

Drift diffusion modelling in big data:

Lower episodic memory abilities are associated with better reasoning performance

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Introduction

Drift diffusion model (DDM): computational model of memory-guided decision making, generally applied to reaction times to simple stimuli¹

Can DDM be applied to large datasets with few trials on more complex tasks?

People differ in how they remember the past (rich re-experiencing of details vs. gist)²

Episodic memory contributes to a variety of functions (e.g., future imagination, problem solving)—but a tendency to focus on specific details may hinder performance on tasks that require inferential reasoning or generalization²

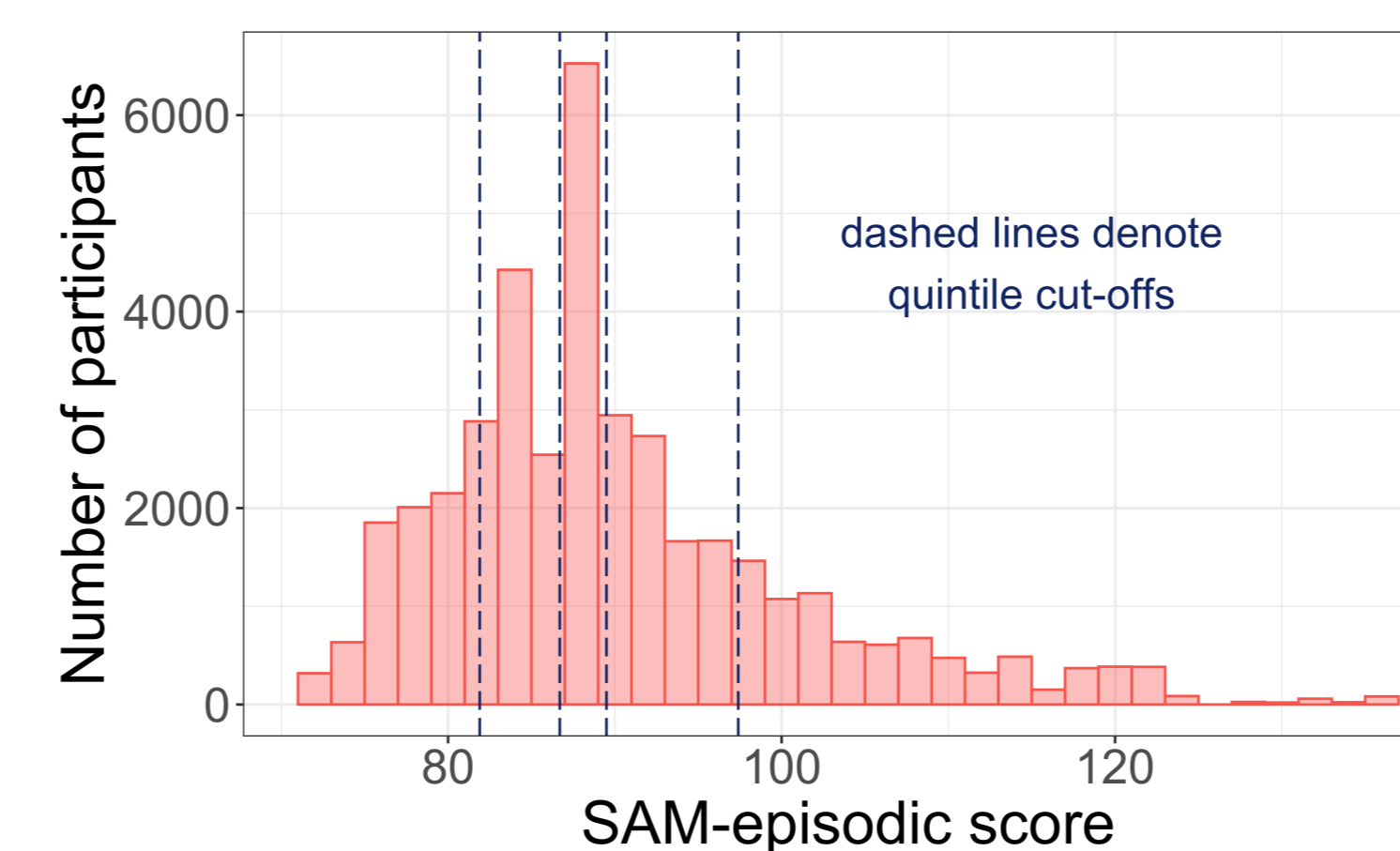
Can DDM parameters reveal individual differences in episodic memory as they relate to cognitive task performance?

