Characteristics of the Visual and Auditory P300 ERP in Individuals with High and Low Self-Reported Deficits of Attention

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Introduction

Attention Deficit Hyperactivity Disorder, as defined by the DSM-V, is a neurodevelopmental disorder characterized by the symptoms of impulsivity, inattention, and hyperactivity lasting for 6 months or longer (Substance Abuse and Mental Health Services Administration 2016). These symptoms can affect people in the classroom, in the workplace, and in their everyday life.

ADHD is a common disorder affecting 4% of adults and 8-12% of children worldwide (Gold et al. 2014). In the US alone, 1 in 20 children are affected by ADHD, and 80% of childhood cases last through adolescence into adulthood (Faraone et al. 2003).

When studying the brain using EEG, early electrical activity can help in gaining an understanding of how the brain is reacting to stimuli and how people are processing that stimuli. These studies are important when analyzing ADHD populations as it can give insight into how the ADHD brain differs from a non-ADHD population. The benefit of using EEG as a technique to study ADHD is that it offers recording across time, thus allowing for researchers to study the brain in a real-time format. EEG is especially valuable in its use in Event-Related Potential (ERP) research.

ERPs are time-locked electrical brain responses to stimuli. These potentials are defined by their latency, the time after stimulus onset they appear, and their amplitude. For example, the P300 peak is a positive peak that happens around 300 ms after stimulus onset. This peak has been widely studied in relation to cognitive processing and decision making (Polich 2007). The P300 ERP is commonly used to study ADHD as its latency and amplitude characteristics can be indicative of cognitive capability (Chi et al. 2019).

Aims

The aims of the current study are to see if differing attention deficits show any differences within P300 characteristics in auditory or visual stimuli presentation. ERP's in passive and active conditions are also analyzed. It is hypothesized that the high AD group will have higher P3 amplitudes.

Methods

Participants: 19 college aged adults (13 females 6 males)

Attention deficit:
9 women self-reported low symptoms.
4 women self-reported high symptoms.
4 men self-reported low symptoms
2 men self-reported high symptoms

Attention Inventory:
The 18 item Adult ADHD Self Report Scale was given to participants. Participants were grouped into high AD and low AD groups based on their answers on the first six questions (Adler et al.).

Methods

Stimuli Presentation: Stimuli were presented in an oddball paradigm format with an 75:25 ratio.

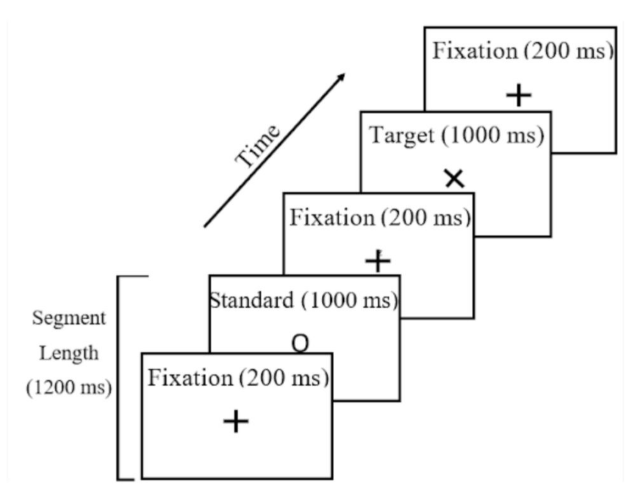
EEG Recording: EEG/ERP data was collected using a HydroCel GSN 128 channel sensor net supplied by Electrical Geodesics, inc.

EEG Sessions: The study was split into two days. Visual stimuli EEG sessions took place on the first day. Auditory stimuli sessions took place between 2-8 days after the visual.

