



# Design Considerations for Introducing a Brain-Computer Interface to People without Existing Communication



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## BACKGROUND

Brain-computer interfaces (BCIs)

- Do not require pointing, speaking, or eye movements.
- Can be used for communication or computer access

BCI has been developed and tested with:

- Adults
- Typically developing participants; no impairment
- Brains without known pathology

**BCI processes are challenging for those without established communication**

## OBJECTIVES

- Identify BCI design and training protocol barriers
- Propose modifications to optimize utilization

## METHODS

Participants: 13 individuals with cerebral palsy (CP):

- 3 individuals without established communication
- 10 AAC communicators

Intervention: Calibration of BCI and use for specified tasks

Measurements: Behavioral observations, participants report of instructions, calibration results

Brain-Computer Interface Description:

- EEG BCI using P300 design [1]
  - Flashes on-screen buttons
  - Participant mentally counts or reacts when desired button flashes
- BCI-Adapted multiple choice test (Fig 1, top) [2]
- BCI-Adapted Speech Generating Device (Fig 1, bottom)

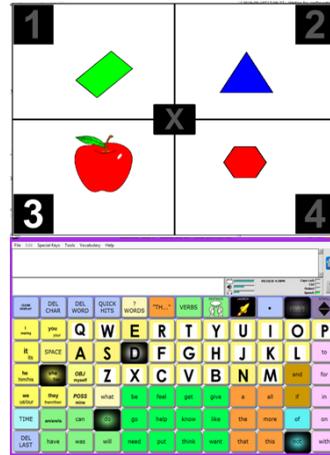


Fig 1: Top: Multiple-choice test  
Bottom: Speech generating device



Fig 2: Participant with CP and first BCI calibration screen

## RESULTS

No calibration for those without established communication

- Refused to open eyes (Fig 2)
- Little attention to flashing buttons

Mixed results for AAC communicators

- Calibration difficult with multiple choice test application
- Calibration successful with Speech Generating Device
- Slow speed frustrated AAC speakers

Changes needed in Instructions

- Directions to say “Yes” in your head when the button flashes frequently miss-understood
- Counting flashes of button more easily understood.

## RESULTS: Challenges Identified

Compliance issues

- Boring
- Attention issues

Understanding of calibration task

- Separation of picture and label adds cognitive load
- Counting adds cognitive load and/or stress
- Unfamiliar concept of mental response
- “Repeating ‘yes’ in head” instead of responding to flash

Other

- Letter-by-letter keyboarding often expected
- Agency in accessing technology unfamiliar

## DISCUSSION

Reduce cognitive load

- Eliminate dependence on spelling/numbers
- Integrate stimuli into pictures

Make calibration interesting

- Explore manipulation of interest by stimuli content
- Can we replace compliance with interest?

Utilize scaffolded learning of communication skills

## CONCLUSIONS

- BCI possible for people with severe CP who cannot talk or point
- Design changes needed for those without communication experience

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