Survey of Autobiographical Memory (SAM)⁴

Self-report questionnaire measuring individual differences in autobiographical memory

Online participants

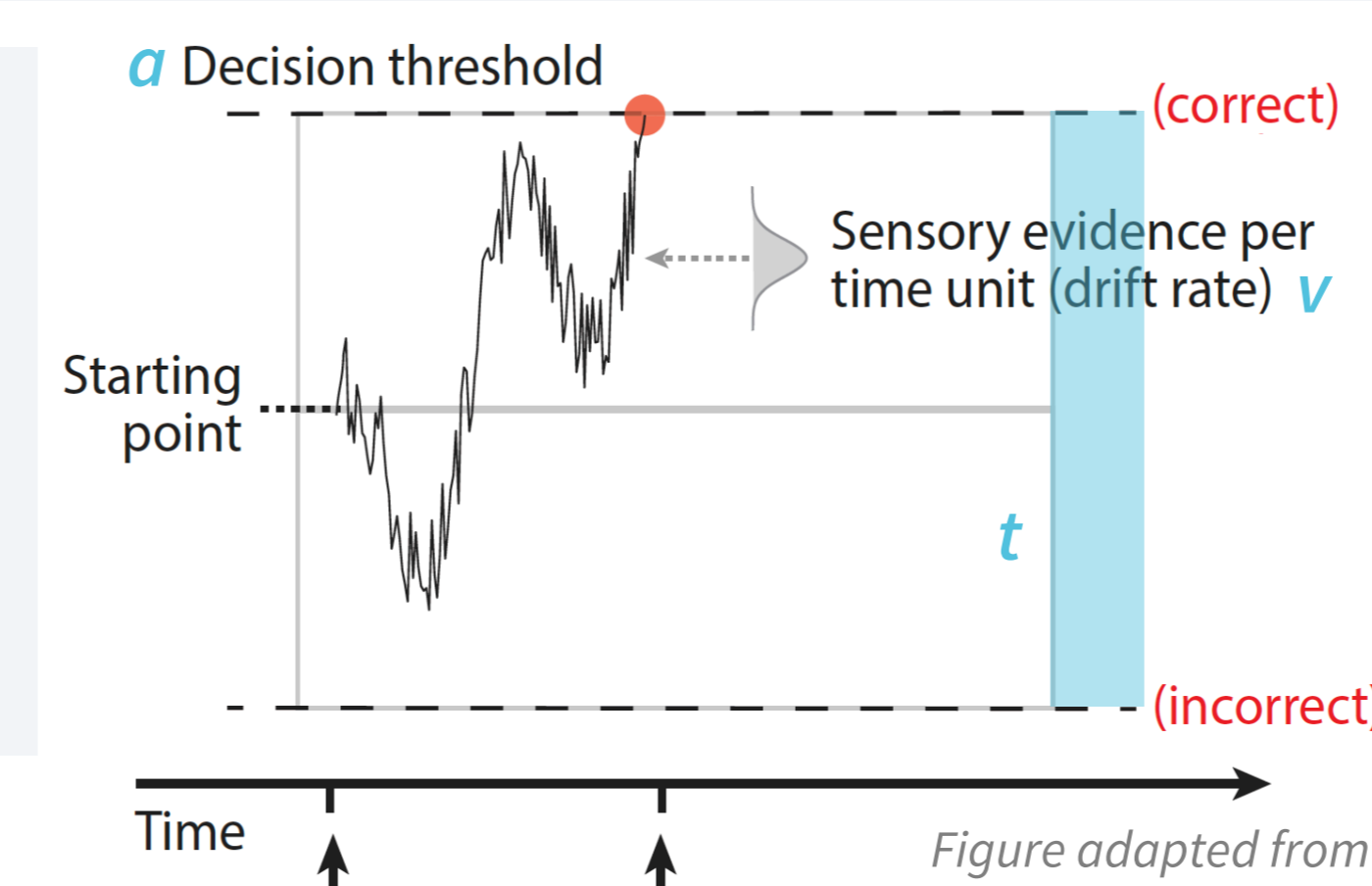
2118 adults
mostly recruited through our lab's media exposure
aged 18–90
1327 F / 749 M / 42 other



