sectional and longitudinal studies, proximity to greenspace has been shown to promote lower levels of "mental distress" and stress, as well as greater psychological well-being (General Health Questionnaire), after controlling for demographic and socioeconomic factors (Ward Thompson et al., 2012; Wells, 2000; White, Alcock, Wheeler, & Depledge, 2013). These findings suggest that exposure to nature, broadly defined, can decrease stress and increase positive affect.

If decreased exposure to nature is causing changes in mental health, one might expect the affective consequences to extend beyond stress and positive mood. For example, many psychological disorders are associated with changes in other aspects of affect, including increases in anxiety, rumination, and negative mood. Importantly, prior studies have not specifically assessed anxiety or rumination, although some have employed scales that may in part reflect changes in anxiety (e.g., Perceived Stress Scale in Ward Thompson et al., 2012). With some notable exceptions (e.g., Hartig et al., 2003; Ulrich, 1979), fewer studies have observed impacts of nature experience on negative affect. This study aims to address these gaps by examining the impacts of nature experience on these aspects of affective responding.

1.1.2. The cognitive impact of nature experience

Why might nature experience influence cognition? According to Attention Restoration Theory (ART), urban environments heavily tax the top-down voluntary attentional control that is required to filter relevant from irrelevant stimuli adequately. Demands from the urban environment deplete this cognitive resource, and can thereby worsen performance on tasks that rely on this focused, directed attention (Hartig, Mang, & Evans, 1991; Kaplan & Kaplan, 1989). According to ART, natural environments invoke a different sort of attention from people – a sense of "fascination," "being away," "extent," and "compatibility" – that may result in the replenishment of directed attention because they are less heavily taxed in these alternative environments. This, in turn, may lead to improved performance on tests that measure memory and attention.

Consistent with ART, Tennessen and Cimprich (1995) found that dormitory students who had views of nature through their windows performed better on tasks that require concentration (Necker Cube pattern test) than students without such views. Berto (2005) demonstrated the restorative influence of nature on sustained attention (sustained attention to response test), showing that participants who viewed nature photographs performed better on the task than those who saw images of urban environments. Similarly, walking through a natural greenspace, compared to walking through an urban environment, yields benefits for verbal working memory (backward digit span), cognitive control (executive attention component of the attention network task), and concentration (Necker Cube pattern test) (Berman et al., 2008, 2012; Hartig et al., 2003). These results suggest that exposure to nature improves performance on cognitive tasks that require directed attention.

A primary measure of working memory used in prior studies is the backward digit span task. While this task may recruit voluntary executive control to some degree, it is typically thought to reflect domain-specific storage processes (i.e., the ability to keep phonological information in short-term memory) more than domain-general executive control processes (e.g., Engle, Tuholski, Laughlin, & Conway, 1999). By contrast, *complex* span tasks, which employ a demanding concurrent task to prevent participants from simply rehearsing the items, are thought to provide a clearer assessment of voluntary control mechanisms in working memory. To our knowledge, performance on complex working memory span tasks has not been assessed after exposure to nature. Similarly, it is not yet clear whether these cognitive benefits generalize beyond verbal working memory measures to executive control over visuospatial working memory representations. Therefore, in this study we aim to broaden the examination of cognitive impacts by adding assessments of dual-task memory (operation span task) and visuospatial working memory (change detection task).