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

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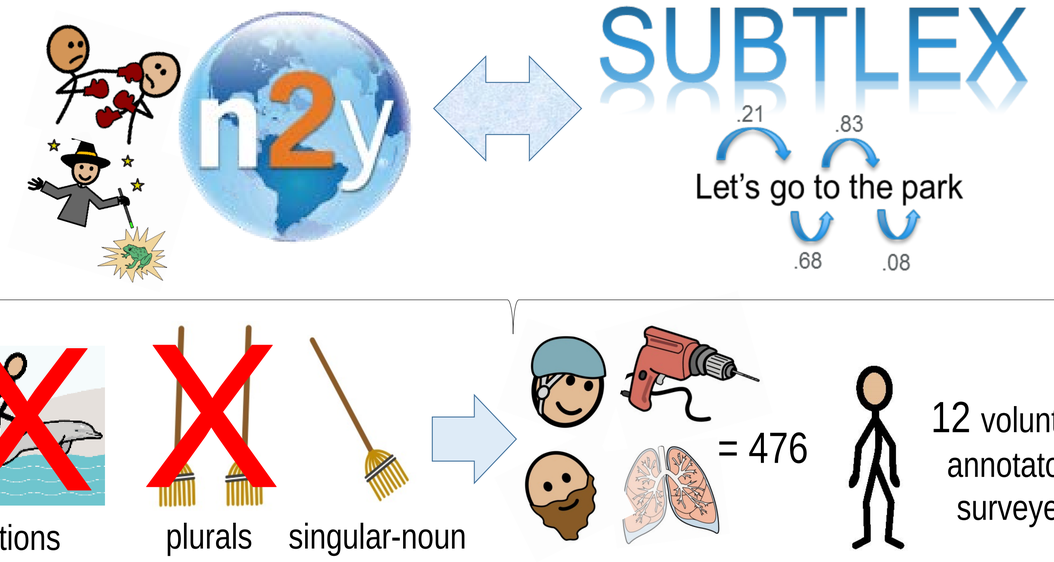
Background

- Brain-computer interfaces (BCI) for literate adult users[1,2]
- Previous proof of concept for icon-based BCI system[3]
- Icon features influence performance[4-6]
- Conceptual knowledge influences EEG (P100, N400)[7-8]
- Trial-error instruction is common to teach icon meanings[9-10]

Question 1

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

Icon Selection Methods



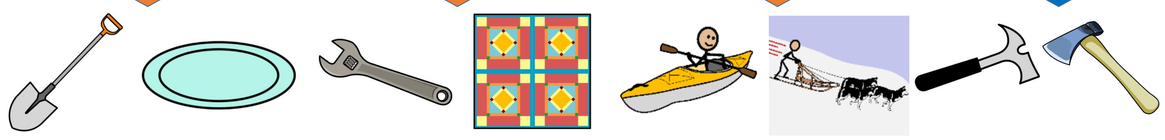
Icon Feature Survey

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.*"

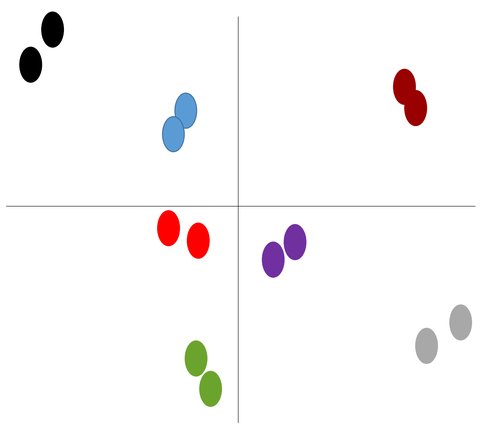
Meaningfulness
"How meaningful is this icon to you? *Symbols that convey a great deal of meaning should be given a high rating and those that convey little meaning should be given a low rating.*"

Semantic Distance
"How closely related is this icon to the word above?"

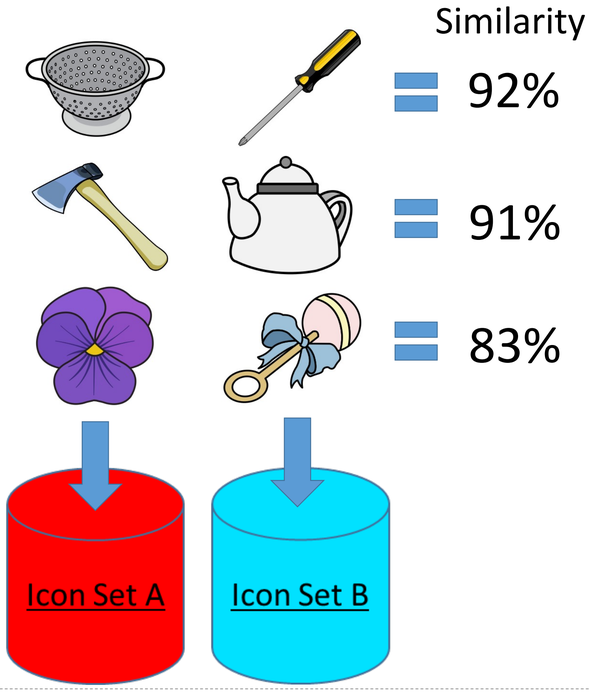


Survey Results

Multidimensional Scaling and L-infinity norm



Rated Similarity



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?

