

B. Peters, A. Mooney, & M. Fried-Oken

Oregon Health & Science University, Portland, OR, USA

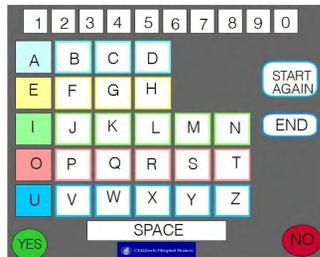
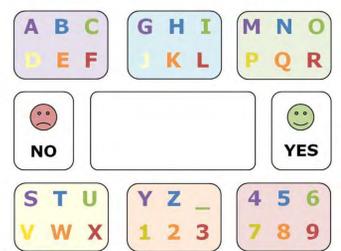
Introduction

Problem: BCI R&D increasingly involves end users with severe disabilities as study participants. Those who experience communication limitations present challenges for

- Obtaining consent
- Giving instructions
- Requesting and receiving user feedback
- Being part of a user-centered design team.

Solution: Augmentative and alternative communication (AAC) strategies and tools allow BCI researchers to communicate effectively with these individuals.

Goal: To match AAC strategies with International Classification of Functioning, Disability & Health (ICF) [1] codes for standardized communication guidelines in all research tasks.



AAC Strategies [2]

Unaided:

- Eye blinks
- Gestures
- Natural speech

Quick Access Tools:

- Eye gaze boards
- Alphabet boards
- Laser pointer on word boards

High-tech tools:

- Speech-generating devices

ICF code(s)	Communication strategies: how to apply with research participants
b3: Voice and speech functions and/or b7: Movement-related functions	<ul style="list-style-type: none"> • Learn participant's yes/no responses. Ask him to "show me your yes" and "show me your no". • Ask questions with clear yes/no answers. "Did you prefer setting A or setting B?" is not a yes/no question. • For multiple-choice questions, use partner-assisted scanning [2]. • Present options one at a time, using multimodal input; wait for participant's selection.
b1: Cognitive function	<ul style="list-style-type: none"> • Provide verbal and/or written cues.
b2: Sensory functions	<ul style="list-style-type: none"> • Use multimodal input when sharing information or asking questions: both written and spoken words.
b167: Mental functions of language	<ul style="list-style-type: none"> • Use multimodal input; write down key words. • Keep instructions and questions simple; rephrase if necessary. • For open-ended questions, offer response choices.
Any of the above	<ul style="list-style-type: none"> • Schedule study visits to allow adequate time for communication. • If complex responses or additional information are required, provide questions in written form and allow time before or after study sessions for participant to respond. • Two researchers attend each study visit. One focuses on system setup and software operation. One focuses exclusively on communicating with the participant. • Ensure that communication aids, glasses, hearing aids, or other sensory aids are available. • Establish participant's signal for a rest break or to receive medical care.

Discussion

AAC strategies have been used successfully in BCI research with 18 individuals with communication limitations for:

- Obtaining informed consent [3-6]
- Participant screening [3]
- Providing task instructions [4]
- Qualitative interviews [5]
- Soliciting user feedback [6]

Significance

AAC strategies and tools support effective interactions between BCI researchers and people with severe communication impairments, aiding in the inclusion of potential end users in research tasks. International guidelines for AAC strategy implementation in all end-user research can be based on the ICF.

References

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- [2] Beukelman DR, Garrett KL, Yorkston KM (eds.). Augmentative communication strategies for adults with acute or chronic medical conditions. Paul H. Brookes, Baltimore, 2007.
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- [4] Oken BS, Orhan U, Roark B, Erdogmus D, Fowler A, Mooney A, Peters B, Miller M, Fried-Oken MB. Brain-computer interface with language model-EEG fusion for locked-in syndrome. Neurorehabilitation and neural repair, 28(4): 387-94, 2014.
- [5] Andresen EM, Fried-Oken M, Peters B, Patrick DL. Initial constructs for patient-centered outcome measures to evaluate brain-computer interfaces. Disability and Rehabilitation: Assistive Technology, early online, 2015. DOI: 10.3109/17483107.2015.1027298.
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