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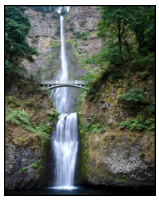

Restoration, well-being, and everyday physical activity in indoor, built outdoor and natural outdoor settings

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ABSTRACT

Physical activity in natural settings has been found in experimental research to be more restorative than physical activity in built indoor or outdoor settings, yet we lack evidence of this in everyday life. In this study we examined recalled restoration (with the 9-item Restoration Outcome Scale) of the most recent physical activity session in indoor, built outdoor and natural outdoor settings using measurement invariance tests (n = 2577). We also compared the relationships between restoration, emotional well-being and frequency of physical activity in these groups. Recalled restoration formed two factors, Restorativeness and Assurance, in all groups, with equal loadings but partly varying item-specific means. Restorativeness was positively connected to emotional well-being in all settings but it did not explain the connection between well-being and physical activity in natural settings. Future studies could explore in more detail how emotional well-being and repeated restoration in different types of environments intertwine.

1. Introduction

Contact with nature has consistently shown a positive correlation with well-being (Hartig, Mitchell, de Vries, & Frumkin, 2014). A recent synthesis identified three major pathways that explain this correlation: harm reduction (such as less pollution and noise), psychological restoration (attention restoration, stress reduction), and capacity building (such as social cohesion and physical activity; Markevych et al., 2017). These different pathways intertwine and may be mutually reinforcing. For example, natural environments are often conducive to physical activity, known to enhance well-being, and they have also been suggested to bring an added value to the known benefits of physical activity in relation to built indoor or outdoor environments (Bowler, Buyung-Ali, Knight, & Pullin, 2010; Fox, 1999; Markevych et al., 2017; Pasanen, Tyrväinen, & Korpela, 2014; Thompson Coon et al., 2011). This added value has been explained by experienced psychological restoration, covered by two well-known theories within environmental psychology (Markevych et al., 2017). Ulrich's stress reduction theory (STR) describes a restorative experience as both psychologically and physically reduced stress (Ulrich, 1983; Ulrich et al., 1991). Kaplan and Kaplan's attention restoration theory (ART) sees stress as depleted attentional capacities which recover and are replenished involuntarily and effortlessly during a restorative experience (Kaplan & Kaplan, 1989; Kaplan, 1995). However, the majority of the evidence indicating that physical activity in natural settings is more restorative than physical activity in built indoor and outdoor settings is experimental, and observational evidence from restorative everyday experiences is lacking (Markevych et al., 2017). We do not know if restorative experiences through physical activity differ in everyday life when individuals have themselves chosen the activity and its setting.

Restoration is a short-term, mood-like state involving affective, physiological and attention restoration (Kaplan & Kaplan, 1989). These different aspects of restoration have been integrated in the Restoration Outcome Scale (Korpela, Ylén, Tyrväinen, & Silvennoinen, 2008), widely used in empirical research on restorative environments. The scale originally consisted of six items deriving from SRT and ART (Korpela et al., 2008; cf.; Hartig, Lindblom, & Ovefelt, 1998) and it was later extended into a 9-item version based on empirical evidence. The additional items measure vitality (an energetic positive state) and self-confidence (Korpela & Ylén, 2009), both consistently found to improve after contact with restorative (natural) environments (Barton & Pretty, 2010; Ryan et al., 2010). Restoration is a multifaceted experience and precise knowledge of the effects of nature on these different aspects would help to better evaluate the contributions of each component in the restorative process. How these additional concepts, vitality and self-confidence, relate to and interact with each other and the stress- and attention-related concepts has nevertheless not been examined to date to our knowledge.

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The theories and the majority of the applied research on restorative environments have focused on examining natural settings (Kaplan & Kaplan, 1989; San Juan, Subiza-Pérez, & Vozmediano, 2017; Ulrich, 1983). The restorative potential of built urban settings has been largely ignored, and often unpleasant urban scenes have been chosen merely to highlight the restorative qualities of nature (Karmanov & Hamel, 2008; San Juan et al., 2017). As recent evidence suggests that urban settings can also be restorative (Stigsdotter, Corazon, Sidenius, Kristiansen, & Grahn, 2017), there is a need to evaluate whether they provide restoration on similar aspects as natural settings. Similarly, the restorative potential of physical activity in indoor environments has been underinvestigated (Hug, Hartig, Hansmann, Seeland, & Hornung, 2009). Physical activity indoors has become more and more popular in recent decades in Finland, while the share of physical activity in natural settings has decreased (Husu, Paronen, Suni, & Vasankari, 2011). To assess if and how different types of environments for physical activity support our everyday restoration, we examine recalled restoration after physical activity in indoor, built outdoor and natural outdoor environments.

