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The influence of urban green environments on stress relief measures: A field experiment

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ABSTRACT

This study investigated the psychological (perceived restorativeness, subjective vitality, mood, creativity) and physiological (salivary cortisol concentration) effects of short-term visits to urban nature environments. Seventy-seven participants visited three different types of urban areas; a built-up city centre (as a control environment), an urban park, and urban woodland located in Helsinki, the capital of Finland. Our results show that the large urban park and extensively managed urban woodland had almost the same positive influence, but the overall perceived restorativeness was higher in the woodland after the experiment. The findings suggest that even short-term visits to nature areas have positive effects on perceived stress relief compared to built-up environment. The salivary cortisol level decreased in a similar fashion in all three urban environments during the experiment. The relations between psychological measures and physiological measures, as well as the influence of nature exposure on different groups of people, need to be studied further.

1. Introduction

The quality of urban environments is increasingly recognised to contribute to human health and well-being. The supply and maintenance of health-promoting areas and elements within urban areas such as green spaces are suggested to support residents' possibilities to cope with everyday stress and to have a beneficial effect on human health (Frumkin, 2001; Maas, Verheij, Groenewegen, de Vries, & Spreeuwenberg, 2006; Maller, Townsend, Pryor, Brown, & St Leger, 2005; Nilsson, Baines, & Konijnendijk, 2007). The continuing urbanisation process and pressures on existing green spaces, however, challenge the adequate provision of these areas. In urban planning processes, the health and well-being benefits of nature areas are not fully acknowledged and therefore, their provision is difficult to justify faced with competing land-use interests (e.g. Tyrväinen, Pauleit, Seeland, & de Vries, 2005).

In modern urbanised societies, acute and chronic stress, and insufficient recovery from stress, are recognised as an increasing problem and a cause for long-term effects on health (McEwen, 1998; Sluiter, Frings-Dresen, Meijman, & van der Beek, 2000). Stress is an important public health concern that is related to mental health problems such as burnout syndrome as well as cardiovascular, gastroenterological, immunological and neurological diseases (Nilsson, Sangster, & Konijnendijk, 2011). In Europe, for example, the main work-related problems include musculoskeletal problems (59.8%) followed by stress, depression or anxiety (13.7%) (Europe in figures – Eurostat Yearbook, 2011, p. 187). This suggests that stress control is a vital issue in maintaining good health and preventing stress-related diseases in urbanised societies. The current health care practices, however, are costly and often focus on the treatment of stress-related illnesses instead of preventing them.

Previous research shows that green spaces help to reduce stress, and generally enhance psychological recovery (e.g. Björk et al., 2008; Hartig, Evans, Jamner, Davis, & Gärling, 2003; Herzog, Maguire, & Nebel, 2003; Laumann, Gärling, & Stormark, 2003). For physiological recovery, there is somewhat less evidence of an effect (Bowler, Buyung-Ali, Knight, & Pullin, 2010), but there are studies reporting positive effects of green spaces on stress relief

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(Lee et al., 2012; Li et al., 2008; Park et al., 2007; Tsunetsugu et al., 2007). There is also increasing interest in studying whether nature may assist both in preventing illnesses that are mediated by psychological processes, such as stress, and in curing stress-related diseases, such as burnout and depression. The economic implications of any positive contribution of urban green settings to health are likely to be substantial (Nilsson et al., 2011).

Many studies from Europe, North America and Asia report that compared to urban environments, natural environments improve human mood states (Hartig et al., 2003; Hartig, Mang, & Evans, 1991; Morita et al., 2007; Tsunetsugu et al. 2013) as well as concentration and performance (van den Berg, Koole, & van der Wulp, 2003; Hartig et al. 2003, 1991; Laumann et al., 2003). Research has shown that even exposure to photographic pictures of nature, compared to pictures of urban environments, has positive effects on emotional states and cognitive performance (Hartmann & Apaolaza-Ibáñez, 2010; Ulrich et al., 1991).

A number of studies focussing on physiological stress-releasing effects of one type of nature area (forest) visits compared to visits in the built environment have been conducted in Japan. The field experiments conducted in different parts of the country show that forest visits can lower blood pressure and pulse rate, reduce cortisol level, suppress sympathetic nervous activity, and enhance parasympathetic nervous activity (Lee et al., 2012; Park, Tsunetsugu, Kasetani, Kagawa, & Miyazaki, 2010; Tsunetsugu et al., 2013).