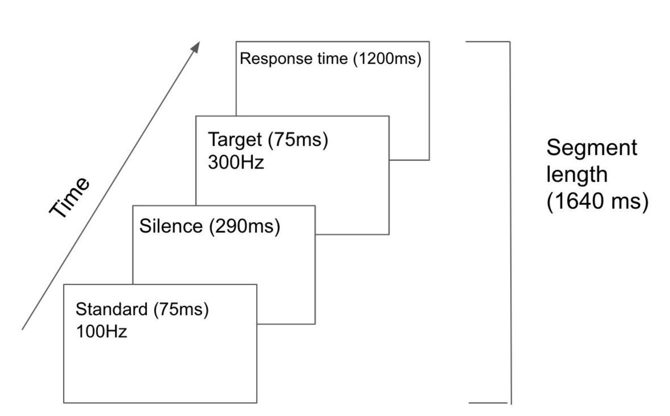
Conditions: Participants had both passive and active conditions in both visual and auditory stimuli days. Passive conditions consist of paying attention to stimuli while active conditions consist of pressing a button when the target stimuli is presented.

Stimuli:

Visual:
With visual stimuli, the ratio of standard (O) to target (X) was 75:25 with 160 standard events and 40 target.



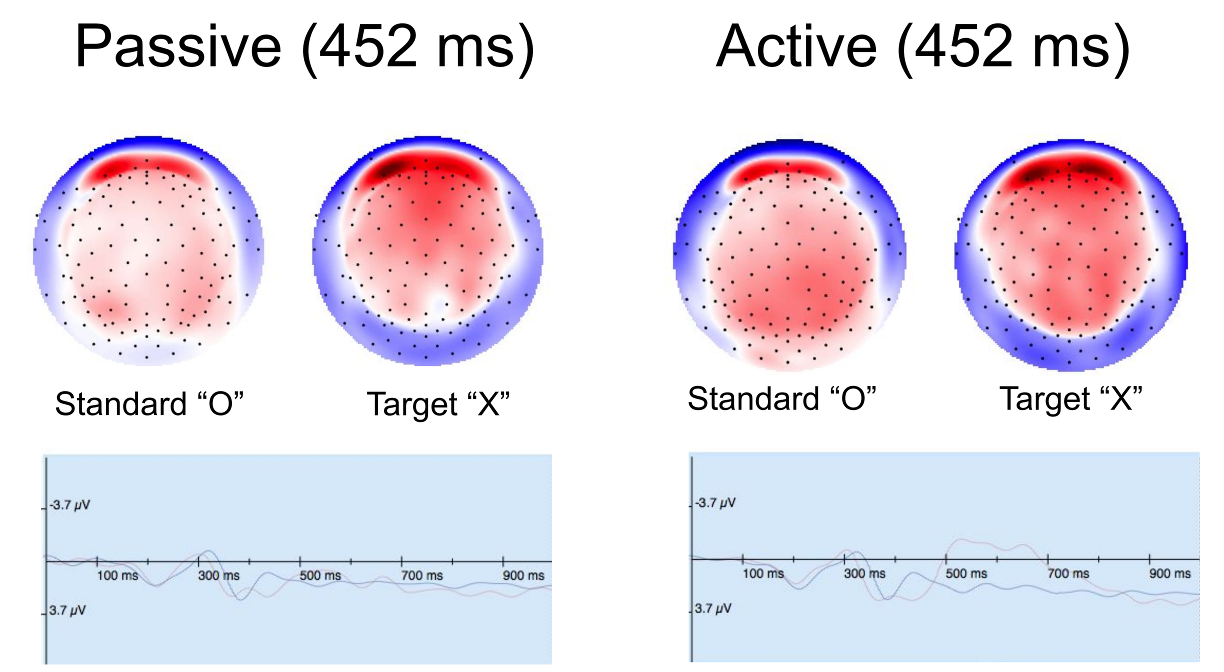
Auditory:
Stimuli were presented as a pair of tones with differing frequencies separated by 75 ms. Standard tones were a low-low pair of 100 Hz-100 Hz while the target was a low-high pair of 100 Hz-300 Hz. Each pair was separated by 290 ms. 680 standards were presented with 175 targets.



