Reduced Frontal Cortical Responses Associated with Cognitive Changes in Individuals with mTBI or PTSD During Working Memory

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Combat veterans suffer from traumatic brain injury (TBI) and post-traumatic stress disorder (PTSD). Both are associated with various neurological and psychiatric sequelae. However, the neural mechanisms underlying core cognitive ability, e.g. attention and working memory, are not yet well understood. Previously, we have identified Event Related Potential (ERPs) signatures associated with working memory in healthy young (Guo et al., 2008), older adults (Lawson et al. 2007), and patients with early Alzheimer's disease (Li et al., 2017). The current study investigated altered brain activity during working memory in 15 vets with mTBI and/or PTSD, and 10 combat healthy controls. We hypothesize that these patterns will be different in individuals with mTBI and/or PTSD. In addition to 32-electrode scalp EEG recording as well as functional MRI brain imaging during delayed match-to-sample task, each subject completed a battery of neuropsychological tests assessing attention, processing speed, and executive function.

We revealed reduced bilateral brain responses for person with PTSD compared to controls during retrieval of memory targets using ERPs, i.e. mean amplitude of the P3 of left (-.56 vs 4.37, p=.002) and right frontal electrodes(1.15 vs 6.67, p=.003). This was also true for retrieval of nonmatch distractors at left (-0.72 vs 4.28, p=.002) and right frontal (-0.01 vs 5.07, p=.005) electrodes for PTSD compared to controls. The results from functional MRI showed similar reduced brain responses in PTSD. In the mTBIs, left frontal ERPs show reduced mean P3 amplitude compared to controls during retrieval of memory targets (4.37 vs 0.59 uV, p< .05), and distractors (4.28 vs -.03 mV, p =.05). Right frontal ERP differences trended towards significance in response to memory target (p=.09) but were not statistically significant in response to distractors. There is a significant correlation between left frontal P3 for retrieving target (r = -.457, p= .025), and distractor (r = -.489, p= .015), and the Trail Making Test (frontal executive functions). Interestingly, Connors performance test (attention measures) correlates with the parietal P3 (known attention-related ERPs; p< .05), but not with frontal ERPs.

Our findings show altered brain responses of veterans with mTBI from those of combat control during working memory. Such alteration is disassociated with attention-related responses. Our findings are consistent with a recent report of reduced amplitude in individuals with PTSD or mTBI during attention and decision task at Pz sites (Gilmore et al, 2016). The mTBI brainwaves of working memory are also distinct from our reported patterns in older adults with early AD.