Volume 131S
October 2018
ISSN 0167-8760
131S S1–S184 (2018)

ELSEVIER

INTERNATIONAL JOURNAL OF PSYCHOPHYSIOLOGY

Official Journal of the International Organization of Psychophysiology

IOP

Special Issue: IOP 2018

Guest Editor
Emiliano Ricciardi

our results point on the normalization of brain bioelectrical activity in the experimental group of stroke patients. Changes in brain bioelectrical activity correlated with the improvement in the Beck depression scale and in the Spielberg-Khanin anxiety scale. These results support the objectivity of including neurofeedback trainings in the rehabilitation process of people with stroke.

doi:10.1016/j.ijpsycho.2018.07.410

02
A cortical network related to cognitive control revealed by theta oscillations: a MEG study

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Recent theories of cognitive control put large emphasis on theta oscillations in relation to action monitoring. Multiple EEG studies of cognitive control revealed increased power of theta oscillations restricted to midfrontal areas, while there is a substantial body of functional connectivity data demonstrating that theta oscillations may be a carrier of informational exchange over multiple cortical regions. fMRI studies revealed immense distributed networks involved in cognitive control. Paradoxically, MEG has been considered almost insensitive to theta oscillations in such an experimental context. It also remains debatable what is the functional role of such theta oscillations. An influential line of evidence links feedback-related theta oscillations to two types of prediction errors (unsigned and signed), but this distinction has not been tested during trial-end-error learning with theta activity measured beyond the midfrontal cortex.

We recorded MEG while participants were involved in trial-and-error learning within a novel multiple-choice behavioral task with complex stimulus-to-response mapping. Three conditions were analyzed: correct and erroneous trials during the initial stage of learning acquisition, as well as correct trials during stable performance. Sources of MEG activity were analyzed using minimum-norm estimation method within 4-6 Hz frequency range.

We revealed a number of bilateral cortical areas that displayed theta oscillations to the feedback signal: in addition to the "classical" medial frontal areas (the anterior part of the medial cingulate cortex and the pre-supplementary motor area), this network included the insula and the auditory cortex, the frontal operculum and posterior inferior frontal gyrus, the premotor cortex, the paracentral lobule, and the posterior part of the medial cingulate cortex. Granger causality analysis revealed overall communication directed from lateral to medial sites. During the initial stage of trial-and-error learning, we observed a strong non-differential response to feedback signal that reflected an unsigned component of the prediction error. The signed component of the prediction error was observed later – with greater theta activations after errors compared with correct responses.

Thus, using MEG, we were able to reveal a distributed network of brain areas in relation to feedback-related processing that included not only medial frontal, but also auditory areas, insula, lateral frontal, and medial parietal areas. The data obtained confirm the existence of two components of the prediction error, and this distinction was evident all over the network revealed.

The study was implemented in the framework of the Basic Research Program at the National Research University Higher School of Economics (HSE) in 2018.

doi:10.1016/j.ijpsycho.2018.07.411

03
The Role of Fear and Impulsivity in Exogenous Attention to Emotional Stimuli as Indexed by the Early Posterior Negativity and Late Positive Potential

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Emotional stimuli capture attention more readily than neutral stimuli, even when attentional resources are limited, suggesting that the emotion modulation of attentional allocation occurs rather automatically. The present study investigated whether exogenous attention to emotional stimuli, as indexed by the early posterior negativity (EPN) and late positive potential (LPP), is differentially influenced by underlying differences in the behavioral approach system (BAS) and its facets, the flight-fight-freeze system (FFFS), and the behavioral inhibition system (BIS), of the reinforcement sensitivity theory of personality (RST). Participants viewed neutral and emotional images that differed in arousal level to examine valence-arousal interactions in exogenous attention to emotional stimuli. On half of the trials, attentional resources were manipulated by having participants perform a visual detection task on emotional and neutral words that were presented successively in the surroundings of the image. The results suggest that exogenous attention is driven by the valence-arousal interactions with regard to the EPN, while it is driven by the arousal value of the stimulus with regard to the LPP. More importantly, the FFFS correlated negatively with EPNs elicited by negative images and negative words presented during directed attention trials. Impulsivity was associated negatively with LPP amplitudes elicited by negative and positive low-arousal images and positive words when attention was directed away from the affective image. Results are discussed within the revised RST framework that differentiates fear from anxiety and reward components from impulsivity.

doi:10.1016/j.ijpsycho.2018.07.412

04
Depressed patients are more aroused by left presented stimuli: A multilevel study

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Introduction: Major Depressive Disorder (MDD) is associated with emotional and attentional deficits over the visual field leading to physiological and cognitive manifestations. Hence, the aim of this study was to compare, in patients with MDD and healthy controls, the physiological and cerebral impact of the emotional pictures presented in central and peripheral vision (CV, PV).

Methods: Fifteen patients and 15 matched controls were presented with pictures from the International Affective Picture System. Two sets of 175 pictures (unpleasant and neutral) were presented at five eccentricities (-24°; -12°; 0°; +12°; +24°). The participants had to categorize pictures according to their emotional valence. Participants fulfilled questionnaires of depression (BDI) and anxiety (STAI). We analyzed the electrodermal responses (ED) to the pictures, as well as the dynamic of the associated cerebral events with a spatiotemporal principal component analysis (PCA) applied to the electroencephalogram signal.