Neurofeedback in Alzheimer's Disease

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NO – PHOTO / RECORD

Background

- Brain-computer interface (BCI) systems are controlled by users through neurophysiological input.
- Previous work has demonstrated that use of feedback mechanisms has the potential to improve user performance with BCI.
- BCIs have emerged as a potential tool for broader populations, especially with regards to delivering cognitive training/interventions with neurofeedback.
- The goal of this study is to investigate application of a BCI system with neurofeedback (NFB) as an intervention for people with Alzheimer's disease (AD), a neurodegenerative disease characterized by cognitive decline and associated functional impairments in language and reading.

Assessment Measures

Inclusion Criteria:

Mild AD: Diagnosis of possible/probable AD
- Clinical Dementia Rating (CDR) of 0.5 or 1
- Montreal Cognitive Assessment (MoCA) score ≥ 14

Language Impairment:
- score ≥ 0.5 on language supplemental CDR or comparable clinical indication of language-related cognitive impairment

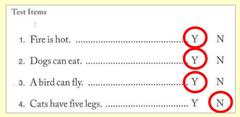
Summative Measures:

- Discourse Comprehension Test[1]
- Weschler Adult Intelligence Scale 3rd Edition
  Digit Span Subtest
- Reading Confidence and Emotions Questionnaire[2]

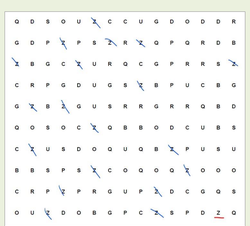
Repeated/Formative Measures:

- Woodcock Johnson Test of Achievement 4th edition
  Sentence Fluency Subtest
- Letter Cancellation Task[3]
- Computerized Letter Span Task

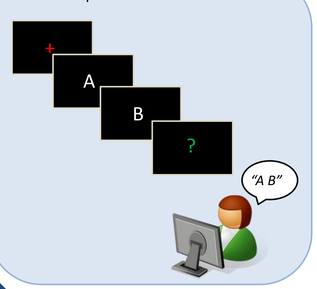
WJTA IV Sentence Fluency Subtest



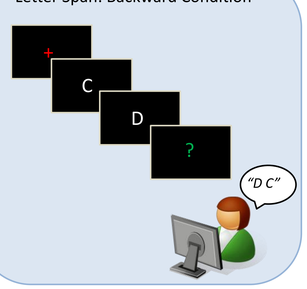
Letter Cancellation Task



Letter Span: Forward Condition

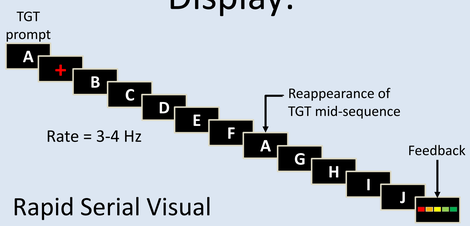


Letter Span: Backward Condition

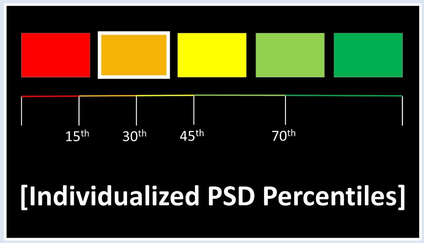


Feedback Development

Display:

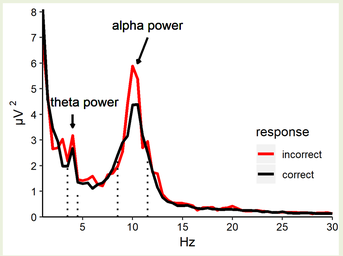


Rapid Serial Visual Presentation (RSVP)



Mechanism:

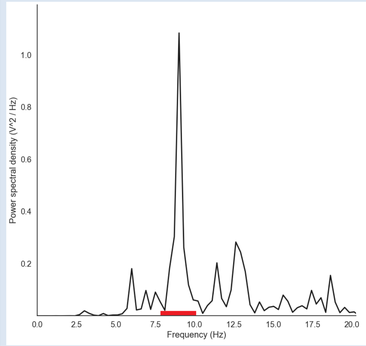
N-Back RSVP Pilot: Normalized Power By Condition



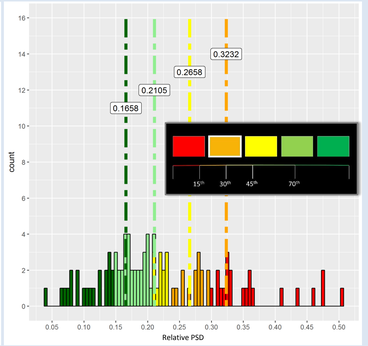
- Significant relationship between posterior alpha power and behavioral performance in analogous n-back pilot task (n=5)
- Minimal relationship between performance accuracy and SSVEP (4 Hz)

Implementation:

Participant A: Relative PSD During RSVP Feedback Calibration (Intervention Visit #4)



Participant A: Feedback Distribution (Intervention Visit #4)



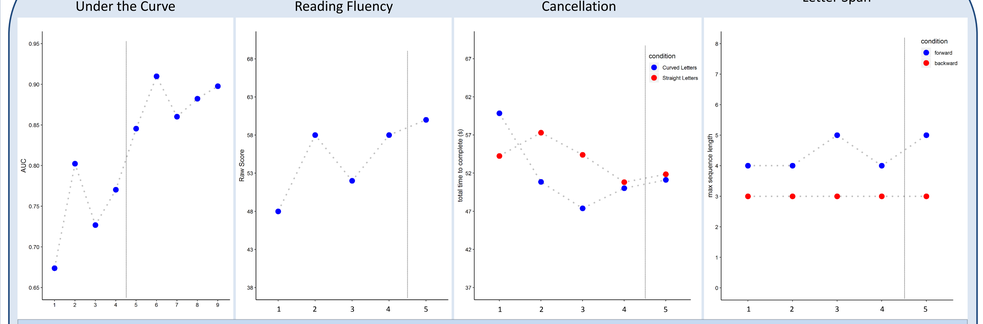
- Relative power spectral density (PSD; μV²/Hz) at P4
- Individualized posterior alpha rhythm activity at 9 Hz (highlighted 8-10 Hz)
- Cutoffs for week #2 of intervention generated from average of week #1 posterior alpha activity (visits 1-3)
- Dynamic adaptation of relative PSD percentiles (dashed lines)

Research Design

Single-Case Design[4] (SCD)

- **Recruitment** — Identification of potential participants through OHSU Layton Aging and Alzheimer's Disease Center
- **Screening** — Screening measures and summative measures will be administered to determine eligibility for study
- **Baseline** — Baseline performance on formative measures and RSVP task will be measured across 3-7 sessions (weekly)
- **Intervention** — Intervention (RSVP with feedback) will be administered three times per week for 6 weeks; formative measures weekly.
- **Follow-Up** — Maintenance will be assessed with 1 follow up session 1 month following treatment period

Ongoing Results



Repeated baseline assessment of dependent variables (DVs) to demonstrate learning effects and establish stable performance prior to intervention initialization (3-7 weeks; gray vertical line)

- Variable but level performance during baseline in AUC and Sentence Fluency task
- Ostensible increase in AUC after initialization of feedback intervention
- Slight increase in sentence fluency following 1 week of feedback
- Learning effects in letter cancellation curved/straight-letter conditions
- Stable letter span performance

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References:
[1]Brookshire, R. H. & Nicholas, L. E. (1993). The discourse comprehension test. Tucson, AZ: Communication Skill Builders Corp
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