Nature Therapy: Physiological Effects of Relaxation Caused By Natural Stimuli

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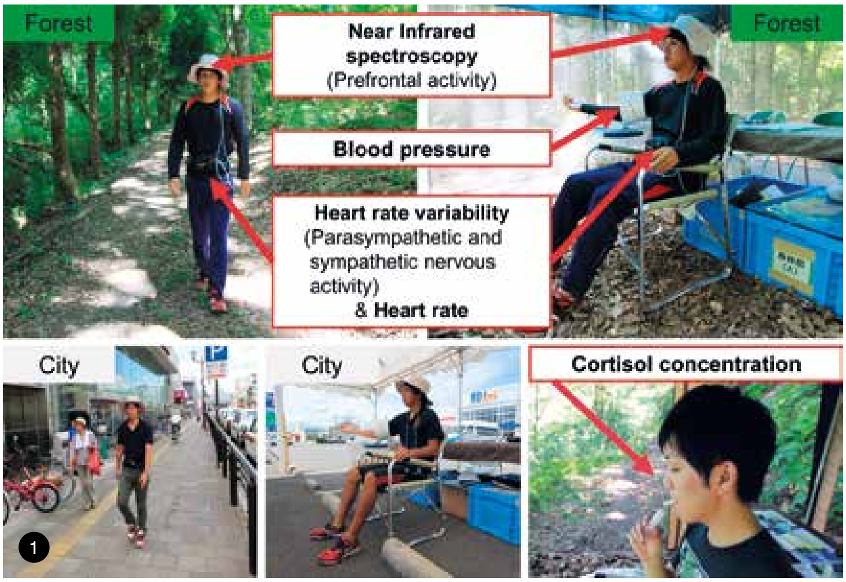


Humans have evolved into what we are today over the course of six to seven million years.[1] If we define the beginning of urbanisation as the start of the industrial revolution, then less than 0.01% of our history has been spent in modern surroundings; humans have thus spent more than 99.99% of their existence living within the natural environment.[2] The gap between the natural setting, to which our physiological functions have adapted to, and the highly urbanised and artificial setting, in which we now inhabit, is a root cause of stress among urbanites. Thus, when we are exposed to a natural setting, our physiological responses revert to how they should be, bringing forth a feeling of comfort and relaxation. In recent years, consistent with the growth of evidence-based medicine, mounting evidence points towards the physiological effects of relaxation that can come from natural stimuli from forests, urban green spaces, and plants.

From 2005 to 2015, physiological experiments involving a total of 744 participants were performed, each over a one-week period, in 62 forests spread out across Japan. In one particular study, the results encompassed 280 participants (mean age of 21.7 years) in 24 locations.[3]

Control experiments were performed in urban settings: stations and urban centres located in large cities of the respective prefectures while following the same experiment schedule. The participants in this experiment comprised of 12 male university students who were residents of each region. On the first day, divided into two groups of six persons each, one group underwent the experiment in a forest environment, while the other group was tested in an urban environment; on the second day, the group switched environments. Upon arrival at the given site, the participants sat on chairs and viewed the landscape of their assigned areas. The participants also went for walks around the given site. These activities were performed for about 15 minutes. Salivary cortisol levels (a typical stress hormone), systolic and diastolic blood pressure, pulse rate, and heart rate variability were then measured (See Image 1). On the basis of these results, it can be concluded that viewing or walking around a forest environment for 15 minutes had the following effects: (1) decreased levels of salivary cortisol, (2) decreased pulse rate, (3) decreased systolic and diastolic blood pressure, (4) increased parasympathetic nervous activity, which is enhanced in relaxing situations, and (5) suppressed sympathetic nervous activity, which is increased under stress. These findings thus demonstrate that forest environment induces a state of physiological relaxation.

