Using the Linear Ballistic Accumulator to Understand How List Length Affects Decision Making in Free Recall

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Background

01

PAST RESEARCH

List length research has been primarily focused on the accuracy and order of recalls.

02

GAP

Without consideration of the latencies/response times (RTs) required to make a recall decision

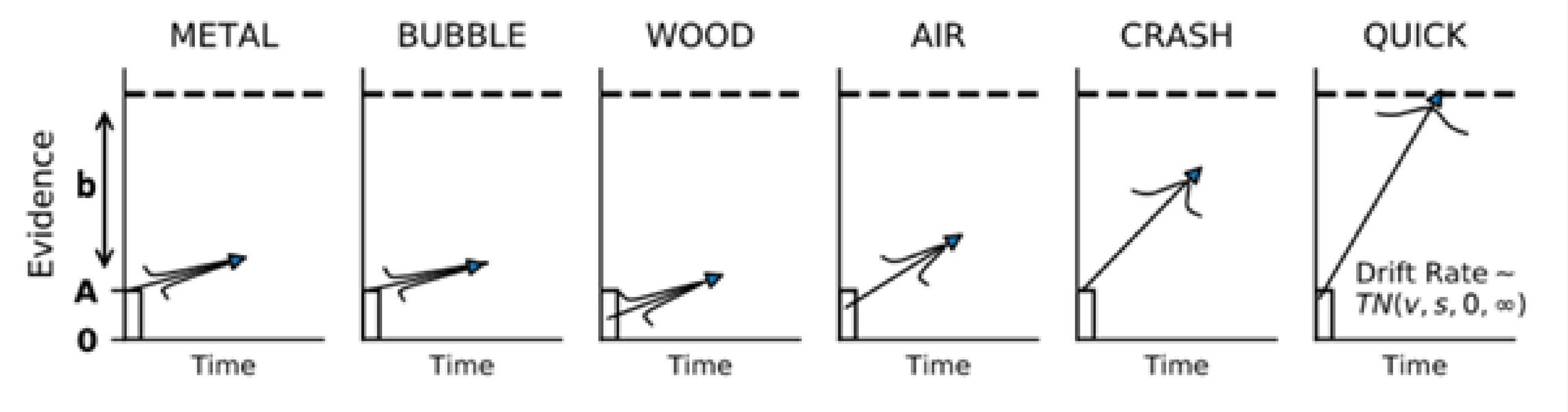
03

AIMS

Provide a greater theoretical understanding of list length effects by jointly accounting for both response probabilities and RT distributions.

Linear Ballistic Accumulator

Example in Free Recall for Study List with Six Items



From “Using response time distributions and race models to characterize primacy and recency effects in free recall initiation”, by Osth, A. F., and Farrell, S., 2019, Psychological Review, 126(4), 578–609.

How Does List Length Affect Recall?

Three parameterisations/modifications were compared

01

NORMALISATION MODEL

Memories inhibit one another to be recalled (e.g., Wixted et al., 1997)

02

THRESHOLD MODEL

Different levels of evidence are required to make a decision (e.g., Donkin & Nosofsky, 2012)

