

# A Study of Mindfulness Effectiveness among Neurotic Students based on EEG

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**Abstract**— Anxiety and stress are commonly reported problems related to working life where physical and mental conditions become worse due to environment exhaustion. An objective assessment is conducted to analyze brain signals using electroencephalography (EEG). In this study, Cognitive Ability Modulation Index (CAMI) was measured by calculating the relative band power in the prefrontal lobe to measure cognitive ability. It is observed that CAMI showed higher value in post-MI than pre-MI, especially for the Fp1 channel which relates to the outcome of a positive impact of MI in reducing anxiety and stress while performing the Stroop Colour Task. To validate CAMI as a suitable measure for effectiveness of Mindfulness Intervention (MI) towards reducing anxiety and stress among neurotics, classification of CAMI before and after MI is performed. The classification achieved 80% accuracy using the Quadratic Support Vector Machine classifier.

**Keywords**— EEG, anxiety, stress, power spectral, mindfulness, Stroop Test, classification

## I. INTRODUCTION

Most adolescents and young adults face mental health problems, especially depression, anxiety, and stress. These may happen due to non-stop difficult academic work, alternating from teenage to adulthood lifestyle, and hard-to-make life decisions that can impact future life. [1]. Anxiety disorders are related to extreme feelings of distress or anxiety about uncertainty. They also are likely susceptible to multiple physical symptoms such as heart palpitations and heavy breath [2]. Besides that, severe stress can negatively impact the quality of life and lead to work inefficiency, low attention levels, and unstable emotions [3]. A study found that individuals with high neuroticism are more vulnerable to having a mental breakdown due to constant anxiety, excessive perfectionism, and sensitivity to negative information during stress [4].

Electroencephalography (EEG) is an imaging technique that reads brain activities in voltage form against time by attaching the electrodes to the scalp [1], [5]. A part of the brain in the frontal lobe namely the prefrontal cortex is important in performing executive functions such as problem-solving since it represents cognitive skills to process information that come from sensory areas, memory, and emotion then leads to behavior selection [2], [6].

Mindfulness is a practice that has been used to earn an individual's attention, influencing them to be fully present and engaged in the activities of the moment while adopting a non-judgmental approach [7]. Several papers studied the effectiveness of mindfulness in reducing depression, anxiety, and stress [8], [9].

Stroop Colour and Word Test (SCWT) is generally utilized as a mental stress-induced tool in neuropsychological and cardiovascular research. It is employed to study the ability to suppress cognitive interference when the processing of a stimulus feature obstructs the concurrent processing of another trait of the same stimulus [10].

In this study, prefrontal cortex region signal analysis and classification are employed to observe the effectiveness of mindfulness before and after intervention in terms of anxiety and stress reduction among university students with neuroticism.

## II. METHODOLOGY

Twenty healthy Malaysian female students from Universiti Teknologi PETRONAS participated in this experiment. Their ages ranged from 18 to 25 years old, and they volunteered for the study, providing written informed consent. Only right-handed students with normal or corrected-to-normal vision were included. Participants were identified as belonging to the neuroticism group based on their scores from the Eysenck Personality Inventory (EPI) and Big Five Inventory (BFI) questionnaires. The ethics approval was obtained by the Royal College of Medicine Perak