REGION-OF-INTEREST SOURCE LOCALIZATION ANALYSIS FOR COGNITIVE IMPAIRMENT DURING PUBLIC SPEAKING ANXIETY.

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REGION-OF-INTEREST SOURCE LOCALIZATION ANALYSIS FOR COGNITIVE IMPAIRMENT DURING PUBLIC SPEAKING ANXIETY.

WHICH HAS BEEN APPROVED BY FACULTY OF ELECTRONIC AND COMPUTER ENGINEERING.

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This report is submitted in partial fulfilment of the requirements for the degree of Bachelor of Electronic Engineering with Honours

Faculty of Electronic and Computer Engineering
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UTeM
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UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DECLARATION

I declare that this report entitled **"REGION-OF-INTEREST SOURCE LOCALIZATION ANALYSIS FOR COGNITIVE IMPAIRMENT DURING PUBLIC SPEAKING ANXIETY.."** is the result of my own work except for quotes as cited in the references.

Signature : ……

Author : DHARMA SEELAN S/O BALA

Date : 14 / 06 / 2021

APPROVAL

I hereby declare that I have read this thesis and in my opinion this thesis is sufficient in terms of scope and quality for the award of Bachelor of Electronic Engineering with Honours.

Signature	:	
Supervisor Name	:	Dr. Farah Shahnaz Binti Feroz
Date	:	15/ 06 / 2021

DEDICATION

Specially Dedicated to,

My parents **Mr.Bala Muniandy** and **Miss Chandra Ramasamy**,

My brother **Puvendan Bala,**

My Friends,

My Idol **Mr.AR.Rahman,**

&

My Supervisor **Dr. Farah Shahnaz Binti Feroz**

ABSTRACT

The major aim of this research was to compare the time courses of the current density within the ACC in cognitive impairment during Stroop Task in high PSA (HPSA) and low PSA (LPSA) subjects. 24 EEG data was recorded from undergraduate students (12 low, 12 high PSA) from the Faculty of Electronic Engineering, Universiti Teknikal Malaysia, Melaka (UTeM) has been selected to participate in the Stroop Test. A low-cost electroencephalogram (EEG) headset 14-channel Emotiv EPOC+ was used to record the brain signals with integration of stimuli marking circuit. The Raw EEG datawas pre-processed with EEGLAB. All analyses were obtained using Statistica software which used the methods of repeated measured ANOVA and T-test. Using a modified Stroop paradigm, we investigated the time course of neuronal activations within the dACC and rvACC using event-related potentials (ERP) and standardized low-resolution electromagnetic tomography (sLORETA) region of interest (ROI) source localization studies. The dACC and rvACC had very distinct time courses of brain activation, with the rvACC having more dramatic initial responses and the dACC having enhanced activity primarily in the late negative window. We observed the rVACC in HPSA group has the highest current density compared to the rVACC in LPSA group which is slightly lower in current density within the rvACC, a post-hoc

Bonferroni test revealed that the incongruent condition had significantly higher mean current density than the congruent condition.During the N450 window, there is a substantial negative correlation between trait anxiety and current density in the incongruent condition within the rvACC for HPSA subjects, but not for LPSA subjects. Using high density EEG and source localization, it was possible to distinguish various disturbances within the dACC and rvACC in subjectswith PSA, during cognitive impairment processing.

ABSTRAK

Tujuan utama penyelidikan ini adalah untuk membandingkan kursus masa kepadatan semasa dalam ACC dalam gangguan kognitif semasa Stroop Task pada subjek PSA tinggi (HPSA) dan PSA rendah (LPSA). 24 data EEG direkodkan dari pelajar sarjana (12 rendah, 12 tinggi PSA) dari Fakulti Kejuruteraan Elektronik, Universiti Teknikal Malaysia, Melaka (UTeM) telah terpilih untuk mengambil bahagian dalam Ujian Stroop. Alat dengar 14-saluran Emotiv EPOC + alat dengar electroencephalogram (EEG) kos rendah digunakan untuk merakam isyarat otak dengan penyatuan rangkaian penandaan rangsangan. Data Raw EEG telah diproses terlebih dahulu dengan EEGLAB. Semua analisis diperoleh menggunakan perisian Statistica yang menggunakan kaedah ujian ANOVA dan T-pengukuran berulang. Dengan menggunakan paradigma Stroop yang diubah suai, kami menyiasat jangka masa pengaktifan neuron dalam dACC dan rvACC menggunakan potensi yang berkaitan dengan peristiwa (ERP) dan kajian lokasi penyetempatan sumber tomografi elektromagnetik (sLORETA) resolusi rendah standard (ROI). DACC dan rvACC mempunyai waktu pengaktifan otak yang sangat berbeza, dengan rvACC mempunyai tindak balas awal yang lebih dramatik dan dACC mempunyai peningkatan aktiviti terutamanya di jendela negatif akhir. Kami memerhatikan rVACC dalam kumpulan

HPSA mempunyai ketumpatan arus tertinggi berbanding rVACC dalam kumpulan LPSA yang sedikit lebih rendah dalam ketumpatan arus di dalam rvACC, ujian Bonferroni pasca-hoc mendedahkan bahawa keadaan tidak serentak mempunyai ketumpatan arus min yang jauh lebih tinggi daripada kongruen keadaan. Semasa tetingkap N450, terdapat korelasi negatif yang besar antara kebimbangan sifat dan ketumpatan semasa dalam keadaan tidak sesuai dalam rvACC untuk subjek HPSA, tetapi tidak untuk subjek LPSA. Dengan menggunakan EEG berketumpatan tinggi dan penyetempatan sumber, adalah mungkin untuk membezakan pelbagai gangguan dalam dACC dan rvACC dalam subjek dengan PSA, semasa proses gangguan kognitif.

ACKNOWLEDGEMENTS

Initially, I would like to express my gratitude to my supervisor, Dr. Farah Shahnaz Binti Feroz for her advice, guidance and suggestions. She lends a hand in guiding me on the right track to do my project and motivating me when facing circumstances. Secondly, I would like to express my deepest gratitude to my family members for their support and motivation. Moreover, I would like to thank my housemates from FKEKK because they give me support during my research. They also give suggestions and pieces of advices about my project. Lastly, I am very thankful to Dr. Hazura who always give me the useful information about the final year project.

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LIST OF SYMBOLS AND ABBREVIATIONS

EEG	:	Electroencephalogram
PSA	:	Public Speaking Anxiety
LPSA	:	Low Public Speaking Anxiety
HPSA	:	High Public Speaking Anxiety
ACC	:	Anterior Cingulate Cortex
ROI	:	Region of Interest
dACC	:	dorsal Anterior Cingulate Cortex
rvACC	:	Rostral-ventral Anterior Cingulate Cortex
ICA	:	Independent Control Analysis
FFT	:	Fast Fourier Transform

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CHAPTER 1

INTRODUCTION

1.1 Research Overview

The main objective of this study is to examine the time course of the current density within the anterior cingulate cortex (ACC) in a cognitive impairment during stroop task. While in our contemporary society, public speaking anxiety (PSA) is widespread, the basic brain behavioral causes of this anxiety are yet to be explained. Therefore, in this research, source localization was performed to convert the signal form the scalp by using the low-cost EEG Emotiv EPOC++ into the current density at the brain region ACC. sLORETA which is standardized Low-Resolution Electromagnetic Tomography was used to get a region of interest (ROI) source localization analyses which was to explore the time course of neural activations within the anterior cingulate cortex (ACC) during the stroop task experiment. Then, the statistical analyses were examined by using the Statistica software to detect the aberrant conflict modulation in PSA subjects. Finally, the correlation analysis was conducted to examine the relationship between the current density with the level of anxiety of the subjects.

1.2 Problem Statement

In our daily lives, the dynamic interplay between emotional and cognitive functions is present. Unbalanced communication in emotion-cognition, such as those found in anxiety and mood disturbances, can be destructive. Especially for PSA patients, they feel feelings like apprehension and anxiety as they find themselves in conditions where they become the center of attention, leading to nausea and heavy sweating. Much of them attempt and prevent cases where they must act or communicate in public, but when necessary, anxiety triggers those circumstances. While the fear of public speaking has become prevalent in our modern culture which approximately 25% of people report feeling it, the underlying cause of this anxiety in brain activity during cognitive impairment has yet to be understand.

Table 1.1 shows that up to now, there is no experiment or study about source localization of the PSA during the Stroop task. The table below proved that there is a lack of source localization studies that use the low-cost EEG to investigate the source localization in PSA individuals. It is discovered non-PSA studies with the same parameters investigated in this study, which is the current density withing the ACC using time window analysis. Using time window source localization analysis, these studies managed to detect aberrant modulations within brain regions and the time window.

Table 1.1: The Literature Gap regarding the Related Study.

Title	Methods	Results	Similarity	Gap/Limitations
The Emotional Stroop Paradigm: Performance as a Function of Stimulus Properties and Self-Reported Mathematics Anxiety	-The high math anxious group of 25 (13 male, 12 female), the low math anxious group 17 (9 male and 8 female	- Additionally, the high math anxious group also exhibited a longer response time on both the numeral and letter conditions. All other main effects and interactions were not significant	-Stroop Task	-Not using Sloreta to analyze the cognitive in stroop task.
The Electrophysiological Dynamics of Interference during the Stroop Task	21 subjects (5 men and 16 women) with a mean age of 24.9 years (range = 20 to 33 years)	- RTs increased linearly from congruent to negative priming items [F(1, 20) = 59.597, p < .001].	- Stroop Task -Analyzing several measures of EEG activity.	- Not using Sloreta to analyze the cognitive in stroop task.
Anxiety and Stroop Performance	-A mixed sample of 89 students (43 boys & 46 girls)	- anxiety can have a negative effect on working memory performance. That this leads to emotional interference	-Anxiety scale questionnaire is used -Cognitive stroop task	- Not using Sloreta to analyze the cognitive in stroop task.

		while performing on Stroop task		
Using a Brain-Computer Interface to Categorize Human Emotional Response Indices While Playing Video Games	The study included 20 users (20 who performed the Stroop and 17 who completed The Towers of Hanoi), with each test lasting an average of 20 minutes (Theta-Beta band readings)	- When a subject experience a change in these feelings, the headset's attention and meditation datasets clearly show it.	-Used stroop task.	- Not using Sloreta to analyze the cognitive in stroop task.
Coping styles and stroop test in non-clinical sample: exploring the associations and predictors of cognitive styles	Undergraduate medical students (N= 203, 57 male, 146 female) ranging in age from 18 to 25 years (M= 21.48, SD= 1.97)	- There were no reports of colorblindness, dyslexia, or depression or other mental illnesses among the individuals.	- Cognitive Stroop Task	- Not using Sloreta to analyze the cognitive in stroop task.
Effects of sleep deprivation on Color-Word, Emotional, and Specific Stroop interference and on self-reported anxiety	Twelve healthy male subjects, ranging in age from 18 to 26 years (meanD21.5 years, SDD2.3)	- The incongruent card in the Stroop Color-Word task took longer to process and is more prone to errors than the control one.	- Cognitive Stroop task.	- Not using Sloreta to analyze the cognitive in stroop task.
The Stroop Color and Word Test	- Electronic databases and citations from a selection of relevant papers were used to find studies.	- The parameters of speed and accuracy of the performance, essential	- The Stroop Color and Word Test extensively used to assess the ability to	- Not using Sloreta to analyze the cognitive in stroop task.

