Performance Optimization of a Brain-Computer Interface Communication System for Children with Disabilities

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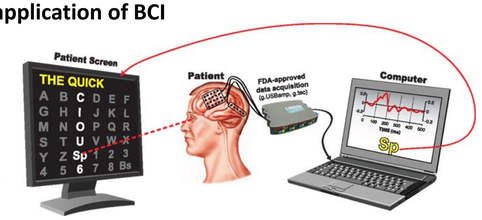
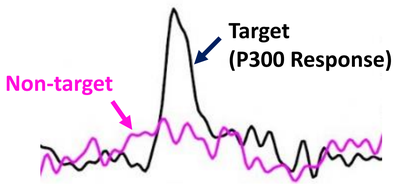
BACKGROUND

Brain-computer interfaces (BCIs)
decode brain activity and translate them into external commands

P300 Speller – An application of BCI

- User presented with grid of characters
- Characters flash in random sequence
- User visually focuses on desired character





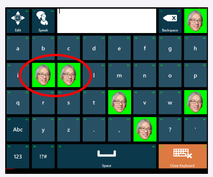
- When target character is flashed a distinct brain activity, the P300 response, is triggered
- Allows the BCI to differentiate between target and non-target stimuli

RESEARCH QUESTION

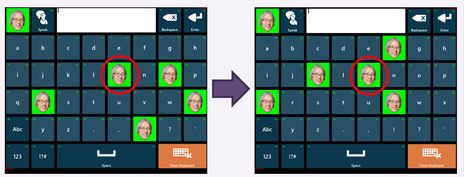
Can a P300-based BCI speller be an effective form of communication for children with disabilities?

METHODS

Developed a flash sequence algorithm to eliminate all occurrences of adjacent flashes and double flashes



Adjacent flash:
Cause distractions



Double Flash:
Reduce the size of the P300 response

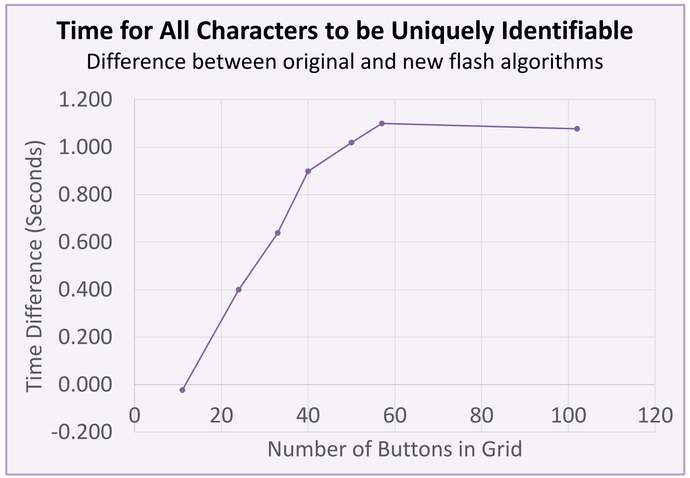
The speed of the algorithm and the amount of double/adjacent flashes were compared to the previous flash sequence generation method, which was random selection of flash groups

More research is required to determine whether a P300 speller can be an effective form of communication for children with disabilities

RESULTS

Average Double and Adjacent Flashes in 1 Minute				
Number of Characters in Grid	Double Flashes		Adjacent Flashes	
	Previous Method	New Method	Previous Method	New Method
11	27.067	0	127.4	0
40	18.933	0	243.067	0
102	3.6	0	310.133	0

The algorithm was successful in eliminating all double/adjacent flashes



Time difference becomes more significant for larger grid sizes.
Largest time difference was 1.1 seconds for a grid with 57 buttons

NEXT STEPS

1. **Recruit participants ages 8-19 with disabilities to test the communication system**
2. **Develop auditory and tactile P300 systems for individuals with visual impairments**

RELEVANCE TO HOLLAND BLOORVIEW

A P300 speller can provide an alternative form of communication for Holland Bloorview clients who have not found a reliable access method

Holland Bloorview Kids Rehabilitation Hospital | prism lab | University of Toronto