Both situational and individual factors play a role in what kind of environments we choose for physical activity. Not all physical activity can be conducted in (natural) outdoor settings due, for example, to weather, seasonal variation and lack of facilities. These constraints reflect the activities conducted: the most common activities in indoor environments are gymnastics and swimming, whereas in outdoor environments people prefer to walk, cycle and ski (Husu et al., 2011). Individual characteristics, such as identifying with the natural or urban, influence the types of environments we choose to visit and how restored we feel after visiting them (Morton, van der Bles, & Haslam, 2017). Furthermore, individuals may use natural and built, indoor or outdoor environments for different reasons and restoration needs (Hartig et al., 2014; Markevych et al., 2017). Having different motives for physical activity such as maintaining physical fitness and reducing stress does not, however, exclude the possibility of experiencing restoration, but restoration may be qualitatively different after physical activity conducted for different reasons in different types of environments (Markevych et al., 2017; Pasanen, Neuvonen, & Korpela, 2017).

One way to disentangle the potentially different restorative qualities that built and natural environments may support is to assess restoration with more detailed methods. Experimental studies often compute summary scores of different psychometric scales measuring restorative outcomes. Summary scores, even though useful in some cases, can mask differences between the items within a scale by assigning equal weight to each variable (Marsh, Lüdtke, Nagengast, Morin, & Von Davier, 2013; Williams & O'Boyle, 2008). More refined methods that assess the qualities within and between scales, such as structural equation modelling (SEM) have become common in psychological research and their use in environmental psychology has been encouraged (Hine, Corral-Verdugo, Bhullar, & Frias-Armenta, 2016; Markevych et al., 2017). With SEM we can assess if and how items within a scale intercorrelate and compare the correlative structures between different groups by a methodology known as measurement invariance (Kline, 2016). We use these measurement invariance methods in the first part of this study to explore the qualitative and quantitative differences in restorative experiences after everyday physical activity in different types of environments.

Restorative experiences may be important for our everyday coping and resource management (Hartig et al., 2014). Hence an underlying idea in restorative environments research has been that experiencing restoration (in natural settings) repeatedly supports emotional well-being in the longer-term (Hartig et al., 2014; Markevych et al., 2017). We call this the *repeated restoration hypothesis*. This idea that recurrent restorative experiences accumulate over time into greater well-being has not, however, been properly addressed in past research (Markevych et al., 2017). There is some experimental evidence to suggest that perceived restoration mediates the increase in positive affect followed by exposure to natural rather than urban, virtual settings (McAllister, Bhullar, & Schutte, 2017) but similar findings from everyday life are scarcer. Tentative evidence was provided in a study by Korpela, Borodulin, Neuvonen, Paronen, and Tyrväinen (2014), where recalled restoration from the most recent visit to nature mediated the relationship between the frequency of visiting natural environments and emotional well-being. This study, however, was limited to natural settings.

Although the evidence for repeated restoration is so far scarce, we know more about the direct connection between well-being and exposure to natural settings. Residents in greener neighbourhoods constantly rate their mental well-being better than those in less green areas (van den Berg et al., 2015). Similarly, more frequent PA in natural settings (but not in indoor or built outdoor environments) has been associated with greater emotional well-being (Pasanen et al., 2014). Yet the evidence is partly ambiguous. Mitchell (2013) found that regular physical activity in natural environments was connected to a reduced risk of poor mental health, whereas regular physical activity indoors was connected to positive aspects of well-being. One possible explanation for these inconsistent findings could again be that different types of environments induce different types of positive responses (Mitchell, 2013). We know that physical activity in general, regardless of the environment, is moderately related to better emotional well-being (Fox, 1999; Penedo & Dahn, 2005). This connection is mediated by mood enhancement and increased self-esteem, indicating that the positive effects of physical activity on mood and self-esteem accumulate over time into greater longer-term well-being (Fox, 1999). The 'repeated restoration' hypothesis, in turn, suggests that regular physical activity in natural environments is connected to emotional well-being specifically via repeated restorative experiences. Is this connection exclusive to, or stronger, in natural environments than in other settings? This question is the focus of the second part of our study.

Our study makes two main contributions to the research on restorative environments. First, we examine in detail whether restorative outcomes of recent everyday physical activity differ in quantity and/or quality between three types environments: indoor (for example, home or a gym), built outdoor (streets, sports fields) and natural outdoor settings (forests, urban parks). Second, we examine the 'repeated restoration' hypothesis by assessing whether the frequency of physical activity and recalled restoration in indoor, built outdoor and natural outdoor settings are related to emotional well-being in different ways.

2. Materials and methods

2.1. Data

We used two rounds from the 'Outdoor recreation demand inventory', collected in winter and spring/summer 2009 by Statistics Finland (Sievänen & Neuvonen, 2011). In these two rounds the survey was sent to a sample of 8000 randomly selected Finnish citizens aged 15–74 years, drawn from the population registry. With 3060 respondents, the response rate was 38%. The response rates were higher for women than men, and younger age groups were underrepresented in comparison to older age groups (Virtanen, Nyberg, Salonen, Neuvonen, & Sievänen, 2011). However, these biases were relatively small, and the interviewed sample of the non-respondents revealed no differences in the recreation patterns of the respondents and non-respondents (Virtanen et al., 2011). We excluded those respondents who reported physical handicaps that prevented them from engaging in physical activity outdoors. Due to this screening and missing responses, the present analyses included 2568–2577 respondents (Table 1).

2.2. Measures

Recalled restoration after the most recent physical activity was measured with 9-item Restoration Outcome Scale where the

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