

Emotion-cognition abnormality detection in individuals with public speaking anxiety using EEG

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Keywords: Electroencephalogram; Eriksen-Flanker; public speaking anxiety

ABSTRACT – In order to examine emotion-cognition disorders in people with public speaking anxiety (PSA), this study used electroencephalogram (EEG) signal analysis involving event-related potential (ERP) and spectral power analysis. The Eriksen-Flanker EEG experiment, recorded with the low-cost 14-channel Emotiv EPOC +, was performed on 12 people with low PSA and 12 people with high (H) PSA. Abnormalities in the N200 ERP was observed while abnormalities in spectral power correlates in HPSA individuals were hypothesized. In conclusion, with the use of low-cost EEG, we were able to distinguish brain activity differences between HPSA and low (L) PSA individuals.

1. INTRODUCTION

Although 1 in 4 individuals in the world suffer from PSA, yet no ERP and Spectral Power experiment used low-cost EEG to analyse its correlation to the modulations of emotion-cognition during a conflict in subjects that suffered from PSA. Previous EEG studies of subjects suffering from depression, anxiety[1], and schizophrenia[2] have reported similar emotional dysfunction during cognition.

This is the first experiment to research the impact of PSA on emotion-cognition in individuals with HPSA using the low-cost Emotiv EPOC+. Independent tests have validated the accuracy of the technology several times over [3]-[5]. The aims of the study were to analyse the N200 ERP and to compare the spectral power of conflict-related emotion modulation abnormalities in HPSA individuals in the emotion-cognition Eriksen Flanker task.

2. METHODOLOGY

The flow chart of this project is shown in Figure 1. below.

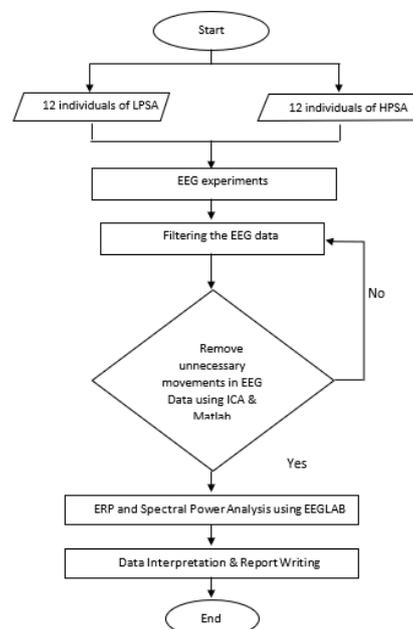


Figure 1 Flow chart of the study

The paradigm of the study was adapted from [6]. The word stimuli, translated to Malay from [7], consisted of three emotional or neutral words, displayed at the center on a computer's monitor. Participants were told to recognize the ink color of a central word while ignoring the color of the flanker words above and below the target word by pressing a button. Flanker and goal colors may be the same or different, producing congruent and incongruous experiments.

The experimental paradigm started with a fixation point in the first screen which enabled subjects to focus on the upcoming stimuli position. All stimuli appeared in either red, green, yellow or blue color. The congruent trial can be viewed in Figure 2, while Figure 3 showed the incongruent trial.

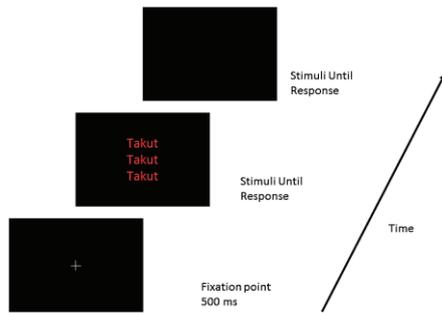


Figure 2 Illustration of a congruent trial in the Eriksen-Flanker task

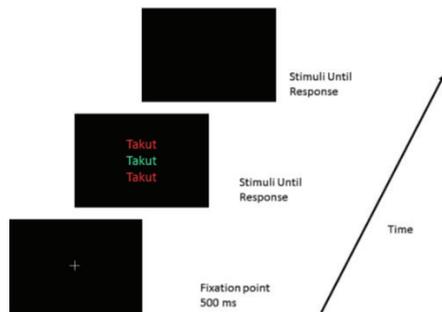


Figure 3 Illustration of an incongruent trial in the Eriksen-Flanker task

3. RESULTS AND DISCUSSION

Similar to the process in [2], [8] EEG preprocessing were conducted with EEGLAB. Filtering was done to eliminate baseline drift and gamma oscillation noise using low (0.3 Hz) and high (30 Hz) pass filter. Unnecessary noise from unwanted muscle or head movements during the experiment were detected in the waveforms and were rejected, as illustrated in Figure 4.

