Urban Forestry & Urban Greening 55 (2020) 126855

Contents lists available at ScienceDirect

Urban Forestry & Urban Greening

journal homepage: www.elsevier.com/locate/ufug

Short communication

# Individual differences in the psychological effects of forest sounds based on type A and type B behavior patterns

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ARTICLE INFO

Handling Editor: Matilda van den Bosch

*Keywords:*
Nature therapy
Natural sound
High-Resolution sound
Psychological relaxation
Individual difference
Type A personality
Semantic differential method
Profile of mood states
Kwansei gakuin (KG) daily life questionnaire

ABSTRACT

Studies on the psychological effects of nature have been increasing, but few studies have focused on individual differences in these effects. The purpose of this study was to examine the individual differences in the psychological effects of forest sounds based on Type A and Type B behavior patterns. The Kwansei Gakuin (KG) daily life questionnaire was used as an indicator for Type A and Type B behavior patterns. This study included 29 female university students (mean age, 22.3 ± 2.1 years) who were exposed to high-resolution forest and city sounds for 60 s, and they provided subjective evaluations on a modified Semantic Differential method and the Profile of Mood States questionnaire. After exposure to the forest sounds, the Type A group (n = 12) reported higher levels of feeling comfortable, relaxed, and natural, as well as lower levels of anger–hostility, than the Type B group (n = 17). The findings demonstrated that the Type A and Type B groups experienced different psychological effects from forest-derived auditory stimulation.

## 1. Introduction

Human have evolved in nature over the past 6–7 million years (Brunet et al., 2002). Researchers mentioned that the physiological functions of the human body have adapted to natural environment (Miyazaki et al., 2011; Song et al., 2016). However, since the industrial revolution started in the 18th century, the dwelling environments of the number of people have been changed from natural environments to urban environments (United Nations, Department of Economic and Social Affairs, Population Division., 2014). Artificial environments such as those in urban areas induce stress in modern people (Lederbogen et al., 2011), whose bodies have adapted to exist in natural environments (Miyazaki et al., 2011; Song et al., 2016).

Recent research has focused on the relaxing effects of nature as a solution for stress (Miyazaki, 2018; Song et al., 2016; Doimo et al., 2020). In the progressive field of forest therapy research, several studies have reported the psychological effects of forest therapy. One study analyzed the responses of 60 female participants using a modified Semantic Differential (SD) method and reported that they felt more comfortable, relaxed, and natural after walking in forests compared with walking in cities (Song et al., 2019a, 2019b). Song et al. (2019a, 2019b) recruited 65 female participants and used the SD method to show that viewing forests also induced comfortable, relaxed, and natural feelings compared with viewing in cities. In total, 585 male participants who responded to a Profile of Mood States (POMS) questionnaire had lower scores for the subscales of tension–anxiety, anger–hostility, depression–dejection, fatigue, and confusion after walking in forests than walking in cities. Moreover, their vigor subscale scores were higher in forest environments than in city environments (Song et al., 2018). A recent study on 650 male participants who completed the POMS questionnaire showed that compared with viewing cities, viewing forests increased the participants' positive mood state of vigor, decreased negative mood states (Song et al., 2020). Another research used the POMS questionnaire revealed that during winter season, forest recreational activities increased psychological relaxation in female participants (Bielinis et al., 2019).

Individual differences in responses to forest therapy have also been studied (Song et al., 2013; Ikei et al., 2013). Song et al. (2013) reported the physiological effects of forest therapy comparing the pulse rates and blood pressures of 485 participants who were evaluated based on Type A and Type B behavior patterns (Friedman and Rosenman, 1974; Jenkins et al., 1974). The Type B group had significantly lower pulse rates and

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https://doi.org/10.1016/j.ufug.2020.126855
Received 11 March 2020; Received in revised form 31 August 2020; Accepted 6 September 2020
Available online 10 September 2020

diastolic blood pressures in the forest environment than in the city environment, whereas the Type A group experienced no differences in pulse rates and diastolic blood pressures between the two environments. Ikei et al. (2013) analyzed POMS data for 420 participants and reported that the Type A group had significantly higher anger–hostility subscale scores than the Type B group in both environments.