		for proper detection of the Stroop Effect, are scored differently between studies	inhibit cognitive interferenc e	
Towards a Comprehensive Simulator for Public Speaking Anxiety Treatment	Participants' are subjected to the full event flow encountered during the delivery of a speech, which consists of three phases: Anticipation,Performance and Recovery	The simulated training environmen t aims to help lower the anxiety levels of participants who suffer from public speaking anxiety	Experiment design in terms of methods handling -Public speaking anxiety scenario is been used	- Not using Sloreta to analyze the cognitive in stroop task.
PSD based Coherence Analysis of EEG Signals for Stroop Task	PSD is calculated by both the methods, Welch method and periodogram method for both situation that is, congruent as well as incongruent situation	- The synchroniza tion of the brain electric activities of different frequencies between the brain areas.	- EEG methods handling using Stroop Task.	- Not using Sloreta to analyze the cognitive in stroop task.
Domain-general Stroop Performance and Hemispheric Asymmetries: A Resting-state EEG Study	Fifty-six university students participated in the experiment after providing informed consent.	- The analysis revealed a characteristi c pattern of results, with higher RTs for the incongruent condition for both tasks	-Stroop task using EEG	-Not using Sloreta to analyze the cognitive in stroop task.
EEG based Stress Level Identification	10 subjects between the age 21 and 35 years from Nanyang Technical University	The design of temporal sliding window with different overlapping	-Using Emotiv Epoc neuroheads et and Matlab module for	-Not using Sloreta to analyze the cognitive in stroop task.

		increases the accuracy	processing EEG signals	
Instantaneous EEG coherence analysis during the Stroop task	a special dynamic approach for a continuous coherence estimation	Higher coherences are observed within the left frontal and left parietal areas, as well as between them for the incongruent situation in comparison with the congruent situation.	-EEG technical analysis is conducted -Stroop Task is conducted	-Not using Sloreta to analyze the cognitive in stroop task
Public Speaking Anxiety Scale: Preliminary psychometric data and scale validation	375 undergraduate students enrolled in psychology courses	a significant difference in anxiety between males and females, such that females report higher levels of public speaking anxiety than males	Assess reliability and validity of a new scale for speech anxiety, the Public Speaking Anxiety Scale (PSAS).	-Not using Sloreta to analyze the cognitive in stroop task

The significance of this study is to identify and observe the brain activity of PSA subjects during the Stroop Task to detect aberrant emotional-conflict modulation. By conducting this analysis, we discover new knowledge which is the source localization analysis for aberrant emotional-conflict modulation in PSA subjects. An opportunity has been taken to study this selected title to make a scientific contribution in the field of cognitive neuroscience.

1.3 Objective

1.1.1 The objectives are:

- To compare the time courses of the current density within the dACC and rvACC between HPSA and LPSA in a modified Stroop Task.
- To determine the brain region responsible for cognitive control modulation in HPSA subjects.

1.4 Significance of the project.

Upon completion of this research and all objectives were successfully satisfied, it was reported novel results in the relation of cognition interactions during PSA. This was the first study that uses the low-cost EEG to analyze the source localization for cognitive impairment using Stroop Task. Besides, this project offered a major opportunity to advance the knowledge of cognition relations among PSA subjects to help them minimize the weight of this condition so that they have a lot of confidence while making a speech to the crowd. The studies can make a major contribution to the area of neurobiology and neuropsychology since these observations may be applied by medical professionals in the development of medications or interventions. The group should be clear of the burden of needing PSA as therapies have been planned, thereby making them better at public contact would be more relaxed and happier.

1.5 Thesis Outline

There are five chapters in this thesis, whereas the first chapter was an introduction to this research. The first chapter included the objectives of the study, problem statements and the significance of the project. In the second chapter, the background study for the experiment was discussed, which included a literature review on PSA, Stroop Task, EEG and the comparison of the previous research. Throughout the third chapter, the project's methodology was explained in detail, while in the fourth chapter, the findings were analyzed and discussed. Finally, the fifth chapter concluded all the findings in the previous chapter.

CHAPTER 2

BACKGROUND STUDY

The table below shows the previous studies, which is related to the current study. It includes the results, similarities, and the method handling techniques to conduct the experiment. The table consist an additional column which states none of them are handling the coherence analysis.

Table 2.1: Background Studies / Literature Review.

Title	Methods	Results	Similarity	Gap/Limitations
The Emotional Stroop Paradigm: Performance as a Function of Stimulus Properties and Self-Reported Mathematics Anxiety	-The high math restless gathering of 25 (13 male, 12 female), the low math restless gathering 17 (9 male and 8 female	- Additionally, the high math restless gathering likewise showed a more drawn out reaction time on both the numeral and letter conditions. Any remaining fundamental impacts and connections were not significant	-Stroop Task	-Not utilizing Sloreta to dissect the psychological in stroop task.
The Electrophysiological Dynamics of Interference during the Stroop Task	21 subjects (5 men and 16 ladies) with a mean period of 24.9 years (range = 20 to 33 years)	-RTs expanded straightly from harmonious to negative preparing things [F(1, 20) = 59.597, p < .001].	-Stroop Task	The Electrophysiological Dynamics of Interference during the Stroop Task
Uneasiness and Stroop Performance	-A blended example of 89 understudies (43 young men and 46 girls)	-tension can negatively affect working memory execution. That this prompts enthusiastic impedance while performing on Stroop task	-Anxiety scale poll is utilized	Uneasiness and Stroop Performance

Assessing a Brain-Computer Interface to Categorize Human Emotional Response Indices During Video Game Play	20 clients partook in the examination (20 finished the Stroop and 17 attempted The Towers of Hanoi), with each test averaging 20 minutes (Theta-Beta band readings)	-the consideration and reflection datasets yielded by the headset obviously demonstrate when a subject goes through a change in these emotions.	-Used stroop task.	-Not utilizing Sloreta to investigate the psychological in stroop task.
Adapting styles and stroop test in non-clinical example: investigating the affiliations and indicators of psychological styles	Undergraduate clinical understudies (N= 203, 57 male, 146 female) going in age from 18 to 25 years (M= 21.48, SD= 1.97)	-None of the members were accounted for of being visually challenged, dyslexic or determined to have sadness or other mental disorders	- Cognitive Stroop Task	Adapting styles and stroop test in non-clinical example: investigating the affiliations and indicators of psychological styles
Impacts of lack of sleep on Color-Word, Emotional, and Specific Stroop impedance and on self-revealed nervousness	Twelve solid male subjects, going in age from 18 to 26 years (mean = 21.5 years, SD=2.3)	-The incongruent card in the Stroop Color-Word task took more time to measure and is more inclined to mistakes than the control one.	- Cognitive Stroop task.	-Not utilizing Sloreta to dissect the intellectual in stroop task.
The Stroop Color and Word Test	-Studies were recognized utilizing electronic data sets and references from a	-The boundaries of speed and exactness of the	-The Stroop Color and Word Test widely	-Not utilizing Sloreta to investigate the psychological in stroop task.

	determination of pertinent articles	exhibition, fundamental for legitimate location of the Stroop Effect, are scored contrastingly between studies	used to survey the capacity to hinder intellectual obstruction	
Towards a Comprehensive Simulator for Public Speaking Anxiety Treatment	Participants' are exposed to the full occasion stream experienced during the conveyance of a discourse, which comprises of three stages: Anticipation,Performance and Recovery	The recreated preparing climate plans to help bring down the tension degrees of members who experience the ill effects of public speaking anxiety	Experiment plan as far as strategies taking care of	Towards a Comprehensive Simulator for Public Speaking Anxiety Treatment
PSD based Coherence Analysis of EEG Signals for Stroop Task	PSD is calculated by both the methods, Welch method and periodogram method for both situation that is, congruent as well as incongruent situation	- The synchronization of the brain electric activities of different frequencies between the brain areas.	- EEG methods handling using Stroop Task.	- Not using Sloreta to analyze the cognitive in stroop task.
Domain-general Stroop Performance and Hemispheric Asymmetries: A Resting-state EEG Study	Fifty-six university students participated in the experiment after providing informed consent.	- The analysis revealed a characteristic pattern of results, with higher RTs for the incongruent condition for both tasks	-Stroop task using EEG	-Not using Sloreta to analyze the cognitive in stroop task.

EEG based Stress Level Identification	10 subjects between the age 21 and 35 years from Nanyang Technical University	The design of temporal sliding window with different overlapping increases the accuracy	-Using Emotiv Epoc neurohea dset and Matlab module for processin g EEG signals	-Not using Sloreta to analyze the cognitive in stroop task.
Instantaneous EEG coherence analysis during the Stroop task	a special dynamic approach for a continuous coherence estimation	Higher coherences are observed within the left frontal and left parietal areas, as well as between them for the incongruent situation in comparison with the congruent situation.	-EEG technical analysis is conducte d -Stroop Task is conducte d	-Not using Sloreta to analyze the cognitive in stroop task
Public Speaking Anxiety Scale: Preliminary psychometric data and scale validation	375 undergraduate students enrolled in psychology courses	a significant difference in anxiety between males and females, such that females report higher levels of public speaking anxiety than males	Assess reliability and validity of a new scale for speech anxiety, the Public Speaking Anxiety Scale (PSAS).	-Not using Sloreta to analyze the cognitive in stroop task

2.1 The Emotional Stroop Paradigm: Performance as a Function of Stimulus Properties and Self-Reported Mathematics Anxiety

Stroop errands are considered valuable in surveying restless effect. Albeit apparently math nervousness is like other uneasiness conditions, exhibiting a Stroop impedance impact among people with math tension has demonstrated troublesome. High and low math restless people were regulated a Stroop-like card task including the tallying of numerals and letters, alongside a standard PC based Stroop shading naming errand utilizing numerical and unbiased control words.

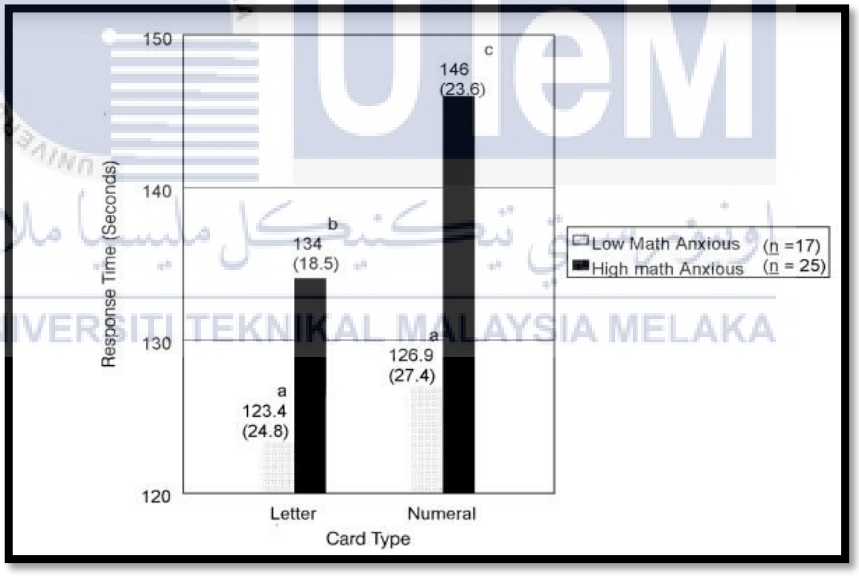


Figure 2.1.1 Mean card task response times as a function of math anxiety. Means that do not share a common superscript differ significantly at p < .05. Standard deviations are in parentheses

On the card task, high math agitated members took much longer to complete the test, which was reflected in the numerical condition. As a function of tension gathering

or word type, reaction time did not differ in the typical Stroop shading naming task. The findings suggest that arithmetic tension's obstructive effects are a result of inhibitory inadequacies or excitatory cycles (or both) that are amplified when more significant (for example, quantitative) increases are given. Suggestions for assessing arithmetic unease and completing the Stroop assignment.

