Do encoding and prediction compete or cooperate?

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Introduction

The hippocampus alternates between states that prioritize encoding new memories and states that prioritize retrieving existing memories to support prediction.[1,2,3,4]

Encoding and prediction are computationally at odds.[5]

Do encoding and prediction compete at a behavioral level or do they cooperate?

Approach: Manipulate prediction distance and uncertainty to observe if there are trade-offs with encoding

Task Overview

Sequence Learning

Multiple exemplars of each category

Time

Simultaneous Prediction and Encoding

Cue Image

Novel exemplar

Probe Images

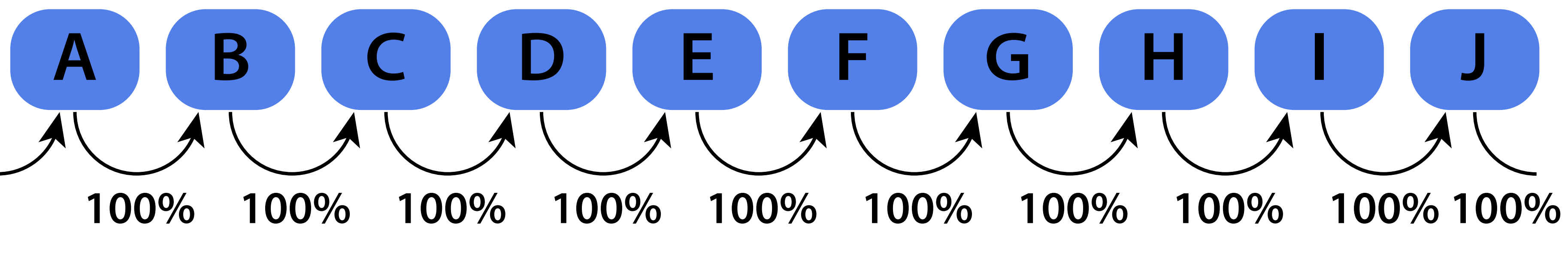Which comes sooner? (correct answers are variable steps into the future)
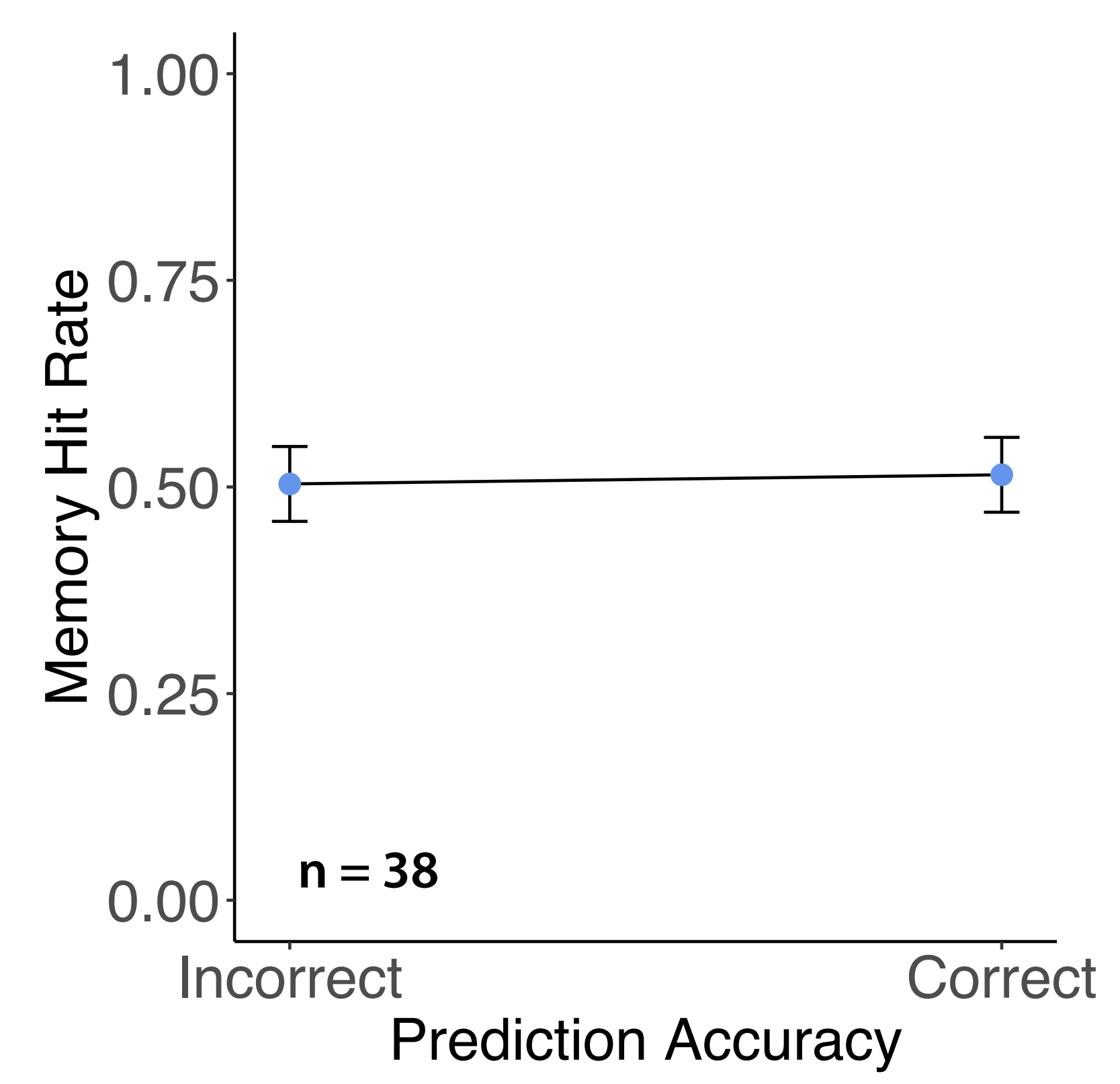
Surprise Memory Test

