

Shannon M. Locke¹ - Michael S. Landy^{1,2} - Pascal Mamassian⁴ - Eero P. Simoncelli^{1,2,3}

New York University, NY: (1) Dept. of Psychology, (2) Center for Neural Science, (3) Courant Institute of Mathematical Sciences;
(4) Laboratoire des Systèmes Perceptifs, CNRS UMR 8248, Département d'Études Cognitives, École Normale Supérieure, Paris, France

Exp. 1 Summary

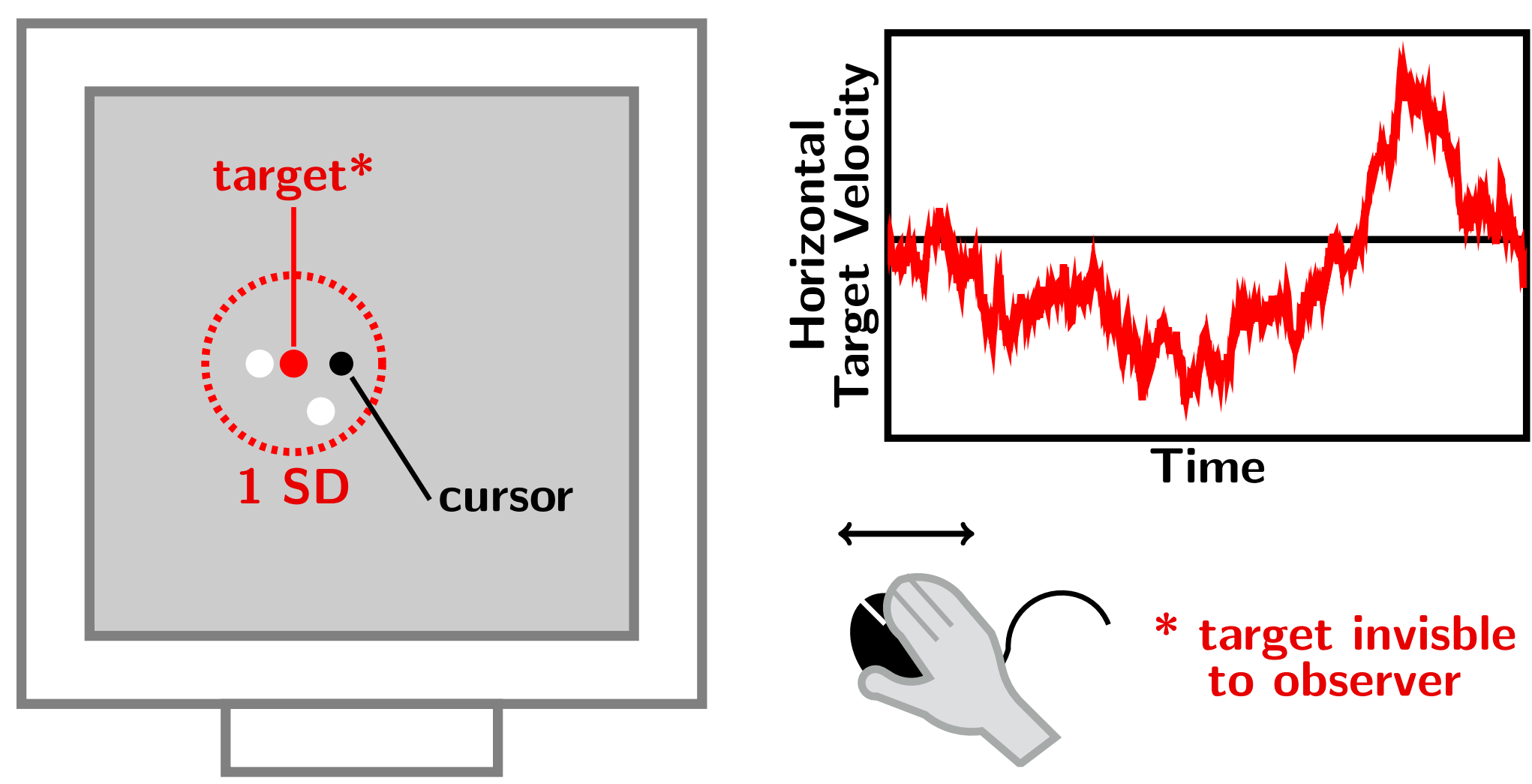
Even in simple perceptual tasks, humans may rely on heuristics to assign confidence^{1,2}. Yet, in a complex sensorimotor tracking task we found participants monitored error (sub-optimally) to judge confidence.

