Cognitive Profiles of Children with Traumatic Brain Injury

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ABSTRACT

Electroencephalography (EEG) can't tell you what you're thinking, but it can tell who has a traumatic brain injury. The current study aims to combine EEG with the Woodcock-Johnson IV (WJ-IV) in order to provide accurate discriminative abilities as well as an in-depth understanding of the cognitive impairments suffered by those who have a brain injury. Researchers and practitioners will learn the EEG and WJ-IV variables indicative of a traumatic brain injury.

INTRODUCTION

➢Traumatic brain injuries (TBIs) are defined as "…an alteration in brain function, or other evidence of brain pathology, caused by an external force" (Menon, Schwab, Wright, & Maas, 2010).

➢ Most children have two common problems as a result of TBI: slowed processing speed and attention problems (Rutter, 1981). These two symptoms can cause academic and educational difficulty.

➢Assessing cognitive impairment resulting from TBI is crucial in school settings as educational institutes are legally required to provide support to children with TBIs according to the Individuals with Disabilities Education Act (IDEA 2004).

➢In school settings, neuropsychological measures such as the Woodcock-Johnson IV (Schrank, Mather, McGrew, 2014) are used to assess individuals for cognitive and academic strengths and weaknesses.

➢In clinical settings measures including the Glasgow Coma Scale, symptom checklists, and neuroimaging techniques are used to assess TBI; however, reported symptoms and the Glasgow Coma Scale do not reveal underlying neurological deficits. Additionally, most neuroimaging techniques are not readily available and can be expensive.

➢EEG is a cost-effective and easy to use method that has been used to assess individuals with TBI. Previous studies which have used EEG to discriminate between individuals with a TBI and those without found group differences in EEG coherence (Thatcher, Walker, Gerson, & Geisler 1989; Thatcher et al. 1991).

➢The purpose of this study is to investigate the relationship between EEG and neuropsychological test performance in children with traumatic brain injury to provide a comprehensive assessment of their cognitive and academic abilities.

METHOD

➢Participants were referred by their primary care physician for neuropsychological testing as a result of a traumatic brain injury. Subjects ages range between 7.5 and 18.5 years old. All participants suffered from a TBI within the last 2 years.

➢To investigate underlying cognitive functioning, EEG was collected during both eyes closed and eyes open conditions with 19 electrodes using the 10-20 system. EEGs were artifacted for eye movement and drowsiness prior to analyses using the software Neuroguide.

METHOD CON'T

➢To investigate the cognitive and academic abilities, the WJ-IV Tests of Cognitive Abilities and the WJ-IV Tests of Achievement were given. Cognitive subtests 1-10, 13, and 17 were administered, providing a full GIA as well as Comprehension-Knowledge (GC), Fluid Reasoning (Gf), Short-Term Working Memory (Gwm), Processing Speed (Gs), and Long-Term Retrieval (Glr) composite scores. Academic subtests 1, 2, 4, 5, 9, and 10 were administered, providing Broad Math, Broad Reading, Math, Reading, and Math Calculation composite scores.

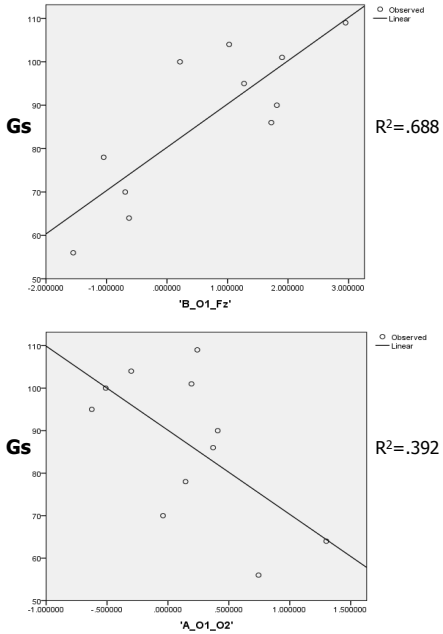
➢Preliminary analyses were conducted using Z scored Coherence. Delta, Theta, Beta, and Alpha band coherence scores were regressed on the Gs composite scores.

RESULTS

➢ The results of the regression analyses suggested Beta coherence between O1 and Fz can significantly predict Gs composite scores, such that an increase in Beta coherence between these electrodes is associated with a better processing speed score.

➢ Results also suggested that Alpha coherence between O1 and O2 can significantly predict the Gs composite score, such that an increase in Alpha coherence between these two electrodes is associated with a poorer processing speed score.

Figure 1: Coherence and Processing Speed Regression



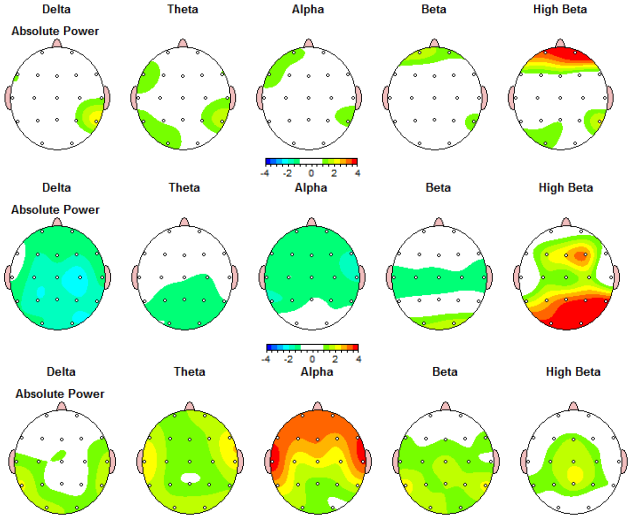
DISCUSSION

Conclusions: The results of this preliminary analysis suggests that increased posterior/anterior Beta coherence and decreased posterior Alpha coherence can significantly predict the Gs composite score on the WJ-IV. Previous studies offer support of these findings as they have also found changes in coherence to be significant predictors of TBI (Thatcher et al. 1989; Thatcher et al. 1991).

Limitations: There are several limitations to this study: (1) The number of participants is low (2) Various severity levels of TBI, location of injury, and time from injury to assessment may affect EEG results. (3) No control group exists to compare to the TBI group, therefore this may limit the generalizability of the study.

Future Research: Future goals of this study include addressing the limitations mentioned previously. Assessing more children with TBIs will provide a more accurate representation of cognitive, academic, and underlying neurological deficits. The inclusion of a control group, in which the children will have no prior history of a TBI, will offer a greater understanding of the differences that exist between children with TBI and children without. Finally, other EEG variables including amplitude asymmetry, phase lag, and peak frequency will be analyzed for similar comparisons.

Figure 2: Absolute Power Brain Maps of 3 TBI Participants



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