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PRESENTER ABSTRACTS

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Electroencephalographic Signatures of Interior Design Appreciation in a CAVE System: A Pilot Study

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The aim of the present work is to provide evidence of how it is possible to correlate neurophysiological parameters with the appreciation of interior designs. For this purpose, we performed electroencephalographic (EEG)recordings within an immersive virtual reality CAVE system during the perception of three kinds of interior designs. Results highlighted that EEG alpha rhythms are correlated with judgments of familiarity and novelty, showing asymmetrical activations of the prefrontal cerebral areas as signs of motivational factors. Such as preliminary findings have to be further investigated to be used as tools for designing architectural environments.

1. EXTENDED ABSTRACT

1.1. Introduction

Nowadays there is the hope that neuroscientific findings will contribute to improvements in the design and control of intelligent buildings and ultimately help to create artificial environments that satisfy the man's dual demand of easy adjustment (familiarity) and easy arousal (novelty) (Eberhard, 2008; Gombrich, 1984). In order to investigate the brain activity related to the experience of architectural environments, we performed three pilot electroencephalographic (EEG) recordings in an immersive virtual reality CAVE system during the perception of three different kinds of interior design. Specifically, the goal is to examine how the motivational factors, as indexed by EEG asymmetrical activation of left and right hemispheres over the prefrontal cortex, could be associated with the experience of familiar and novel environments. In fact, left- and right-anterior brain regions are part of two separate neural systems underlying motivational aspects (Davidson, 2004; Coan and Allen, 2003).

1.2. Methods

Three-dimensional environments have been simulated in a virtual reality CAVE system formed by three back-projected active stereo screens and a front-projected screen on the floor surrounding the subject (Sanchez-Vives and Slater, 2005; Cruz-Neira et al., 1993). Three rooms have been designed in real size and tested with different interior design: empty, common and cutting edge furniture, respectively. After the appreciation of each room, the enrolled volunteers expressed three different judgments about familiarity, novelty and comfort. Correlation analysis between these ratings and with EEG index of frontal lobe asymmetry in processing the different stimuli was performed.

1.3. Results

The alpha power of the left frontal lobe resulted positively correlated with judgment of familiarity ($R = 0.81$, $p = 0.01$), whereas the alpha power of the right frontal lobe is negatively correlated with novelty ($R = -0.72$, $p = 0.03$). Moreover, synchronization of both theta and alpha power, computed across both hemispheres, resulted negatively correlated with novelty.

1.4. Conclusions

The present experiment provides neuroelectrical evidence of the asymmetrical involvement of the prefrontal cortical areas during the appreciation of familiar and novel architectonical stimuli in a CAVE virtual reality system. Although further investigation is needed, these observations may allow to develop quantifiable neural markers for testing how the design process of architectonical environments matches the changing needs of man.

2. REFERENCES

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3. AUTHOR BIOS

Dr. Giovanni Vecchiato achieved his Bachelor and Master degree in Telecommunication Engineering at Federico II University (Naples) in the 2004 and 2007, respectively. He achieved his Ph.D. in Neurophysiology at Sapienza University in 2010. Since then, he is Ph.D. fellow at the Dept of Physiology and Pharmacology of Sapienza. In his research, Dr. Vecchiato is currently investigating cognitive and emotional correlates of the EEG related to the observation of advertisements, emotional, artistic and architectonical stimuli. In the 2012, Dr. Vecchiato developed a system for the biometric measurement and analysis of cognitive and emotional variables during the observation of TV commercials and appreciation of artistic exhibitions. He is author of several scientific publications on international peer-reviewed journals, book chapters and a book. Dr. Vecchiato also acts as reviewer and guest associate editor for peer-reviewed journals and as member of several conference program committees. Dr. Vecchiato ideated the experiment, performed the recordings, analyzed the data and wrote the abstract.

Dr. Gaetano Tieri achieved his Bachelor and Master degree in Psychology and Cognitive Psychology at University "G. d'Annunzio" of Chieti in the 2008 and 2010, respectively. He is Ph.D. student in Social and Cognitive Neurosciences at Sapienza University. Dr. Tieri is an expert in modeling and programming of 3d virtual bodies and environments and currently he is investigating the behavioral and neurophysiological responses of human experience through the exposure to the Immersive Virtual Reality. Dr. Tieri designed and programmed the 3d virtual environments.

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Prof. Fabio Babiloni got his degree in electronic engineering from the Sapienza University of Rome with honors in 1986. In the 2000 he received his PhD in Neural Engineering at the University of Technology of Helsinki, Finland. He is currently Professor of Physiology at the Dept of Physiology and Pharmacology at the Sapienza University of Rome. To now, Prof. Fabio Babiloni has published 185 papers on peer-reviewed journals, with a total impact factor of more than 400, H-index of 45. He is in the list of the Top Italian Scientists and his current interests include the use of brain computer interfaces for communication between people and electronic devices and the study of the cortical activities during cognitive tasks in humans. Prof. Babiloni is auditor of research projects for several international agencies and editor of four international scientific journals, such as International Journal of Bioelectromagnetism, IEEE Trans. On Neural Systems and Rehabilitation Engineering, IEEE Trans. On Biomedical Engineering and Computational Intelligence and Neuroscience. Prof. Babiloni ideated the experiment and supervised the data analysis.