1. Field experimental scenery (Image: Song Chorong).

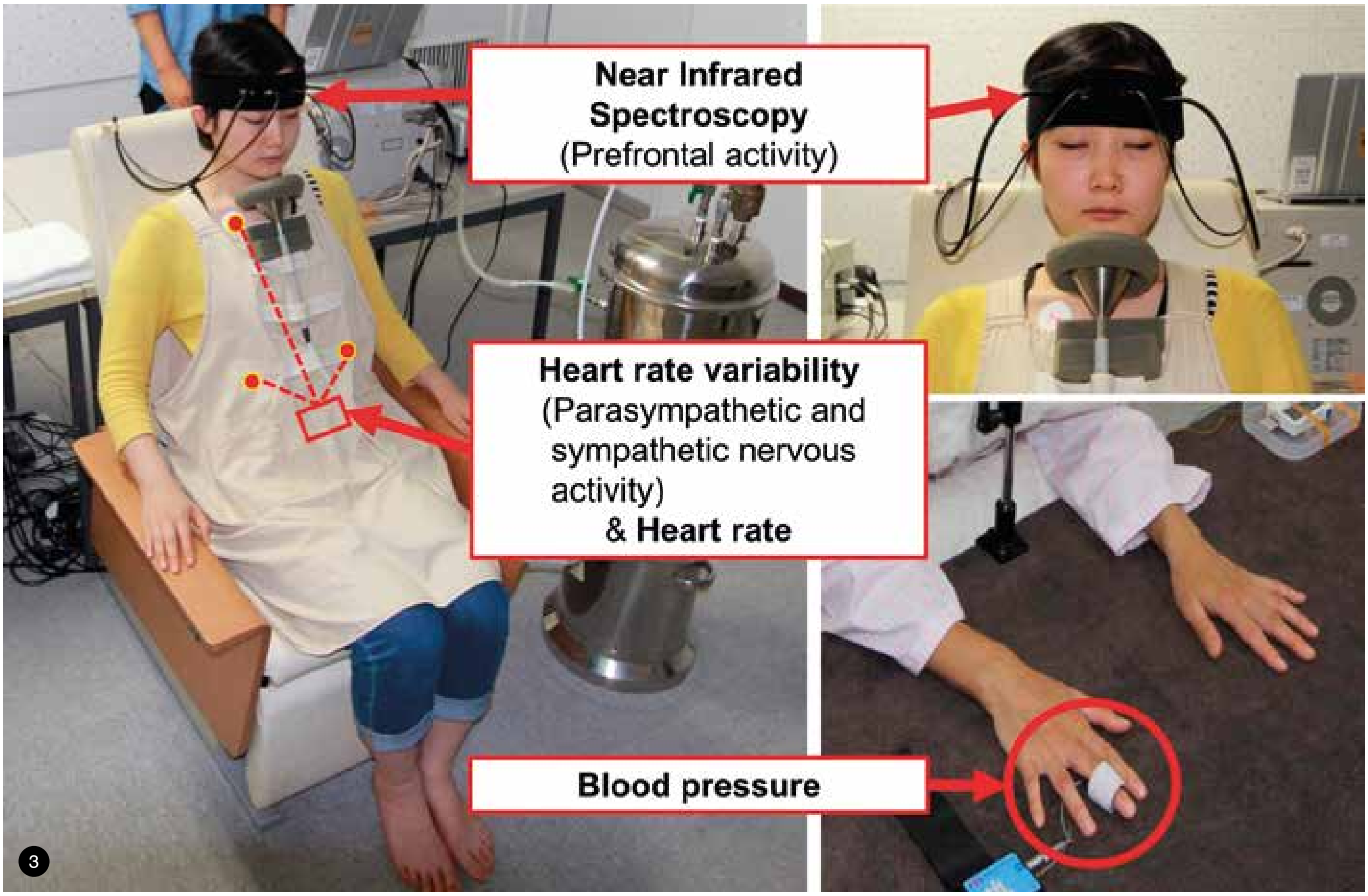
2. Experimental scenery in an urban park (top) and a city street (bottom) during winter season. (Image: Song Chorong).