Implementing DDM

hddm⁵ toolbox in Python: hierarchical model that leverages data from an entire participant sample to estimate effects on model parameters

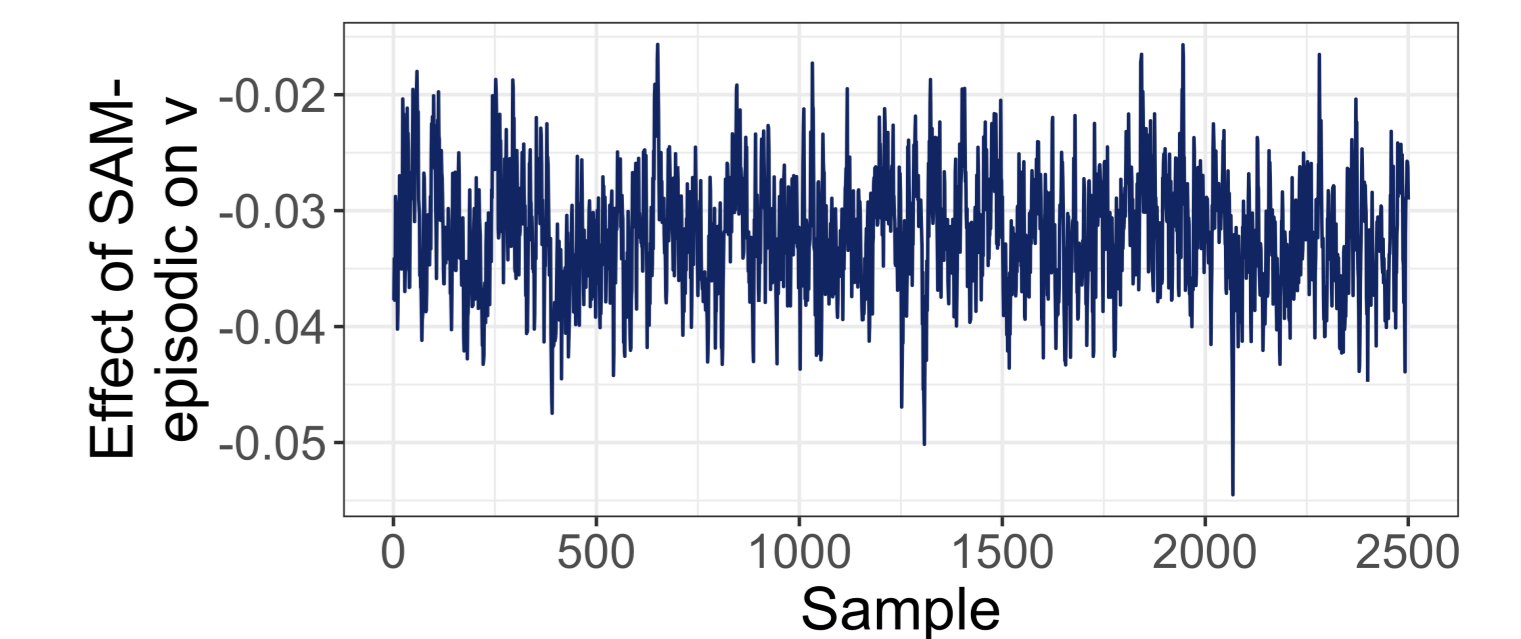
a (boundary separation),
 t (non-decision time), and
 v (drift rate) modelled as a function of episodic memory ability