Notwithstanding the research into forest therapy, little is known about the individual differences in the effects of nature-derived auditory stimulation. The present study examined individual differences in terms of Type A and Type B behavior patterns using the nature-derived auditory stimulation data from Jo et al.'s study (2019), which explored the psychological effects of exposure to 60 s of high-resolution forest and city sounds on 29 female university students using the modified SD method and POMS.

The present study aimed to clarify individual differences regarding Type A and Type B behavior patterns using data from the modified SD method and POMS, acquired in the auditory stimulation experiment of Jo et al., 2019.

## 2. Materials and methods

### 2.1. Participants and statements

The information on participants has been briefly described based on that by Jo et al. (2019). In that study, 29 healthy female university students (mean age ± standard deviation, 22.3 ± 2.1 years) participated. All participants signed an individual written informed consent. The study was conducted in accordance with the Declaration of Helsinki, and the experiment was approved by the Ethics Committee of the Center for Environment, Health, and Field Sciences at Chiba University, Japan (project ID number 36). The experimental information was also registered in the University Hospital Medical Information Network (UMIN) of Japan (ID UMIN000034821).

### 2.2. Auditory stimulation

The auditory stimulation protocol was based on that described by Jo et al. (2019). High-resolution sounds, with a sample rate of 96.0 kHz and 24-bit quantization, were used to heighten the realism of the auditory stimuli. Forest sounds included a murmuring brook sound recorded in the Togakushi forest in the Nagano Prefecture. The city sounds included traffic sounds recorded at the Shibuya intersection in Tokyo. The auditory stimuli were presented to participants via headphones at levels of 48.6 dB (forest sound) and 51.5 dB (city sound). The sensory intensity of both auditory stimuli was evaluated as easy-to-hear sounds.

### 2.3. Experimental design

The experimental design was based on that described by Jo et al. (2019). To maintain the same physical and soundproof conditions, the experiment was conducted in a chamber with an artificial climate (temperature: 25 °C; relative humidity: 50 %; illumination: 200 lx) at the Center for Environment, Health and Field Sciences at Chiba University, Japan. Participants received an explanation regarding the measurement protocol. We performed a within participants experiment. Each participant was instructed to rest for 1 min with eyes closed. Then, one auditory stimulus (forest or city sound) was played for 1 min. Physiological activities (heart rate variability and near-infrared spectroscopy) were continuously measured. Thereafter, the participants completed the subjective tests (modified SD method and POMS) for about 2 min. The effect of the other auditory stimulus (city or forest sound) was assessed after a short resting period (5–7 min). The order of the auditory stimuli was counterbalanced. The Kwansei Gakuin (KG) daily life questionnaire to identify Type A and Type B behavior patterns was applied after the measurement protocol in a waiting room.

### 2.4. Psychological measurements

The modified SD method and POMS subscale scores were used to evaluate the psychological effects of forest and city auditory stimuli. The modified SD method (Osgood et al., 1957) consisted of three opposing adjective pairs: "comfortable to uncomfortable," "relaxed to aroused," and "natural to artificial," and each adjective pair was evaluated on 13 levels (e.g., very uncomfortable: −6, moderately uncomfortable: −4; slightly uncomfortable: −2, indifferent: 0, slightly comfortable: 2, moderately comfortable: 4, very comfortable: 6). The POMS, which measures mood states, includes six subscales: tension–anxiety, depression–dejection, anger–hostility, vigor, fatigue, and confusion (McNair et al., 1964). We used a short form of the POMS with 30 questions adapted from the Japanese version to reduce participant burden (Yokoyama, 2005). As an indicator of Type A and Type B behavior patterns, the KG daily life questionnaire was used to classify the Type A and Type B groups (Yamazaki et al., 1992). The questionnaire comprises 55 items for which participants choose one of three options (yes,? or no) for each question, and scores of 2, 1, or 0 are given for the replies. A total score of ≤43 points classified a participant in the Type B group, whereas a score of ≥44 points classified a participant in the Type A group (Yamazaki et al., 1992).

### 2.5. Statistical analysis

Wilcoxon rank sum test was used to compare the psychological effects between Type A and Type B groups. Statistical analysis was conducted using SPSS (version 21.0, IBM, Armonk, NY, USA). Statistical significance was considered with $p$-values of $<0.05$.

