Interpreting EEG data to enhance cognitive retention in the classroom

Ajayi, V., Erickson, A., Hoang, J., Jordahl, G., Leach, S., Peterson, B., Peterson, H., Peterson, S., & Dunbar, R.L.

Background and Significance

- Emotion/Affect and Learning
  - Research suggests that higher academic performance correlates with certain affective states.[1]
- Affective states describe emotions, feelings, and moods grouped into a single topic.[2]
- CVC trigrams
  - Three letters consisting of a consonant-vowel-consonant.[3]
  - Ensures there is no previous knowledge that can give the participant an advantage.[4]
- Independent variable: Different Affective states (Engagement, Focus, Excitement, Stress, Interest, Relaxation)
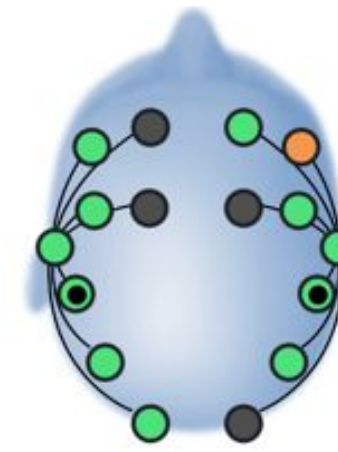- Dependent variable: Pass or Fail Test Score (60%)

Hypothesis

Higher academic performance on solving complex problems and memory tasks will be correlated with specific affective states, comparing correlational differences using an ANOVA statistical test.

Figure1: Location of EEG electrodes for testing

Methods

Memorization	Testing	Analyzing

- Baseline is collected
- Student memorizes nine CVC trigrams with corresponding definitions

RIY
- His
- She
- Cat

- Students construct three grammatically correct sentences with the CVC trigram definitions

- Student classified as passing or failing by 60% as passing.
- Affective states connected to their test scores to determine a possible correlation of performance
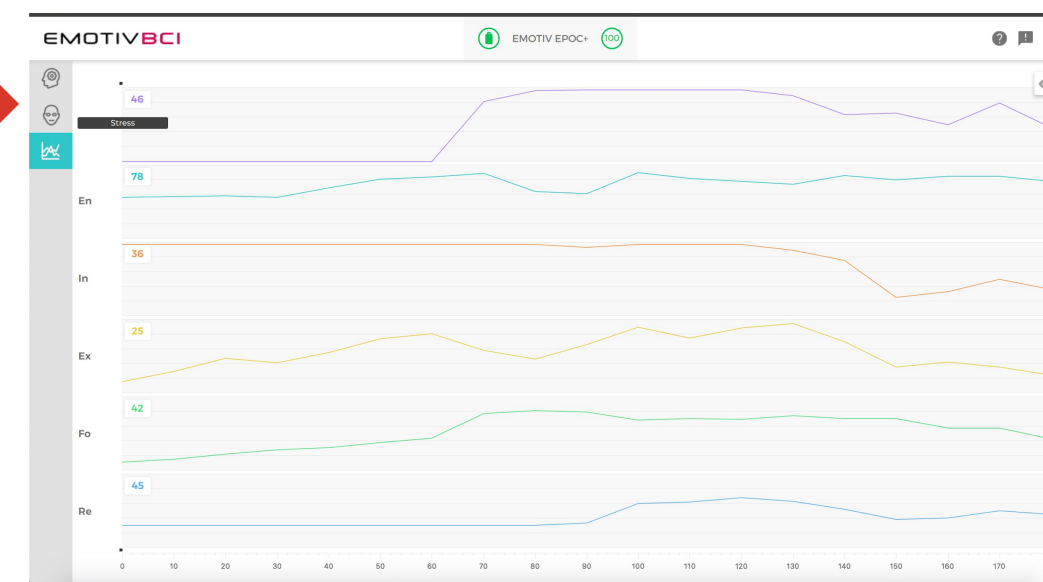
XOP=Car BEK=Run RIY=She

