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EEG Alpha Asymmetry in Virtual Environments for the Assessment of Stress-Related Disorders

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Abstract. In this study we consider neurophysiological aspects for the assessment of stress-related disorders. EEG Alpha Asymmetry could represent an effective method to be used in the virtual environment. Nonetheless, new protocols need to be defined. In this study herein, we present two methods and a case study.

Keywords. Stress, EEG, Alpha asymmetry, Virtual Reality

Introduction

There has been growing interest in examining the roles of cognitive appraisal and emotions in physiological responses to psychological stress [1]. According to Cohen [2], psychological stress occurs when an individual perceives that the environmental demands are taxing, or exceed his or her adaptive ability. This gap gives rise to label oneself as being stressed, and to a concomitant negative emotional response.

In this study herein, we consider neurophysiological aspects for the management and treatment of stress-related disorders. One of the widely used instruments to analyze presented aspects is the EEG. In particular, the frontal EEG activation asymmetry has been generally used, giving evidence that greater left frontal activity seems to be more highly related to positive mood, whereas greater right frontal activity seems to be more involved in negative moods, such us stress. According to the recent literature, Alpha waves seem to be the most useful to study the frontal EEG activation asymmetry. It is observed that lower Alpha values indicate higher cortical activation.

1. Standard Procedures

One of the most widely used procedures to study EEG alpha asymmetry has been the use of a sequence of pictures. Visual stimulation has been widely demonstrated to be effective in the elicitation of specific emotions. The most used and recognized pictures

database is the International Affective Picture System (IAPS), that provide a wide range of normative emotional stimuli to experimentally test emotions and attention. The standard method used to present stimuli in an EEG alpha asymmetry study is the Rapid Serial Visual Presentation (RSVP). Thus the subject wears an EEG and watches a sequence of images on the monitor.

2. Procedures for Virtual Environments

Virtual Reality is by definition a dynamic environment where subjects are free to move [4]. Thus an EEG Alpha Asymmetry study could be of the following two types:

- Subject enters a virtual room where a virtual monitor projects IAPS images according to the RSVP method. This method requires the subject to stay immobilized once the pictures sequences begin. The differences between this setting and a standard setting is to be deeper studied by researchers, above all to understand which advantages the use of virtual environments may offer.
- Subjects have some tasks in the virtual environment, and a long series of "events" have been inserted by the researchers. Such a method requires a big effort to insert events in the virtual environment, and need to define a marker per each event created in order to accurately synchronize stimuli and EEG signals. On the other hand, the effort could be balanced by the higher ecological validity of such experiments. A case study is reported in Fig.1 (sum of 30 neutral events during a baseline session) and Fig. 2 (sum of 30 stressful events from a stressful situation exposure).

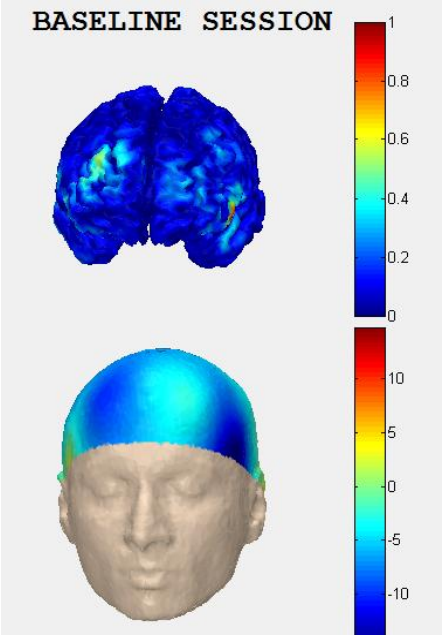

Figure 1. Sum of EEG Alpha cortical activations on 30 neutral events, during a Baseline session.

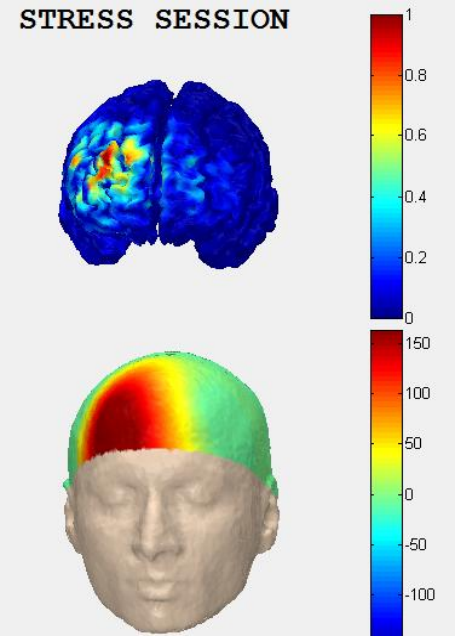

Figure 2. Sum of EEG Alpha cortical activations on 30 stressful events from a stressful situation exposure.

A recently funded European project, "INTERSTRESS – Interreality in the management and treatment of stress-related disorders," will take into account these aspects, verifying frontal EEG activation asymmetry, in the interreality paradigm, i.e. creating a bridge between the physical and virtual worlds.

3. Acknowledgments

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References

[1] Feldman P, Cohen S, Hamrick N, Lepore SJ. (2004). Psychological stress, appraisal, emotion and cardiovascular response in a public speaking task, Psychology & Health. 19, pp. 353-368.

[2] Cohen S, Janicki-Deverts D, Miller GE (2007). Psychological stress and disease, Journal of the American Medical Association, 298(14), pp. 1685-1687.

[3] Coan J.A. and J.J.B. Allen, Frontal EEG asymmetry as a moderator and mediator of emotion, Biological Psychology 67 (2004) 7-49.

[4] Cipresso P, Raspelli S, Pallavicini F, Grassi A, Balgera A, Gaggioli A, Albani G, Villamira M, Mauro A, Riva G (2011). Investigations of executive functions using Virtual Multiple Errands Test and Psychophysiological measures, Journal of CyberTherapy and Rehabilitation 4(2), pp. 259-60.