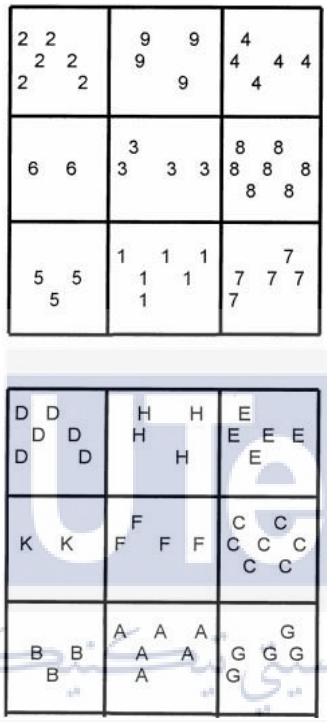


Figure 2.1.2 shows the simple-matched numeral and letter cards.

The discovery of differences in a computational impedance task among only high math restless members, but not in a shading naming impedance task, is intriguing. Although more detailed research is needed to confirm this notion, it appears that the card game could be a useful tool for surveying math anxiety. This social list, rather than self-reporting amounts of math tension caused for adults, may be a more effective alternative for evaluating arithmetic unease in rudimentary educational contexts. Early intervention approaches could be used in this way to help advance more positive viewpoints on arithmetic and reduce wear and tear from math-related courses.

Furthermore, the investigation entails determining the qualities of improvements incorporated into exploratory plans with caution in order to ensure that they are sufficiently notable to alter behaviour. Further examination of the current discoveries, as well as the specific management deficits associated with arithmetic anxiety, is warranted.

2.2 The Electrophysiological Dynamics of Interference during the Stroop Task.

When respondents are asked to name the shade of the word red imprinted in blue ink, there is an impedance between the importance of the word and the tone of the ink, which slows down response time. This effect is known as the Stroop effect. The cerebrum's handling of impedance in this type of task remains a vexing problem. An electroencephalogram (EEG) study was conducted to further analyse this matter. Two major discoveries resulted from dissecting a few proportions of EEG activity. To begin with, the ERP demonstrated increased front-focal pessimism for incongruent things rather than consistent and impartial things in a time window of roughly 400 msec for incongruent things. A source in the anterior cingulate cortex (ACC) contributed the most to the difference, according to source limitation analysis. Second, a time–recurrence analysis revealed that theta movements (4–7 Hz) in the ACC increased in direct proportion to the size of the blockage, and that stage coupling between the ACC and the left prefrontal cortex was more vigilant for incongruent things than for harmonic and impartial items. These collisions occurred in a time frame of about 600 milliseconds. We deduce that in the Stroop test, an obstruction between shading naming and word significance appears at roughly 400 msec, essentially triggering the ACC. instruments.

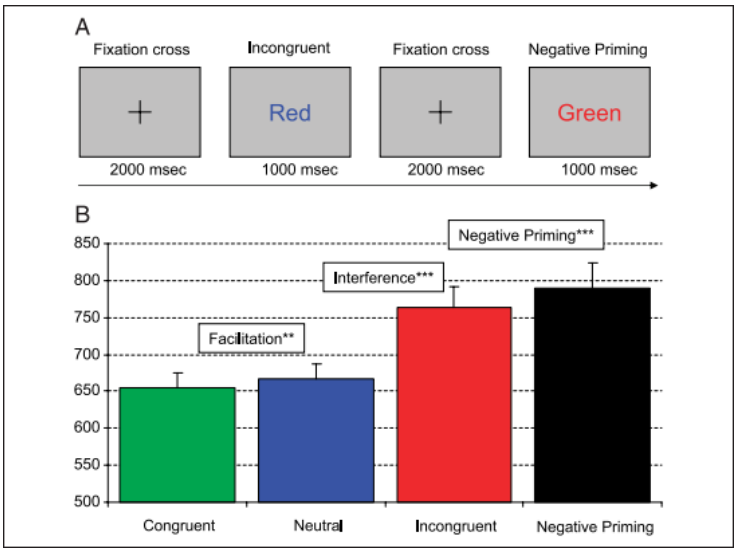


Figure 2.2.1 shows an example of a trial sequence for the negative priming condition is depicted.

The Stroop task's brief parts of neuronal cycles triggered by blockage. We've found that obstruction causes a negative going ERP about 400 msec, as we've seen in previous ERP studies. Dipole confinement revealed that this effect is unquestionably generated in the ACC, which is more active for items with a high degree of blockage (incongruent and negative preparation) than for items with a low degree of impedance (consistent and impartial).

2.3 Anxiety and Stroop Performance

The study looked how how intellectual and passionate Stroop affected the presentation of understudies with varying levels of tension. Uneasiness is a common and strong reaction to a potential threat that causes a variety of physical, mental, and behavioural changes in order to work with a quick response (WHO, 2004). In cases of intellectual conflict, anxiousness has been discovered to have an important role once again. The Stroop effect has been widely used in surveys of

conflict in the past (Stroop, 1935; MacLeod, 1991).

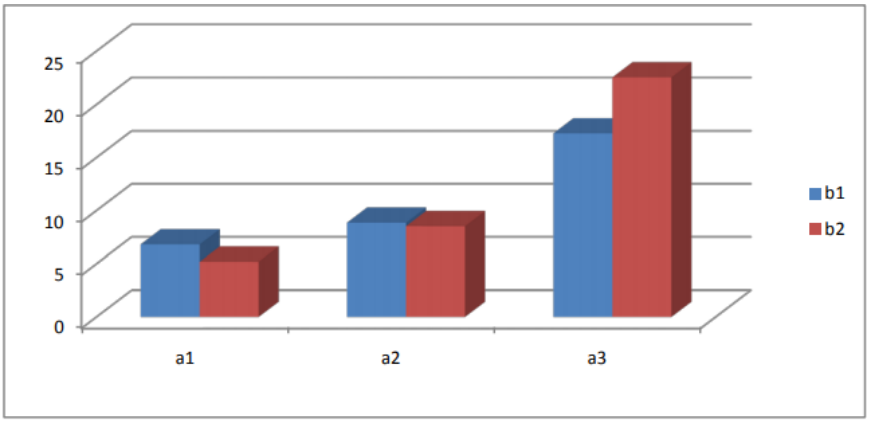


Figure 2.3.1 shows the trends for means of cognitive and emotional Stroop errors across the three anxiety groups.

For the purpose of this study, a combined sample of 89 understudies from Chandigarh Government schools in the age range of 14-18 years (mean age= 15.9 years) was used. The repeated measures ANOVA and other examinations of the information carried out execution contrasts as to how diverse groups of anxiety execute through intellectual and passionate Stroop task situations. The investigation discovered that tension is inextricably linked to Stroop's execution. Furthermore, high anxiety has a greater impact on emotional Stroop execution than on psychological Stroop execution, implying that high tension people have higher receptive control (Braver, 2012). Then again, low and moderate tension appears to prompt more blunders on psychological Stroop when contrasted with the enthusiastic Stroop.

2.4 Evaluating a Brain-Computer Interface to Categorize Human Emotional Response

The goal of this investigation is to see if NeuroSky's Mindset headset is a non-intrusive method for evaluating a subject's level of attention and reflection. Two mental-based tests were used to assess the headset's ability to quantify and categorize a client's level of consideration and reflection. When using genuine games to gauge a client's passionate response, a problem arises. Different forms of evaluations cannot answer questions that a human assessor can. Was the understudy concerned? Did the understudy appear to be pressed? Did they appear to be certain? This information can be useful in evaluating a child's growth. 'Whether or not the essential evaluation reason excludes enthusiastic reaction, it has a lot of value as optional information.' Serenity is an example of a sensation that could be useful for evaluation. The term 'silent' is used to describe how loose and formed a client is. In evaluating feelings, the assessor's perception will always lead the way. The goal of this investigation is to see if NeuroSky's Mindset is capable of detecting clients' degrees of reflection and deliberation in a situation where a spectator is unlikely to be present. The benefit and curiosity of utilizing NeuroSky's Mindset Brain-Computer Interface (BCI) to acquire feeling data lies in the way that students can survey themselves whenever without the requirement for assessors.

Figure 2.4.1 shows the plot representing meditation level of subject – clearly indicating speed changes of the test.

The Stroop Color-Word Interference Test (Stroop, 1935) is a well-known mental test that assesses mental flexibility and quickness. It is frequently employed as a mental or psychological stressor. The test takes advantage of the fact that perusing a word has become an automatic process for experienced perusers. Word recognition takes a lot longer than colour recognition. For example, to distinguish the shading boost from the word upgrade, the subject must name the shading that is presented rather than the phrase. The most natural or programmed reaction is to determine the semantic value of the word. For example, when reading the word'red,' the person considers the colour red. The psychological system involved in this project is coordinated consideration, and the subject should cope with their consideration by preventing one reaction from causing them to say or do something different. As part of their research on Voice Stress Analysis, Rothkrantz et al. used a form of the Stroop test to mimic pressure in dialogue. The Rothkrantz version is computer-based and consolidates a gradual increase in the degree of difficulty in the test over a five-minute period.

2.5 Coping styles and Stroop test in non-clinical sample: exploring the associations and predictors of cognitive styles

The adaptation of styles in literary works on factors influencing the execution of the Stroop obstruction has been difficult. Because of the inconsistency of multidimensional adapting models and the use of diverse Stroop tests, previous studies of the adapting effect on the Stroop test have been backhanded and ambiguous. Character and adapting styles have been linked to Stroop execution by the concept of confined vs adaptable or expansive psychological style. The purpose of this study was to determine the relationship between adaptation styles and Stroop obstruction towards impedance (Stroop RI) and, as a result, to determine the indications of Stroop execution. Purposive testing was used in this cross-sectional local area study configuration focus. 205 undergrad clinical understudy participated in this study, which included self-controlled Brief COPE stock polls and the Stroop Test. Findings revealed that behaviour withdrawal (r=-0.361), broken adaptation (r=-0.355), self-fault (r = 0.222), and drug usage (r = -0.173) all had a negative link and a strong link with Stroop RI. Various relapse studies identified conduct withdrawal (R2 = 0.13) and pointless adaptation (R2 = 0.024) as critical impedance markers. End: Coping strategies have been linked to intellectual styles that have shifted as a result of the Stroop test. The future bearing of various neuropsychological appraisal batteries on the value of profiling individualized benchmark standards has been witnessed by the coordination of adaptive styles component on the Stroop test..

2.6 Effects of sleep deprivation on Color-Word, Emotional, and Specific Stroop interference and on self-reported anxiety

The goal of this study was to see how lack of sleep affected impedance execution in brief Stroop tasks (Color-Word, Emotional, and SpeciWc) as well as abstract tension. Emotional exhaustion and performance on a psychomotor assisted contemplation task were also investigated to corroborate our lack of sleep hypothesis. Twelve healthy young people were tested during a 36-hour period of attentiveness using a consistent standard procedure. Lack of sleep harmed self-appraisal of sleepiness on a visual simple scale, as well as mean response time execution on the supported consideration job, both for the Wrst minute and for the 10 min of testing. Investigations revealed an increase in self-detailed discomfort scores on the STAI poll, but no significant eVect following lack of sleep on blockage lists or precision in Stroop errands. In any case, in the danger-related (Emotional) and rest-related (SpeciWc) Stroop assignments, studies revealed affectability to circadian eVect on verbal reaction times. We hypothesised that 36 hours of delayed alertness aVect self-announced anxiousness and the Emotional Stroop task would result in a cognitive easing back. Furthermore, complete loss of sleep had no effect on impedance control in any of the three brief Stroop tasks.

