

Research Report

# Event-related theta oscillations during working memory tasks in patients with schizophrenia and healthy controls

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## Abstract

Altered frontal lobe activity and executive control associated with working memory (WM) dysfunction are recognized as core deficits in schizophrenia. These impairments have been discussed as being associated with deficits in self-regulated action monitoring and anticipatory action plan generation. To study electrophysiological correlates of executive control – specifically action monitoring and action rule switching – under varying WM load, we used a paradigm derived from classic N-back (WM) tasks and requiring monitoring of simple actions. We focused on event-related changes in post-stimulus theta oscillatory activity during varying cognitive and WM demand in healthy controls and schizophrenia patients. The results show significant WM load and rule-switching-related increases of post-stimulus theta amplitude at fronto-central locations in controls. In patients with schizophrenia, there was no such modulation, but – apart from an increased early theta at left temporal locations – generally reduced late theta responses in all tasks and at all locations. Furthermore, the patients with schizophrenia showed significant differences in their error patterns, which imply differences in automation and anticipation of actions between controls and patients. These findings suggest that theta oscillations are involved in mediating frontal lobe activity and functions related to enhanced executive control. We conclude that the patients with schizophrenia showed deficits in acquiring a mental task set which appear to be associated with impairments in action monitoring and task-specific regulation of executive control.

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## 1. Introduction

Schizophrenia is associated with a variety of pervasive cognitive deficits, particularly dorsolateral and medial prefrontal lobe-related cognitive functions, so-called executive functions [5,18,37,61,72]. Executive functions are referred to as a group of abilities closely related with working memory (WM) and comprising the abilities to self-regulate initiation of tasks or activities, to organize task

materials, to sequence, to prioritize, to shift between activities, and to inhibit an action. Impairments in WM function have been recently discussed as representing a core deficit or a basic disorder underlying cognitive performance of schizophrenia patients [38]. It is supposed that WM is a system, which greatly contributes to higher cognitive functions (including executive functions) such as reasoning, planning, and problem solving and that it is modulated by (pre-) frontal brain activations [6,19,20,25,44,54,58].

Theoretical and empirical investigations of the prefrontal and medial frontal cortex have provided evidence that this region mediates both mnemonic processes (such as storage and rehearsal) and non-mnemonic processes

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