Synchronization of EEG Activity with Body Balance During Cognitive Visual Exercises

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Summary

When evaluation cognition, there is a certain complexity surrounding electroencephalographic (EEG) recordings, which would greatly benefit from being supplemented by secondary recordings, such as those from a force platform. Currently, there is also a lack of evidence supporting the need to implement creative exercise on analytical coursework, specifically in STEM degrees where there is gaining momentum to incorporate the arts [3]. This pilot study aims to correlate electroencephalography (EEG, Brain Vision) and postural sway (AMTI AccuSway) data to verify cognitive changes. This study hypothesizes that participants will have 1) increased EEG alpha activity and 2) increased postural sway when participating in iterations of a problem-solving tasks administered after the participant engages in creative activities.

Introduction

The study will use human-subject data gathered from electroencephalography (Brain Vision) and postural sway (AMTI AccuSway) to quantify the cognitive engagement of participants during the learning of new concepts in a unique manner that allows the participants to think about them visually. The hypothesis is that the teaching methods introduced will encourage participants to have increased cognitive attention.

Methods

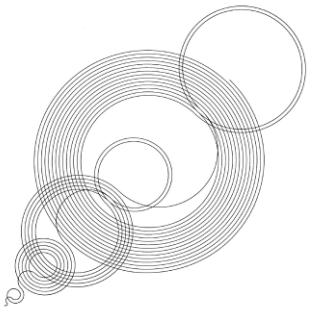

Figure 1: An example of the material presented to participants, in this case a mathematical sequence (Recamán's Sequence) as a visual representation [2].

Participants will be asked to wear an EEG headset while answering a series of problem-solving questions both before and after periods of learning concepts taught in a manner that cultures creative and visual thinking, and viewing material such as that in Figure 1 that illustrates these concepts. The EEG data collected will be evaluated on the spectral power density of the alpha band in the time domain. There is sufficient research to suggest that visual art significantly increases cortical activity in the EEG alpha band [1], which are often associated with cognitive processes and divergent thinking [5]. The problem-solving task will be a randomized variation of the Raven's Progressive Matrices test (RPM), a commonly used evaluation for cognitive activity. While the participant is wearing the EEG to answer these questions, they will be asked to stand on a force platform to measure various parameters shown to correlate with cognitive activity [4].

Results and Discussion

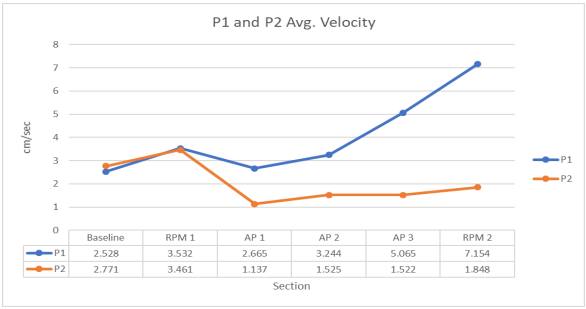

Figure 2: Preliminary sway data collected from two participants.

In Figure 2, which shows pilot data collected from preliminary experiments of this study, two participants were evaluated on the velocity of their postural sway during the answering of the Raven's Progressive Matrices tests before and after the activities ("RPM 1" and "RPM2", respectively). They were also evaluated during the viewing of artistically represented mathematical sequences, such as those seen in Figure 1 ("AP 1-3"). In the data, it is interesting to note that these two participants started with a high velocity of sway that dramatically lowered with a decrease in attentional demand (between RPM 1 and AP 1), which increased as the activities went on. Of course, more data is needed to validate the hypothesis, however this is a promising start to the study.

Conclusions

This study has the potential to build a link between two very different analyses of cognitive activity (EEG and postural sway), as well as validate the concerns that individuals involved in the STEM field would highly benefit from a regimen that includes creative outlets in addition to analytical ones. The data generated by this study by these means will show that increased cognition is apparent when concepts are presented in a visual manner, fortifying a philosophy that engineering curricula would benefit from artistic additions.

References

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