Exp. 2 Summary

A robust recency effect in the weighting of tracking error was replicated when trial duration was uncertain. This result could be due to lossy accumulation of the error signal or use of memory in assigning confidence.

Methods

1. track random-walk stimulus



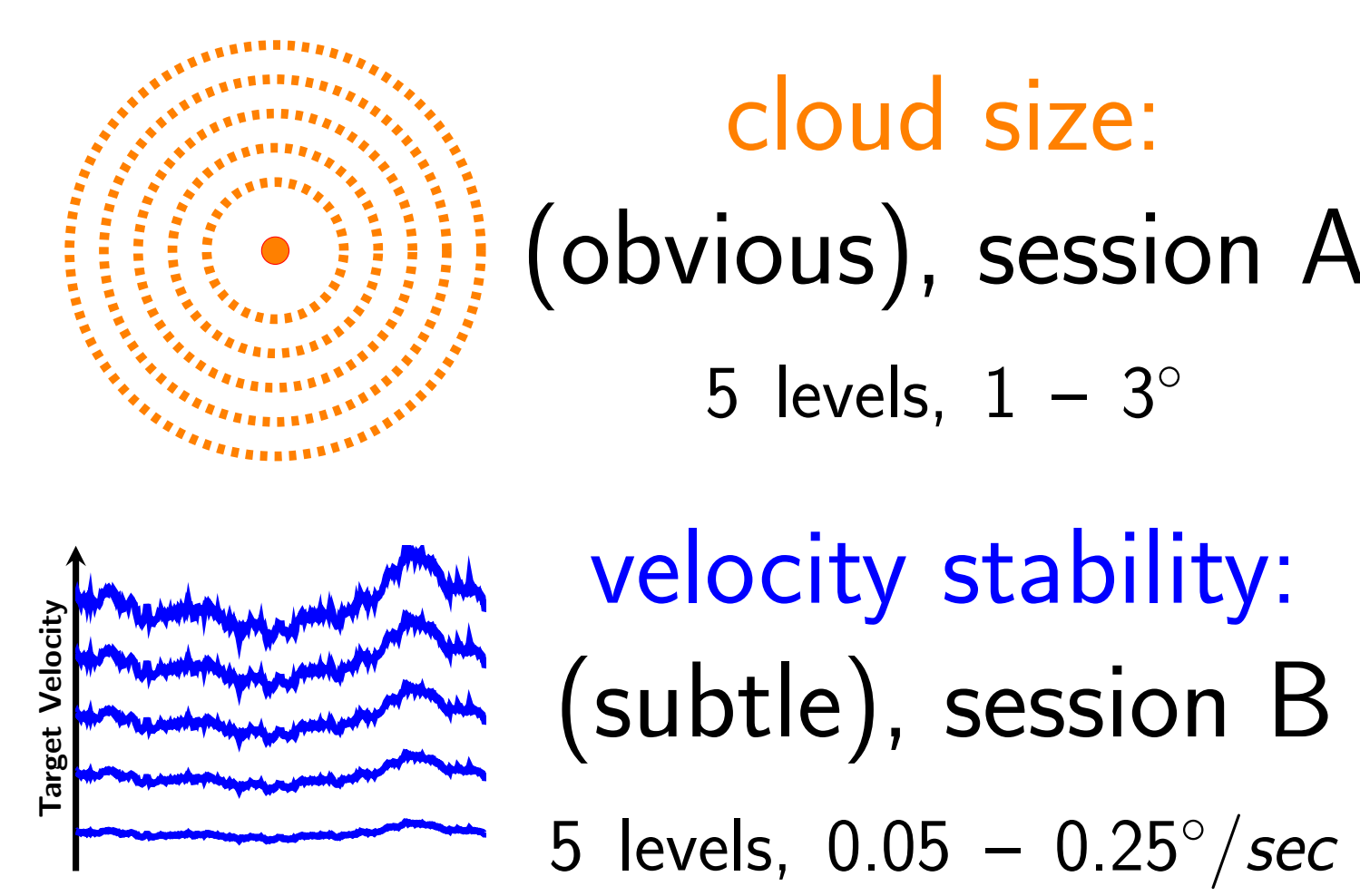
2. report confidence

Relative to all trials in this session, do you think your performance in the current trial was better or worse than average?

