

A Study on Comfort Evaluation using Brain Waves and Questionnaire Survey in Outdoor Spaces

Tepei Ishiuchi, Department of Civil Engineering, National Institute of Technology, Akashi College, Japan, ishiuchi@akashi.ac.jp

Yuuki Kawamoto, Advanced Course of Architecture and Civil Engineering, National Institute of Technology, Akashi College, Japan

Izumi Huruie, Advanced Course of Architecture and Civil Engineering, National Institute of Technology, Akashi College, Japan

Introduction

Modern society can be stressful, and there is growing interest in the creation of comfortable living space. Many studies of urban space have focused on ways of creating relaxing space and comforting environments. For example, green space at highway rest facilities has been found to ease driver stress (Iwasaki et al., 2007). In recent years, devices for measuring biological information that were originally used in the field of medicine have become generally available and are being used in a variety of research fields. Research into the evaluation of urban space is no exception, and many researchers are now using biological information to quantify the effects of spatial recognition on the human body. Examples are the measurement of salivary amylase levels (Nakagawa et al., 2014) and brain waves in moving subjects (Miura et al., 2005). Here, we quantified the difference between the healing effects and stress-reduction effects of green space and general street space (including space at a train station), by using inexpensive EEG (electroencephalography or “brain wave”) machine. Our aim was to quantitatively verify the healing and stress-reduction effects of these spaces by using EEG measurement and a psychological analysis performed with a questionnaire survey.

Study Methods

We used four observation points: the side of a road, a train station forecourt, a closed green space, and an open green space (Fig. 1). For our measurements we used a relatively inexpensive and portable simple EEG machine.

We used the following method to measure brain waves. Subjects donned the EEG machine, which then recorded their brain waves while they performed mental arithmetic (30 s) → landscape appreciation (60 s) → video viewing (30 s). After we had observed the subjects’ brain waves, we performed a questionnaire survey at the same



Figure 1. Observation points used in the survey

time as the subjects appreciated the landscape at each site. The survey items in the questionnaire covered each subject's living environment, the degree of stress in the environment in which they had grown up (5-stage evaluation), and the subjects at each observation point. There were 22 subjects, all of whom were students aged from 16 to 22 years.

Results

In the case of four urban spaces used frequently by the general public, we examined the differences between the results of a questionnaire survey of the respondents' subjective images and the potential effects of their consciousness on brain wave observations. We obtained the following results: 1) The match between the results of the questionnaire survey and the brain wave observations was as high as 90% in the open green areas, whereas in the enclosed green space it was about 70%. Although green space in general is considered to have a relaxing effect, the enclosed green space seemed to be less relaxing because of a feeling of pressure. This result was consistent with those of existing conventional studies. 2) In the questionnaire survey, the preferred reasons given by subjects who answered that they relaxed in enclosed green space were "the presence of tall trees" and "many sidewalks have street trees," and the "dimness of the forest." These reasons explained the differences in preference between these subjects and those who relaxed in open green spaces. 3) In the case of the train station space and the roadside space, there was a large discrepancy between the EEG results and those of the questionnaire survey: even though the questionnaire survey indicated that the respondents felt stressed, the EEG results showed that they were likely to be relaxed.

Acknowledgment

This study was supported by JSPS KAKENHI Grant Number 26820224, Grant-in-Aid for Young Scientists (B).



Yutaka IWASAKI & Satoshi YAMAMOTO (2007) Effect on stress easing of green space in highway rest facilities, The 38th Scientific research meeting (Special Issue), J. Jpn. Soc. Reveget. Tech, No.33 (1), pp.255-257 (in Japanese)

Nakagawa Takuya & Mayumi Seto (2014) The cerebral and evaluation method in man who walks outdoors, Architectural Institute of Japan, Summaries of technical papers of annual meeting, pp.175-176 (in Japanese)

Miura et al., (2005) A Study on the Urban Space in Venetia Part29: Potential Change of the Brain Waves on Wayfinding, Architectural Institute of Japan, Summaries of technical papers of annual meeting, pp.421-422 (in Japanese)