03

STARTING POINT VARIABILITY MODEL

Different levels of evidence are already present before the recall task itself

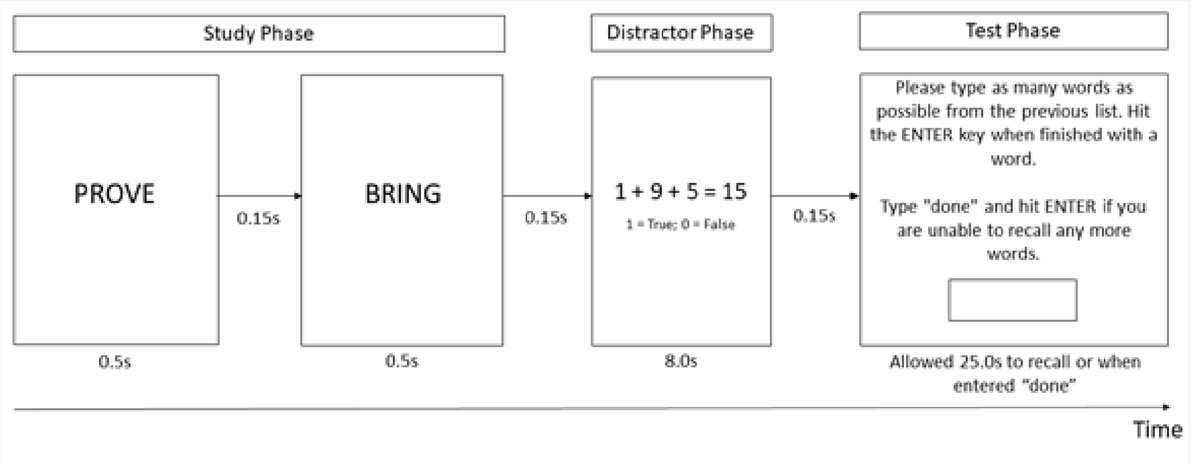
Methods

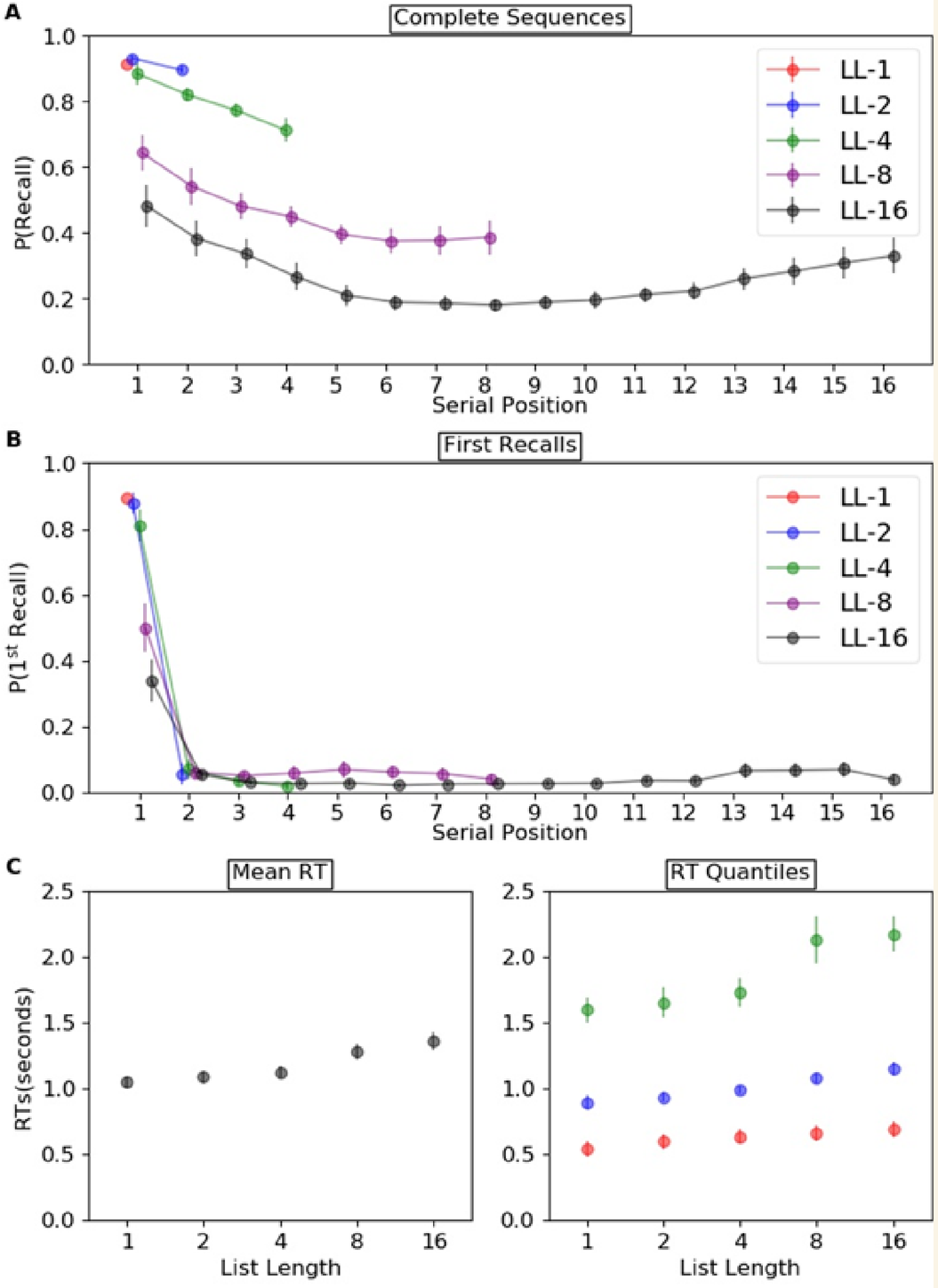
PARTICPANTS

49 participants completed up to four identical sessions.
Each session consisted of 100 trials