Cortisol concentration is a widely utilised stress marker in the studies above but also in various other scientific fields. Cortisol is released by the hypothalamic pituitary adrenal (HPA) axis in response to stress (Seplaki, Goldman, Weinstein, & Lin, 2004), and it is considered one of the major components of the physiological stress response in humans (Ockenfels et al., 1995). Cortisol can be measured in blood, urine or saliva. In psychobiological research, salivary measurements are often preferred because of their non-invasive nature. Salivary cortisol can be a convenient and reliable parameter of endocrine stress responses (Kirschbaum & Hellhammer, 1989), because its response to stress is immediate and it is highly associated with the free cortisol fraction in the blood (Kirschbaum & Hellhammer, 1994). Importantly, the sampling procedure does not affect cortisol values (Kirschbaum & Hellhammer, 1989). In response to a stressor, the excretion of cortisol usually increases, but there is considerable diurnal variability in cortisol levels, normally peaking in early morning and declining towards the evening (Levine, Zagoory-Sharon, Feldman, Lewis, & Weller, 2007). Therefore, standardisation of the timing of sampling is important in field studies.

Salivary cortisol response to psychological stress is considered to be influenced by gender, as the response is generally greater in men compared to women (e.g. Kudielka, Buske-Kirschbaum, Hellhammer, & Kirschbaum, 2004; Lovallo, Farag, Vincent, Thomas, & Wilson, 2006). Moreover, nicotine and alcohol intake may reduce cortisol responses (Lovallo, Dickensheets, Myers, Thomas, & Nixon, 2000; Rohleder & Kirschbaum, 2005). Field studies conducted mainly in Japan with young male participants have reported lowered salivary cortisol concentrations by viewing landscapes in forested areas as well as walking in forest environments compared to built-up areas in city centres (Lee et al., 2011; Park et al., 2008, 2010), but results are still somewhat mixed. In a recent study conducted in Portland, United States, the salivary cortisol concentration when viewing different urban settings (from very natural to very built) revealed no differences between four experimental sites (Beil & Hanes, 2013). In that study, only a small number of participants (15) were involved. The participants visited each site for a short period (20 min) and may not have given enough time to allow measurable changes in salivary cortisol to occur. These results show that there is a need to have stronger evidence about the effect of green areas on stress relief in urban environments.

In the previous experiments, emotional responses have been measured mainly by Profile of Mood States, POMS (e.g. Park et al., 2009, 2010; Tsunetsugu, Park, & Miyazaki, 2010) and Zuckerman Inventory or Personal Reactions, ZIPERS (e.g. Hartig et al., 1991), but other emotional measures have seldom been used. However, the most consistent evidence over several studies on the differences between the effects of natural and urban environments concerns emotional outcomes (Bowler et al., 2010). Natural environments evoke positive moods (tranquillity and energy) and decrease negative moods such as anger, sadness and fatigue. Thus, we decided to use as short a measure of mood as possible (the Positive and Negative Affect Scale PANAS) and concentrate more on other, less studied experiences. Thus, we used the Restoration Outcome Scale (ROS) that has been used mainly in favourite place studies (Korpela, Ylén, Tyrväinen, & Silvennoinen, 2008). Moreover, vitality is a distinct but related concept to restoration (Ryan et al., 2010) and deserves further study in different environments. Lastly, it has been argued that research in this field should also consider how the environment fosters not only emotions and energy but also ongoing personal development such as creativity (Newell, 1997). Consequently, we also measured feelings of creativity.

Little experimental research has so far investigated how different real-world environmental settings actually influence stress. This is why there is a need to study the adult working people after their work day.

Moreover, little is known about the amount of exposure to nature areas needed to gain health benefits. The study of Tyrväinen, Silvennoinen, Korpela, and Ylen (2007) showed that the positive feelings (concentration, eagerness, vigour) of urban citizens were stronger when green areas were used more than five hours per month in comparison to those who used areas less or not at all. More research evidence is also needed about the health benefits of the use of different types of nature areas in an urban context. The current study aims to increase our knowledge about the effects of these types. In a recent study conducted in Finland, restorative experiences in favourite urban woodlands together with exercise and activity outdoor areas and waterside environments were significantly stronger than in favourite parks or built urban settings (Korpela, Ylén, Tyrväinen, & Silvennoinen, 2010).

1.1. Objectives

The main objective of this study was to investigate the restorative effects of short-term visits in three different types of urban environments: a built-up area in a city and two types of green areas, a park and a woodland (forested area). Thus, we add to earlier studies by including two different types of green environment.

As an individual's response to stress is a result of a complex, temporal chain of psychophysiological and emotional responses, we use both physiological and psychological indices/measures. We are interested in how these changes emerge in different phases of the experiment that includes both a viewing and a walking phase. More specifically, the aim was to study the effect of viewing and walking on perceived restorativeness, subjective vitality, mood, creativity, and salivary cortisol concentration.

We expect that the green areas differ in terms of their restorative quality, so that the woodland is a more restorative environment than the urban park. We hypothesise that all dependent variables (restoration, vitality, positive mood states) show stronger stress relief in green environments compared to the built-up environment (control) after the experiment. We expect a decrease in negative mood states and cortisol levels in green environments. Moreover, we expect that positive feelings decrease and cortisol level and negative feelings increase or remain unchanged in the built-up environment (city centre). Because we