Differential Sensitivity of Items in the n-back Task: “Lures” Explain Variance in Executive Control That “Non-lures” Don’t

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1. INTRODUCTION

The n-back task is a widely used probe of working memory:
- Used in neuroimaging studies
- Recently, become more prominent in behavioral studies.
- Little emphasis on task analysis of the n-back task.

Some trials in the n-back may be more sensitive to executive control differences:
- Global accuracy measures fail to distinguish different types of items and their underlying processes.
- Comparison of “lure” nontargets to “non-lure” nontargets may be particularly sensitive to executive control differences.
- “Lure” nontargets contain more irrelevant or misleading information than “non-lure” nontargets.
- For an analysis of other trial types, as well as a different operationalization of “lures”, see Conway and Kane (2001).

Active maintenance of context information:
- Biases processing toward task-relevant pathways
- Protects from interference from task-irrelevant pathways
- “Lure” performance may be more sensitive to active maintenance of context information, and overall efficiency of executive control

Predictions:
- Subjects will false alarm (FA) more to lures than to non-lures
- Lure FAs will predict variance in executive control stemming from:
  - Individual differences in fluid intelligence (Dempster, 1991)
  - Individual differences in working memory span (Engle, 2002)
  - Age-related differences (Braver et al., 2001)
- Those relationships will stand, even after controlling for non-lure FAs

2. METHOD

Study 1: Participants, procedure
- 58 subjects: 6 task blocks (see Gray, Chabris, & Braver, submitted)
- 3-back task = Verbal (words) or Non-verbal (faces)
- Instructed: “Is the current item the same as or different from the one 3 previously?”
- AX-CPT (Active Maintenance of Context Information)
- Reading Span (working memory span)
- Raven’s Advanced Progressive Matrices (fluid intelligence)

Study 2: Participants, procedure
- Behavioral study with younger and older adults (see Braver et al., 2001)
- 256 subjects: 175 younger adult subjects; 81 older adult subjects
- 3-back task = Verbal (single letters)
- Instructed: “Is the current letter the same as or different from the one 3 previously?”
- Reading Span (partial)
- Raven’s APM & Lure Nontargets
- AX-CPT (active maintenance of context information)

3. RESULTS

Study 1: Correlations of lure false alarms with:

Fluid Intelligence...
- as predicted, higher Raven’s APM score was associated with:
  - lower lure false alarm rate
  - pr = .17, p = .007
  - lower lure false alarm rate controlling for non-lures
  - pr = .28, p = .028

Working Memory Span...
- as predicted, higher reading span was associated with:
  - lower lure false alarm rate controlling for non-lures
  - pr = .32, p = .014

Active Maintenance of Context...
- as predicted, higher AX-CPT target discrimination was associated with:
  - lower lure false alarm rate controlling for non-lures
  - pr = .36, p = .006

4. CONCLUSIONS

Lure nontargets are differentially sensitive to executive control differences
- Fluid Intelligence
- Reading Span
- AX-CPT (Active Maintenance of Context Information)
- Healthy Aging

This differential sensitivity may not be due to psychometric issues
- Even after controlling statistically for baseline FA rates, individuals / groups predicted to have less executive control also have higher lure FA rates

References

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