DESIGN

Within-subject list length manipulation
List Length = 1, 2, 4, 8, and 16



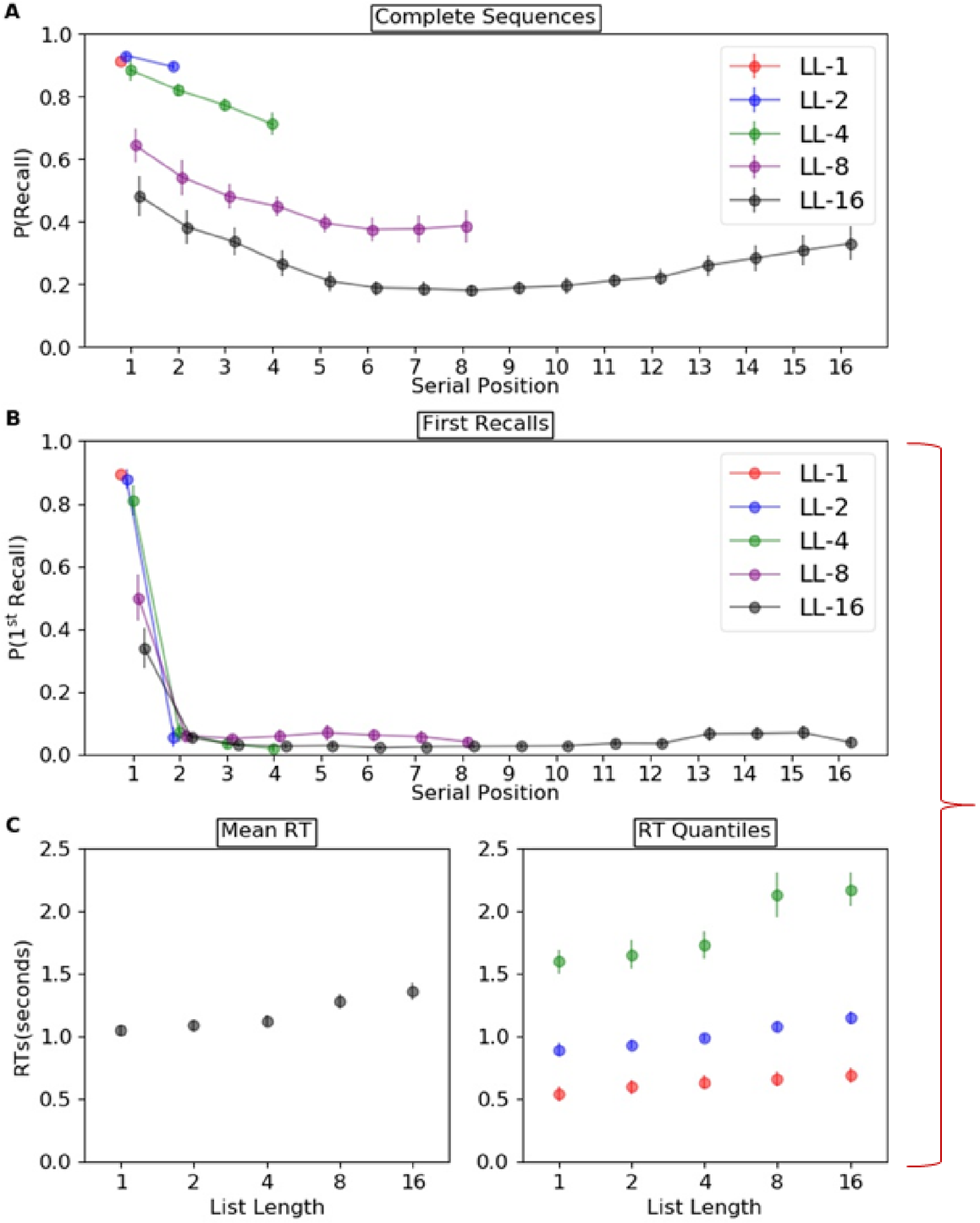


Results

#1: Descriptive Results

- As expected, primacy decreased with increasing list lengths for both complete sequences and first recalls

- Time required to make a "first recall" decision increases with list length, but only between list lengths 4 and 8.
- Largely driven by the upper tail (.9) quantile.



