REWIRE: Realtime Evaluation of Waves for Intervention-Based Reinforcement of Engagement - A Novel Approach to Enhancing Attention and Memory by Leveraging Neuroplasticity via Noninvasive Real-Time Electroencephalogram (EEG) Guided Neuroadaptive Feedback

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Sustained attention span is declining among adolescents, linked to weakened memory and reading comprehension, a significant barrier to academic/social success. This study tested and developed REWIRE, a novel neuroadaptive reading web application built to detect realtime decline in attention and re-engage the user with interventions to enhance focus. It was hypothesized REWIRE would optimize cognitive performance over static reading environments. To test this, a HTML/Python-based application was developed to monitor electroencephalogram-derived data, calculating a Focus Score through a ratio of beta, alpha, gamma, and theta waves. 49 participants were divided into a test group, which used the REWIRE application and received realtime audio/visual interventions when focus dropped below a personalized baseline threshold, and a control without interventions. Across 245 total sessions, performance was evaluated via reading focus scores, comprehension quizzes, and spatial memory tests, completed 5 times each. Results from Mixed-Effects Regression(Mixed ANOVA) tests indicated that while both groups began with similar cognitive metrics, the REWIRE group showed statistically significant improvements ($p<0.10$) in all metrics by the final sessions. Furthermore, a paired t-test confirmed a significant increase in self-reported focus ($t = -4.48, p=0.0001$). These findings suggest that REWIRE successfully utilizes synaptic plasticity to reinforce attention spans. By providing immediate feedback during moments of cognitive decline, this neuroadaptive approach offers a superior method for improving focus and retention compared to traditional, stagnant media, demonstrating the potential for interventions based on realtime brain activity to "rewire" and strengthen the modern attention span.

Awards Won:

Third Award of $1,200

Foresight: Second Place

Society Alumni Special Award: Rookie of the Year