

NEURO-COGNITIVE EFFECTS OF NATURE EXPERIENCE ON DIRECTED ATTENTION

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NEURO-COGNITIVE EFFECTS OF NATURE EXPERIENCE ON DIRECTED ATTENTION

by

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CERTIFICATE

This is to certify that the thesis titled “**Neuro-Cognitive effects of Nature Experience on Directed Attention**” submitted by **Ms Pooja Swami Sahni**, to the Indian Institute of Technology, Delhi, for the award of the degree of **Doctor of Philosophy**, is a bonafide record of the research work done by her under our supervision. The contents of this thesis, in full or in parts, have not been submitted to any other Institute or University for the award of any degree or diploma.

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LIST OF ABBREVIATIONS

NCH	Nature in the Childhood Neighbourhood
NCU	Nature in the Current Neighbourhood
NVF	Nature Visit Frequency
NR	Nature Relatedness
MAAS	Mindfulness Attention and Awareness
NE	Nature Experience
DA	Directed Attention
ERP	Event- Related Potential
EEG	ElectroEncephaloGraphy
BDST	Backward Digit Span Test
OESR	Open Eye Resting State

GLOSSARY

Nature: Spaces consisting predominantly of flora and fauna and having little or no human constructions (Schultz, 2002).

Experience: Thoughts, feelings, emotions that we undergo when we observe a given phenomenon, it encompassing the affective and cognitive states (Price and Barrel, 2012).

Nature experience: Thoughts, feelings, emotions, including the affective and cognitive states that we undergo when we observe nature during mentally and physically being present in nature.

Nature relatedness (NR): Individual levels of connectedness with the natural world. It is an internalized identification with nature described as feelings and thoughts about one's personal connection to nature (Nisbet, 2009).

Mindfulness Attention and Awareness (MAAS): The ability to direct one's attention- informed by a sensitive awareness of what is occurring in the present (Brown and Ryan, 2003).

Directed Attention: The ability to concentrate or focus on a phenomenon. It is more focal and perceptual. According to William James, "directed attention is the taking possession by the mind, in clear and vivid form, of one out of what may seem several simultaneously possible objects or trains of thought. It implies withdrawal from some things in order to deal effectively with others" (James, 1890)

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ABSTRACT

Humans and nature have shared a close interrelationship in the past. Natural environments have been sought for both physical as well as psychological restoration. In literature, the experiences while being in natural surroundings have been referred to as ‘nature experience’. Several theoretical frameworks have proposed pathways through which nature experience may affect mental wellbeing. One of the theories suggests that ‘elements’ in nature effortlessly engages the attention, thus giving directed attention a chance to rest and replenish.

This doctoral research has studied the effects of nature experience on directed attention through two studies. The first study was a cross-sectional study, which examined the association of nature experience with attention. Self-reported questionnaires pertaining to different possible human-nature interaction models have been studied. The second study was a lab-based experimental study, with a pre-post design using nature audio-video as stimulus. Neurophysiological data using electroencephalography (EEG) was collected on cognitive tasks pre and post the nature stimulus.

Findings from the cross-sectional study suggest a significant relationship between the nature experience and the individual’s ability to direct attention. Further, nature relatedness was found to strengthen the association of nature experience and the individual’s ability to direct attention. It was also found that people who have nature in the neighbourhood and frequently visit such places report being higher on the individual’s ability to direct attention. Interestingly, nature in the current neighbourhood was not found to be associated with an individual’s ability to direct attention, and the relationship was significant only when the individual reported to visit the nature-rich areas frequently.

Outcomes from the lab-based EEG study has shown a significant improvement in the cognitive task performance after nature experience. During the viewing of nature audio-visual, participants self-reported that they experienced feelings of increased ‘peace’, ‘calmness’, and ‘relaxation’. The

self-reported experiences also correlated with the EEG data. Spectral analysis showed a significantly enhanced alpha in frontal and theta in fronto-central regions while watching nature stimuli. This pattern is an indicator of the state of relaxation and internalized attention. ERP analysis of EEG data found a significant decrease in the N2 and P3 mean amplitudes during the cognitive tasks post nature stimuli, which suggests an improved ability to inhibit the distractions and efficient allocation of attentional resources in the fronto-parietal attentional network. Given the findings from the EEG study, this thesis argues that nature experience deactivates task-irrelevant processing and activates task-related brain areas. The deactivation of task-irrelevant processing means lower distraction and therefore, lesser mental effort required for inhibitory control.

This thesis has provided evidence using cognitive assessment, neurophysiological measurements and self-reports, which suggests that the nature experience induces a relaxed state of mind and enhances directed attention which can be attributed to improved inhibitory control. This evidence may help motivate people to connect with nature for improved cognitive performance.