## 3. Results and discussion

According to the KG daily life questionnaire scores, the Type A group included 12 participants (from 44 to 66 points) and the Type B group included 17 participants (from 27 to 43 points).

Fig. 1 shows the comparisons between the Type A and the Type B groups of the subjective feeling scales of comfortable–uncomfortable, relaxed–aroused, and natural–artificial after exposure to the forest (a) or city (b) sounds, as measured using the modified SD method.

The Type A group felt significantly higher comfortable feelings from the forest sounds, evaluating it as "moderately-to-very comfortable," than the Type B group who evaluated it as "slightly-to-moderately comfortable" ($p < 0.05$; Fig. 1a). The Type A group, who indicated that the forest sound evoked "moderately-to-very relaxed" feelings, experienced significantly more relaxed feelings than the Type B group for whom it evoked only "slightly-to-moderately relaxed" feelings ($p < 0.01$). The Type A group reported a "moderately-to-very natural" feeling, in response to the forest sounds, and experienced significantly more natural feelings than the Type B group who reported only "slightly-to-moderately natural" feelings ($p < 0.05$).

There was no significant difference between the Type A and the Type B groups on the three scales of comfortable–uncomfortable, relaxed–aroused, and natural–artificial with respect to city sounds (Fig. 1b). For the comfortable–uncomfortable scale, both groups reported the sound as "indifferent-to-slightly uncomfortable," indicating no significant difference. For the relaxed–aroused scale, no significant difference was observed as both groups reported "indifferent-to-slightly aroused" feelings. Similarly, for the scale of natural–artificial, both groups evaluated the sound as "slightly-to-moderately artificial," showing no significant difference.

Fig. 2 shows the scores for the tension–anxiety subscale for the forest sound (a) and the scores for the anger–hostility subscale for the city sound (b). The mean score for the tension–anxiety subscale for the forest sound was significantly lower in the Type A group (0.4 ± 0.2) than in the Type B group (1.9 ± 0.6; $p < 0.05$).

The mean score for the anger–hostility subscale for the city sound

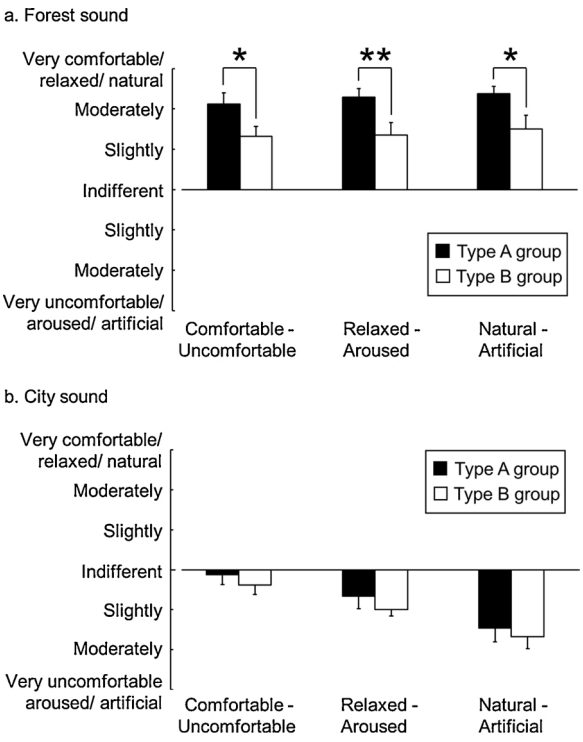


**Fig. 1.** Comparison between Type A and Type B groups' subjective feelings as measured by a modified Semantic Differential method after auditory exposure to forest (a) and city sounds (b); data are expressed as mean ± standard error, Type A group: n = 12, Type B group: n = 17, ** $p < 0.01$, * $p < 0.05$, as determined by the Wilcoxon rank sum test.

was also significantly lower for the Type A group (0.5 ± 0.3) than for the Type B group (2.2 ± 1.0; $p < 0.05$).

These findings indicate that the Type A group felt significantly more "comfortable," "relaxed," and "natural," and significantly lesser tension–anxiety after listening to forest sounds than the Type B group. Also, the Type A group experienced lesser anger–hostility when listening to city sounds than the Type B group.

