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"Effect of visual and auditory stimuli in cortical activation during saccadic eye movements"

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ABSTRACT (CHAPTER 1)

BACKGROUND/OBJECTIVES:

The objective of this systematic review is to provide a compilation of literatures pertaining to saccadic eye movement tasks and to determine if these saccadic eye movements' tasks can be used in assessment of cognitive function and its outcome measures as cognitive markers/predictors in assessing cognitive decline in ageing cognition and neurodegenerative diseases.

METHODS:

PubMed/Medline, Embase/Scopus, CINHALL and Cochrane Library were the databases that were searched for the relevant literature involving saccadic eye movement tasks and other cognitive tests, using specific keywords for each group (Aging cognition and Neurodegenerative diseases). The search strategy had no restriction with time and only included literatures published in English language. Two independent reviewers carried out the screening and data extraction processes and a third reviewer helped in resolving any conflict of inclusion of articles and with any other skeptical issued. Different outcome measures of the saccadic eye movement tasks and the correlations between the saccadic eye movement tasks and other cognitive tests used in the literature were the main data that was focused on. Further synthesis of the qualitative data was done.

RESULTS:

We reviewed 49 articles obtained from different databases using specific terms and from hand search of the reference lists. Remarkable findings of this review are 1. Eye movement characteristics, specifically latency and error rates of complex saccade tasks, are affected in patients with neurodegenerative diseases and in older adults when compared to the respective control population. 2. 20 of 34 studies in Part 1 and 10 of 15 studies in Part 2 tried to asses cognitive function using clinically available cognitive tests and it resulted in the presence of cognitive decline in both neurodegenerative diseases and in older adults. 3. Significant correlation of eye movement characteristics, specifically in complex saccade tasks, and cognitive test measures being reported that eye movement tasks which involve decision making are directly related to cognitive aspects of an individual and hence they can be considered as a cognitive marker/predictor.

CONCLUSION:

From all the literatures that were filtered out and fully reviewed with a systematic approach, we can infer that latency and error rate obtained from complex eye movement tasks can be used as a cognitive marker/predictor while assessing cognitive function, since, these characteristics have shown significant correlation with the outcome measures of the cognitive tests used in each literature. Further implementation of these eye movement tasks clinically to detect the presence of cognitive decline will be an important step forward.

ABSTRACT (CHAPTER 2)

Background and Objectives:

P300 wave has been studied using auditory stimuli in wide range of individuals which represents the stimulus evaluation and attention. It has been observed in normal individuals, patients with neurodegenerative diseases, in elderly population, etc. The lack of literature in noticing the P300 wave using eye movement tasks and its outcome measures being vital to act as an early marker for neurodegenerative diseases is the root cause and the aim of this study.

Methods:

20 individuals who met the specific criteria were recruited and Electroencephalogram (EEG) was performed on them using Brain Products by presenting with two experiments in E-prime Studio. The first experiment included Go/No-Go Pro-Saccadic (PS) and Anti-Saccadic (AS) eye movement tasks and the second one involved auditory Spatial Stroop task which demanded the individuals to make an eye movement response accordingly. Respective elicited ERPs' latency and amplitude was analyzed and measured using Besa Research software, for each individual in each experiment.

Results:

We analyzed P300's and P200's latency, amplitude of all the conditions in both experiments. In eye movement task, P300 latency resulted in a significant delay and near to significantly larger amplitudes with AS task than PS task, but P200 latency showed a non-significant difference in both characteristics. In the Spatial Stroop task, P300 and P200 latency did not show any significant difference between congruent and incongruent conditions, but we found a near to significant difference with P200's mean amplitude being larger for Incongruent task condition. We also found a significant negative potential (Ninc) at around 200 to 400 milliseconds (ms) for both task conditions which showed delayed mean latency for incongruent task condition.

Conclusion:

These results suggest that, eye movement tasks with PS and AS and Spatial Stroop task of congruent and incongruent conditions elicit P200 and P300 in normal adults. AS condition demands more cognitive function since it was elicited with a significant

difference when compared to the PS task. The incongruent negativity wave seen in the Spatial Stroop task, showing alterations in latency for incongruent task, represents the auditory Stroop conflict resolution across the task conditions, which is also a part of cognitive function.