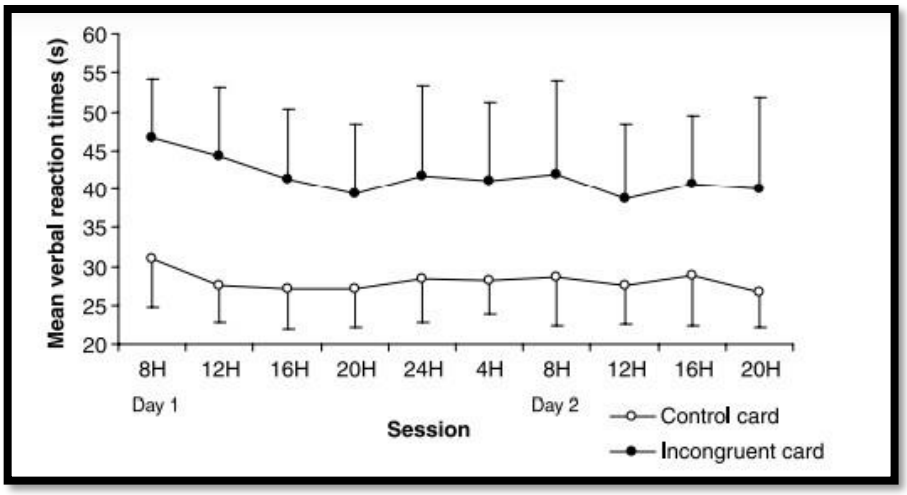


Figure 2.6.1 shows the mean color naming reaction times in seconds to complete a card for the Classical Stroop as a function of type of card and of session (mean and SD)

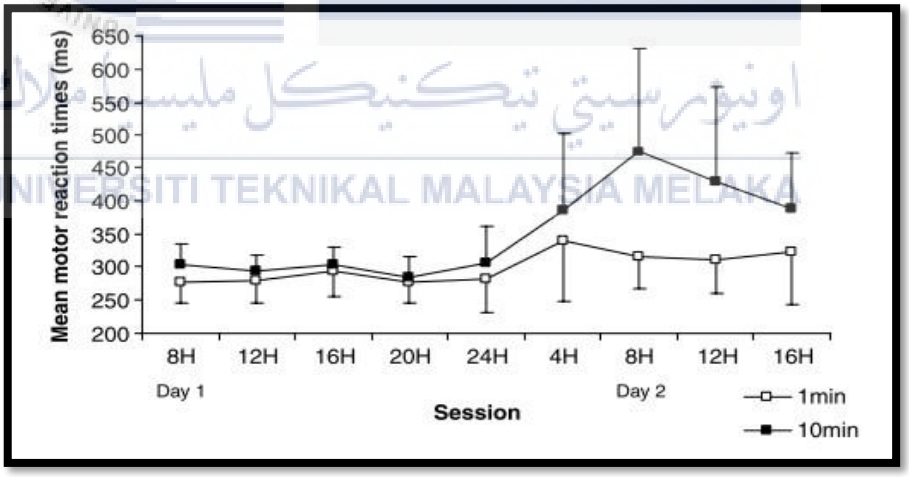


Figure 2.6.2 shows the reaction times in milliseconds as a function of time on task and of session (mean and SD).

The effect of one night of complete lack of sleep over a 36-hour period under consistent routine convention on impedance execution, verbal response times, and the level of errors in three short Stroop tasks (Color-Word, Emotional, and SpeciWc), as well as abstract state-nervousness levels, was investigated. Abstract sluggishness and plain supported contemplation were both studied. The findings demonstrate that throughout the evening of sleep deprivation, abstract state-unease scores rise. After 8 hours of sleep deprivation, there is a decline in self-reported unease, followed by a recovery after 20 hours. These findings are similar to those of a study that looked at self-detailed mental characteristics such as negative mindset, inspiration, and so on.

2.7 The Stroop Color and Word Test

The Stroop Color and Word Exam (SCWT) is a neuropsychological test that is commonly used to assess the ability to repress intellectual inhibition, which occurs when the handling of one improved highlight prevents the concurrent preparation of another, known as the Stroop Effect. The goal of this study is to determine whether the various scoring techniques used to determine the Stroop impact are hypothetically sufficient. Introducing a rigorous survey of studies that have provided the SCWT with standardised data. It mentioned electronic data sets (such as PubMed, Scopus, and Google Scholar) as well as references.

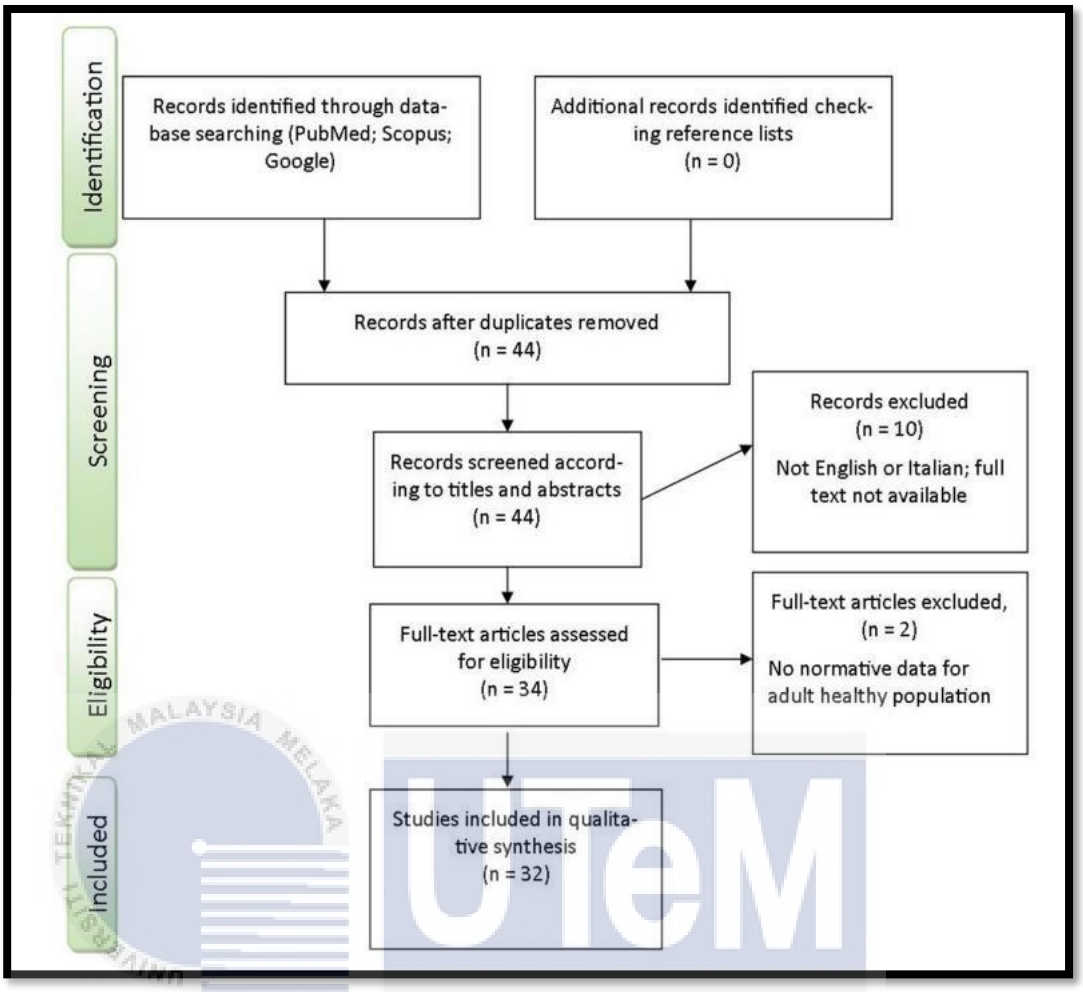


Figure 2.7.1 shows the flow diagram of studies selection process.

The findings demonstrate that, though a few scoring systems have been documented, none of the methodologies examined allows us to fully assess the Stroop effects. Aside from that, there are a few regularising scoring systems from the Italian presentation that have been written about. It promises to be an elective scoring methodology that considers both reaction speed and precision. Finally, it's worth emphasising the importance of evaluating the show in all Stroop Test situations (word perusing, shading naming, named shading word).

2.8 Towards a Comprehensive Simulator for Public Speaking Anxiety Treatment

The dread of public speaking is sometimes referred to as the most well-known social phobia. With life-like settings, augmented reality allows us to defeat PSA. This paper first examines the cutting edge in virtual environments as a potential treatment for public speaking anxiety, and then presents a comprehensive Virtual Environment (VE). The inclusion of physical and vocal signs is required in the majority of assessments. The crowd's physical and vocal cues are powerful supporters of PSA. We're going to create a virtual amphitheatre with a group of individuals displaying these physical and vocal cues; a thorough VE that will defeat PSA. The ensuing test method would thus be able to be used for both preparing and treating PSA, as well as distinguishing signals to which speakers are more sensitive.

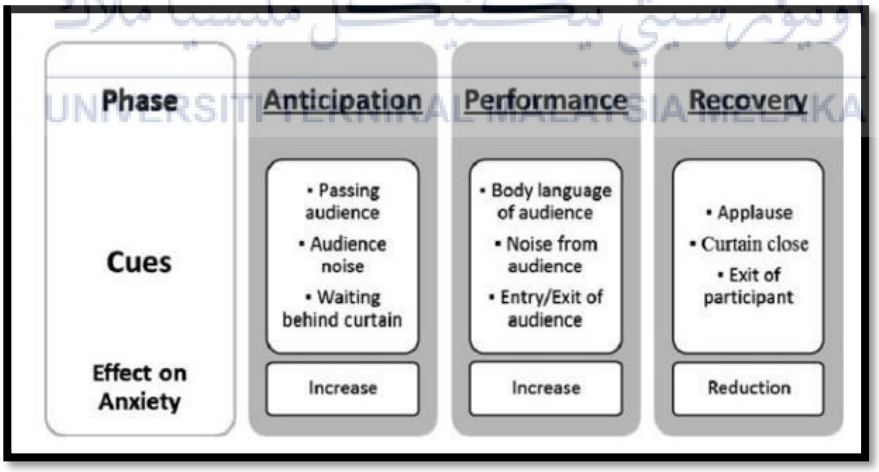


Figure 2.8.1 shows the expected effects on anxiety level caused by physical and vocal cues during each phase of the experimental procedure.

2.9 SD based Coherence Analysis of EEG Signals for Stroop Task

The rationality research is based on phantom examinations, which depict the synchronization of electroencephalogram (EEG) rhythms between different parts of the brain. Intelligence analysis is a non-intrusive method of considering utilitarian relationships between different parts of the brain. The lucidity investigation is a type of range examination-based study that can represent the synchronization of distinct frequencies of mind electric workouts between cerebrum areas. Using a movement Stroop Task, the healthiness of EEG signal between cerebrum areas was investigated. The study of event-related coordination of neurophysiological indications of brain response for a given task that the participant does redundantly was conducted using force unearthly thickness (PSD). To consider the PSD, the Welch method is used. We created simulated EEG data, looked for an appropriate approach for intellectual EEG, and tried to apply it to Stroop Tack's EEG data. The results reveal that the EEG signals of the mental regions for Stroop task movement are in sync.

