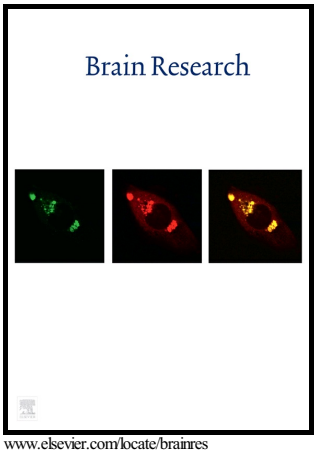

www.elsevier.com/locate/brainres

Distinct electroencephalographic responses to disturbances and distractors during continuous reaching movements

Igor Demchenko, Reuven Katz, Hillel Pratt, Miriam Zacksenhouse

PII: S0006-8993(16)30687-4
DOI: http://dx.doi.org/10.1016/j.brainres.2016.09.040
Reference: BRES45133

To appear in: *Brain Research*

Received date: 4 March 2016
Revised date: 23 September 2016
Accepted date: 27 September 2016

Cite this article as: Igor Demchenko, Reuven Katz, Hillel Pratt and Miriam Zacksenhouse, Distinct electroencephalographic responses to disturbances and distractors during continuous reaching movements, *Brain Research* http://dx.doi.org/10.1016/j.brainres.2016.09.040

Distinct electroencephalographic responses to disturbances and distractors during continuous reaching movements

Igor Demchenko[a*], *Reuven Katz*[a,b], *Hillel Pratt*[b,c] *and Miriam Zacksenhouse*[a,b]

[a]*Brain Computer Interfaces for Rehabilitation Lab., Faculty of Mechanical Engineering, Technion – Israel Institute of Technology*

[b]*Technion Autonomous Systems Program*

[c]*Evoked Potentials Lab., Technion – Israel Institute of Technology*

[*]*Corresponding author: Igor Demchenko, d.igorek@gmail.com*

Abstract

Discrepancies between actual and appropriate motor commands, dubbed low-level errors, have been shown to elicit a P300 like component. P300 has been studied extensively in cognitive tasks using, in particular, the three-stimulus oddball paradigm. This paradigm revealed two sub-components, known as P3a and P3b, whose relative contributions depend on saliency and task-relevance, respectively. However, the existence and roles of these sub-components in response to low-level errors are poorly understood. Here we investigated responses to low level errors generated by disturbances – including target and cursor jumps, versus responses to distractors, i.e., environmental changes that are irrelevant to the reaching task. Additionally, we examined the response to matching cursor and target jumps (dual jumps), which generate estimation errors, and are thus considered task relevant disturbances, but do not generate low level errors.

We found that a significant P3a-like component is evoked by both disturbances and distractors, whereas the P3b-like component is significantly stronger in response to disturbances than distractors. The P3b-like component appears also in response to dual jumps, even though there are no low level errors. We conclude that disturbances and distractors elicit distinct responses, and that the P3b-like component reflects estimation errors rather than low-level errors.

Keywords: EEG, ERP, Error-related potentials, Error-processing, Low-level errors, High-level errors, Estimation errors, ERN, P300, P3a, P3b.

1. Introduction

Error processing has been investigated extensively in the context of cognitive tasks, and was shown to evoke an error-related negativity (ERN), which is hypothesized to reflect task monitoring and to originate from the Anterior Cingulate Cortex (ACC) (Gehring et al., 1993; Falkenstein et al., 2000). However, in the context of reaching tasks (Krigolson and Holroyd, 2007; Krigolson et al., 2008) target jumps did not elicit ERN, at least not in the activity synchronized to the onset of the jump. Those experiments included both correctable and uncorrectable target jumps, where the latter refer to trials in which movement correction was