Old or New?

Memory test for trial unique cue images

Experiment 1

Sequence Structure

A → B → C → D → E → F → G → H → I → J

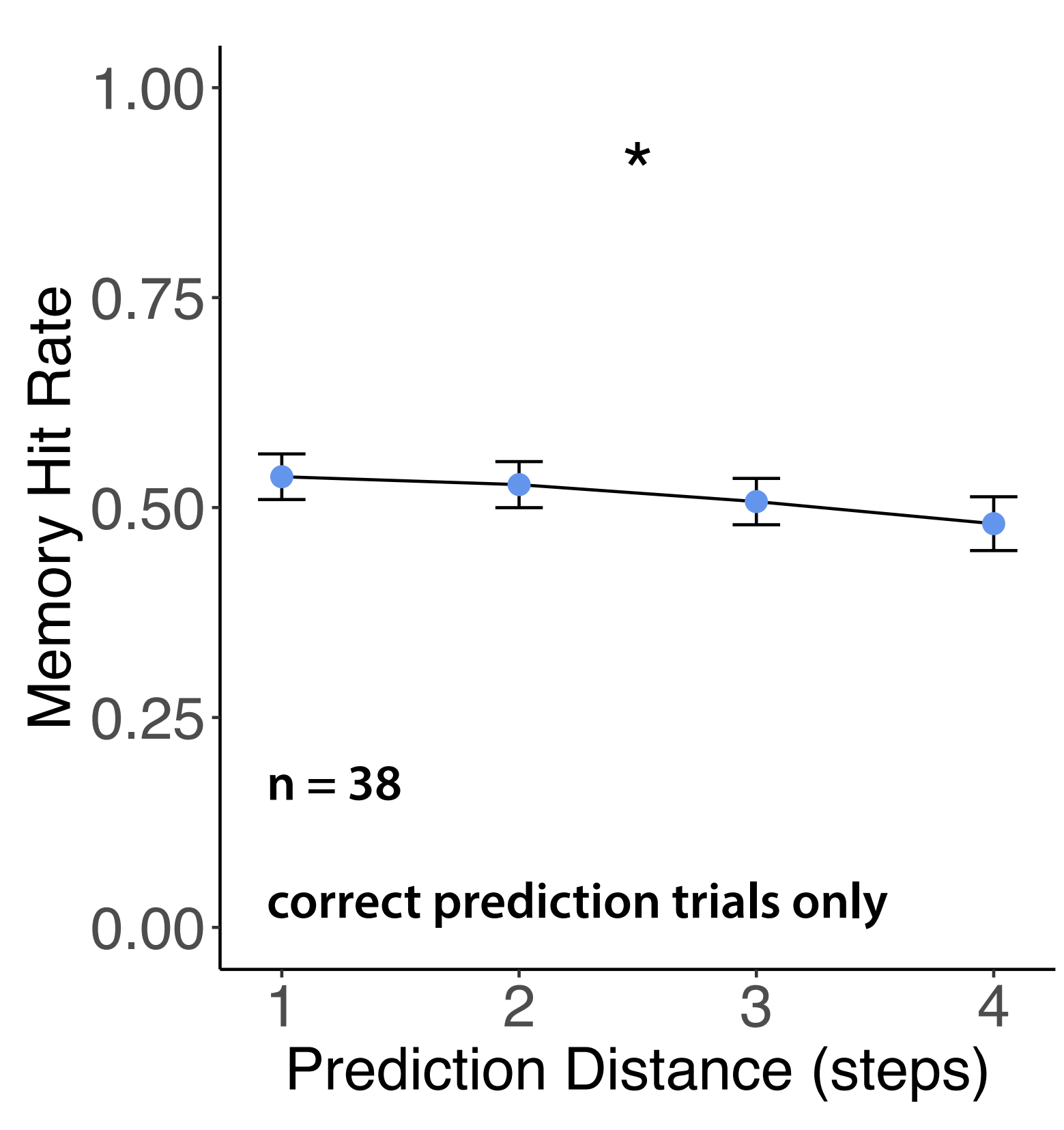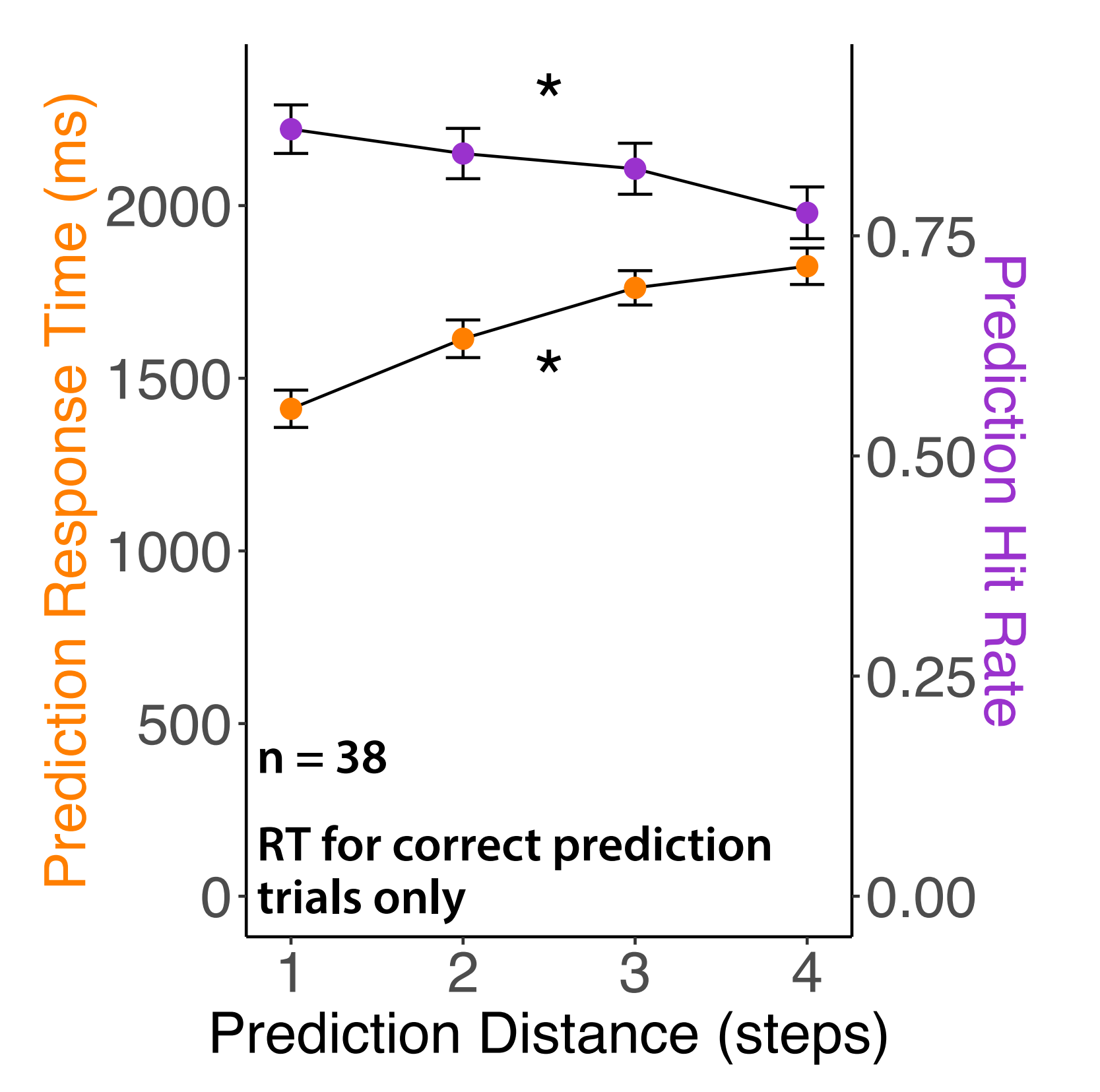100% 100% 100% 100% 100% 100% 100% 100% 100% 100%

