

Communication Strategies to Involve Potential Users in BCI Research

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Introduction: Brain-computer interface (BCI) research and development increasingly involves potential end users as study participants. For BCIs with habilitative or rehabilitative purposes, end users are typically people with severe disabilities. Many of these individuals experience communication difficulties as a result of their physical, sensory (e.g. hearing or vision), cognitive, and/or language impairments, presenting challenges to BCI researchers when obtaining informed consent, giving instructions, requesting and receiving user feedback, and involving people with disabilities in user-centered design and participatory action research. Simple, proven techniques from the field of augmentative and alternative communication (AAC) will help researchers to communicate effectively with these individuals. Pairing these techniques with International Classification of Functioning, Disability & Health (ICF) [1] codes and qualifiers for performance restrictions will present guidelines for more effective communication strategies that could be used for obtaining consent.

Strategies for Communicating with People with Disabilities: People with communication impairments have a diverse range of needs and abilities. They may use AAC strategies ranging from unaided (e.g. eye blinks, gestures, natural speech) to high-tech (e.g. speech-generating devices) [2]. Researchers must understand how these methods are used and plan interactions accordingly. Table 1 presents strategies for communicating with people with various types of impairments, described using ICF codes. These strategies have been used successfully with a total of 18 individuals with disabilities for obtaining informed consent [3-6], participant screening [3], providing task instructions [4], qualitative interviews [5], and soliciting user feedback [6].

ICF code(s)	Communication strategies
b3: Voice and speech functions and/or b7: Movement-related functions	<ul style="list-style-type: none"> Learn the 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. Use partner-assisted scanning [2] for multiple-choice questions. Present options one at a time, preferably using multimodal input (see below), and wait for a signal to indicate the participant's selection.
b1: Mental functions (cognition)	<ul style="list-style-type: none"> Use spaced retrieval and/or errorless learning [2] in experimental tasks. Provide verbal and/or written cues.
b2: Sensory functions	<ul style="list-style-type: none"> Use multimodal input [2], e.g. both written and spoken words, when sharing information or asking questions.
b167: Mental functions of language	<ul style="list-style-type: none"> Use multimodal input (see above). Writing down key words is often helpful. Keep instructions and questions simple, and rephrase them if necessary. If open-ended questions are difficult, offer response choices.
Any of the above	<ul style="list-style-type: none"> Schedule study visits to allow adequate time for communication. If longer responses or additional information are required, provide questions in written form and allow time before or after study sessions for the participant to compose responses. When possible, have two researchers present during each study visit. One can focus on system setup, software operation, etc., while the other focuses exclusively on communicating with the participant. Ask what behavior the participant expects from you as a communication partner. Ensure that communication aids, glasses, hearing aids, or other sensory aids are available when applicable. Establish a signal participants can use to indicate when they need a break to rest or receive medical care.

Table 1. Suggested strategies for communicating with individuals with physical, cognitive, sensory, and language impairments.

Discussion: Communication strategies should be chosen based on an individual's specific needs and abilities, using functional descriptions and severity qualifiers consistent with the ICF [1]. Family members or care providers can suggest other methods for optimizing communication.

Significance: Simple AAC techniques support effective interactions between BCI researchers and people with communication impairments who have relatively spared cognition, aiding in the inclusion of potential end users in research tasks, such as giving informed consent, providing user feedback, and decision making.

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