"better" → high conf.
"worse" → low conf.

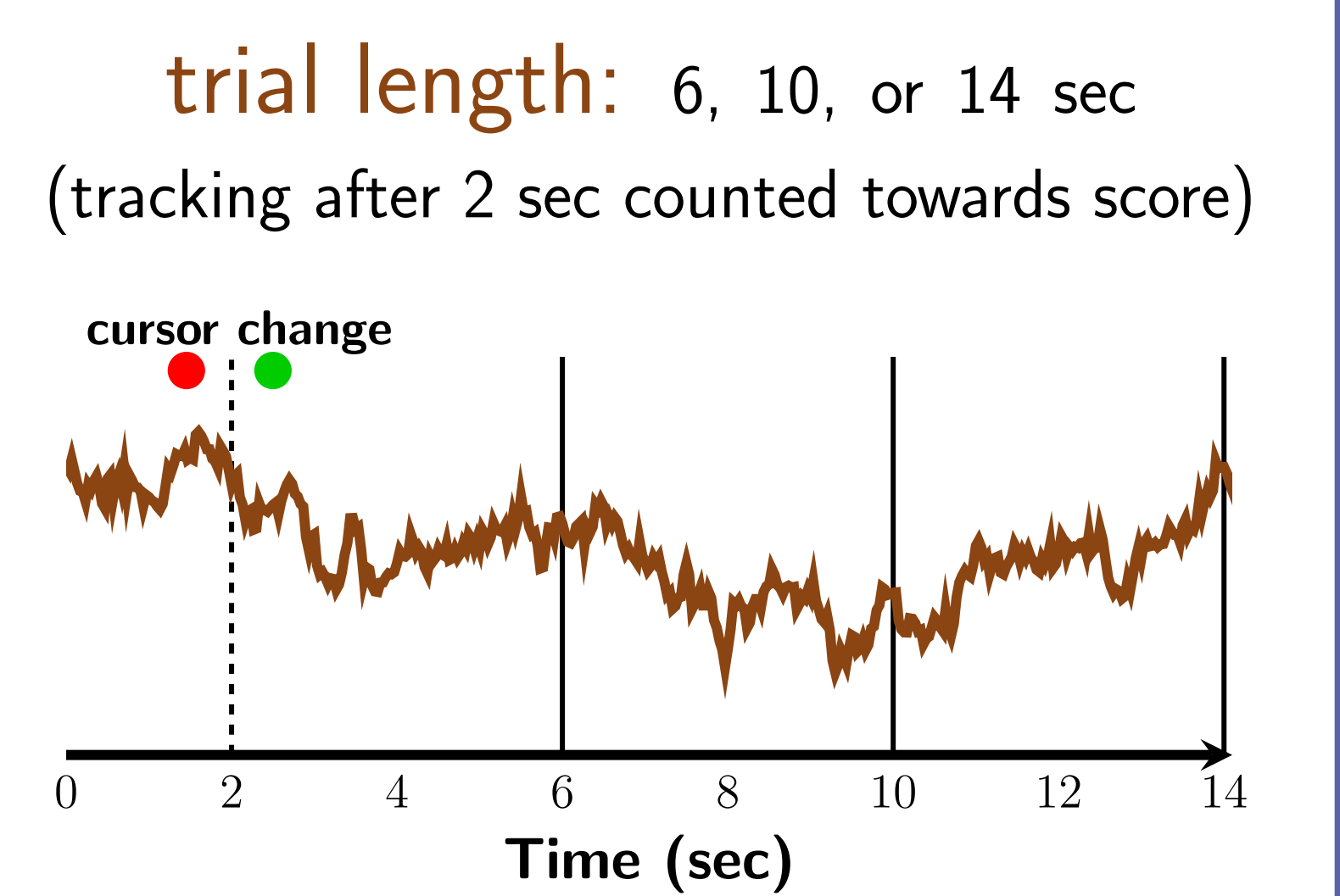
Exp. 1:

