



# It is not all bad for the grey city – A crossover study on physiological and psychological restoration in a forest and an urban environment<sup>☆</sup>



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## ABSTRACT

Today, urbanization presents a challenge to urban planning with regard to creating healthy living environments. The aim of this research is to gain further knowledge of the restorativeness of a best case urban and natural environment: that is a historic down town urban environment and forest environment located in an arboretum. The study has a cross-over design where 51 (N) female university students are exposed to the two environments through both seated viewing and walking. A mixed method approach is used with both physiological measurements of blood pressure (BP) and heart rate variability (HRV) and psychological measurements of mood change and perceived restorativeness. The HRV results show no significant differences between the two environments, and both environments are found to be more physiologically restorative than being at the office or on the minibus. The results of the psychological measures indicate that the forest walk has a positive effect on mood, while the walk in the urban environment has no effect. The forest environment is also rated more highly with regard to perceived restorativeness than the urban environment. The results support the current research that shows natural environments as more restorative than urban environments. The study also adds to the ongoing debate on healthy urban planning by indicating that architectural and historical qualities may be associated with the physiological well-being of citizens.

## 1. Introduction

One can say that the urban environment has become our new habitat with more than half of the world's population living in urban areas for the first time in human history (<http://www.who.int>). Urbanization is predicted to continue, and in 2050 it is expected that 70% of the world's population will be living in cities (*ibid.*). The rapid urbanization has resulted in many challenges to urban planning and design with regard to creating healthy everyday living environments. According to the United Nations (UN) program 'Working towards a better urban future': "Many cities still underestimate the importance of a city's look and feel, public spaces, and public infrastructure, failing to fully comprehend the correlation with quality of life, social development, and other key components of human well-being" (<http://unhabitat.org>). Urbanization may further be connected to ill health in the form of the rise in non-communicable diseases such as obesity, diabetes II, osteoporosis and stress-related illnesses such as heart disease, depression and mental fatigue (World Health Organisation, 2010).

Healthy urban planning often refers to research on the positive outcomes of nature and human health relations, and there is growing evidence of and political interest in promoting natural environments for public health as part of creating sustainable cities (European Commission, 2014; World Health Organization, 2016). An increasing number of studies demonstrate that natural environments have positive impacts on human health with regard to encouraging physical activity (Lovell, 2016), facilitating social cohesion (Maas et al., 2009), and by promoting psychological (Bratman et al., 2015) and physiological restoration (Hartig et al., 2003; Park et al., 2010). The term restoration stems from the field of environmental psychology and, according to Joye and van den Berg, refers to "the experience of a psychological and/or physiological recovery process that is triggered by particular environments and environmental configurations" (Joye and van den Berg, 2013, p. 58). A restorative environment should offer the visitor four specific components; fascination (to draw attention without cognitive effort), extent (immersion in a coherent environment), being away (from daily hassles and obligations) and compatibility (between the individual's inclinations and the characteristics of the environment) (Kaplan and Kaplan, 1989).

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When it comes to environmental preferences with regard to restoration, natural environments are preferred over built environments in a substantial number of studies (Hartig and Staats, 2006; Joye and van den Berg, 2013; Van den Berg et al., 2003).

The research specifically focusing on forest environments for stress restoration is a relatively new, but a growing area within the research field of restorative natural environments (Meyer and Bürger-Arndt, 2014; Nilsson et al., 2011). At present, Asian, especially Japanese and Korean studies dominate the field of research; more recently in collaboration with Finnish researchers (e.g. Lee et al., 2014; Li et al., 2011; Park et al., 2010, 2011; Song et al. 2013; Takayama et al., 2014; Tsunetsugu et al., 2007). The Japanese and Korean studies operate with the term “forest bathing”, which refers to the act of taking in the forest atmosphere (*ibid.*), and they have continued the tradition of studying nature/forests versus built environments, which is a common approach in the research area of restorative environments (Joye and van den Berg, 2013; Staats et al., 2016). The Japanese and Korean studies repeatedly present positive physiological and psychological effects derived from exposure to the forest environments measured by a decrease in blood pressure and cortisol levels, enhancement of parasympathetic nervous activity and elicitation of positive mood change, while negative effects are found to result from exposure to urban environments (e.g. Lee et al., 2014; Li et al., 2011; Park et al., 2010, 2011; Song et al., 2013; Takayama et al., 2014; Tsunetsugu et al., 2007).

