Icons are not equal: Considerations for use of icons in BCI systems

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Background

- Brain-computer interfaces (BCI) for literate adult users
- Previous proof of concept for icon-based BCI system
- Icon features influence performance
- Conceptual knowledge influences EEG (P100, N400)
- Trial-error instruction is common to teach icon meanings

Question 1

Can two equal sets of singular-noun form icons be created?

Icon Selection Methods

Icon Feature Survey

- Concreteness
  “How well does this icon depict a real object, material or person? Concrete icons depict real objects, materials, or people. Abstract icons do not.”

- Visual Complexity
  “How visually complex is this icon? Consider the amount of detail or intricacy of lines or color.”

- Meaningfulness
  “How meaningful is this icon to you? Symbols that convey a great deal of meaning should be given a high rating and those that convey little meaning should be given a low rating.”

Semantic Distance

“How closely related is this icon to the word above?”

Survey Results

- Multidimensional Scaling and L-infinity norm
  - Icon Set A: 92%
  - Icon Set B: 91%
  - 12 volunteer annotators surveyed

Question 2

What are the effects of trial-and-error instruction for icon meaning on calibration AUC and selection accuracy in an RSVP BCI icon paradigm?

Independent Variable:
- Training method

Dependent Variables:
- Calibration accuracy
- Icon-icon copy accuracy
- Word-icon copy accuracy

Study Design:
- Single-subject alternating treatments across participants
- Counterbalanced treatment condition order

Participant Criteria:
- 5 participants with SSPI
- Ages 21-80
- Normal/corrected hearing
- Normal/corrected vision

Tasks

- Calibration
- Icon-Icon Copy
- Word-Icon Copy

Feedback

Training Conditions

- Trial & Error Training
  - Find UMBRELLA
- Exposure Training
  - Look at each icon.

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References