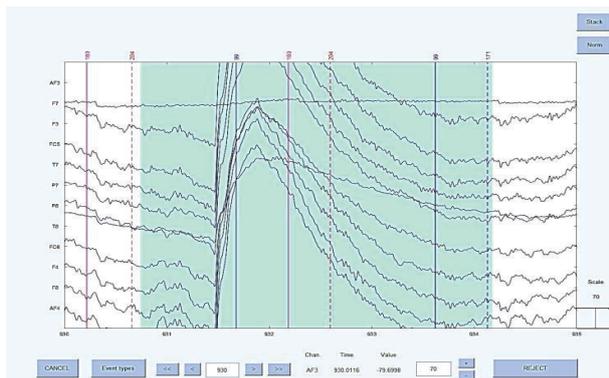


Figure 4 The selected noise were rejected

Eye movements (blue highlights section) were then removed through the Independent Component Analysis (ICA) method. In HPSA individuals, ERP analysis showed reversed N200 conflict results. Contrary to congruent objects, there was a trend towards significantly increased fronto-central amplitude in incongruent objects [$F(1,22) = 3.09$, GG Epsilon = 1.00, partial $\eta^2 = 0.12$ $p = 0.09$] in HPSA subjects, but not in LPSA subjects. Spectral power analysis will be conducted to determine emotion-cognition

abnormalities in the frequency domain in HPSA subjects.

4. CONCLUSIONS

We distinguished ERP differences between HPSA and LPSA individuals in this study. This project provided significant opportunity to advance the understanding of emotion-cognition interactions among HPSA subjects, which is essential in the field of neuroscience. Through advanced treatments, individuals with PSA may be able to recover and may result in increased academic performance [9], career prospects and quality of life.

ACKNOWLEDGEMENT

This work was conducted as part of Rawiyani Syazana Roslan's undergraduate thesis. This research was supported by Universiti Teknikal Malaysia (UTeM) through PJP/2019/FKEKK (3D)/S01691.

REFERENCES

- [1] P. Kanske and S. A. Kotz, "Effortful control, depression, and anxiety correlate with the influence of emotion on executive attentional control.," *Biol. Psychol.*, vol. 91, no. 1, pp. 88–95, 2012.
- [2] F. S. Feroz, G. Leicht, J. Rauh, and C. Mulert, "The Time Course of Dorsal and Rostral-Ventral Anterior Cingulate Cortex Activity in the Emotional Stroop Experiment Reveals Valence and Arousal Aberrant Modulation in Patients with Schizophrenia," *Brain Topogr.*, vol. 32, no. 1, pp. 161–177, 2019.
- [3] M. Duvinage, T. Castermans, T. Dutoit, and M. Petieau, "A P300-based Quantitative Comparison between the Emotiv EPOC Headset and a Medical EEG Device," *Biomed. Eng. Online*, 2012.
- [4] N. A. Badcock, P. Mousikou, Y. Mahajan, P. De Lissa, J. Thie, and G. McArthur, "Validation of the Emotiv EPOC® EEG gaming system for measuring research quality auditory ERPs," pp. 1–17, 2013.
- [5] K. Kotowski, K. Stapor, J. Leski, and M. Kotas, "Validation of Emotiv EPOC+ for extracting ERP correlates of emotional face processing," *Biocybern. Biomed. Eng.*, vol. 8, 2018.
- [6] P. Kanske and S. a Kotz, "Modulation of early conflict processing: N200 responses to emotional words in a flanker task.," *Neuropsychologia*, vol. 48, no. 12, pp. 3661–4, 2010.
- [7] Mandeville MY, "Using a Unique Cognitive Approach--A Variation of the Stroop Test--in the Identification and the Measurement of Public.," *Annu. Meet. Speech Commun. Assoc.*, 1994.
- [8] F. S. Feroz, G. Leicht, S. Steinmann, C. Andreou, and C. Mulert, "The Time Course of Activity within the Dorsal and Rostral-Ventral Anterior Cingulate Cortex in the Emotional Stroop Task," *Brain Topogr.*, vol. 30, no. 1, pp. 30–45, 2017.
- [9] S. I. Devi and F. S. Feroz, "Oral communication apprehension and communicative competence among electrical engineering undergraduate in UTeM," *J. Hum. Cap. Dev.*, vol. 1, no. 1, pp. 1–10, 2008.