In a previous study examining the effects of forest therapy on Type A and Type B behavior patterns (Song et al., 2013), after viewing forest and city environments for 15 min, the Type B group showed significantly lower pulse rates and blood pressures (i.e., a higher physiological relaxation) in the forest environment than in the city environment, whereas environments did not have any effect on the Type A group.

However, in the present study, the Type A group experienced higher psychological relaxation effects from the forest auditory stimulation than from the city sounds, which is not in line with the previous study's report.

Although the exact reason for the discrepancy in results is unknown, it is important to recognize that the two studies differed in their approaches. Song et al. (2013) examined the physiological effects in a field experiment, whereas the present study examined the psychological effects in an indoor auditory stimulation environment.

Our results do nonetheless indicate significant differences in the effects of auditory simulation for both Type A and Type B groups. In future studies, it will be necessary to consider Type A and Type B behavior patterns, in addition to sex, age, and so on, when selecting participants for natural therapy research. In the current study, the participants were only exposed to the auditory stimuli for 60 s. Thus, to facilitate more extensive investigations, future studies will also use longer exposures to forest sounds.

## 4. Conclusion

The purpose of this study was to investigate individual differences in the psychological effects of auditory forest stimuli as an indicator of Type A and Type B behavior patterns. Exposure to forest auditory stimulation showed that the Type A group felt significantly more "comfortable," "relaxed," and "natural" and experienced significantly lower tension and anxiety than the Type B group. Therefore, a difference exists in the psychological effects of forest auditory stimulation between the Type A and Type B groups.

## Role of the funding source

This research was funded by the Vehicle Racing Commemorative Foundation.

## CRediT authorship contribution statement

**Hyunju Jo:** Data curation, Investigation, Resources, Visualization, Writing - original draft, Writing - review & editing. **Harumi Ikei:** Investigation, Methodology, Project administration, Resources, Visualization, Writing - review & editing. **Chorong Song:** Data curation, Investigation, Resources. **Yoshifumi Miyazaki:** Conceptualization, Funding acquisition, Investigation, Methodology, Project

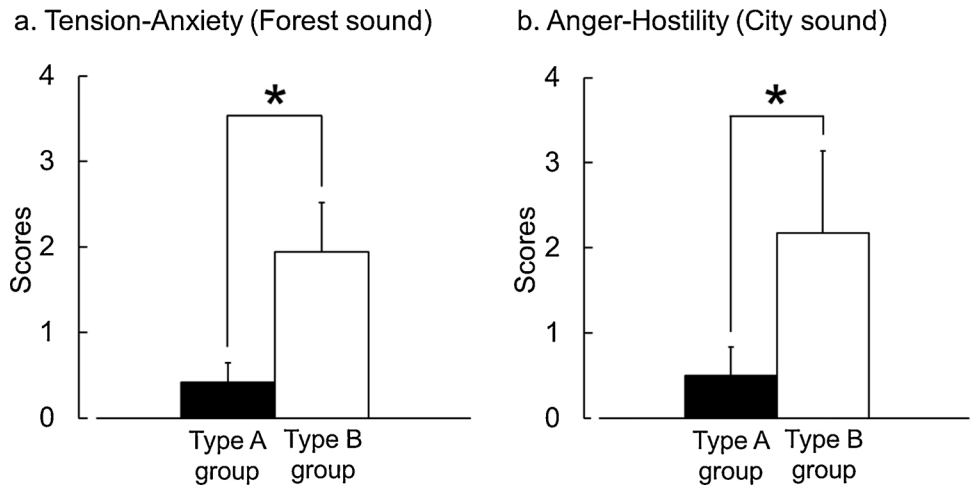


**Fig. 2.** Comparison between Type A and Type B groups' subjective feelings of tension–anxiety and anger–hostility as measured by the Profile of Mood States questionnaire, after auditory stimulation with forest (a) and city sounds (b); data are expressed as mean ± standard error, Type A group: n = 12, Type B group: n = 17, * $p < 0.05$, as determined by the Wilcoxon rank sum test.

administration, Resources, Supervision, Writing - review & editing.

## Declaration of Competing Interest

The authors declare no conflict of interest.

## Acknowledgments

We appreciate Seiya Enomoto of JVCKENWOOD Victor Entertainment Corporation for providing the high-resolution sound sources.

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