Results

#2: Modelling Details

2 x 2 x 2 Factorial Model Comparison:

Fit the LBA models to both response probabilities and RT distributions required for first recalls under a hierarchical Bayesian framework

Model Selection Metric:

Widely Applicable Information Criterion (WAIC)

Results

#3 Modelling Results

Table 2

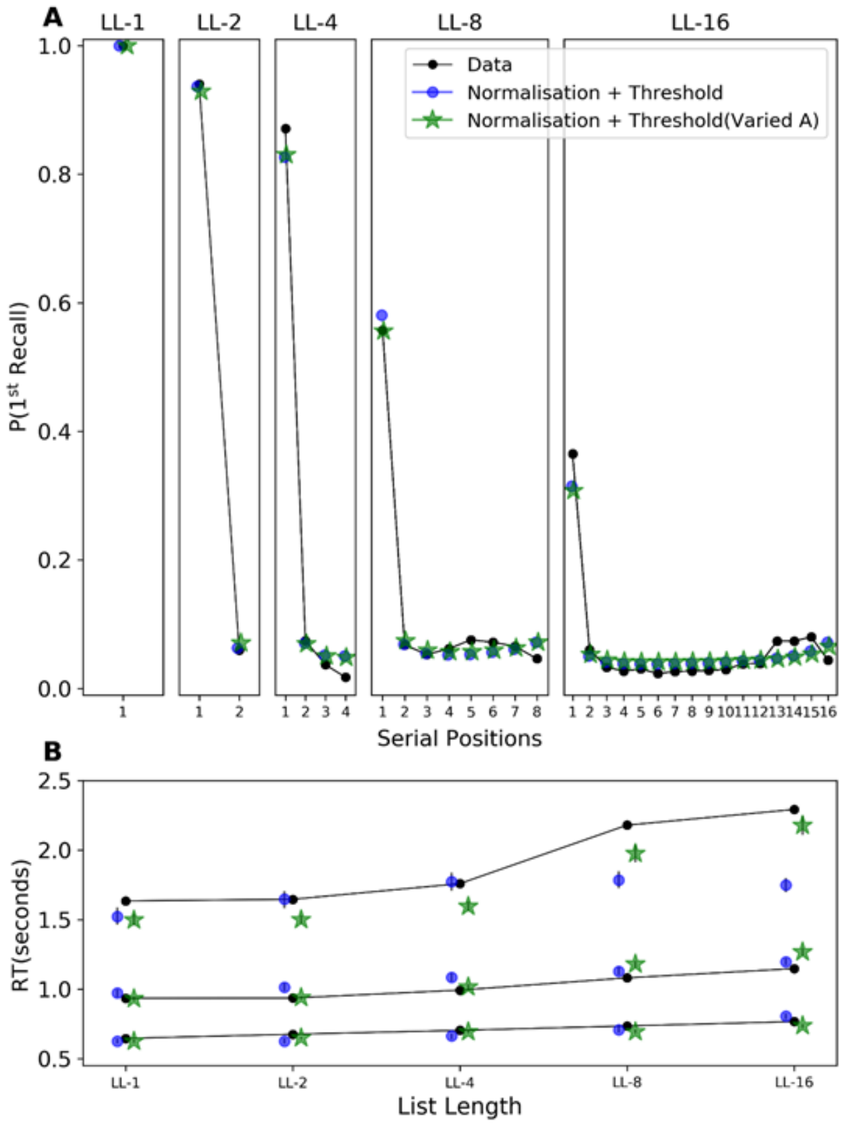
Quantitative Fits of the Models to Data

Models	P_{WAIC}	LPPD	WAIC	ΔWAIC
1. Baseline	375	-15740	32229	1744
2. Normalisation	354	-15788	32283	1798
3. Threshold	553	-15345	31795	1310
4. Normalisation + Threshold	522	-15392	31828	1343
5. Baseline (Varied *A*)	492	-15157	31298	813
6. Normalisation (Varied *A*)	496	-15107	31206	721
7. Threshold (Varied *A*)	655	-14605	30519	34
8. Normalisation + Threshold (Varied *A*)	**647**	**-14595**	**30485**	**0**

Note. Log Pointwise Predictive Density (LPPD), Effective Number of Parameters (P_{WAIC}), and Widely Applicable Information Criterion (WAIC), with ΔWAIC computed as the WAIC difference to the winning model. The best LPPD/WAIC are bolded.