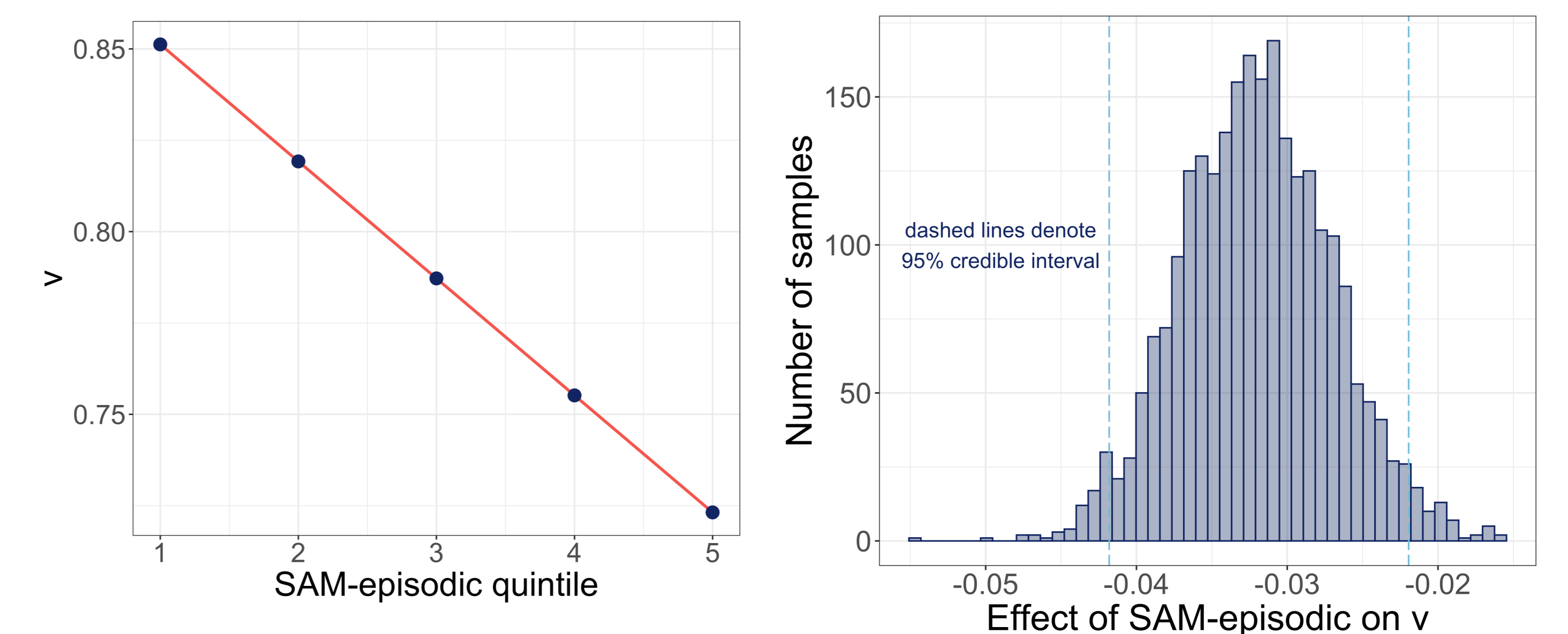
Results

Compared 3 models of GR regressing a , t , and v on SAM-episodic quintiles

Best model fit v : individuals with lower episodic memory abilities were quicker to accumulate evidence to come to a decision



