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Touching Wood

Published in Design

Wood usually gives people a harmonious and warm feeling with its delicate texture. A study is conducted to clarify the physiological effects of touching wood with the palm, in comparison with touching other materials on brain activity and autonomic nervous activity. By Harumi Ikei, Forestry and Forest Products Research Institute, and Song Chorong and Yoshifumi Miyazaki, Chiba University

Wood is a familiar natural material that has been used in houses and furniture for a long time, and it is empirically known to have a relaxing effect on humans.

In Japan, a majority (55 percent) of new housing starts in 2014 is wooden, and among them, the percentage of wooden houses in detached houses is 88 percent.

According to an ‘awareness and intention survey on circulation utilisation of forest resources’ conducted by Japan’s Ministry of Agriculture, Forestry and Fisheries in 2015, approximately 80 percent of the respondents answered ‘wooden houses’ to the question of ‘a house you would like to choose in the future when building or buying houses’.

In recent years, the Forestry Agency has been encouraging the use of wood and is expanding its moku-iku (‘moku’ implies ‘wood’ and ‘iku’ implies ‘nurture’) initiative.

First coined in 2004, moku-iku is an expression that has been defined in many ways.These include ‘an initiative to encourage all people, including children, to interact with wood, learn from wood, and live with wood (Wood Culture Promotion Project

Team)' and 'educational activities regarding the use of wood to teach about the merit of wood as a material and the significance of using wood (Forestry Agency)'.

Since then, a new concept of moku-ikuhas been proposed: how the 'quality of life is improved by being brought up in the presence of wood' and that 'contact with wood is physiologically relaxing and enhances immune function'.

As described above, the interest in and expectations of the relaxing effect of wood on humans have increased in recent years, and data based on scientific evidence has been found wanting.

Past studies

The most of the previous studies about the physiological effects of wood or wood-derived stimulation on humans have used olfactory stimulation, and there are extremely few reports on tactile stimuli.

One report said that touching artificial materials with the palm resulted in great fluctuations in the systolic blood pressure and pulse rate and induced a physiological stress state, whereas touching Japanese cypress and Japanese cedar wood plates caused little fluctuation.

Researcher examined differences in the effects of tactile stimulation on human physiology that resulted from materials at different temperatures (cool, room temperature, and warm).

They found the following results: (1) touching an aluminium plate increased blood pressure, but the increase was inhibited when the aluminium was warmed; (2) touching an acrylic plastic plate increased blood pressure, with a greater rate of increase in blood pressure when the acrylic plastic plate was chilled; and (3) blood pressure did not change in response to touching objects made of Japanese cypress, Japanese cedar, or oak, and did not increase even when the oak material was chilled.

Those reports are pioneering studies on the physiological effects of tactile stimulation with wood on humans. However, there are limitations in that they only used blood pressure, which is an index of autonomic nervous activity measurement of physiological responses.

Recent Research

In this study, we investigated the physiological effects of touching wood in comparison with touching other materials on the left and right prefrontal cortex activity, assessed using near-infrared time-resolved spectroscopy (TRS), and on the autonomic nervous activity, assessed using heart rate variability (HRV).

The study participants were 18 female university students (mean age, 21.7 ± 1.6 years). We excluded smokers, those currently in treatment for disease, and those with menstrual period during the study period.

All participants were informed about the aim of the experiment and the procedures involved in it, and they provided written informed consent to participate.

This study was performed in accordance with the regulations of the Ethics Committee of the Center for Environment, Health and Field Sciences, Chiba University, Japan.

Physiological measurements were performed in a chamber with an artificial climate in the Center for Environment, Health and Field Sciences, Chiba University. This chamber was maintained at 25 degC, 50 percent relative humidity, and 230-lux illumination.

In the waiting room, the participants received a description of the experiment and then moved into the chamber with an artificial climate. After sensors for physiological measurement were fit, participants received a description of the measurement procedure while sitting.

After that, they practiced touching a material with their palm using a dummy sample (sheet flooring). The procedure was as follows. Participants rested with their eyes closed for 60s.

When receiving instructions from an experimenter, they moved their right forearm using their elbow as a fulcrum, and placed the palm on the material for 90s.

After touching the material for 90 s, they returned the hand to the previous position upon instruction of an experimenter. The experimenter placed the next material, hid the material with a cloth, and then instructed participants to open their eyes.

Subsequently, the participants answered the subjective evaluation test. Materials were presented in a counter balanced order to eliminate any effects due to the order of tactile stimulation. The physiological responses were measured continually.

Wood Type

The wood type used was white oak.Five laminae without vertical joining (the size of one lamina was 300 × 60 × 15 mm) were mutually bonded along the width. To prevent bending, a second bonding was performed using Japanese cedar plywood (300 × 300 × 28 mm), and the thickness of the material was 43 mm. The surface touched by palm was brushed and non-coated.

As comparable materials, marble and ceramic tiles, which are used as building material, were selected. In addition, stainless steel was used as one of the representative artificial materials.

The size of all slabs was 300 × 300 mm. The thicknesses of the marble, tile, and stainless steel were 15 mm, 8 mm, and 5 mm, respectively. To render the thickness of all materials presented to the participants uniform at 43 mm, Japanese cedar plywood was adhered under each material.

The surfaces of the marble, tile, and stainless steel were processed by buffing. In addition, wax was applied to the tile.

