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PRESENTER ABSTRACTS

ACADEMY OF NEUROSCIENCE FOR ARCHITECTURE

Neural Responses to Restorative Environments: An Eye Tracking and fMRI Study

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With the aim of measure the neural responses to restorative environments, it has been developed and tested an experimental paradigm of psychological restoration suitable for neuroimaging environments. The paradigm includes conditions of psychological stress and environmental restoration. Additionally, we use fMRI coupled with the eye tracking technology to ask whether visual perception differs between scenes that are highly restorative and scenes that are less restorative. The findings support the evidence of several cognitive and emotive physiological indicators related to the stress and restoration condition.

1. EXTENDED ABSTRACT

1.1. INTRODUCTION

The neuro-architecture perspective proposes a new discipline that unites neuroscience with the experience of built environments (Edelstein & Marks 2007). The neuroscience research in restorative environments constitutes an approach useful to understand the neural basis of human-environmental transactions that promote human wellbeing. To date, little is known about the neural circuitry involved in the process of psychological restoration; so more studies are needed in order to investigate the neural correlates of psychological restoration in combination with other physiological restoration measures. These kinds of measures are useful to document this phenomenon through multiple levels of analysis and methodologies; which are convenient to ensure validity criteria for this research (Campbell & Fiske, 1959). Psychological restoration is the result of the recovery from an antecedent deficit (e.g. stress or attentional fatigue) following the exposure to a restorative environment (Kaplan & Talbot 1983). According to attention restoration theory (Kaplan 1995), restorative environments must offer a serie of perceived qualities that facilitate the restoration of attentional fatigue. These environments, usually naturals, offer a particular kind of soft stimulation that does not requiere directed attention contrary to some chaotic urban environments where the stimulus complexity represent a higher demand in the attentional resources. With the aim of explore and validate the neural basis of a psychological restoration process we proposed a fMRI methodology coupled with eye tracking. Our design considers three basic assumptions: (1) the antecedent condition from which a person might restore (e.g. affective and/or cognitive deficit); (2) the environment which the person enters during the time available for restoration (high vs. low restorative potential environments; HRP and LRP respectively) and (3) the outcomes that reflect on actual or potential changes in resources and/or components of the experience which mediate those changes (brain responses during the view of this environments and patterns of eye movements as physiological indicators of cognitive and emotional process related to psychological restoration). A paradigm suitable for neuroimaging environments, which includes a psychological stressor (stressful video) and the exposition to pictures with low and high restorative potential (LRP and HRP respectively) was developed and tested. According to this design, it was expected the activation of brain areas related to stress response. Given the exploratory character of this study, no specific predictions were made toward the brain activations involved with the exposure to LRP and HRP environments. Finally, we use fMRI coupled with the eye tracking technology to ask whether visual perception (saccades, fixations and pupil size) differs between scenes that are highly restorative (HRP, e.g. natural settings) and scenes that are less restorative (LRP; e.g. urban settings without nature).

1.2. METHODS

Participants include 24 clinically healthy male volunteers (18 to 40 years old) residing in urban communities of the Mexican state of Querétaro. They were assessed at the magnetic resonance unit of the Institute of Neurobiology, UNAM. MRI acquisition and image processing methods were recorded with the participants before and after the exposure to HRP and LRP environments. A ViewPoint EyeTracker® was used to record the eye movements (right eye) of the participants during the exposure to HRE and LRP. The restorative influence of these scenarios was tested before and following a period of acute psychological stress induced by means of aversive movie watching with a self-report stress scale.

1.3. Results and Discussion

Brain functional connectivity analysis confirmed the successful stress induction considering the psychological stressor. On the other hand, the results in general suggest the activation of different brain areas during the view of LRP and HRP scenes. Briefly, brain areas relating to novelty seeking behaviour-exploration (e.g. frontal lobe; Dafner et al. 2000), spatial information (middle frontal gyrus; Leung, Gore, and Goldman-Rakic 2002) and awareness of emotionally charged stimuli (Phillips et al. 1998) were predominantly activated during the view of HRP environments. In the case of the LRP category, the results showed brain areas activation related to approximation-avoidance emotion (right superior frontal gyrus, Paradiso et al. 1999), episodic memory, visual attention processes (precuneus, Fletcher et al. 1995), processing the geometric structure of built environments (parahippocampal gyrus; Epstein 2005) and organization of behavior (Pearson et al. 2011). Significative differences were found in the eye patterns (saccades, fixations and pupilar size) during the view of HRP vs. LRP environments. Atributed eye pattern to HRP environments (saccades and pupilar size) are refered to exploration movements evoqued by fascinating environments as suggested by the Kaplan´s attention restoration theory. Conversely, more fixations occurred in the LRP than in the HRP condition, suggesting a major attentional effort during the visual process of LRP stimulus.

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