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Accuracy Analysis of P300 BCI Famous Face Stimuli

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Introduction: The P300 brain-computer interface (BCI) paradigm relies on stimuli to elicit a P300 response in a BCI user. For the P300 BCIs that use flashing stimuli, prior literature [1] has shown that P300 systems that flash famous faces yield higher accuracy rates than the traditional flashing text stimuli. Currently the University of Michigan Direct Brain Interface (UMDBI) lab uses a tiled, repeating pattern of 16 famous faces as the flashing stimulus (Fig. 1). Faces are arranged to maximize visual contrast between adjacent faces. This study investigates if the different faces produce different accuracy in P300 BCI use.

Methods: The P300 BCI data analyzed for this investigation was collected from 5 participants over 6 sessions (about a week apart) using a P300 BCI to access a PRC-Saltillo communication device keyboard with word prediction. For each participant, the BCI was calibrated with data from 20 selections at 15 sequences and the number of sequences optimized for use. The calibration data included 12 of the 16 faces (missing Hathaway, RM, Redford, and Tan). Participants tested BCI performance by copying sentences and composing picture descriptions using both correction of errors and word prediction. Test data had an average of 552.8 selections per participant (range 388-633 selections). An offline analysis of the recorded selections was conducted using a Chi-squared test to assess whether accuracy was dependent on the face stimulus overlaying the intended target. Subsequent pairwise z-tests, with multiple comparison adjustments, were performed to identify the face stimuli that have significant differences in accuracy compared to others.

Results: The Chi-squared test showed significant differences in accuracy based on the face stimulus. Pairwise z-tests indicated that faces Hathaway, RM, and Tan had significantly lower accuracy than multiple other face stimuli. The percentage of intended selections per face varied from 0.43% to 13.64% (see Fig. 2). No statistically significant conclusions could be drawn for face Berry due to its infrequent selection rate (0.43%).

Figure 1: *Tiled faces used as stimuli (without the names) create visual contrast between adjacent faces.*

Conclusion: The 3 face stimuli with significantly lower performance were not included in the calibration session, which could contribute to the lower accuracy. The low percentage of times that these faces were the target also reduces the ability to access accuracy. Apart from these 3 faces the accuracy was relatively consistent between the different faces. Future studies should include all faces as targets in the calibration data and provide better balance of use of each face as the target during testing.

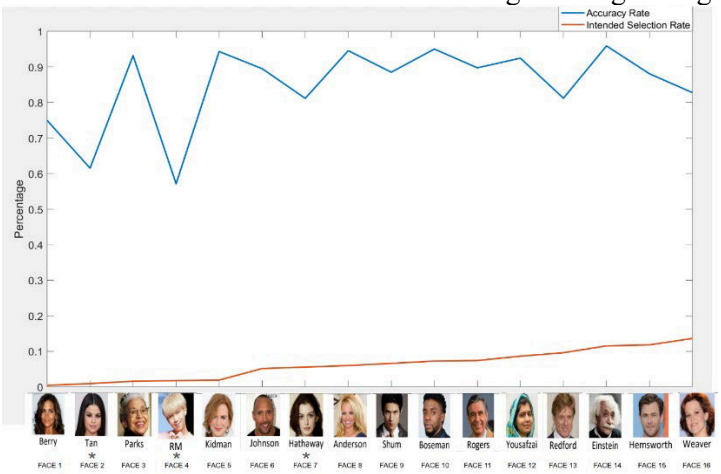

Figure 2: *Graph of the Accuracy and Intended selection rate of the 16 faces stimuli sorted by Intended selection rate. (*) Mark low accuracy faces.*

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References:

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