Prefrontal cortex activity during a walk in a forested area was measured by near-infrared time-resolved spectroscopy,[4] using absolute haemoglobin concentrations in the prefrontal cortex as an indicator. Results showed a drop in total haemoglobin concentration after walking in a forest area than after walking in an urban area. This reduction in the prefrontal cortex suggested that cerebral activity had subsided, implying that walking in a forest environment has a relaxing effect.

Recently, increasing attention has been focused on the role of urban green spaces like urban parks, which provide a natural environment that is accessible for most people in modern society. Recent studies have found that walking in an urban park offers a physiological relaxation effect, regardless of the season. A brief walk in an urban park during the spring and the fall seasons[5, 6] induces parasympathetic nervous activity, suppresses sympathetic nervous activity, and decreases the heart rate, thereby showing physiological relaxation effects. A similar study was also conducted in the winter (see Image 2).[7] Participants wearing a woollen hat, gloves, and other accessories to protect against cold were asked to walk in an urban park for 15 minutes. The results showed that the task induces parasympathetic nervous activity and lowers the heart rate. From these results, we concluded that walking in an urban park has physiological relaxation effects even in winter.

One means of achieving contact with nature indoors is an exposure to fresh flowers and foliage plants that are commonly found decorating homes or offices. Physiological effects of viewing flowers and foliage plants have been demonstrated. For fresh flowers,[8] 30 pink, odourless roses (*Rosa*, cultivar name, Dekora) 40 centimetres in length were used. 31 male workers (mean age of 37.3 years) viewed the roses for four minutes. Viewing the odourless fresh roses increased parasympathetic nervous activity by 16.7% and decreased sympathetic nervous activity by 30.5%, compared to that of the controls who were not exposed to the roses. For foliage plants,[9] three pots of the striped dracaena (*Dracaena deremensis*), which stood at a height of approximately 55 to 60 centimetres from the bottom of the pot, were used. 85 high school students (mean age of 16.5 years) were exposed to the visual stimulus of the foliage plants for 3 minutes. The results showed that parasympathetic nervous activity increased by 21% relative to the activity of controls not exposed to the plants. Visual stimulation with dracaena, a common foliage plant, was also proven to have physiological relaxation effects.

There has also been interest in the effects of daily exposure to essential oils derived from plants. Aromatherapy, the practice of using essential oils in a therapeutic context, is becoming increasingly common. The effects of leaf oil from the Hinoki cypress (*Chamaecyparis obtusa*), which is a common and familiar tree in Japan, on the prefrontal cortex activity and autonomic nervous activity have been investigated.[10] The experiment was performed in an artificial climate chamber with the temperature, humidity, and illuminance set at 25°C, 50%, and 230 lx, respectively (see Image 3). 13 female university students (mean age of 21.5 years) sat with their eyes closed and were exposed to the odour for 90 seconds. The concentration of the essential oils was adjusted to vary from “weak smell” to “easily sensed smell.” Olfactory stimulation by the Hinoki cypress leaf oil induced a reduction in oxyhaemoglobin concentrations in the prefrontal cortex and increased parasympathetic nervous activity. Therefore, olfactory stimulation by Hinoki cypress leaf oil can induce physiological relaxation. The physiological effects of olfactory stimulation with rose and orange essential oils have also been studied.[11] The participants were 20 female university students (mean age of 22.5 years). The stimulus was the scent of the essential oils made from roses and orange peel. The concentration of the essential oils was adjusted to vary from “slight smell” to “weak smell,” and the duration of the stimulation was 90 seconds. The oxygenated haemoglobin in the prefrontal cortex was measured by using near-infrared time-resolved spectroscopy. The results showed that olfactory stimulation by essential oils from roses and orange zest decreased oxygenated haemoglobin levels in the right prefrontal cortex. Next, the effects of olfactory stimulation with fresh roses were studied.[12] The participants were 19 female university students (mean age of 21.6 years). Four fresh rose flowers were used as an olfactory stimulant. The strength of perceptibility of the stimulus was determined as “weak smell” or “easily sensed smell,” and the duration of stimulation was 90 seconds. The fresh rose flowers induced an increase in parasympathetic nervous activity.



