

Fz theta divided by Pz alpha as an index of task load during a PC-based air traffic control simulation

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Abstract

In this investigation 21 students were trained to perform a highly simplified PC-based air traffic control (ATC) approach sequencing task simultaneously with a secondary (auditory) oddball task. Task load was manipulated by varying the number of aircraft on screen. Besides task load, time-on-task effects were investigated by monitoring the ATC task performance during two hours. The effects of the manipulations were assessed using subjective (RSME), performance and physiological (EEG spectral power, ERP P₃₀₀) measures. An index based on EEG spectral power in alpha and theta ranges was calculated by dividing the power of the Fz theta band by the power of the Pz alpha band. The index was tested with regard to its sensitivity for task load and time-on-task effects. The results provide support for Fz theta divided by Pz alpha as an index of task load.

Introduction

There are growing concerns that the continuous increasing level of air traffic, and hence the increasing task-levels of air traffic controllers (ATCOs), may compromise safety and/or efficiency of air travel. Consequently, more attention has been devoted to measuring ATCOs' workload. Two aspects of mental workload are of interest in this context. On the one hand the task load caused by the task properties on a certain moment, such as traffic density, and, on the other hand, the duration of the task. In practical settings, an index of task load should be able to distinguish the effort invested to meet the momentary demands of task load ("task-related effort") from the effort that is invested to prevent performance from degrading over time ("state-related effort"). As a general measure of task load, decreases in EEG alpha power (parietal) and/or increases in EEG theta power (frontal) have been reported in ATC simulators (Brookings et al., 1996), flight simulators (Serman & Mann, 1995; Smith et al., 2001) and actual flight (Wilson, 2002). With increasing time-on-task a diffusely spread increase of both alpha and theta power has been reported (Schacter, 1977).