Findings

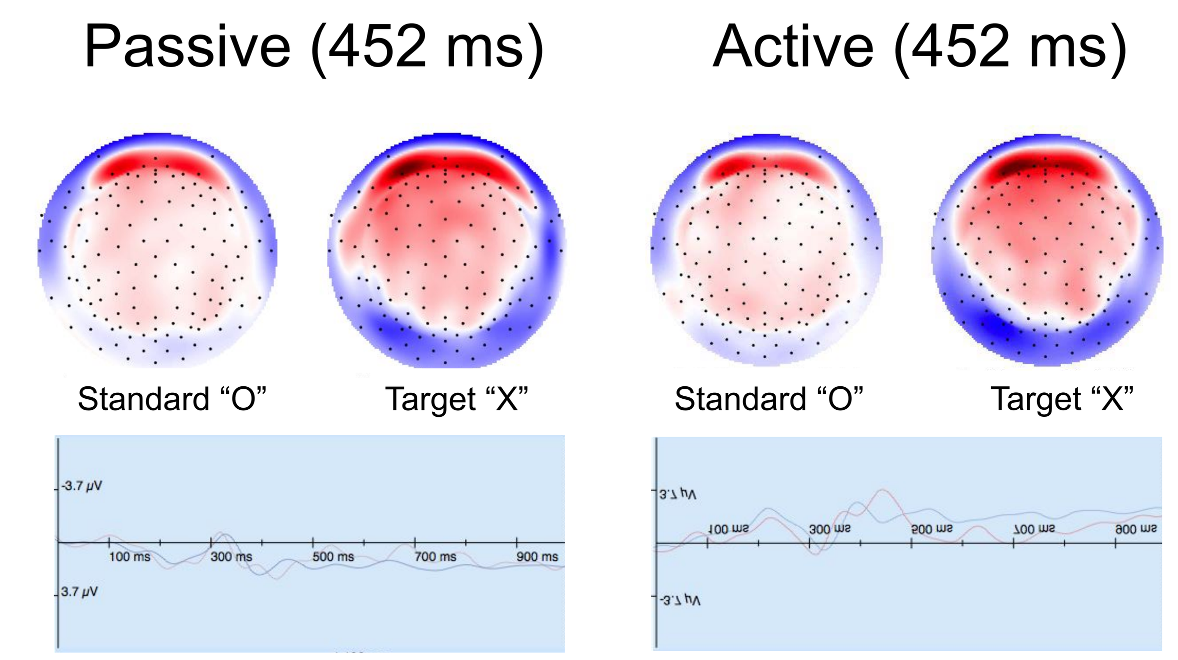
Visual

Low AD



Electrode 16

High AD



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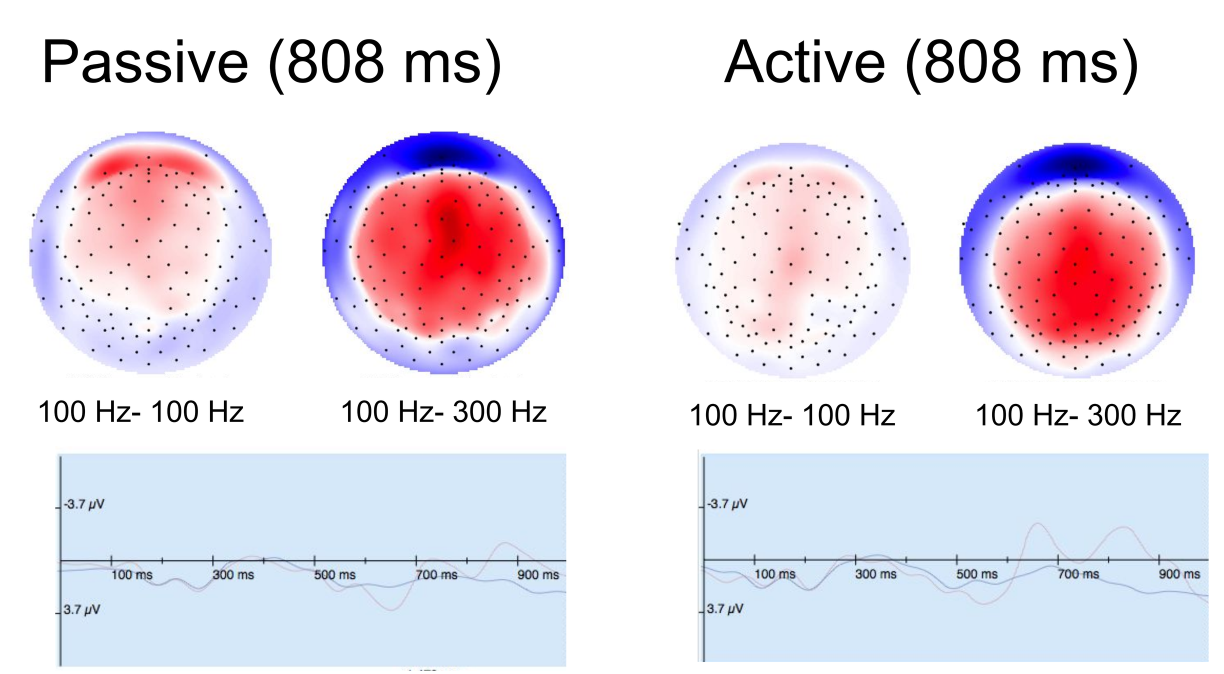
Auditory