3. Laboratory experimental scenery (Image: Song Chorong).

4–1. Changes observed with respect to walking in a forested area. Individual differences (a) and the relationship between the "initial value" and the "changes after walking in a forested area" (b) with respect to diastolic blood pressure (n = 92). **p <0.01 by Pearson correlation test (Song et al. 2015).

4–2. Changes observed with respect to walking in an urban area. Individual differences (a) and the relationships between the "initial value" and the "changes after walking in an urban area" (b) with respect to diastolic blood pressure (n = 92). Pearson correlation test (Song et al. 2015).

5. The relationship between the "initial value" and the "changes after walking" in a forested area (a) and urban area (b) with respect to pulse rate (n = 92). ** p < 0.01 by Pearson correlation test (Song et al. 2015).

It is known that great individual differences are observed in physiological data collected in research on stress and relaxation, but few methods have been proposed to evaluate this variability. We investigated the individual differences in physiological relaxation effects by forest walking from the perspective of the "law of initial value," with the purpose of clarifying the physiological adjustment effects moved close to an appropriate level.[13] The "law of initial value" was advocated by Wilder[14] and describes the principle that the direction of the response to a stimulus depends largely on the initial value. 92 male university students (mean age of 21.5 years) took 15-minute walks in forest and urban areas, and blood pressure and pulse rate were measured before and after their walks. More participants displayed blood pressure and pulse rate reductions from walking in the forest than those who did not; however, these parameters also increased in some participants, which showed that there is great individual variation (see Image 4–1a). We examined the correlation between the "initial value" (absolute value before walking in the forest) and the "change" (value after walking in the forest) – (value before walking in the forest). We found that there was a negative correlation between the "initial value" and the "change," which showed that values were decreased by walking in the forest in the participants whose initial values were high, and values increased in the participants whose initial values were low (see Image 4–1b). However, there was no correlation between the "initial value" and the "change" in the results of the same participants in the urban area (see Image 4–2). The results for pulse rate were similar (see Image 5). Thus, it is clear that these effects were specific to a forest environment. We concluded that walking in the forest has physiological adjustment effects that bring the diastolic blood pressure and pulse rate closer to the ideal values.

In recent years, following the advancements in physiological measurement systems and measuring equipment, the relaxation effects caused by natural stimuli, such as forests, urban green spaces, and plants have been supported by scientific evidence. The stimulation derived from nature has a preventive medical effect that renders a state of physiological relaxation and boosts weakened immune functions, which can help prevent disease. Considering the significance of quality of life in the stress-laden society of today, the physiological relaxation effects caused by natural stimuli will become increasingly important. Moreover, the elucidation of the mechanisms underlying these physiological effects from the viewpoint of evidence-based medicine is an important task for the future. CG

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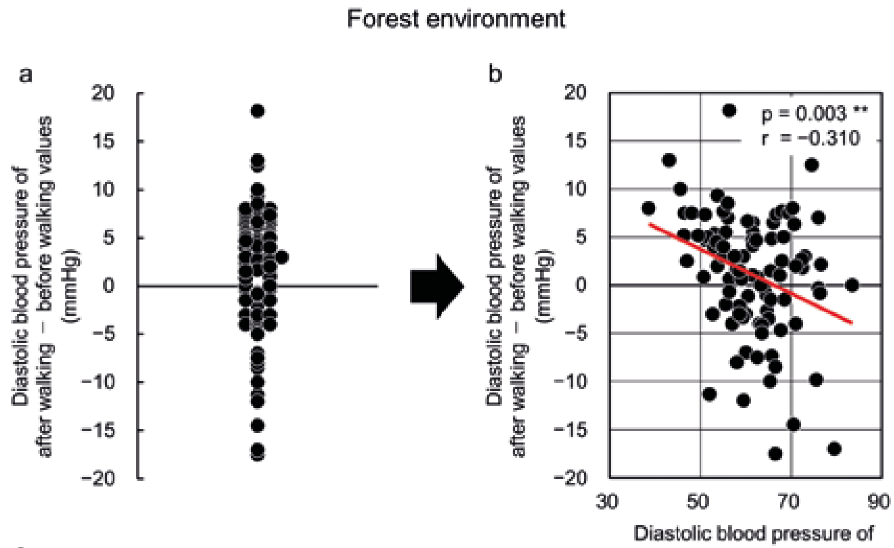