Winning Model

Effects of Starting Point Variability



01

QUANTITATIVE

Allowing starting point variability (A parameter) to vary across list lengths substantially improved the fits of the models according to WAIC

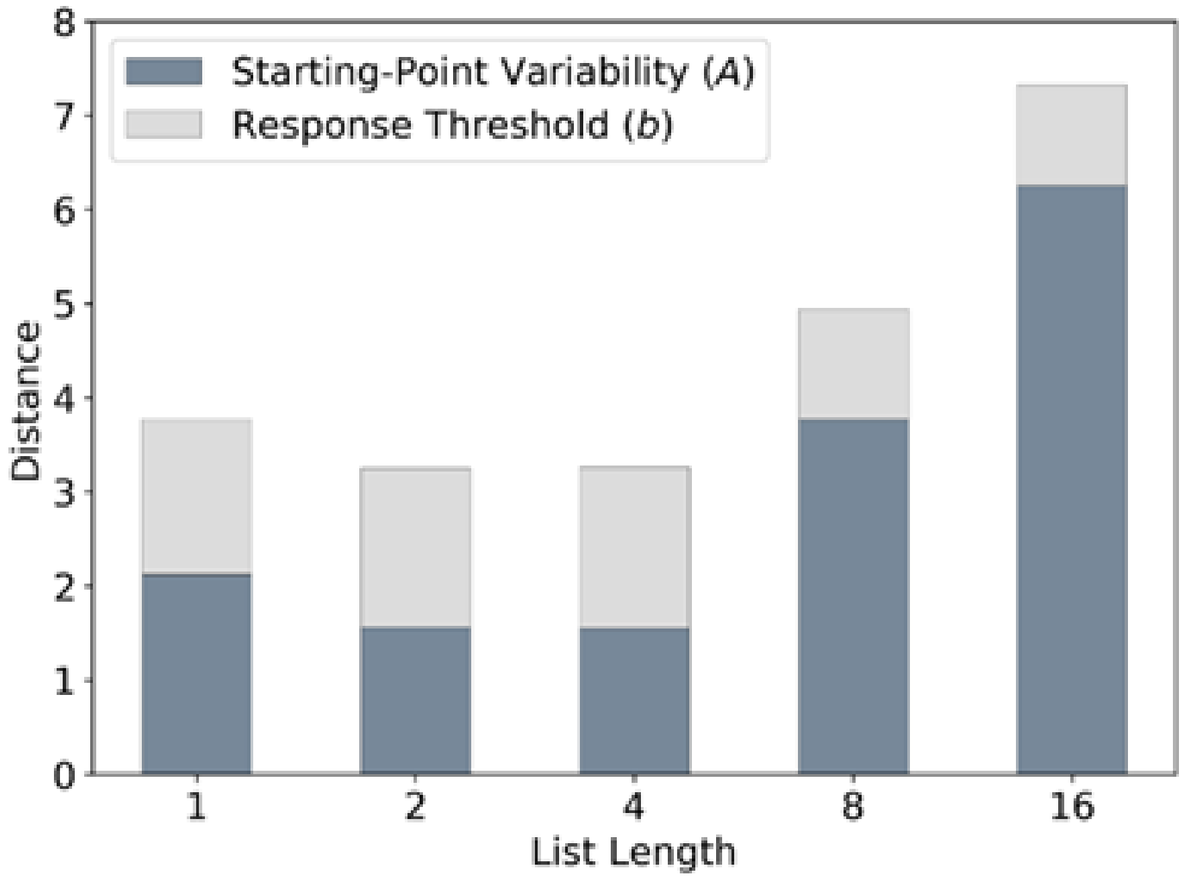
02

QUALITATIVE

Allowing starting point variability (A parameter) to vary across list length was the only parameterisation that could capture the RT distributions

Winning Model

Parameter Estimates



01

WHY DOES STARTING POINT VARAIBILITY INCREASE?

Starting point variability might correspond to rehearsals

- Rehearsal = Recall = Evidence Accumulation

02

WHAT STARTING POINT VARIABLIITY CAN EXPLAIN

It allows the model to capture fast responses, not slow responses. This is a little weird because this model could capture slow responses!

03

WHAT STARTING POINT VARIABILITY CANNOT EXPLAIN

It cannot explain why the model is able to capture slow responses. This implicates other factors responsible for the data.