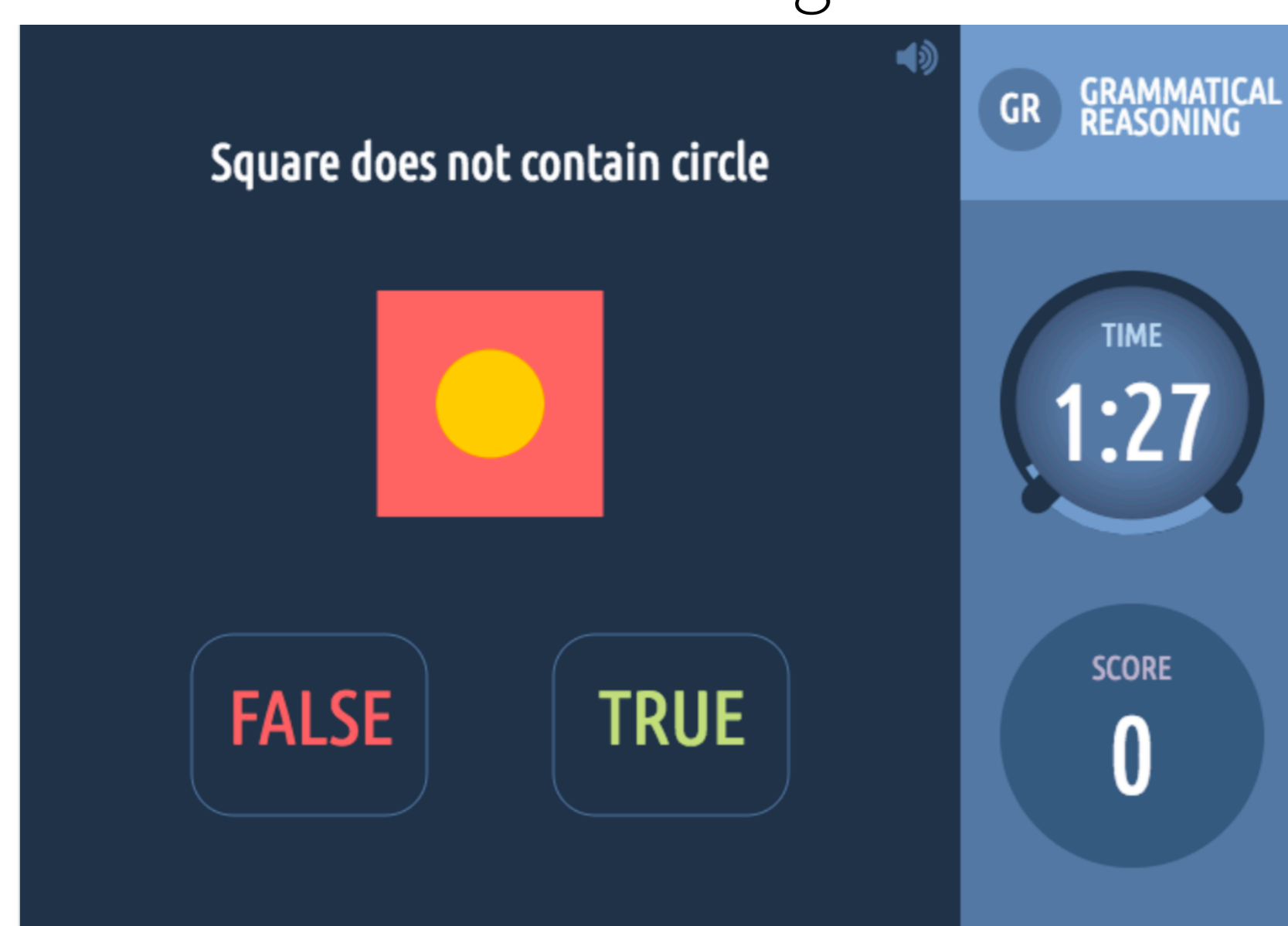
Model	DIC
a	134273.48
t	134268.33
v	134261.86