Results
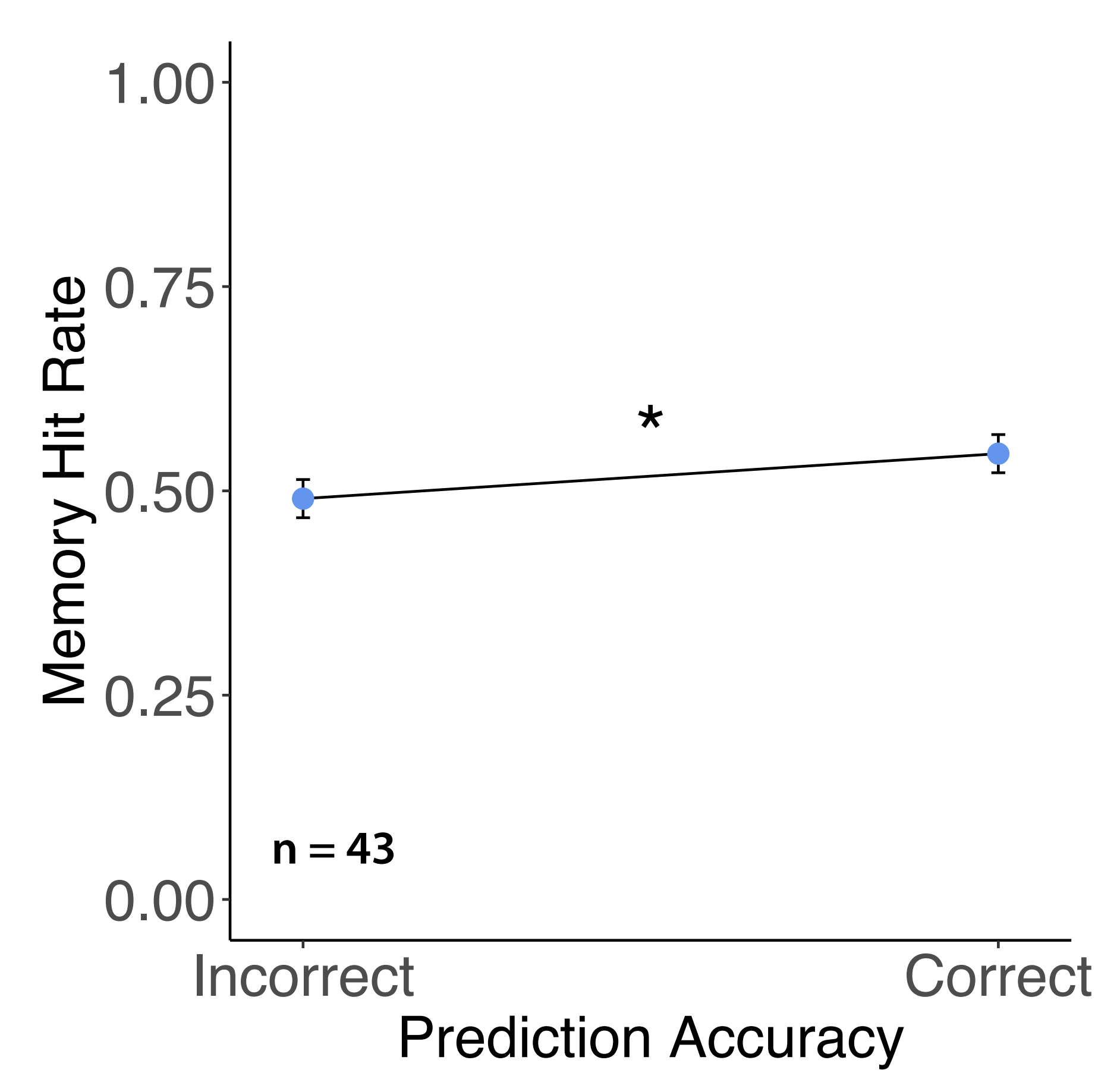

Memory accuracy was not related to prediction accuracy

Worse prediction and worse encoding with increasing prediction distance

RT for correct prediction trials only
n = 38

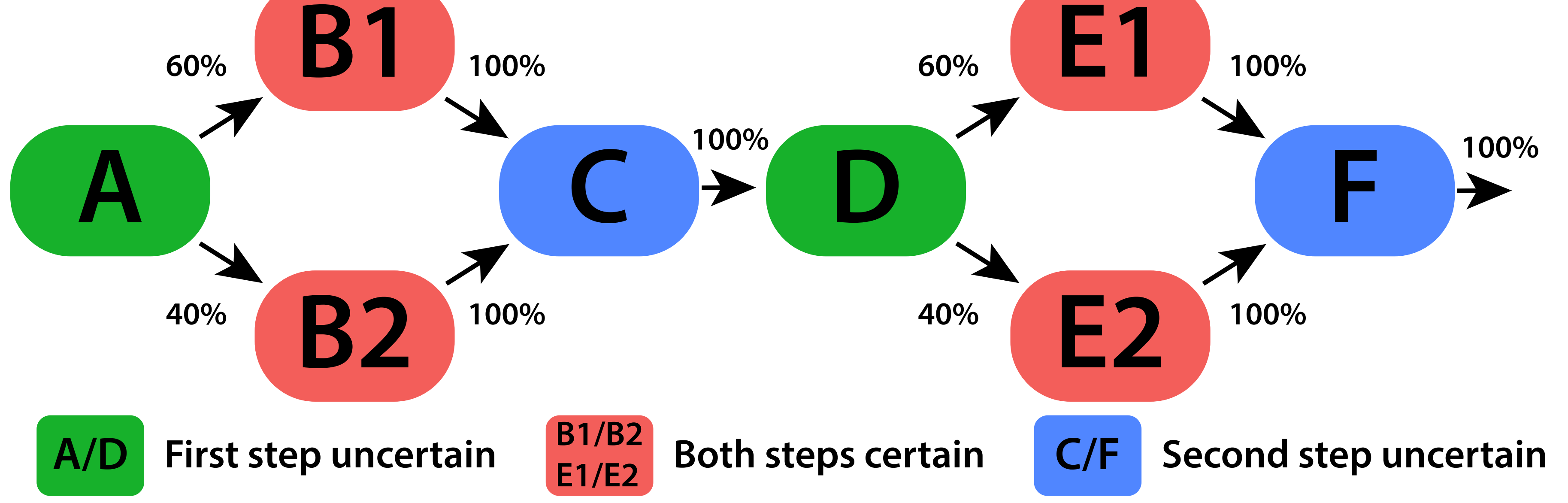correct prediction trials only
n = 38

Experiment 2

Sequence Structure

60% B1 100%
A → C → D → F
40% B2 100%
60% E1 100%
40% E2 100%
100% 100%

A/D First step uncertain
B1/B2 E1/E2 Both steps certain
C/F Second step uncertain

Prediction accuracy was worse for uncertain options (B1 vs. B2; E1 vs. E2) but otherwise comparable across conditions; memory encoding did not vary by prediction uncertainty

