



Research paper

Physiological and psychological effects of viewing urban forest landscapes assessed by multiple measurements

Yuko Tsunetsugu^a, Juyoung Lee^b, Bum-Jin Park^c, Liisa Tyrväinen^d, Takahide Kagawa^a, Yoshifumi Miyazaki^{e,*}^a Forestry and Forest Products Research Institute, 1 Matsunosato, Tsukuba City, Ibaraki Prefecture 305-8687, Japan^b Korea Forest Service, 1 Government Complex, 189 Cheongsu-ro, Seo-gu, Daejeon 302-701, Republic of Korea^c College of Agricultural and Life Science, Chungnam National University, 99 Daehak-ro, Yuseong-gu, Daejeon 305-764, Republic of Korea^d The Finnish Forest Research Institute, PL 16, Rovaniemi, FI-96301, Finland^e Center for Environment, Health and Field Sciences, Chiba University, 6-2-1 Kashiwa-no-ha, Kashiwa City, Chiba Prefecture 277-0882, Japan

HIGHLIGHTS

- ▶ A short-term viewing of forests has physiological relaxing effects such as lowered diastolic blood pressure and heart rate.
- ▶ Viewing forest landscapes caused higher parasympathetic nervous activity and lower sympathetic nervous activity than urban landscapes did.
- ▶ The forest landscapes induced a positive mood.

ARTICLE INFO

Article history:

Received 9 August 2012

Received in revised form 22 January 2013

Accepted 29 January 2013

Available online 1 March 2013

Keywords:

Urban green space

Restorative environments

Environmental design

Physiological responses

Profile of Mood States (POMS)

ABSTRACT

The present study investigated the physiological and psychological effects of viewing urban forest landscapes on 48 young male urban residents. Four forested areas and four urban areas located in central and western Japan were used as the test sites. We found that in the forested areas, the subjects exhibited (i) significantly lower diastolic blood pressure, (ii) significantly higher parasympathetic nervous activity, but significantly lower sympathetic nervous activity, and (iii) significantly lower heart rate. The forest landscapes (iv) obtained better scores in subjective ratings, and (v) induced significantly less negative and more vigorous moods. Taken as whole, these findings suggest that even a short-term viewing of forests has relaxing effects. We have thus concluded that the approach taken in this study is useful in exploring the influences of urban green space on humans, as well as contributing to the planning and design of a healthy environment for urban residents.

© 2013 Elsevier B.V. All rights reserved.

1. Introduction

The possible relationship between contact with nature and good health has long been discussed, and has been demonstrated to a considerable extent (Frumkin, 2001; Thompson, 2011). Despite abundant studies, however, the health benefits of green areas have long been inadequately acknowledged in urban planning and decision-making (Tyrväinen & Korpela, 2009). The current trend of building compact cities does not fully take into account the potential of natural settings in contributing to the quality of working and housing environments, which could enhance the health and well-being of residents.

* Corresponding author at: Center for Environment, Health and Field Sciences, Chiba University, 6-2-1 Kashiwa-no-ha, Kashiwa City, Chiba Prefecture 277-0882, Japan. Tel.: +81 4 7137 8113; fax: +81 20 4666 0398.

E-mail addresses: yukot@ffpri.affrc.go.jp (Y. Tsunetsugu), bjpark@cnu.ac.kr (B.-J. Park), liisa.tyrvaainen@metla.fi (L. Tyrväinen), kagawa@ffpri.affrc.go.jp (T. Kagawa), ymiyazaki@faculty.chiba-u.jp (Y. Miyazaki).

In order to guarantee the benefits of access to nature areas and raise awareness of the issue in urban planning and green space management, it is fundamentally important to accurately assess the health benefits with validated measurements, and provide objective evidence. A recent review pointed out that although natural spaces and interaction with natural environments are recognized as health-promoting settings, there is a lack of quantitative data and controlled studies (Annerstedt & Währborg, 2011). Scientific information is therefore necessary to strengthen the position of health benefits derived from nature in various urban development and decision-making processes (e.g. Tyrväinen, Pauleit, Seeland, & de Vries, 2005).

There have been several studies that addressed this requirement. From a series of field experiments, it has been reported that visiting forests induced significantly lower blood pressure, pulse rate, salivary cortisol and sympathetic nervous activity, along with significantly higher parasympathetic nervous activity, as compared to a visit in urban areas (e.g. Lee, Park, Tsunetsugu, Kagawa, & Miyazaki, 2009; Lee et al., 2011). Mood states and

subjective feelings were also improved while in a forest. These findings collectively support the conclusion that green environments have sedative and stress-reducing effects (review by Tsunetsugu, Park, & Miyazaki, 2010). These previous studies, however, dealt with a relatively small group of subjects (i.e. 12 males in each study). One study examined the incidence of positive emotions in natural settings among 168 participants (Park et al., 2011), but only targeted psychological responses. Few research studies, with certain exceptions (e.g. Park, Tsunetsugu, Kasetani, Kagawa, & Miyazaki, 2010), have been reported on human response to green environments as assessed based on multiple physiological measurements involving larger groups.