Methods

Cambridge Brain Sciences (CBS)³ cognitive tasks

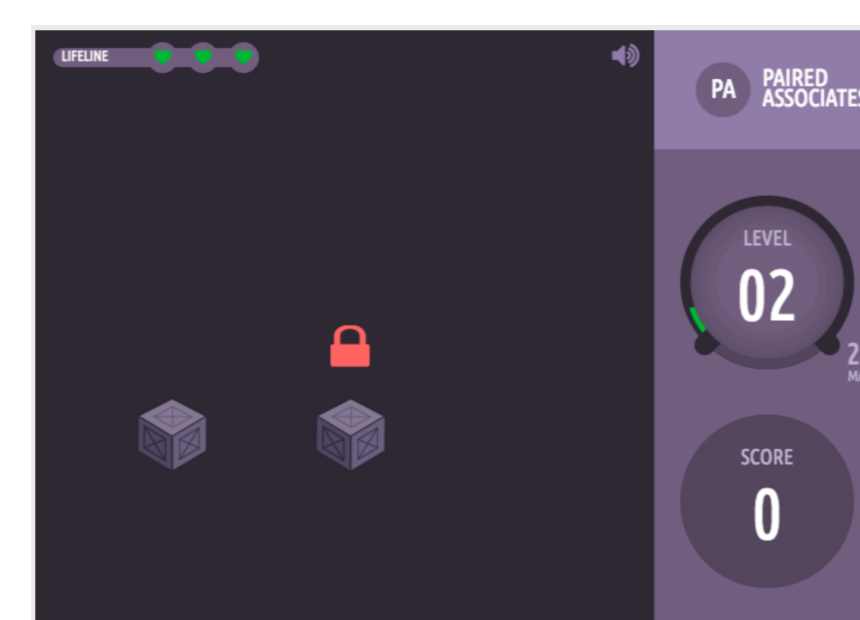
Grammatical Reasoning



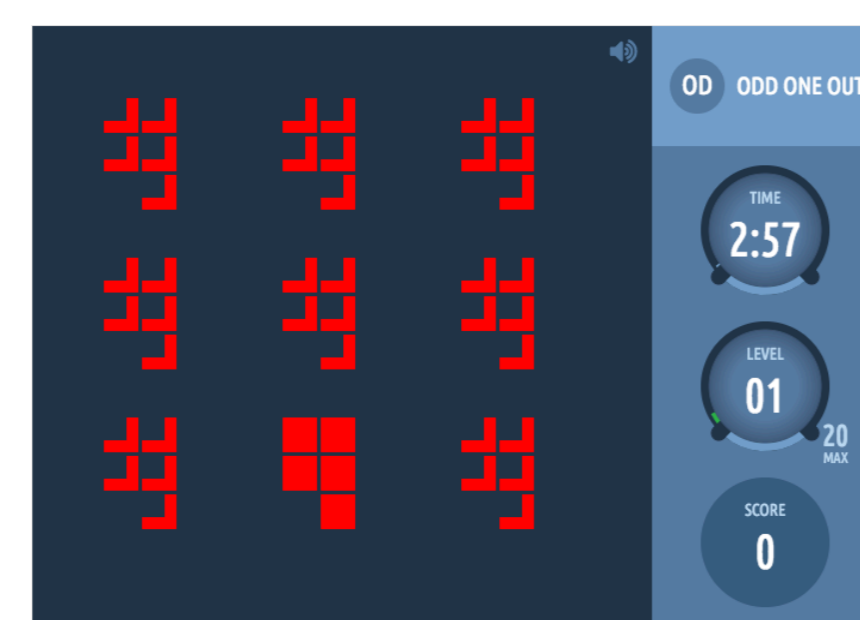
GR used here as basis for simulations and proof of concept