Low AD



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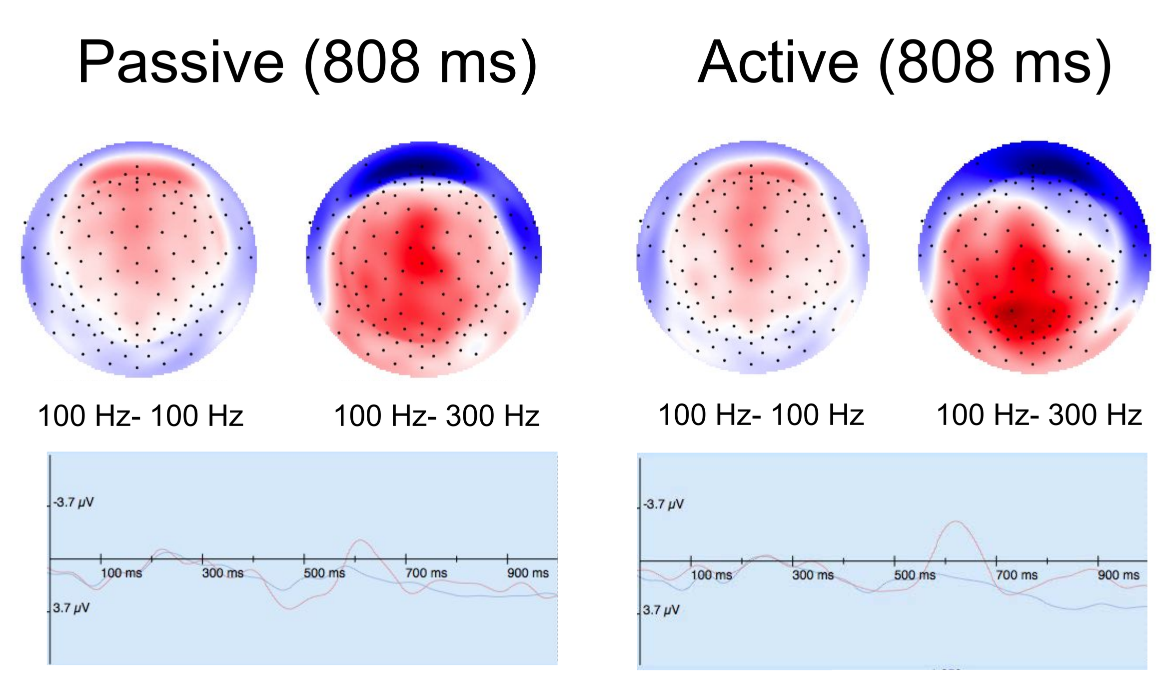
High AD



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Observations

Visual

- P300 amplitude differences were found in both high attention-deficit and low attention-deficit groups in passive and active conditions.
- Left lateralized positive frontal activation found in both high and low AD groups when target stimuli is presented in passive and active visual conditions.

Auditory

- P300 amplitude differences were found in both high attention-deficit and low attention-deficit groups in passive and active conditions.
- Negative frontal activation found in both high and low AD groups when the target stimuli is heard in both active and passive conditions.

Citations

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