सार

मनुष्य और प्रकृति ने अतीत में घनिष्ठ पारस्परिक संबंध साझा किए हैं। प्राकृतिक और मनोवैज्ञानिक बहाली दोनों के लिए प्राकृतिक वातावरण मांगा गया है। साहित्य में, प्राकृतिक परिवेश में रहने के अनुभवों को 'प्रकृति का अनुभव' कहा गया है। कई सैद्धांतिक रूपरेखाओं में प्रस्तावित रास्ते हैं जिनके माध्यम से प्रकृति का अनुभव मानसिक भलाई को प्रभावित कर सकता है। सिद्धांतों में से एक यह बताता है कि प्रकृति में 'तत्व' सहजता से ध्यान आकर्षित करते हैं, इस प्रकार निर्देशित ध्यान को आराम करने और फिर से भरने का मौका देते हैं।

इस डॉक्टरेट अनुसंधान ने दो अध्ययनों के माध्यम से निर्देशित ध्यान पर प्रकृति के अनुभव के प्रभावों का अध्ययन किया है। पहला अध्ययन एक क्रॉस-सेक्शनल अध्ययन था, जिसमें ध्यान के साथ प्रकृति के अनुभव के जुड़ाव की जांच की गई थी। अलग-अलग मानव-प्रकृति इंटरैक्शन मॉडल से संबंधित स्व-रिपोर्टेड प्रभावों का अध्ययन किया गया है। दूसरा अध्ययन एक प्रयोगशाला-आधारित प्रायोगिक अध्ययन था, जिसमें उत्तेजना के रूप में प्रकृति ऑडियो-वीडियो का उपयोग करते हुए पूर्व-पोस्ट डिजाइन था। इलेक्ट्रोएन्सेफेलोग्राफी (ईईजी) का उपयोग करने वाले न्यूरोफिज़ियोलॉजिकल डेटा को संज्ञानात्मक कार्यों पर एकत्र किया गया था और प्रकृति प्रोत्साहन पोस्ट किया गया था।

क्रॉस-अनुभागीय अध्ययन से प्राप्त निष्कर्ष प्रकृति के अनुभव और प्रत्यक्ष ध्यान देने की व्यक्ति की क्षमता के बीच एक महत्वपूर्ण संबंध का सुझाव देते हैं। इसके अलावा, प्रकृति से संबंधित प्रकृति का अनुभव और प्रत्यक्ष ध्यान देने के लिए व्यक्ति की क्षमता को मजबूत करने के लिए प्रकृति से संबंधित पाया गया। यह भी पाया गया कि जिन लोगों के पास पड़ोस में प्रकृति है और अक्सर ऐसे स्थानों की यात्रा करते हैं, जो व्यक्ति के ध्यान को निर्देशित करने की क्षमता पर अधिक होते हैं। दिलचस्प बात यह है कि वर्तमान पड़ोस में प्रकृति को

किसी व्यक्ति की प्रत्यक्ष ध्यान देने की क्षमता के साथ संबद्ध नहीं पाया गया था, और यह संबंध केवल तब महत्वपूर्ण था जब व्यक्ति ने प्रकृति-समृद्ध क्षेत्रों में अक्सर जाने की सूचना दी थी।

प्रयोगशाला आधारित ईईजी अध्ययन के परिणामों ने प्रकृति के अनुभव के बाद संज्ञानात्मक कार्य प्रदर्शन में महत्वपूर्ण सुधार दिखाया है। प्रकृति के दृश्य-श्रव्य दृश्य के दौरान, प्रतिभागियों ने आत्म-सूचना दी कि वे बढ़ी हुई शांति, 'शांति' और 'विश्राम' की भावनाओं का अनुभव करते हैं। ईईजी डेटा के साथ स्वयं-रिपोर्ट किए गए अनुभव भी सहसंबद्ध हैं। वर्णक्रमीय विश्लेषण ने प्रकृति-उत्तेजनाओं को देखते हुए ललाट-मध्य क्षेत्रों में ललाट और थीटा में काफी बढ़ा हुआ अल्फा दिखाया। यह पैटर्न विश्राम और आंतरिक ध्यान की स्थिति का एक संकेतक है। ईईजी डेटा के ईआरपी विश्लेषण ने संज्ञानात्मक कार्यों के बाद प्रकृति उत्तेजनाओं के दौरान एन 2 और पी 3 माध्य आयामों में एक महत्वपूर्ण कमी पाई, जो सामने-पार्श्वीय अनुप्रस्थ नेटवर्क में ध्यान केंद्रित संसाधनों के विचलित और कुशल आवंटन को बाधित करने की बेहतर क्षमता का सुझाव देता है। ईईजी अध्ययन के निष्कर्षों को देखते हुए, इस थीसिस का तर्क है कि प्रकृति का अनुभव कार्य-अप्रासंगिक प्रसंस्करण को निष्क्रिय करता है और कार्य से संबंधित मस्तिष्क क्षेत्रों को सक्रिय करता है। कार्य-अप्रासंगिक प्रसंस्करण के निष्क्रिय होने का अर्थ है कम विक्षेप और इसलिए, निरोधात्मक नियंत्रण के लिए कम मानसिक प्रयास आवश्यक है।

इस थीसिस ने संज्ञानात्मक मूल्यांकन, न्यूरोफिज़ियोलॉजिकल माप और स्वयं-रिपोर्ट का उपयोग करके सबूत प्रदान किए हैं, जो बताता है कि प्रकृति का अनुभव मन की एक आराम की स्थिति को प्रेरित करता है और निर्देशित ध्यान को बढ़ाता है जिसे बेहतर निरोधात्मक नियंत्रण के लिए जिम्मेदार ठहराया जा सकता है। यह सबूत लोगों को बेहतर संज्ञानात्मक प्रदर्शन के लिए प्रकृति से जुड़ने के लिए प्रेरित करने में मदद कर सकता है।