Will later apply DDM to other 3 tasks

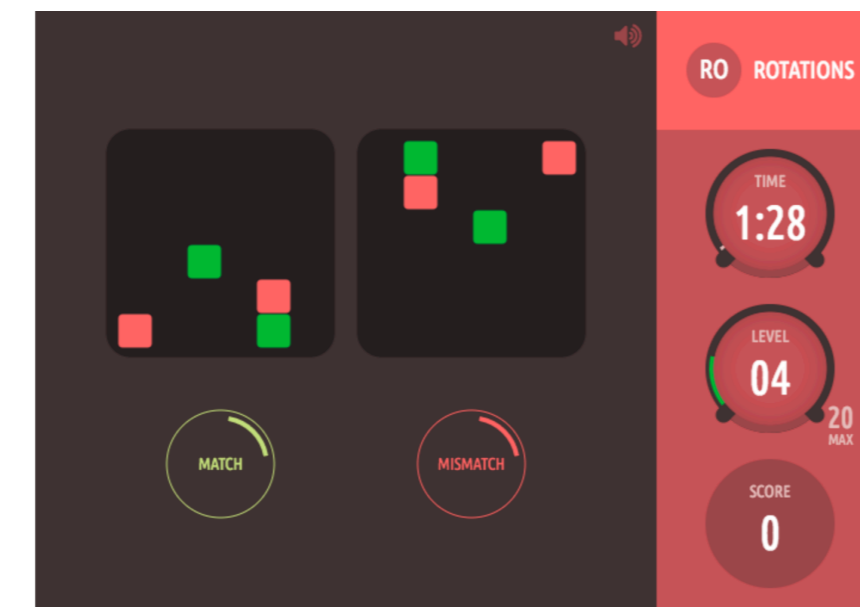
Paired Associates



Odd One Out

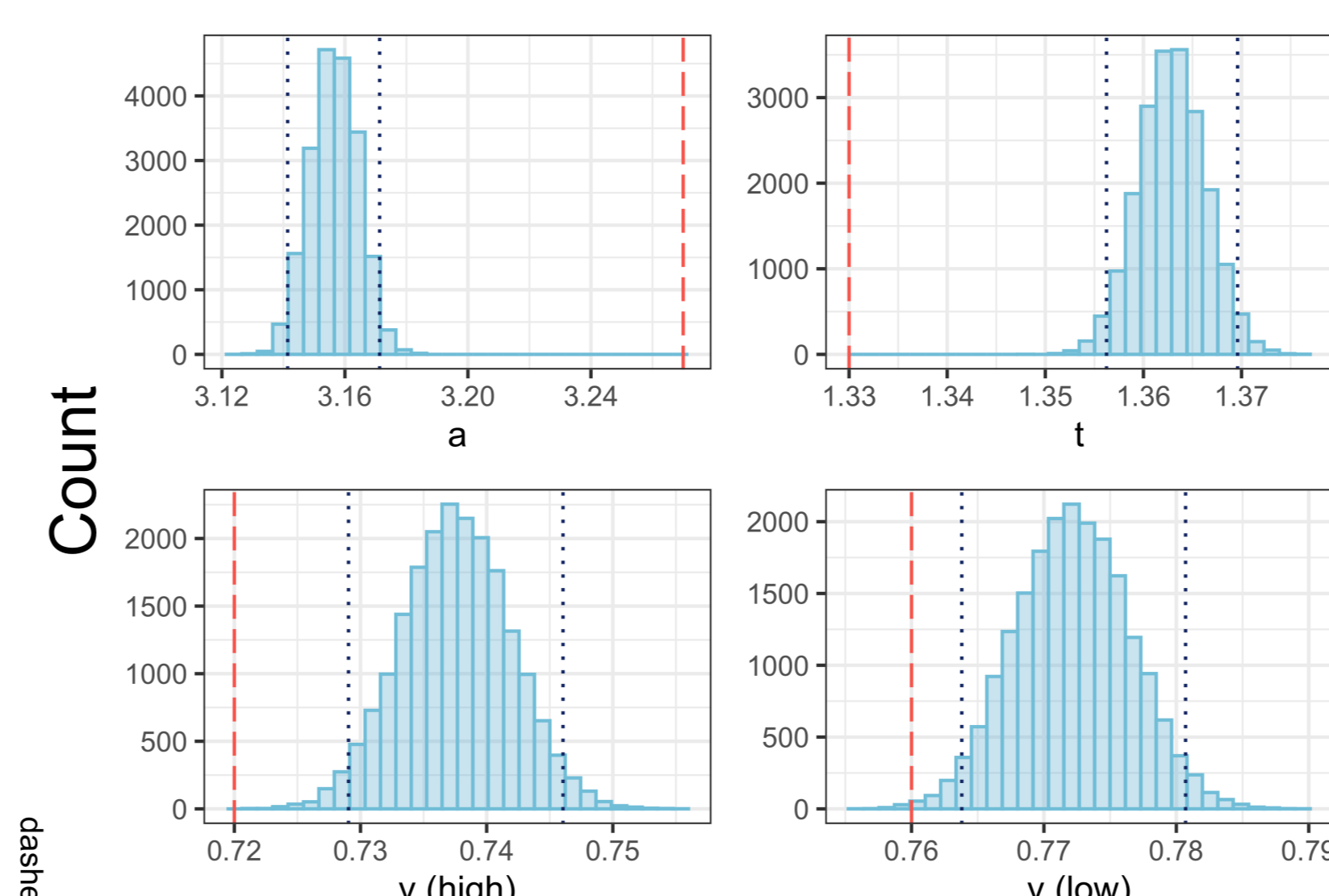
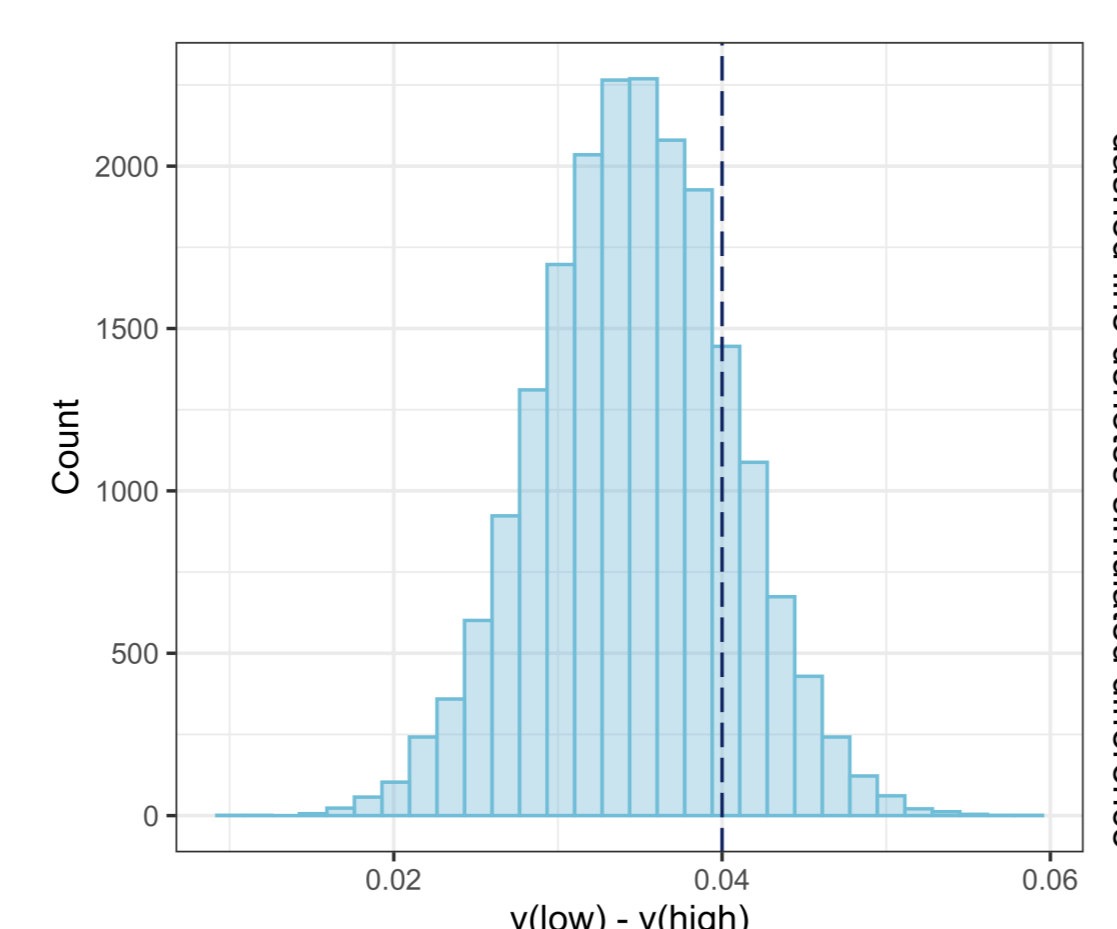


Rotations



Simulations

With big data and few trials, can we recover behaviour generated from differences in drift rates (v)?



Simulated 2000 subjects with 20 trials

Relative group difference in v was recovered

Conclusions

DDM can be applied to large datasets where participants complete few trials of a complex task

Individual differences in episodic memory ability relate to DDM parameters

Lower episodic memory abilities may confer an advantage in reasoning tasks

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