Figure 2. Screenshot of EEG readings of the 6 different affective states for one individual during memorization phase.
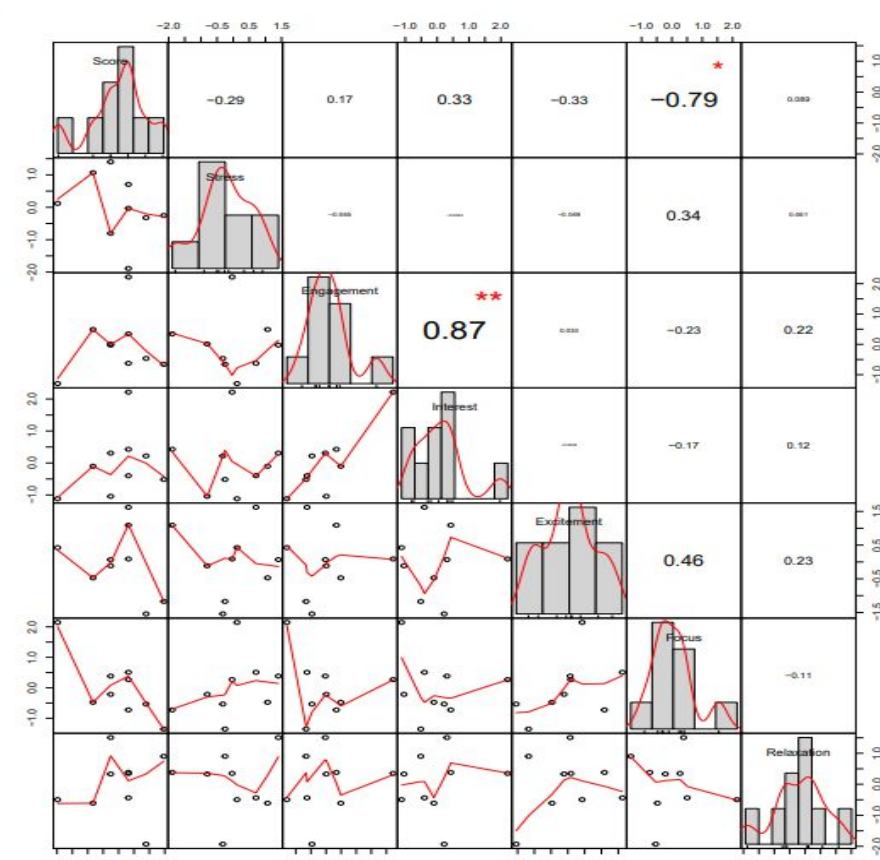
Results

Figure 3: The Multiple Regression graph displays the values from the ANOVA test results of the six affective states

Pass and Fail Comparison: Normalized Averages

Figure 4: The graph displays the normalized averages of the change in levels of the six affective states from their average baseline score.

Pass and Fail: Normalized Percent Difference Averages

Figure 5: The graph displays the normalized percent difference in the levels of the six affective states from their average baseline score.

Discussion and Conclusion

- This data suggests overall that there is no significance between test scores and the 6 affective states

- However there may be a negative correlation between the test score and the focus affective state
  - Could indicate the level of difficulty with the CVC trigram test

- This data also may suggest a positive correlation between engagement and interest

Challenges & Lessons Learned

- EEG equipment malfunctions

- COVID-19 prevented further testing and a larger data set

- Gathering participants and testing time coordination

- Led to growth in resilience and adaptability

Future Directions

Implement methods approved by IRB	Increase sample size
Expand data collection	Repetition of trials

References

(1) Data to Improve Learning in Pevasive Learning Environment. *Educational Technology & Society, 12*(2), 176–189.
(2) IGI global: Disseminator of Knowledge (n.d.). *What is an affective state* retrieve from: https://www.igi-global.com/
(3) Young, A. R. & Webber A. (1968). Standardization of Mexican trigrams. *Psychonomic Science, 11*(10), 354. doi: 10.3758/BF03328233
(4) Ebbinghaus, H. (1913). *Memory: A Contribution to Experimental Psychology.* (Transl: H. A. Ruger & C. E. Bussenius.) New York: Teachers College.
(5) Figure 1 Pizzi, R. (2018). Coding mental states from EEG signals and evaluating their integrated information content: A computational intelligence approach. Retrieved from http://www.researchgate.net/