The present study therefore investigated the physiological and psychological responses to forested and urban environments in a larger group than in the previous studies. The aim of this study was to clarify the influence of two different settings and provide evidence to verify green spaces to be incorporated in urban design and planning. The research questions are (i) if there are differences in the effects of environment between forested and urban landscapes, and (ii) if a relatively short-term visit in accessible managed forests has beneficial effects, as it is not necessarily possible to visit green spaces for a long period of time in daily urban life. Our focus was on urban forests that are not primitive, wild nature, but semi- or fully managed nature where safety is secured.

2. Materials and method

The experiments were conducted in four areas located in central and western Japan (Kamiichi town, Toyama Prefecture, Yoshino town, Nara Prefecture, Akiota town, Hiroshima Prefecture, and Oita city, Oita Prefecture, respectively). In each area, participants visited two experimental sites: a forested and an urban site. The forested sites are located approximately 12–70 km from the city centers and their sizes varied from 800 to 34,225 ha. These forests are among the key recreation forests in the local municipalities, and were suggested for use in the study by city authorities. The urban sites were located close to the business or commercial center of each study town and city. In each experimental site, a spot for viewing (hereafter referred to as a viewing spot), where the participants viewed the landscape and took measurements was set up on the previous day. The viewing spots were located outdoors in both forested and urban test sites. Two of the forest views (at Kamiichi and Yoshino) were within a mature forest stand mainly populated by conifer species, while another (at Akiota) was dominated by deciduous tree species. The other forest view (at Oita) had a view with a small lake combined with the forested landscape. No buildings or roads were visible in the forested landscapes except that the spot faced a trail about 5 m in width in Akiota. All urban views included a road in the foreground on which traffic passed at the rate of 10–45 cars per minute. The experiments in the respective areas took two days and were conducted in August or September 2011.

Twelve male university students participated in each experimental area, for a total of 48 participants (21.1 ± 1.1 years old). They were assembled in the morning of the first experimental day and provided written informed consent. This study was conducted under the regulations of the Ethics Committee of the Center for Environment, Health and Field Sciences, Chiba University.

Half of the 12 participants underwent the experiment in a forested site, while the other half was tested in an urban site on the first experimental day. The participants were transferred to each site by bus, which took about an hour to an hour and a half.

At the experimental sites (a forested site or an urban site), each participant waited in turn in a waiting room to

participate in an individual viewing session. When the time came, each participant filled out the Profile of Mood States (POMS Japanese version; Yokoyama, Araki, Kawakami, & Takeshita, 1990) questionnaire which assesses six mood states: Tension–Anxiety (T–A), Depression–Dejection (D), Anger–Hostility (A–H), Fatigue (F), Confusion (C), and Vigor (V). After moving by car to a spot for viewing the landscape (taking approximately 5 min), each participant took a 5-min rest sitting in a camping chair, underwent physiological measurements at the same place, and then viewed the landscape for 15 min while sitting quietly in the camping chair. The physiological measurements included continuous measurement of the time periods between two consecutive heartbeats (AC-301A, GMS Corporation), as well as the measurement of systolic blood pressure and diastolic blood pressure (HEM1000, Omron). After viewing the landscape quietly for 15 min, each participant underwent another blood pressure measurement. Three kinds of questionnaires were handed to the participants following the physiological measurements: A subjective rating of the levels of comfort, sedation and naturalness, the state of being refreshed (Mackay, Cox, Burrows, & Lazzarini, 1978), and the POMS. Experimental conditions were controlled to be similar in both the forested and urban settings, and between different cities. On the second day of the experiment, the participants visited the opposite area in order to eliminate the effect of order.

3. Analysis

The time intervals of heartbeats were analyzed using the maximum entropy method (Mem-Calc, GMS Ltd.) to calculate the high frequency components (HF; 0.15–0.40 Hz) considered to reflect parasympathetic nervous activity (Cacioppo et al., 1994), and the low frequency components (LF; 0.04–0.15 Hz) that reflect sympathetic nervous activity (Weise & Heydenreich, 1989), in order to obtain the ratio of LF power to HF power (LF/HF).

The HF and LF power values were converted into a natural logarithm, with the means and standard deviations (SD) being computed for every minute. The heart rate for every minute during viewing was also derived from the time intervals. For these data, a paired t-test was conducted to compare the forested and urban areas. To avoid the type I error, the following was considered: The rate at which significant differences would be found between n pairs out of the 15 pairs (taken every minute during the viewing) by error can be calculated by using binomial distribution,

$${}_{15}C_n (0.05)^n (0.95)^{(15-n)}$$

when the significance level is 0.05. The calculated rate becomes <0.05 when n is equal to or greater than 3 in both cases. We therefore considered that more than three significant differences out of 15 data pairs obtained during the viewing would constitute a significant change in the physiological index as a whole.

A two-way analysis of variance (ANOVA) was used to determine the effects of the environment and measurement time on blood pressure and the POMS scores. A Wilcoxon signed rank test was conducted for the subjective ratings and the scores for the state of being refreshed.

Two of the 48 participants failed to complete the experimental procedure and were excluded from the analysis. There were some missing data for the HF and LF/HF due to technical reasons, which made the number of data (N) vary between the time points (Figs. 1 and 2). All statistical analysis was conducted by using IBM SPSS statistics 19, and $p < 0.05$ was considered significant.

Download English Version:

<https://daneshyari.com/en/article/1049423>

Download Persian Version:

<https://daneshyari.com/article/1049423>

[Daneshyari.com](https://daneshyari.com)