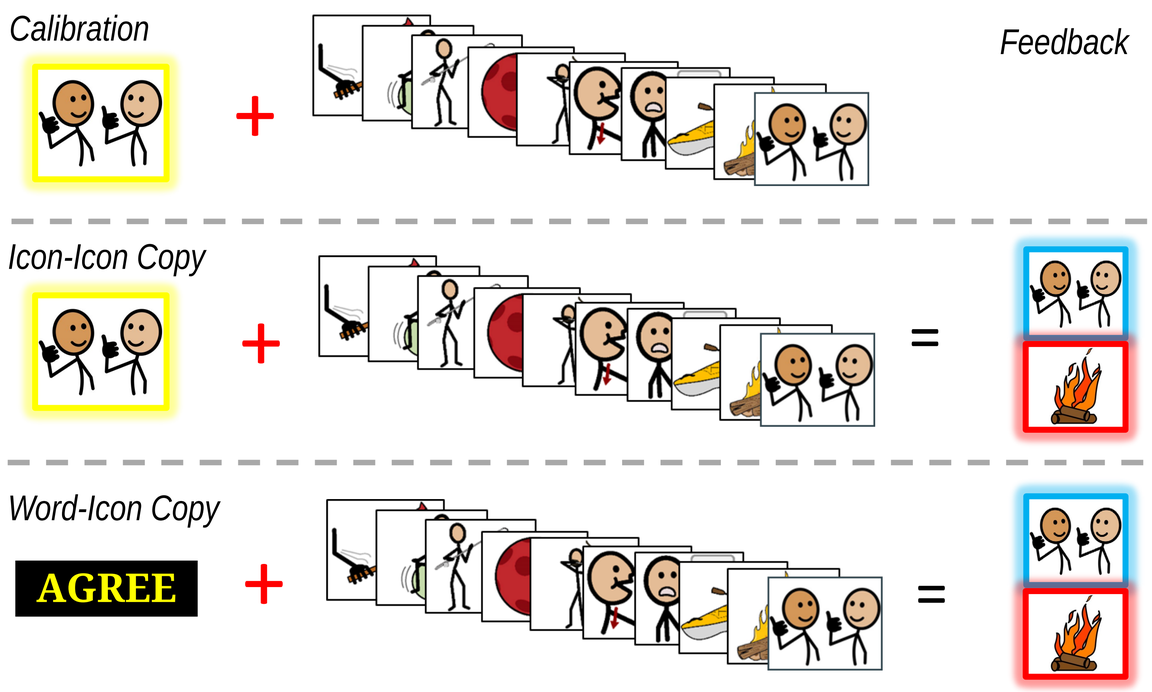
Independent Variable:
- Training method

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

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

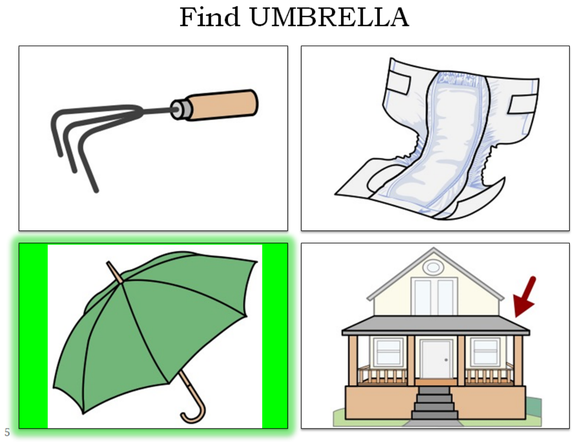
Participant Criteria:
- 5 participants with SSPI
- Ages 21-80
- Normal/corrected hearing
- Normal/corrected vision

Tasks

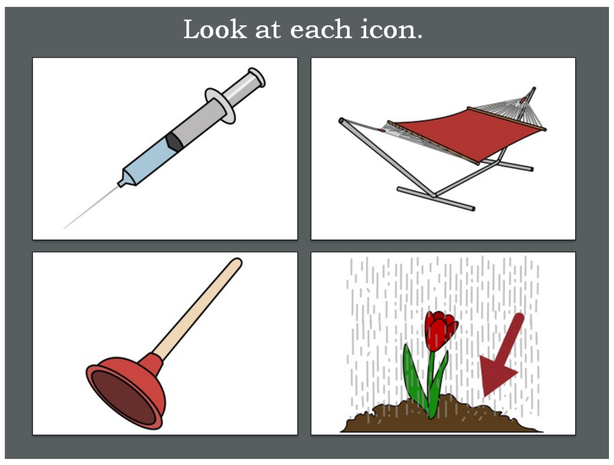


Training Conditions

Trial & Error Training



Exposure Training



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