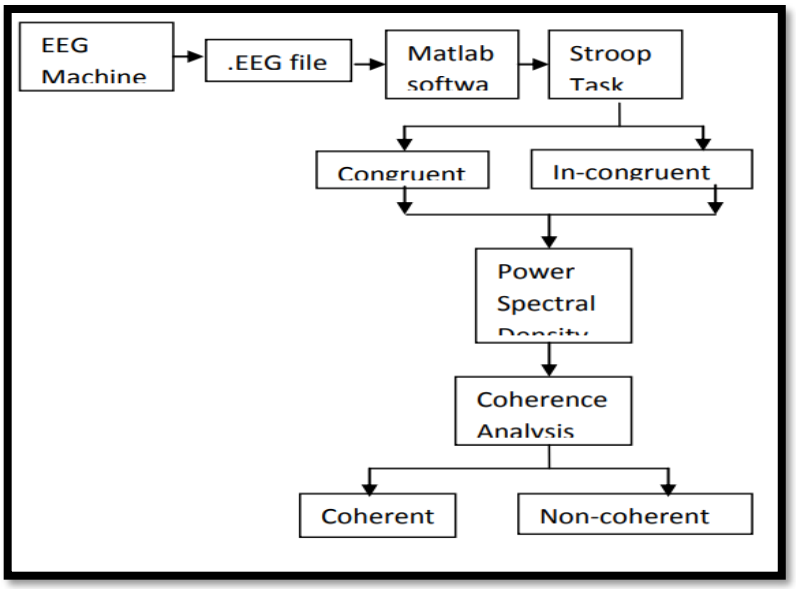


Figure 2.9.1 shows the system Block diagram

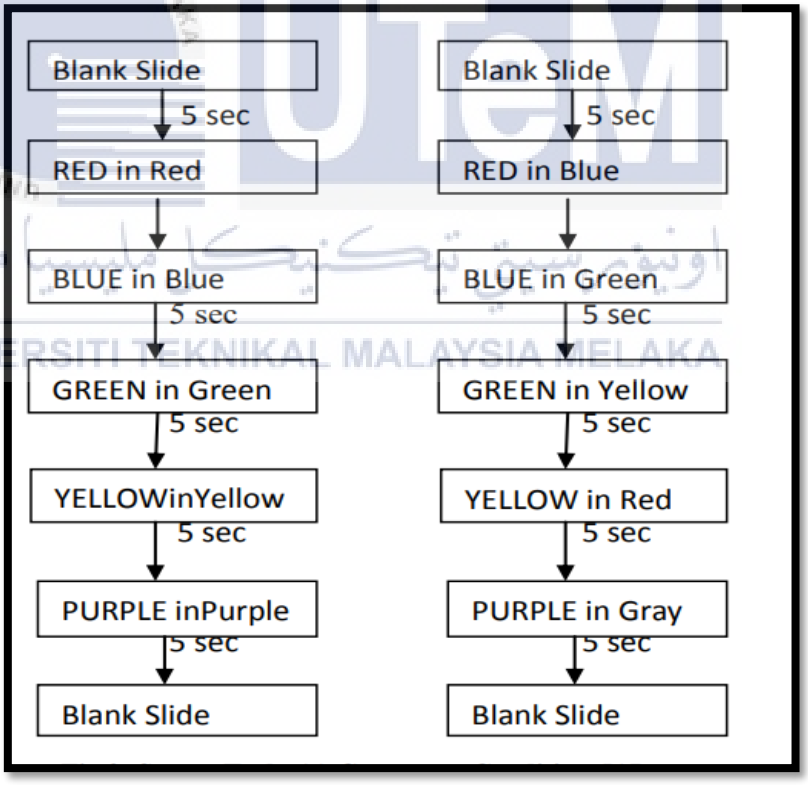


Figure 2.9.2 shows the Stroop Task: (a) Congruent Condition, (b)Incongruent Condition

2.10 Domain-general Stroop Performance and Hemispheric Asymmetries: A Resting-state EEG Study

The Stroop task, which requires subjects to name the shade of a shading word imprinted in compatible (RED in red) or incongruent (RED in blue) ink as quickly as possible while ignoring the word's importance, contains specialized consideration, language handling, and shading naming cycles. As a result, using lucidity to examine the synchronization of practical organizations during the Stroop task may be helpful in understanding the neurophysiological basis of unquestionable level intellectual activities in normal persons, as well as providing clinical evaluations for messes in patients. Subjects must be correctly given, which is one of the requirements for EEG recording in the Stroop task. All of them had normal or corrected to normal visual acuity, as well as normal shading vision. Improvements were imprinted in red, green, or blue shading and presented in the screen's focal point against a white foundation.

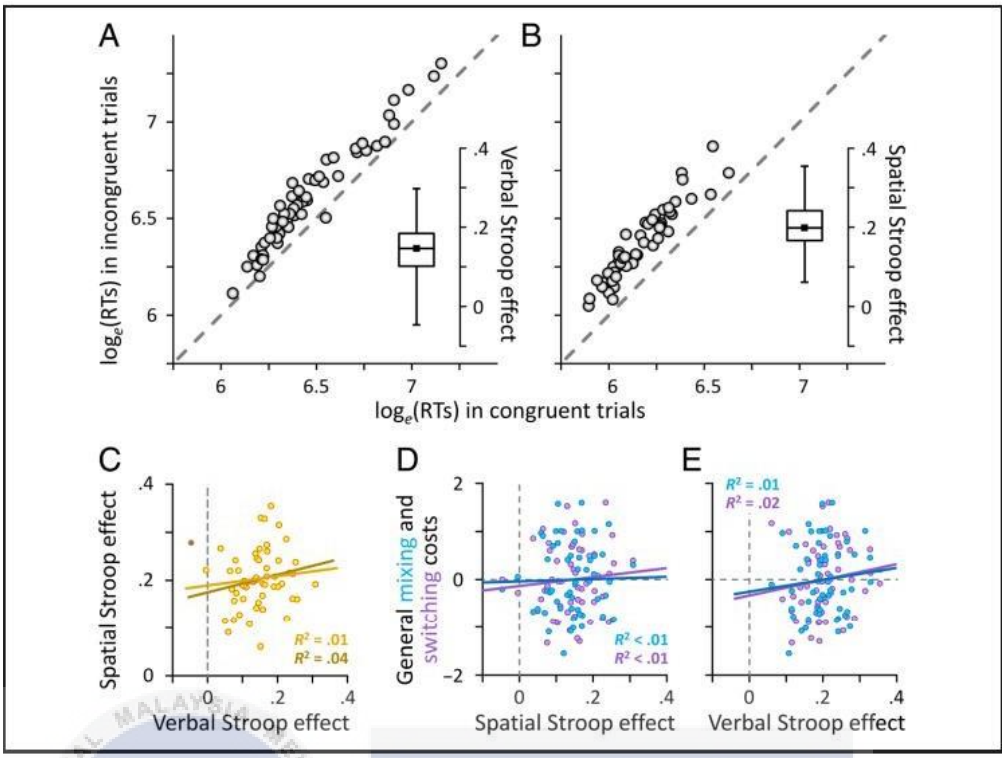


Figure 2.10.1 shows the participants behavioral performance in the Stroop tasks.

At a distance of roughly 100 cm from the screen, the increase persisted. Subjects were instructed to concentrate on the word displayed on the screen and react as quickly and precisely as possible to the ink shade of the words by squeezing the appropriate key. While creating slides for EEG recording of the Stroop task, keep in mind that the text dimension is 140, the textual style type is Times New Roman, the activity type is blur easily, the entomb slide timing is 5 seconds, and the foundation is white. Consistent and in-harmonious are the two conditions of the Stroop task.

2.11 Domain-general Stroop Performance and Hemispheric Asymmetries: A Resting-state EEG Study

Obstruction opposing capability, or the ability to suppress unimportant facts while completing a task, is a component of pFC that is essential for effective objective coordinated human behaviour. Two significant inquiries remain open in the probe of obstruction resistance and, more broadly, leader capacities: Is it possible that pFC enhances psychological control abilities by lateralized yet space-general components or by hemisphere specialization of area explicit cycles? What are the underlying causes of interindividual differences in leader control execution? To have a better understanding of these concerns, we used an interindividual comparison method to see if members' hemispheric unevenness in resting-state electrophysiological mind aspects mirrored their fluctuation in area general obstruction opposition. It captured members' resting-state electroencephalographic movement and investigated the assessed cortical source action with ghostly force investigations. We used the right–left hemispheric deviation score for the / power proportion to quantify members' lateralized cerebrum constituents. Verbal and spatial Stroop assignments were used to assess their general obstacle opposition capacity in their area. Members with more grounded resting-state-related left-lateralized action in various pFC districts, specifically the mid-back unrivalled front facing gyrus, centre and back centre front facing gyrus, and substandard front facing intersection, were more ready to repress unessential data in the two spaces, according to vigorous relationships followed by crossing point investigations. The new findings support and expand on previous findings that reveal neurophysiological distinction components can help to explain interindividual differences in chief working.

2.12 An EEG based Stress Level Identification

This study looks at where instances appear in thought waves when they are triggered by mental strain. The electroencephalogram (EEG) is the most often used method for acquiring brain signals because it is simple, practical, and convenient. In this study, two powerful stressors are used to generate varying degrees of mental pressure using a programmed EEG-based pressure acknowledgment system. The Stroop shading word test and mental number-crunching test are used as stressors to activate mild and high levels of stress, respectively, and their critical C# program are developed in Microsoft Visual Studio to connect with Emotiv Epoc devices. Force band highlights from EEG signals are broken down, and three levels of pressure may be sensed with a precision of 75% using the overall contrast of beta and alpha force as a highlight and a Support Vector Machine as a classifier. Stroop shading word test and mental number-crunching test had accuracy of 88 percent and 96 percent, respectively, for two-level pressure study.

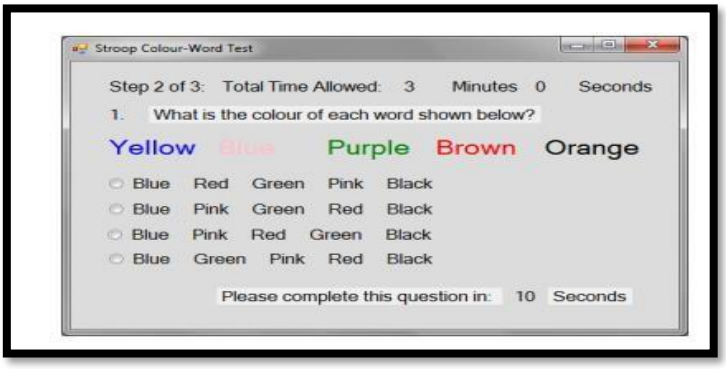


Figure 2.12.1 shows the Stroop colour-word test.

2.13 ICA-based EEG denoising: a comparative analysis of fifteen methods.

Independent Component Analysis (ICA) assumes a significant part in biomedical designing. To be sure, the intricacy of cycles engaged with biomedicine and the absence of reference signals make this visually impaired methodology an amazing asset to remove wellsprings of interest. In any case, practically speaking, just not many ICA calculations like SOBI, (broadened) InfoMax and FastICA are utilized these days to handle biomedical signs. In this paper we bring up the issue whether other ICA strategies could be more qualified as far as execution and computational intricacy. We center around ElectroEncephaloGraphy (EEG) information denoising, and all the more especially on expulsion of muscle curios from interictal epileptiform movement. Presumptions needed by ICA are talked about in such a unique situation. Then, at that point fifteen ICA calculations, specifically JADE, CoM2, SOBI, SOBIrob, (expanded) InfoMax, PICA, two unique executions of FastICA, ERICA, SIMBEC, FOBIUMJAD, TFBSS, ICAR3, FOOBI1 and 4-CANDHAPc are momentarily portrayed. Then, they are concentrated as far as execution and mathematical intricacy. Quantitative outcomes are acquired on reenacted epileptic information created with a physiologically - conceivable model. These outcomes are likewise shown on genuine epileptic chronicles.

