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Abstract

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EEG effects on electrophysiological and behavioural responses during a cued CPT

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The nature of brain dynamics has been well documented in various attentional tasks, with electroencephalographic (EEG) activity during resting states, and in pre-stimulus periods, producing effects on perceptual and cognitive processing. The present study examined the influence of pre-stimulus delta, theta, alpha, beta, and gamma levels on event-related potentials (ERPs) and response times (RTs). The effects of the change in EEG levels from a resting state to the pre-stimulus period (i.e., activation) were also examined in relation to these responses. Continuous EEG was recorded from 70 subjects, first in an eyes closed (EC) resting state, then during a cued Continuous Performance Test. A series of numbers were presented where participants pressed a button for the designated Target, 9, only when cued by 1, and refrained from responding to any uncued numbers or cued NonTargets. Fast Fourier Transformations were used to extract EEG levels during the EC state, pre-Target (PT), and pre-NonTarget (PNT). Target and NonTarget ERPs were separately averaged and submitted to principal components analysis, with the following components identified: CNV, N2c, N2b, Target P3, NonTarget P3, and Slow Wave (SW). Correlations assessed EEG level and change effects in these components, and in RT. Larger PT and PNT delta levels coincided with greater CNV negativity, and increases in delta from EC to PT improved RTs. PT and PNT theta levels were also directly associated with CNV negativity. Greater PNT theta enhanced SW frontal negativity. Larger PNT alpha amplitude corresponded with increased negativity for the CNV and SW parietal positivity, and greater PT alpha levels slowed RTs. Increases in alpha from EC to PT decreased CNV amplitude. Greater PNT beta levels reduced SW parietal positivity, while the increase from EC to PNT decreased SW frontal negativity. Gamma levels and changes did not affect the ERP components or RT. These results indicate that the lower frequency bands are more strongly associated with the anticipatory activity preceding stimulus onset. The alpha effects support previous findings concerning the preparatory role of this frequency band and its subsequent impact on the ability to respond. Also, beta levels were found to influence the later cognitive processing of the cued stimuli. Thus, the brain's state, ranging from a pre-experimental resting state to the task-situation, modulates our expectancy, responding, and processing capabilities.