Individual differences in memory search and their relation to intelligence

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Introduction

In a further exploration of the relationship between recall probability, recall dynamics, and intelligence, we:

- use factor analysis to distill recall dynamics (initiation and clustering) into four factors

- predict recall probability using these factors representing recall dynamics

- predict IQ using recall dynamics factors and recall probability

Methods

Penn Electrophysiology of Encoding and Retrieval Study (PEERS), Experiment 1:

- 118 college-aged participants

- 1 practice session, 6 experimental sessions

- 16 lists of 16 words each (common nouns)

- Each list constructed of pairs of words of varying semantic relatedness

- Varying encoding task: size, animacy, switch-task, no-task

- 75-second recall period immediately following list presentation

PEERS Experiment 2, same as above except:

- 103 participants (subset of Experiment 1 participants)

- 1 practice session, 6 experimental sessions

- 12 lists of 16 words each

- No encoding task control (no-task) lists

- Varying distractor task: 8-sec or 16-sec inter-item (continual) distractor, 8-sec or 16-sec end-of-list (delay) distractor, or control

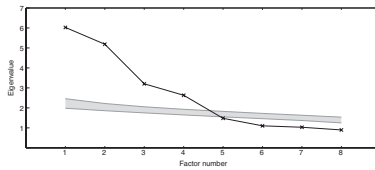WAIS IQ data collected on 76 of the Experiment 2 participants.

Recall Dynamics

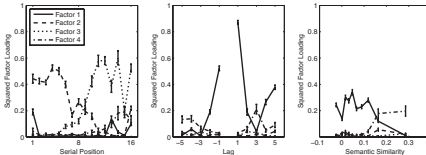36 "recall dynamics" points from PEERS Experiment 1
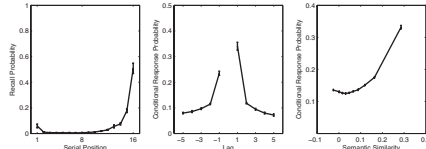
Number of Factors

Parallel Analysis (Horn, 1965) — 1,000 iterations

Factor Loadings

Factors 1 & 4: Clustering factors (temporal and semantic)
Factors 2 & 3: Initiation factors (early and late)

Predictive Power

Linear regression of factor scores against probability of recall:

$$p_{recall} = b_1(\text{Factor}_1) + b_2(\text{Factor}_2) + b_3(\text{Factor}_3) + b_4(\text{Factor}_4)$$
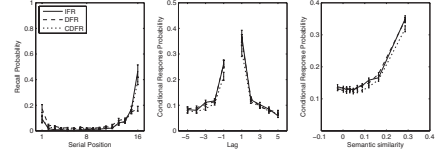$$R^2 = 0.83, \ p < .001$$

Linear regression of factor scores against IQ:

$$\text{IQ} = b_1(\text{Factor}_1) + b_2(\text{Factor}_2) + b_3(\text{Factor}_3) + b_4(\text{Factor}_4)$$
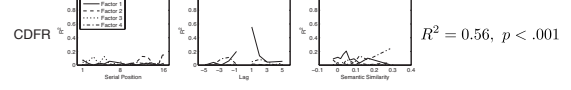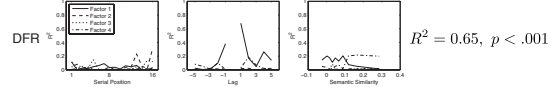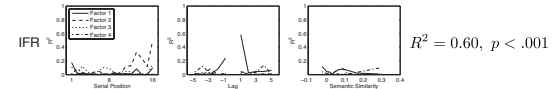$$R^2 = 0.16, \ p < .05$$

Generalizability

Experiment 2 recall dynamics functions for three conditions

Correlate factors calculated from Experiment 1 data with recall dynamics functions from Experiment 2:

Predicting p_{recall}

$$R^2 = 0.60, \ p < .001$$

$$R^2 = 0.65, \ p < .001$$

$$R^2 = 0.56, \ p < .001$$

Conclusions

- Qualitative similarity across participants (Healey and Kahana, in revision), with quantitative variation

- Quantitative variation accounted for by underlying 4-factor structure of recall dynamics

- Factors match existing concepts in recall dynamics: initiation, temporal & semantic clustering

- Factors explain 83% of variability in overall recall probability, and significantly predict IQ

- Factors generalize across experimental conditions

References

Healey, M. K., Crutchley, P., and Kahana, M. J. Individual differences in memory search and their relation to intelligence. *Under review.*

Healey, M. K. and Kahana, M. J. Is memory search governed by universal principles or idiosyncratic strategies? *In revision.*

Horn, J. L. (1965). A rationale and test for the number of factors in factor analysis. *Psychometrika, 30,* 179–185.