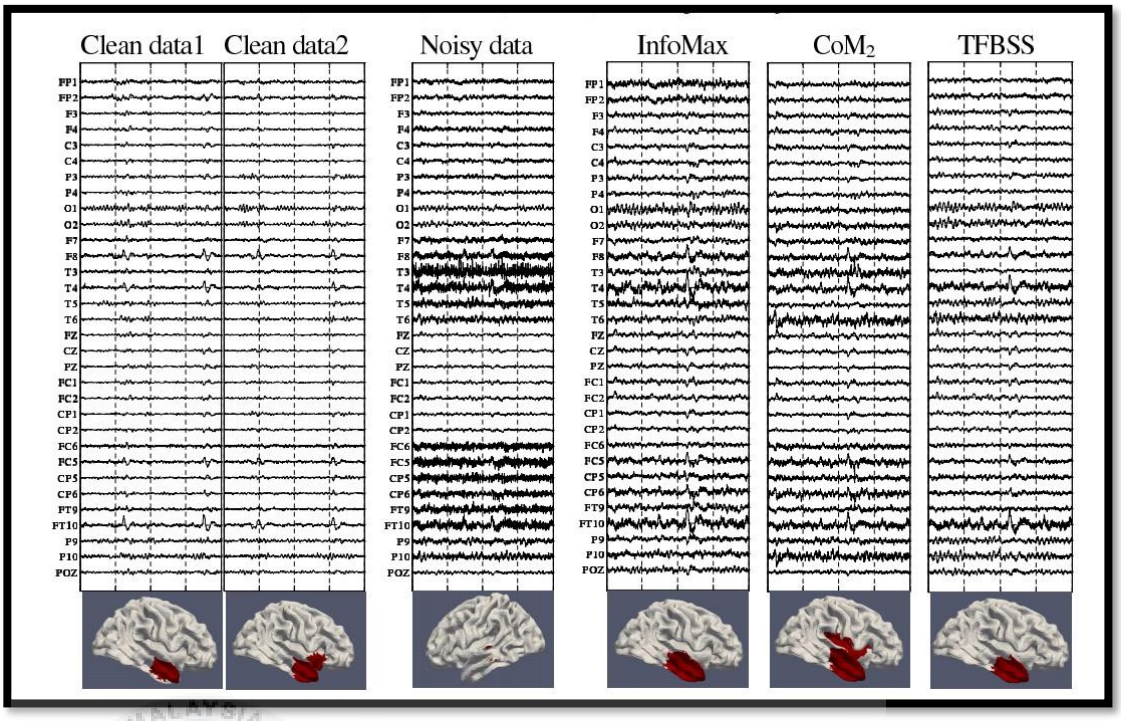


Figure 2.13.1 shows Denoising of real interictal spikes data: i) two noise-free interictal spikes (columns 1 and 2), ii) epoch including spikes hidden in muscle activity with very high level of noise (column 2), iii) EEG denoised by Infomax, CoM2 and TFBSS (columns 3, 4 and 5, respectively).

2.14 Enhanced detection of artifacts in EEG data using higher-order statistics and independent component analysis.

Identifying curios delivered in EEG information by muscle action, eye flickers and electrical clamor is a typical and significant issue in EEG research. It is presently broadly acknowledged that free part investigation (ICA) might be a helpful instrument for disengaging antiques and additionally cortical cycles from electroencephalographic (EEG) information. We present aftereffects of reproductions exhibiting that ICA disintegration, here tried utilizing three famous ICA calculations, Infomax, SOBI, and FastICA, can permit more touchy robotized recognition of little nonbrain antiques than applying similar identification techniques straightforwardly to the scalp channel information. We tried the upper bound execution of five techniques for distinguishing different sorts of antiques by independently upgrading and afterward applying them to curio free EEG information into which we had added recreated relics of a few kinds, going in size from multiple times more modest (−50 dB) to the size of the EEG information themselves (0 dB). Of the techniques tried, those including ghostly thresholding were generally touchy. With the exception of muscle antique identification where we discovered no increase of utilizing ICA, all strategies demonstrated more delicate when applied to the ICA-deteriorated information than applied to the crude scalp information: the mean exhibition for ICA was higher and arranged at around two standard deviations from the presentation dispersion acquired on crude information. We note that ICA decay likewise permits basic deduction of relics represented by single free parts, or potentially discrete and direct assessment of the deteriorated non-curio measures themselves..

CHAPTER 3

METHODOLOGY

This chapter briefs the methods handling to complete the project. Flowchart, tables, and figures were included to explain detail about the process of workflow and visualized as a spectrum from a predominantly quantitative approach towards a predominantly qualitative approach. Moreover, the chapter consist of tools, and experiment scenario to specify more about the research.

3.1 Research Methodology Flowchart.

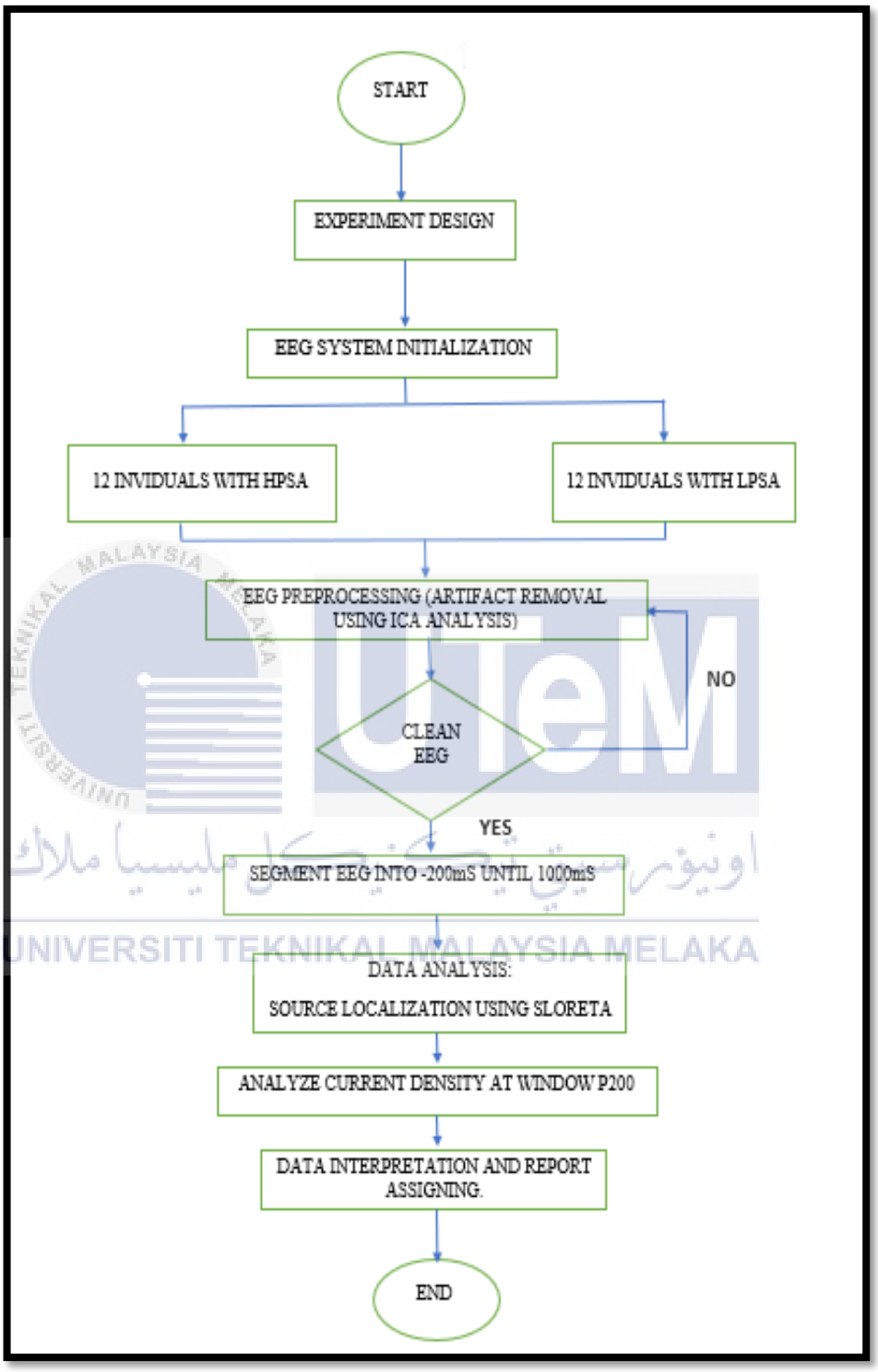


Figure 3.1.1: Flowchart of project.

Twenty-two data were analyzed, in which 12 of them were categorized with low PSA and the rest with high PSA during the Stroop Task. They were required to perform the Stroop task individually. Before analyzing EEG raw data, the EEG preprocessing needed to be done by ICA in MATLAB plugin (EEGLAB). Lastly, the interpretation of data can be carried out to conclude the findings regarding this experiment to be recorded in the report.

3.2 Experiment Scenario.

In the Stroop Experiment, participants were presented with different colored words, name, ‘Hijau’ (Green), ‘Merah’(Red) and ‘Kuning’ (Yellow). The participants had to recognize and choose the colour. There will be two scenarios (congruent and incongruent). Participants should pick the same colour that was displayed on the front screen in specific time. Upon responding to the colours, a black blank screen displayed for 1500ms before another fixation point was display again for 500ms. The process was repeated until all colours are displayed. For the congruent trial, same colour with same word will be executed, while in incongruent trial, different colour with different word will be executed.

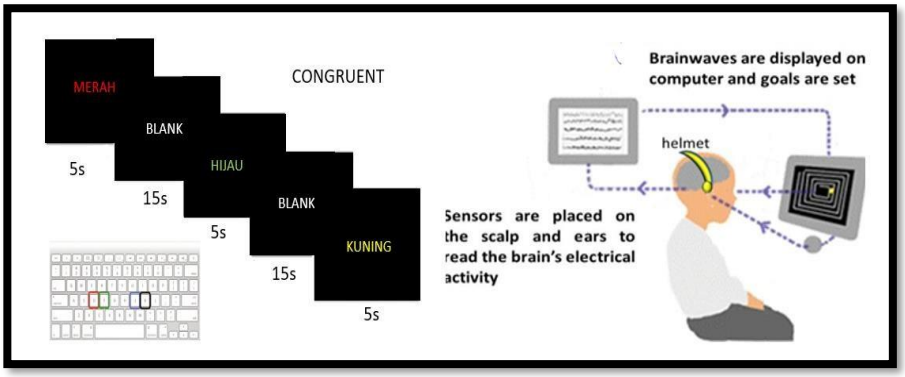


Figure 3.2.1: Experiment Scenario (congruent).

3.3 Modern Tools.

- **EMOTIV EPOC+**
  - Data collection- View raw EEG, performance measurements (0.1Hz), motion data, data packet collection and loss, and contact quality data streams in real time.
  - Flexible data storage- Option out or Option in to save recordings to EMOTIV Cloud. Playback and export for analysis.
  - Quick analysis- Customize and view frequency data for live or recorded data with automatic FFT and power band graphs. Get results without having to export your data.

- EEGlab is a Matlab toolbox for processing continuous and event-related EEG, MEG, and other electrophysiological data, with features such as independent component analysis (ICA), time/frequency analysis, artefact rejection, event-related statistics, and several useful visualisation modes for averaged and single-trial data. EEGLAB is compatible with Linux, Unix, Windows, and Mac OS X. EEGLAB allows users to input

electrophysiological data from over 20 different binary file formats, preprocess it, view activity in single trials, and perform ICA. ICA components that are not real can be removed from the data. ICA components indicating brain activity, on the other hand, might be further processed and evaluated. Users can also group data from several subjects and cluster their separate components in EEGLAB.

- **MATLAB** MathWorks' proprietary multi-paradigm programming language and numeric computing environment (abbreviated as "matrix laboratory") is a proprietary multi-paradigm programming language and numeric computing environment. Matrix operations, function and data visualisation, algorithm implementation, user interface building, and interfacing with programmes written in other languages are all possible with MATLAB.

- **SPSS** Statistics is a software package used for interactive, or batched and statistical analysis.

3.4 EEG Preprocessing.

Intervals comprising movements and muscle artefacts in any EEG channel will be eliminated from further analysis after automatic detection (amplitude criterion of 80 V) and eye assessment. Independent Component Analysis will

be used to rectify eye movements and blinks (ICA). To analyse EEG data, the Fast Fourier Transform (FFT) approach uses mathematical procedures or techniques. Power spectral density (PSD) estimation is used to determine characteristics of the obtained EEG signal to be evaluated in order to selectively represent the EEG samples signal. Change the time domain of the EEG to the frequency domain. For each frequency band, the mean spectral power will be determined. Delta (1.6Hz-3,6Hz, Theta1 (4.4Hz-5.2Hz) Theta2 (5.6Hz-7.2Hz), Alpha (7.6Hz -12Hz) Beta (13Hz-20Hz). The degree of resemblance or linear synchronization of the EEG collected at two sensors is measured using coherence analysis. The range of coherence values is 0 to 1.