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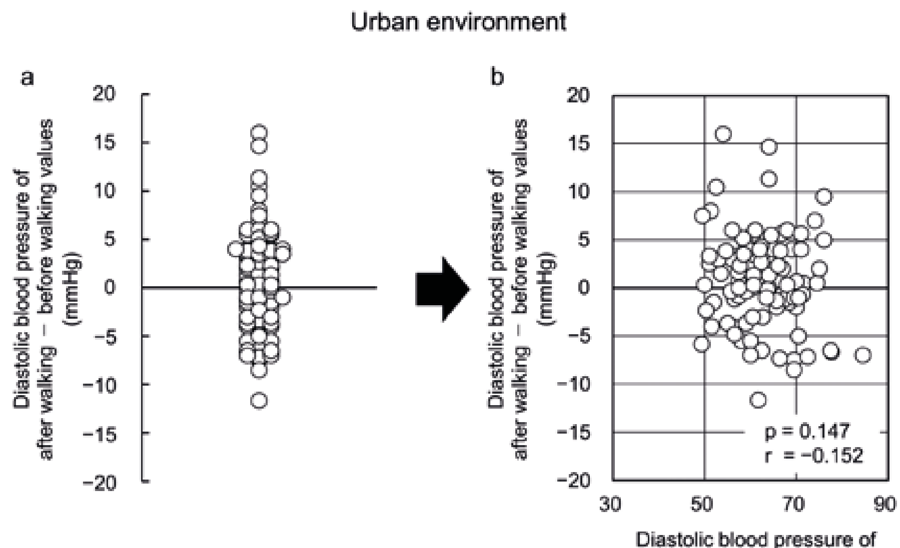

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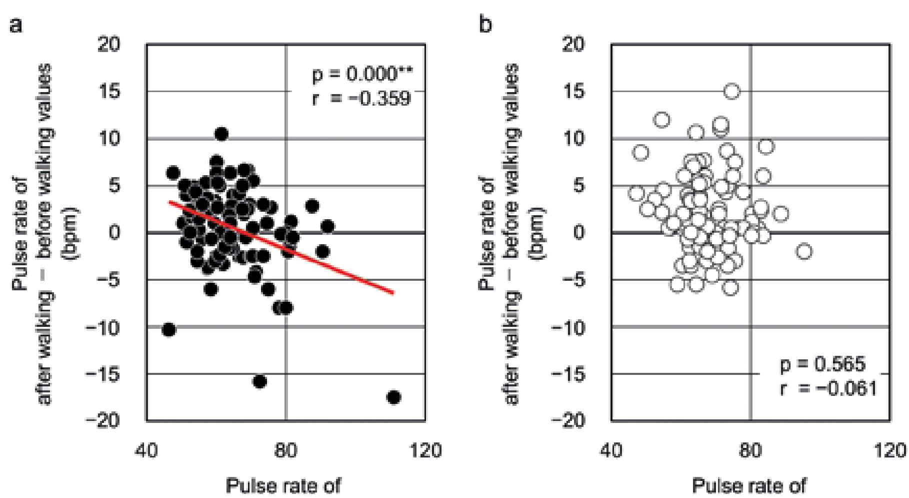

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