Results

Better encoding when prediction was successful

n = 43

Costs to both prediction and encoding with increasing prediction distance

RT for correct prediction trials only
n = 43

correct prediction trials only
n = 43
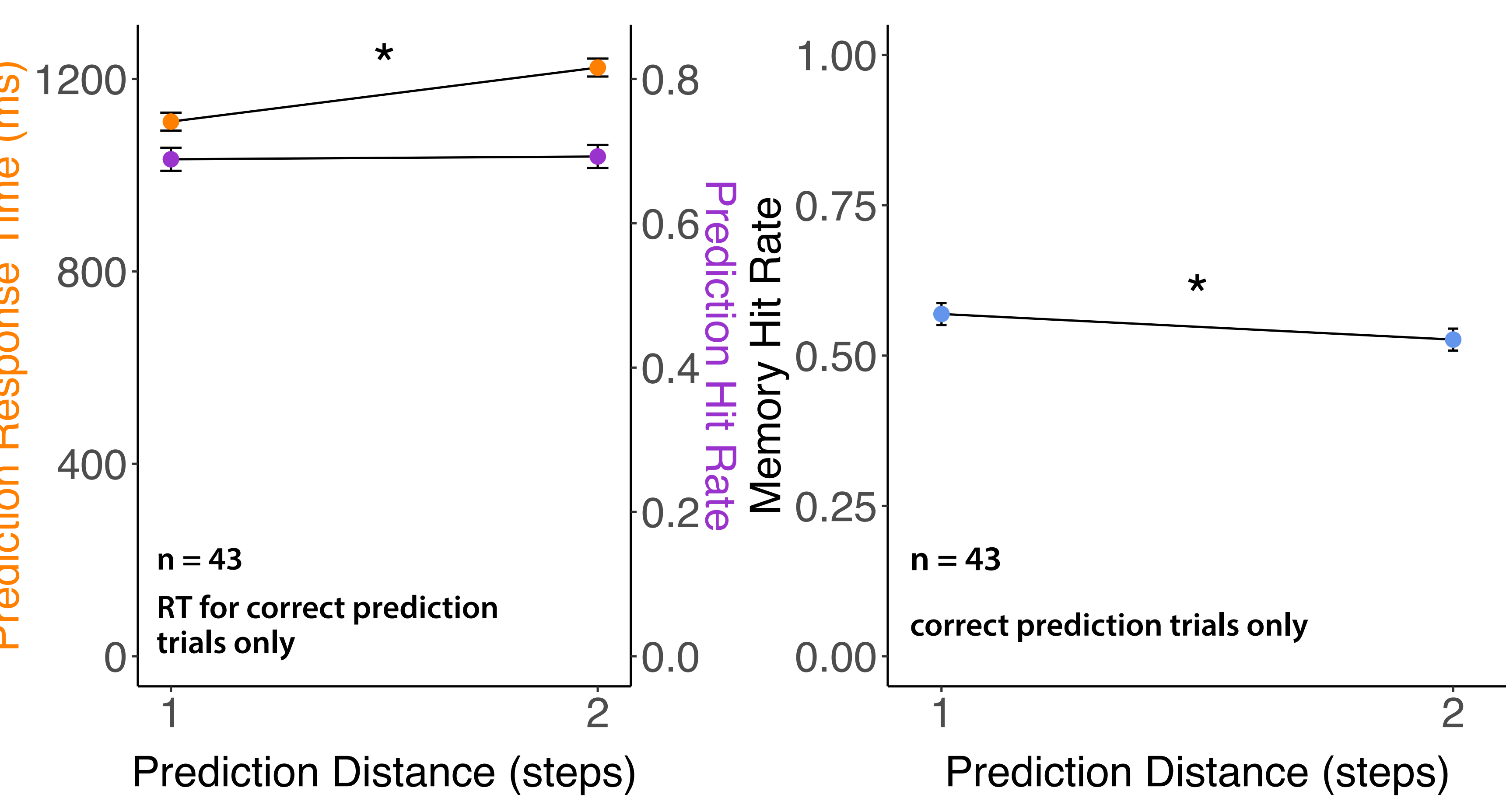
Prediction uncertainty (not shown) did not interact with the effects of prediction distance

Conclusions

Further reaching predictions are less accurate and slower

Both encoding and prediction are worse for further reaching predictions

Encoding and prediction may be cooperative rather than competitive

1. Sherman and Turk-Browne (2020), *PNAS*
2. Duncan et al. (2012), *Science*
3. Hasselmo et al. (2002), *Neural Computation*
4. Hasselmo (2005), *Hippocampus*
5. O'Reilly and McClelland (1994), *Hippocampus*