3.5 SLoreta

The ROI root translation analysis offered by the KEY Institute for Brain-Mind Research University Hospital Psychiatry, Zurich at http://www.uzh.ch/keyinst/loreta was used to create the LORETA KEY software package. The analysis continues to convert EEG/ERPs data to sLORETA files after acquiring clean data from EEG Pre-Processing. Which is how sLORETA gets its data from time-domain scalp electric potential differences (scalp maps). Files containing EEG/ERPs values were converted to LORETA files. Regions of interest (ROI) are then extracted from the sLORETA data. The average current density values for all voxels belonging to the same ROI at any moment in time were used to calculate current density values.

3.6 Statistical Analysis

Using Statistica software, the time course and source localization analysis data were evaluated offline. To specify designs with repeated measures, Statistica's repeated-measured ANOVA (Analysis of Variance) was employed. The outcome was analyzed using repeated-measures ANOVA to see if there were statistically significant differences in three or more separate (non-related) groups. T-test statics were used to see if there was a significant difference in the means of the two classes that might be applied to those features. In this study, a T-test was used to determine the time course of ACC in the HPSA and LPSA regions. A p-value of less than 0.05 indicates statistical significance. This suggests that there is strong evidence against the null hypothesis, which is subsequently rejected and the alternative hypothesis investigated. The results must have a lower p-value since there is a greater link between the two variables.

3.7 Project Planning.

A. PERANCANGAN PROJEK
PROJECT PLANNING (GANTT CHART)

Senaraikan aktiviti-aktiviti yang berkaitan bagi projek yang dicadangkan dan nyatakan jangka masa yang diperlukan bagi setiap aktiviti.
List all the relevant activities of the proposed project and mark the period of time that is needed for each of the activities.

	SEM I																	SEM BREAK					SEM II												
Aktiviti Projek *Project Activities*	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	1	2	3	4	5	6	7	8	9	10	11	12	13
Literature Review	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Experimental Design			X	X	X																																
EEG System Set-Up				X	X	X																															
Gamification Launch/ Questionnaire Distribution					X	X	X																														
Perform Experiment							X	X	X	X																											
Results Analysis										X															X	X	X	X	X	X							
Conclusion																															X	X	X	X			
Issuing Results																																		X	X	X	X
Thesis Produce				X	X	X	X	X	X	X															X	X	X	X	X	X	X	X	X	X	X	X	X

SEMINAR PSM I

SEMINAR PSM II

Figure 3.7.1: Gantt Chart

CHAPTER 4

RESULTS AND DISCUSSIONS

The aim of the study is to acquire the Region-of-interest source localization analysis for cognitive impairment during public speaking anxiety. This part provided an important opportunity to advance the understanding of findings in repeated measures ANOVA (ROI × congruence × Group). ERP was acquired by pre-processing and analyzing EEG waveform for each subject in Stroop task. This section will list all the findings of the study for discussion and conclusion.

4.1 Results

4.1.1 The Time Course of Brain Activity within the dACC and rvACC

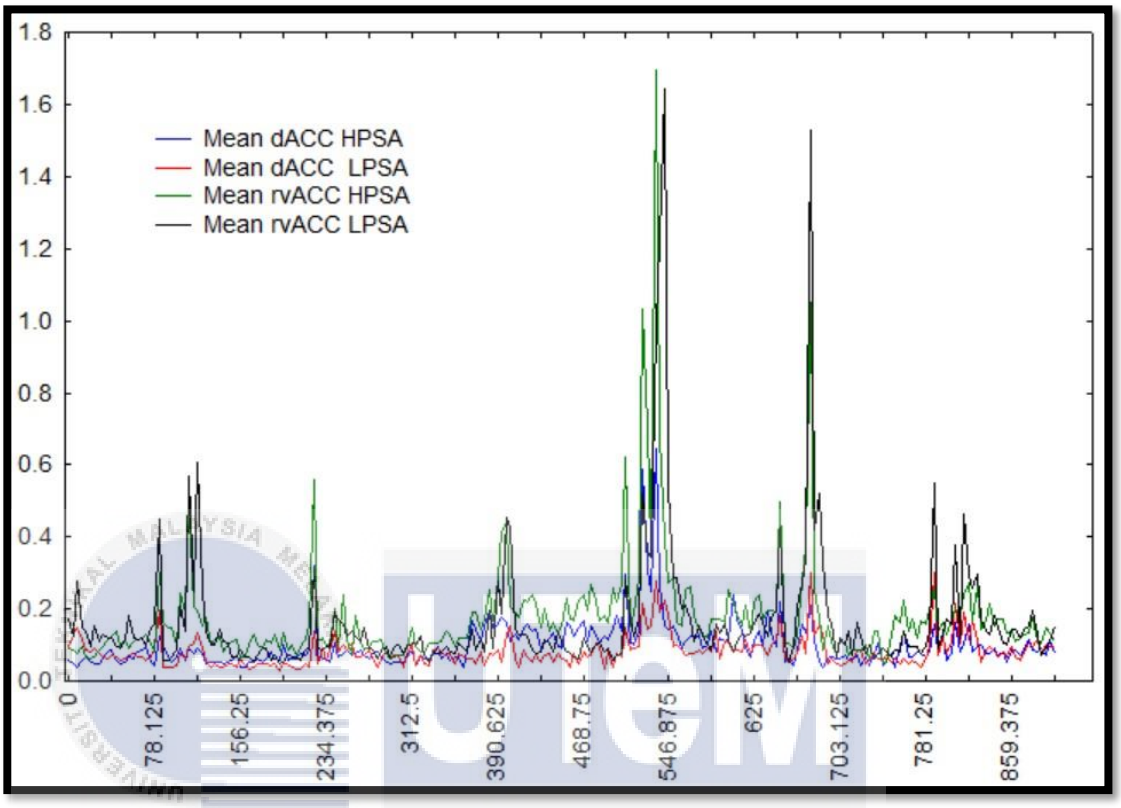


Figure 4.1 Time Course of Brain Activity within the dACC and rvACC for HPSA and LPSA.

What is striking in figure 4.1, there was a significant ROI × group at effect [F (1,22) = 3.184, GG epsilon = 1.00, partial, p = .088] in both subjects. From the figure, we can see that rVACC in LPSA group has initial increase activity at the peak 82.03ms. However, the rVACC in HPSA group has the highest current density at 535.16ms compared to the rVACC in LPSA group which is slightly lower in current density. What stands out in the figure is starting from 546.88ms, the rvACC in LPSA decreased gradually and peaked at 679.69ms with higher current density.

4.1.2 N450 window analysis.

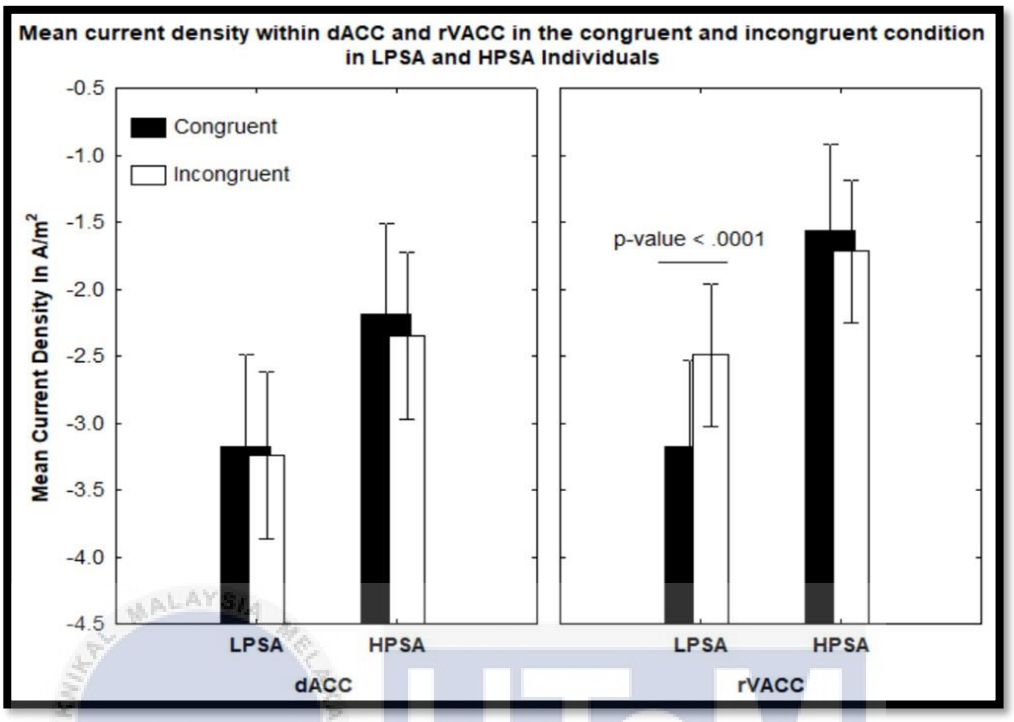
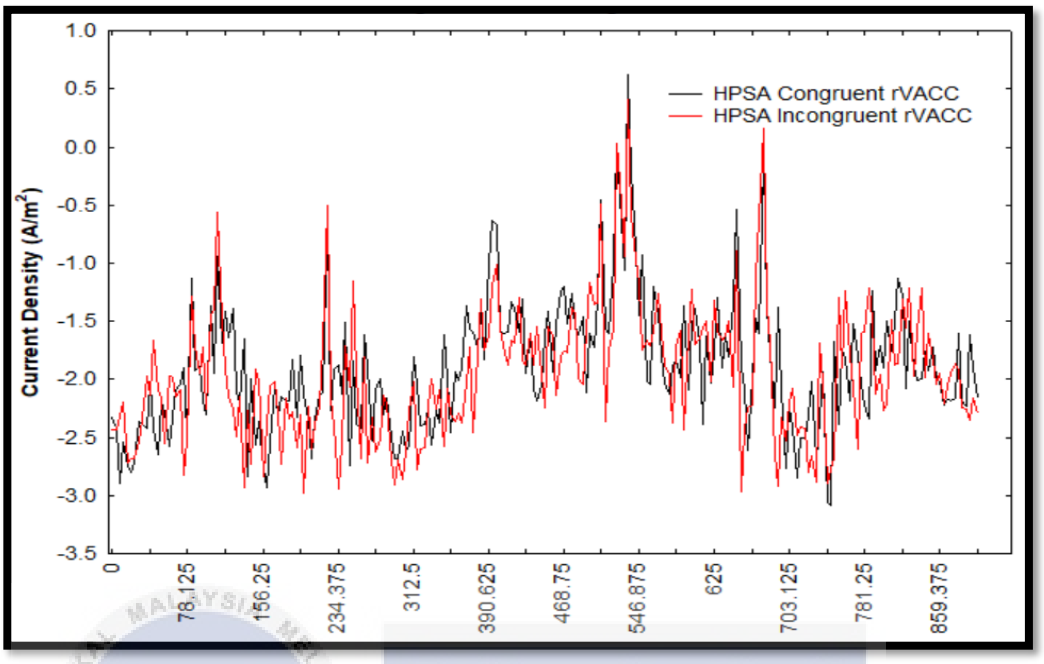