However, are all restorative environments necessarily natural environments? The origin of restorative environments stems from Stephen and Rachel Kaplan's research on attention restoration which focuses on natural environments for restoration (Kaplan and Kaplan, 1989). Even though Kaplan et al. (1993) discussed the possibility of other types of environments possessing restorative qualities (e.g. museums), research within restorative environments has in general continued to focus on natural environments for restoration (Joye and van den Berg, 2013). Though a few existing studies focus on non-natural environments for restoration such as historic urban environments (Fornara and Troffa, 2009), monasteries (Ouellette et al., 2005), art galleries (Clow and Fredhoi, 2006) and shopping malls & cafés (Staats et al., 2016). Based on the study by Fornara and Troffa (2009), which found that a historical setting within an urban environment was perceived as restorative as an urban park, one may assume that urban environments with architectural qualities (like historical and cultural attributes as well as aesthetic values) can also be experienced positively and elicit restorative experiences. This assumption is further supported by the results of a recent study by Staats et al. (2016) in which the authors compare the restorative experience in different urban environments. They found that walking along a busy road was rated low with regard to restoration, whereas being in a mall was rated neutral and sitting in a café received positive ratings with regard to restoration. A study by Herzog et al. (2003) tested the perceived restorativeness of a number of urban and natural environments, and the results also support the notion of the urban environment as potentially restorative. In the study, some of the chosen urban environments exceeded the restorative rating of some of the natural environments, indicating that the choice of setting within the urban and natural environment plays an important role in the experience of restorativeness.

In the previously mentioned Asian crossover studies, serene natural forest environments are compared to urban environments located in urbanized zones, often along major traffic roads or around the main train station. Since the study by Staats et al. (2016) provides evidence that busy urban streets are the least preferred urban areas for restoration, one could argue that the urban environments in the Asian studies are poor representations of a potentially restorative urban environment.

The present study was inspired by the research design used in many of the Asian studies e.g. Park et al. (2010, 2011), Takayama et al. (2014), Tsunetsugu et al. (2007), where the participants both walked in and viewed urban and forest environments. It employed the same measurement as the Japanese study by Park et al. (2010), with measures of heart rate variability (HRV), blood pressure (BP) and mood changes. The study by Park et al. (2010) also employed cortisol measurements, which were not included in the present study, whereas it investigated the participants' perceived restoration, which was not included in the study by Park et al. (2010).

The present research design differed from the study by Park et al. (2010) by using what was expected to be a good case of a forest environment and an urban environment. The forest environment was specially designed according to research on nature experiences, the so-called perceived sensory dimensions (PSDs) (Grahn and Stigsdotter, 2010), while the urban environment was located in the historic part of the capital Copenhagen and comprised pedestrian areas with architectural, cultural and historic qualities, although almost no vegetation.

The aim of the research was to gain further knowledge of the restorativeness of the two environments and their possible impact on physiological and psychological processes. Further, the aim was to extend the research perspective on the choice of urban environment for crossover studies in this field of research.

The research questions guiding the research were:

- Does exposure to a forest and an urban environment through seated rest and walking have an impact on physiological and psychological processes measured in HRV, BP and mood change?
- How are the two environments perceived with regard to restorativeness measured in the four components 'being away', 'fascination', 'compatibility' and 'extent'?

## 2. Method

### 2.1. Participants

We recruited 51 (N) female university students in Copenhagen Denmark to participate in the study (age 20–36). The students were recruited through posters and notice boards, and came from a broad variety of studies within the University of Copenhagen. Exclusion criteria were expert knowledge within the research field e.g. studying landscape architecture or related subjects, drug abuse or taking medications related to cardiovascular function, and/or mental illness. The study was performed under the regulations of the Danish Committee on Health Research Ethics. The participants were fully informed about the aims and procedures of the study, and their written consent was obtained before initiating the research. The participants in the Asian studies were primarily male university students. It was discussed if this study also should recruit male students to have a closer match with the Asian studies. But since cultural difference between Asian and Danish students most likely in itself would make comparison difficult it was decided instead to only recruit female students to balance the research area with regard to gender. Due to limitations in sample size it was not possible to recruit both male and female students and keep them as separate groups in the analyses.

### 2.2. Experimental procedure

The study had a cross-over design where all participants (N=51) were exposed to the two different environments; the health forest Octovia® and the urban downtown environment (see section: Study environments for a description of the two environments). The participants were divided into groups of 4–5 persons. Each group was

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