A revised sensory/cognitive/communication screen for use with communication BCI study participants
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Background
Original BCI Sensory/Cognitive/Communication Screen developed in 2012 [1]
- Designed to assess requisite skills for RSVP Keyboard™ BCI
- Required only yes/no responses and eye movements (suitable for use with people with incomplete and classic LIS)
- Successfully administered to 12 participants with severe speech and physical impairment

Problem: E-TRAN board with Velcro-attached stimuli was cumbersome and time-consuming.
Solution: Flipbook with one screening item printed on each page and a hole for viewing eye movements.

Goal 1: Simplify setup and administration

Goal 2: Obtain more complete background information from caregivers

Problem: Caregiver questions prolonged screening visits. Caregivers may have felt uncomfortable giving thorough answers about some topics (e.g. cognition) in front of participants.
Solution: Revised screen includes a caregiver pre-screen, completed via telephone, with questions on communication, motor, vision, hearing, and cognitive abilities.

Pre-screen: Communication
1. How does participant communicate? Please include any and all communication methods used.
2. Does participant have reliable signals for "yes" and "no"?
3. How does participant signal "yes"?
4. How does participant signal "no"?
5. Do you have any concerns about participant's ability to understand spoken or written words?

Goal 3: Reduce potential for examiner bias

Problem: Examiner knew correct answer locations on E-TRAN board. When a participant's eye movements were difficult to interpret, it was tempting to point to the correct answer to confirm a response, potentially affecting the results.
Solution: Flipbook shows only number-coded boxes on examiner pages. Examiner records the number of a participant's response, then compares it to an answer key for scoring.

Goal 4: Adapt for skills relevant to a different BCI interface

Problem: Original screen assessed requisite skills for the RSVP Keyboard™ BCI. Different skills are relevant to using a BCI with the Shuffle Speller interface.
Solution: Revision began with task analysis to identify skills and characteristics relevant to use of the Shuffle Speller BCI. Visual skills including fixation, pursuit, saccades, visual field, acuity, and visual perception are screened with items based on standardized assessments, modified for yes/no and eye movement responses.


Goal 5: Include informed consent procedures

Problem: Previously, we obtained informed consent before screening, assuming participants had the necessary hearing and auditory comprehension skills. (An authorized research representative signed on the participant’s behalf.) We wished to revise our procedures to reduce the potential for doubt about a participant’s ability to provide informed consent.

Solution: Revised screen includes informed consent procedures based on Vansteensel et al [3]. After a hearing screening, participants answer yes/no situational orientation and auditory comprehension questions. Respondents with a passing score of ≥19/20 on these sections are read the study consent form and asked 10 yes/no questions related to its content.

Pilot Testing Results
- 2 people with severe speech & physical impairments completed the revised screening procedure and provided feedback, using only yes/no responses and eye movements
- 1 caregiver completed the caregiver pre-screen via telephone
- Time required: 20 minutes for caregiver pre-screen phone call, 60 minutes for participant screen (not including informed consent)
- Informed consent times may vary depending on whether participants and their research representatives have read consent form in advance, what questions they have, etc.
- Screen was compact and easy to transport and administer in participants’ homes

Significance
- Revised screening tool:
  - Allows for thorough description of the skills and characteristics of BCI study participants
  - Provides a method for obtaining informed consent from individuals with SSPI
  - May reveal sensory/cognitive/communication barriers to successful BCI use, leading to identification of modifications and supports to help overcome such barriers
  - May be a model for the development of screening tools tailored to other BCI systems.
  - More detailed participant description will lead to better sharing and comparison of results within the field