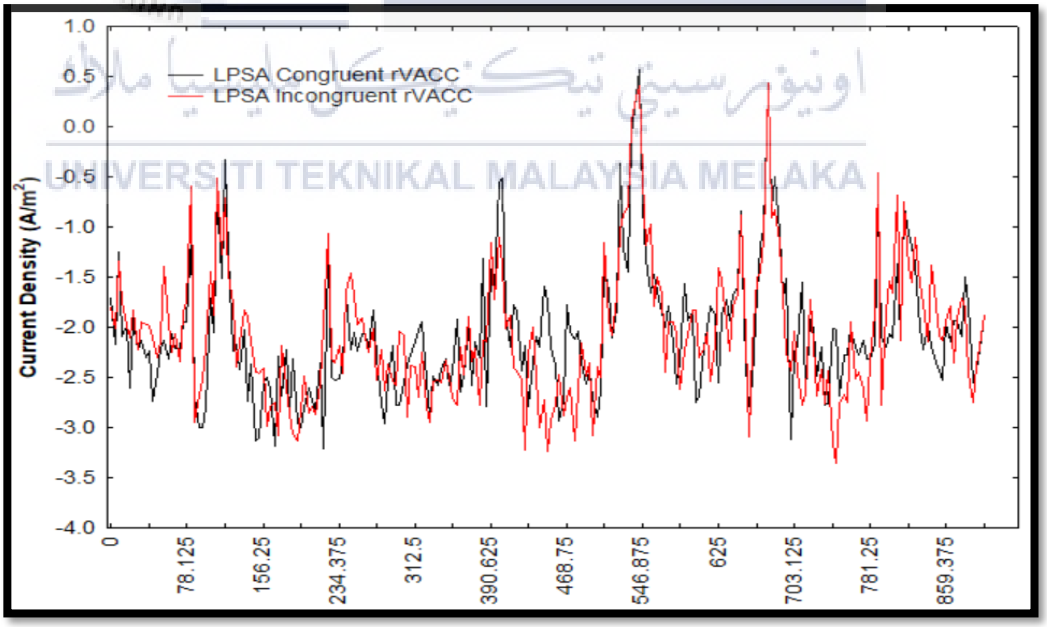
Figure 4.2 The N450 ROI x congruence x group

There was a significant ROI × congruence × group effect at the N450 window [F (1,22) = 21.90, GG epsilon = 1.00, partial η2 = 0.09, p < .001]. Post-hoc Bonferroni test indicated significant higher mean current density in the incongruent compared to the congruent condition within the rvACC (t (22.42) = 2.074, p < .001) in the LPSA group. The effect, however, was not significant in the HPSA group (p = 1.00). Comparing within dACC and rvACC, it is clearly showed that the current density in rvACC is higher in both groups. However, there was a trend towards significance at rvACC in LPSA incongruent condition.

4.1.3 The Time Course of Brain Activity within rVACC.



(A)



(B)

Figure 4.3 Time Course of Brain Activity within the rVACC for (A) HPSA and (B) LPSA.

Repeated measure ANOVA revealed congruence × group effect within the rvACC trending towards significance in both group [F (1,22) = 5.9857, GG epsilon = 1.00, partial, p = .022]. What is striking in Figure 4.3 (A), significant slower increase in current density in HPSA for both congruence condition at 101.56ms. However, there is slower decrease of current density from 101.37ms to 234.37ms for both congruence condition. In additionally, the rVACC in HPSA group for congruent condition has the highest current density at 535.16ms compared to the rVACC in incongruent HPSA group which is slightly lower in current density. From the Figure 4.3 (B), we can see that rVACC in LPSA group for incongruent condition has initial increase activity at the peak 78.13ms. The current density of the rVACC in the LPSA group for congruent condition is the highest at 542.97ms, while comparing the current density of the rVACC in the incongruent HPSA group at 682.35ms.

4.1.4 ROI Current Density Correlation.

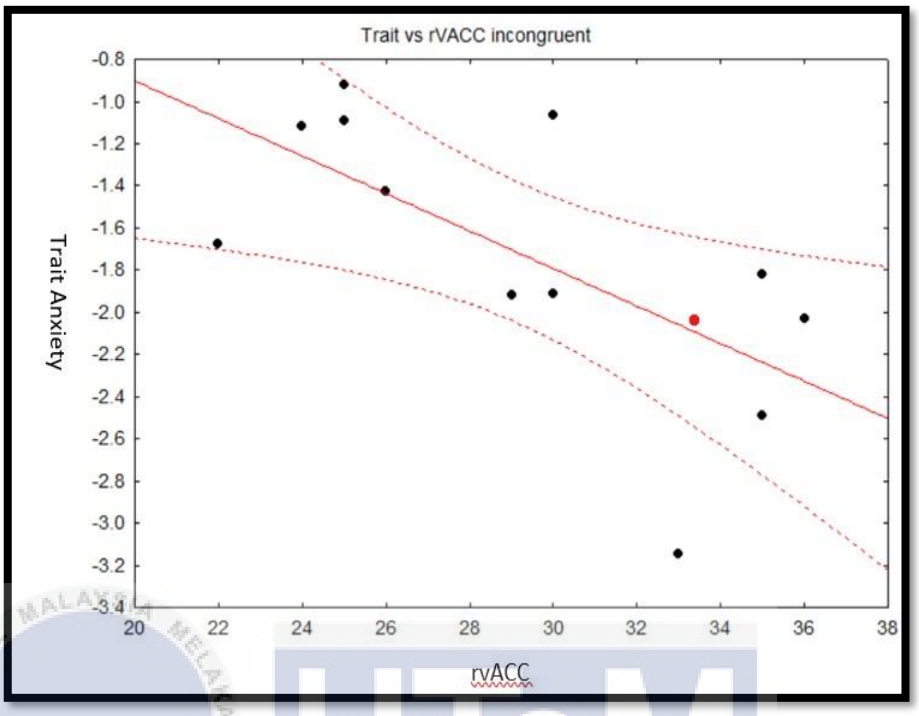


Figure 4.4 Scatterplots of the N450 Mean Current Density with Trait Score vs rVACC incongruent.

The scatterplots (Figure 4.5) describe the relationship between the mean current density of rVACC incongruent condition within the trait score (vertical axis; calculated at the N450 window). There is a significant negative correlation between Trait anxiety and the current density within the rvACC in the incongruent condition for HPSA subjects, but NOT LPSA subjects during the N450 window [r = -.6524, p = .021]. From the figure, it clears that the current density is not depends on the trait score. If the trait score increase, then the current density will decrease.

4.1 Discussion

We found a significant higher current density in rvACC for HPSA group compared to LPSA which has almost significant at the peak of current density according to the time course of the brain responses in the ACC. The time graph showed higher mean current density in the incongruent compared to the congruent condition within the rvACC. In any case, past investigations have revealed that FMRI yielded struggle initiation in the dorsal front cingulate cortex (dACC), a vital piece of the leader control organization. The right ventral ACC (vACC) was initiated for struggle handling in enthusiastic boosts, proposing that it is moreover actuated for struggle preparing in passionate upgrades [6]. Meanwhile, HPSA and LPSA subjects exhibited significantly less activation within the dACC compared to rvACC. Besides that, another researcher [19], stated that the sLORETA analysis found that the left middle frontal gyrus (brain region) has significantly greater recruitment in high anxiety participants compared to low anxiety participants during Attentional Network Test. Thus, it seems that the initial higher ACC activity in the HPSA group is in line with anxiety patients.

The most striking outcome to rise up out of this investigation is that an abnormal conduct occurs in the HPSA bunch. It is seen that the HPSA bunch has no Stroop impact present as the more grounded cynicism (less adequacy) saw in consistent contrasted with incongruent condition. Strangely, our perception is upheld by [7] contemplates which uncover that tension can negatively affect working memory execution. Discoveries from [1] likewise expressed that the circumstance that prompted passionate obstruction while playing out the Stroop task has been demonstrated in numerous examinations. Concerning the ROI connection, there is a negative relationship between Trait uneasiness and the current thickness inside the

rvACC in the incongruent condition. Nonetheless, these outcomes could be identified with the past research in [5], that the relationship examination showed that the relationship among nervousness and mind actuation in the pregenual ACC (rvACC) as an inclination, positive during moderate danger however plainly negative during solid danger.

4.2 Environmental and Sustainability

Using the inexpensive cost of EEG, this work offers an interesting chance to expand our knowledge of source localization. The findings should offer a significant contribution to the field of skilled biomedical engineers, neuroscientists, and psychologists or psychiatrists, who will, first and foremost, identify alternative and related cognitive impairments in patients with PSA and, in the end, to find methods to alleviate or manage anxiety. Furthermore, because this thesis focused solely on PSA students, additional research might be conducted in the future to extrapolate and generalize the findings to other locations.

4.3 Limitation

There are a few flaws in this study that should be mentioned. For starters, incorporating the Stroop problem reduced PSA participants' abnormal mental conflict. Furthermore, it should have a higher sample size in order to discover the probability of a cognitive effect. The ROI of the brain region is another notable shortcoming of the study. This study should take into an account the division of this brain region from ACC into two sub-territories, dACC and rVACC. The goal of this study is to determine which area of the brain has the greatest impact on the Stroop task in PSA participants.

CHAPTER 5

CONCLUSION AND FUTURE WORKS

5.1 Introduction

This section will describe the project's overall goals and make some recommendations for how to make better use of the gathered information.

5.2 Conclusion

The goal of this study was to compare ROI between high and low PSA participants during cognitive control when they were subjected to anxiety triggered by the prospect of public speaking, as well as to examine the differences in rvACC between high and low PSA participants' behaviour at the N450 window.

The findings of this study show that in both groups, the mean current density in congruent conditions is higher than in incongruent conditions (Stroop effect existence). The novel findings in this study are particularly noteworthy; those with low PSA have no Stroop impact on their N450 ERP windows in rvACC. Aside from that, the Stroop effect appears in all trials. This result is consistent with prior research,

such as [1], which found that the Stroop effect is substantial in healthy subjects, which in our instance are LPSA subjects. In contrast to HPSA patients, the odd behaviour altered their ERP signals, leading to the conclusion that the results could be influenced by the number of people that participated in the study.

5.3 Future Works

There are many energizing works that should be possible utilizing the data and information that was being found. As the N450 window is a general biomarker for the Stroop impact, the outcomes and data acquired might be utilized to foster an AI innovation based items; a versatile application with single terminal EEG intended to distinguish uneasiness and afterward assists people with lessening their tension by utilizing methods, for example, contemplation, binaural beats, entrancing, and so on. More data on the examination of ERP identified with intellectual debilitation on people with PSA utilizing high-thickness EEG framework (Research Grade) would help us to build up a more noteworthy level of precision on this matter. In the event, that the discussion is to be pushed ahead, conceivable future examinations utilizing something similar trial set up however with various sorts of nervousness are evident. It would be fascinating to evaluate and contrast the future outcomes and this examination for a superior understanding.

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APPENDICES

```
 close all;
clear all;


DATADIR = 'C:\Users\HP\Universiti Teknikal
Malaysia Melaka\DR. FARAH SHAHNAZ BINTI
FEROZ - PSM Dharma\MATLAB
DATA\MATFILE\HPSA';
DATADIR2 = 'C:\Users\HP\Universiti Teknikal
Malaysia Melaka\DR. FARAH SHAHNAZ BINTI
FEROZ - PSM Dharma\MATLAB
DATA\Average\HPSA';
% averages the ROI for each ERP component


for ifolder = 1:12

    h = num2str(ifolder);
    files = dir( fullfile(DATADIR,  h
,'*.mat' ) );


    for i=1:length(files)
        [sPath,sName,sExt] =
fileparts(files(i).name);
        sDataFile   = fullfile(DATADIR, h
,[sName '.mat']);
        sDataFile2   = fullfile(DATADIR2, h
,[sName '.mat']);

        load(sDataFile)

        if i == 1
        dACC = M(:,1);
```

```
end
```

```
    end

    mean_dACC = mean(dACC');
    mean_vACC = mean(vACC');


save(sDataFile2, 'mean_dACC', 'mean_vACC')
end
```