As an indicator of brain activity, Time-Resolved Spectroscopy (TRS), which is a near-infrared spectroscopy method, was used.

We transformed the data by linear interpolation every 1s in order to show the time series data for oxy-Hb concentration in the left/right prefrontal cortex over a 90-s period.

In addition, all data were calculated as the difference relative to a 10-s baseline period immediately before participants touched the test material.

The oxyhaemoglobin (oxy-Hb) concentrations in the left and right prefrontal cortex were measured before the materials were touched and during the 90 s of touching the materials.

As an indicator of autonomic nervous activity, Heart Rate Variability (HRV) was analysed. The power levels of the low-frequency and high-frequency components of HRV were calculated using the maximum-entropy method. The HF power reflected the parasympathetic nervous activity.

To normalize HRV parameters across the participants, we used natural logarithmic transformed values for the analysis.

The modified semantic differential (SD) method and the Profile of Mood State (POMS) were used to evaluate the psychological effects of touching the materials.

The SD method tests the subjective evaluations of participants through a questionnaire with opposing adjectives, each of which was evaluated on a 13-point scale.

Six pairs of adjectives were assessed as ‘comfortable–uncomfortable’, ‘natural–artificial’, ‘relaxed–awakening’, ‘warm–cold’, ‘uneven–flat’, and ‘dry–moist.’

The POMS scores were determined for the following six subscales: ‘tension–anxiety’, ‘depression’, ‘anger–hostility’, ‘fatigue’, ‘confusion’, and ‘vigour’.

We used a short version of the POMS that included 30 questions to decrease the participants' burden.

Statistical Package for Social Sciences software was used for all statistical analyses. One-sided tests were used for both comparisons because our hypothesis was that humans would be more relaxed after touching the wood than after touching the other materials.

Psychological Effects

This study aimed to clarify the effects of touching wood in comparison with touching other materials on the activity in the left and right prefrontal cortex, assessed using TRS, and on autonomic nervous activity, assessed using HRV. Our findings concentrated on the tactile stimulating effect of wood are consistent with those of previous studies.

The result reveals that touching white oak significantly decreased the oxy-Hb concentration in the left prefrontal cortex compared with marble, tile, and stainless steel.

In comparison with touching other materials, touching white oak significantly decreased the oxy-Hb concentration in the right prefrontal cortex and significantly increased parasympathetic nervous activity according to the 90-s overall mean values.

The ln(HF) value immediately increased after contact with white oak, and it remained higher than the value before touching until the end of the contact. However, the changes in the ln(HF) value during contact with other materials (marble, tile and stainless steel) were small.

According to the results of subjective evaluation by the modified SD method,in terms of the 'comfortable feeling', participants provided subjective reports of feeling 'slightly comfortable' after contact with white oak; however, they provided reports of feeling 'indifferent to slightly uncomfortable' after touching other materials.

Therefore, touching the white oak was believed to induce significantly more comfort than touching other materials.

As the mood state in the short version of the Profile of Mood State (POMS) scale shown, the score for the negative subscale 'tension–anxiety' was significantly lower after touching white oak than that after touching other materials.

Furthermore, the score for 'total mood disturbance' was significantly lower after touching white oak than that after touching other materials.

For the other subscales ('depression', 'anger−hostility', 'fatigue', 'confusion', and 'vigour'), no significant differences were

observed.

The researcher also examined the physiological effects of tactile stimulation of the palm with wood on blood pressure, using materials at different temperatures (cool, room temperature, and warm) to eliminate the influence of the heat flux of each material.

As a result, systolic blood pressure did not increase even upon contact with chilled wood, and the subjective feeling of ‘coarse/natural’was maintained.

Conversely, touching aluminium at room temperature increased blood pressure, and subjective feelings of ‘dangerous/uncomfortable’ and ‘flat/artificial’ were increased. These results revealed that even in a cooled state, touching wood did not cause physiological stress.

Regarding subjective evaluations, the participants felt more comfortable, relaxed, natural, warm, uneven, and dry after contact with white oak than with other materials.

In this study, the physiological response of brain activity and autonomic nervous activity, the subjective evaluation of materials, and evaluations of their physical properties (e.g., surface roughness and heat flow rate) are shown to be consistent.

Limitations

The relationship between the subjective evaluation when touching wood and the physical property values of materials has been examined for a long time.

Besides, we examined the physiological relaxation effect of touching wood in comparison with touching other materials with the palm of the hand. However, this study had three limitations.

First, although this study used non-coated wood, it is necessary to clarify the influence of touching wood with various coatings on the physiological response because much of the wood used in everyday life is coated.

Second, although we clarified the effect of touching wood with the palm here, the effect when touching with the sole of the foot should also be examined because wood is often used as flooring material.

Third, this study measured the physiological effects of only placing the palm on the material. The influence of active contact, such as stroking the surface of the wood with the hand, on the physiological response should also be clarified.

In comparison with other materials (marble, tile and stainless steel), tactile stimulation of the palm with white oak significantly decreased the oxy-Hb concentration in the left/right prefrontal cortex, which is associated with prefrontal cortex activity, and significantly increased the ln(HF) component of HRV, which reflected parasympathetic nervous activity.

These findings indicate that compared with other types of material, contacting with wood induces physiological relaxation. Thus, applying wood to interior decoration or construction can make people feel more comfortable.

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