difficulty manipulation

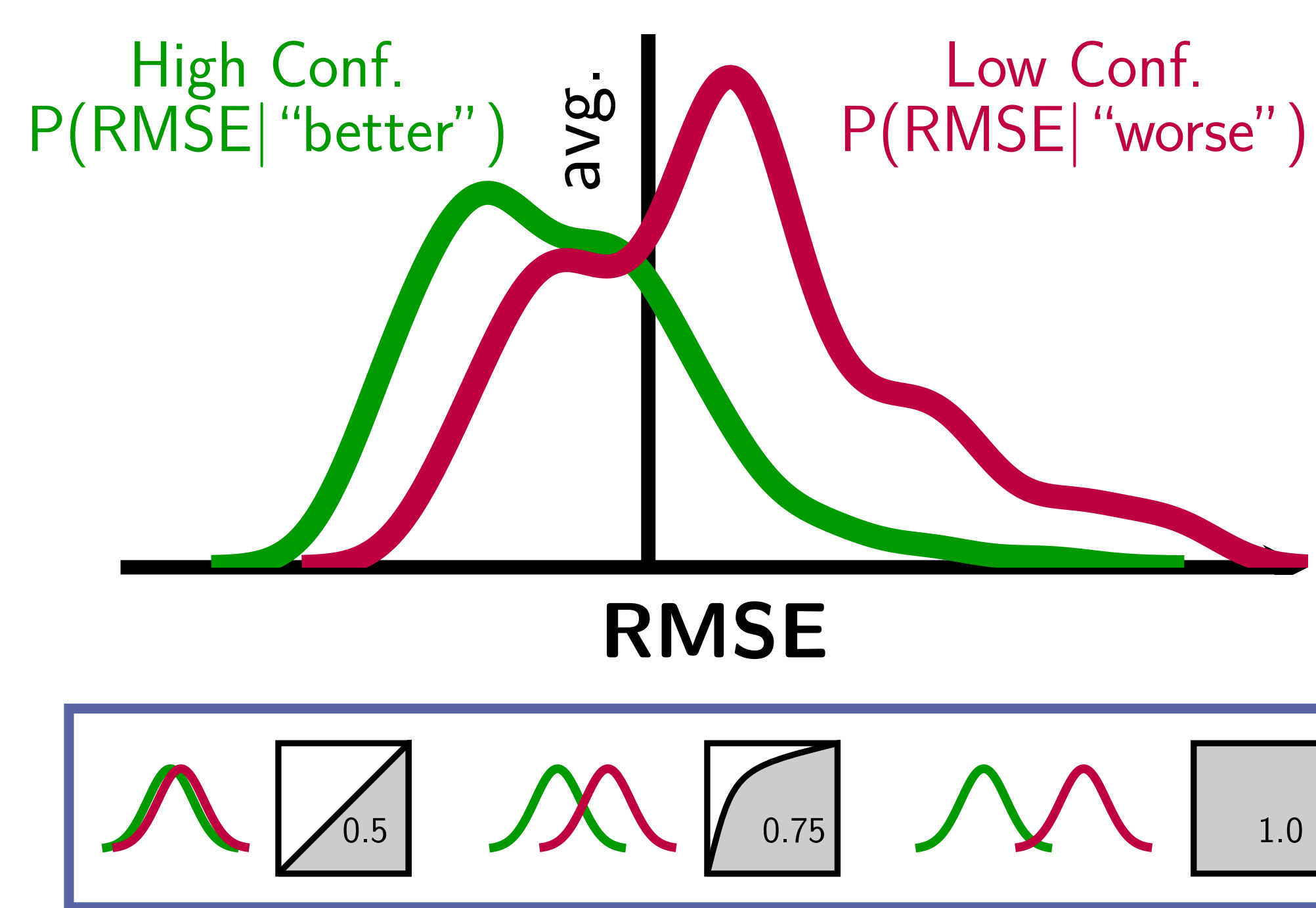


Exp. 2:

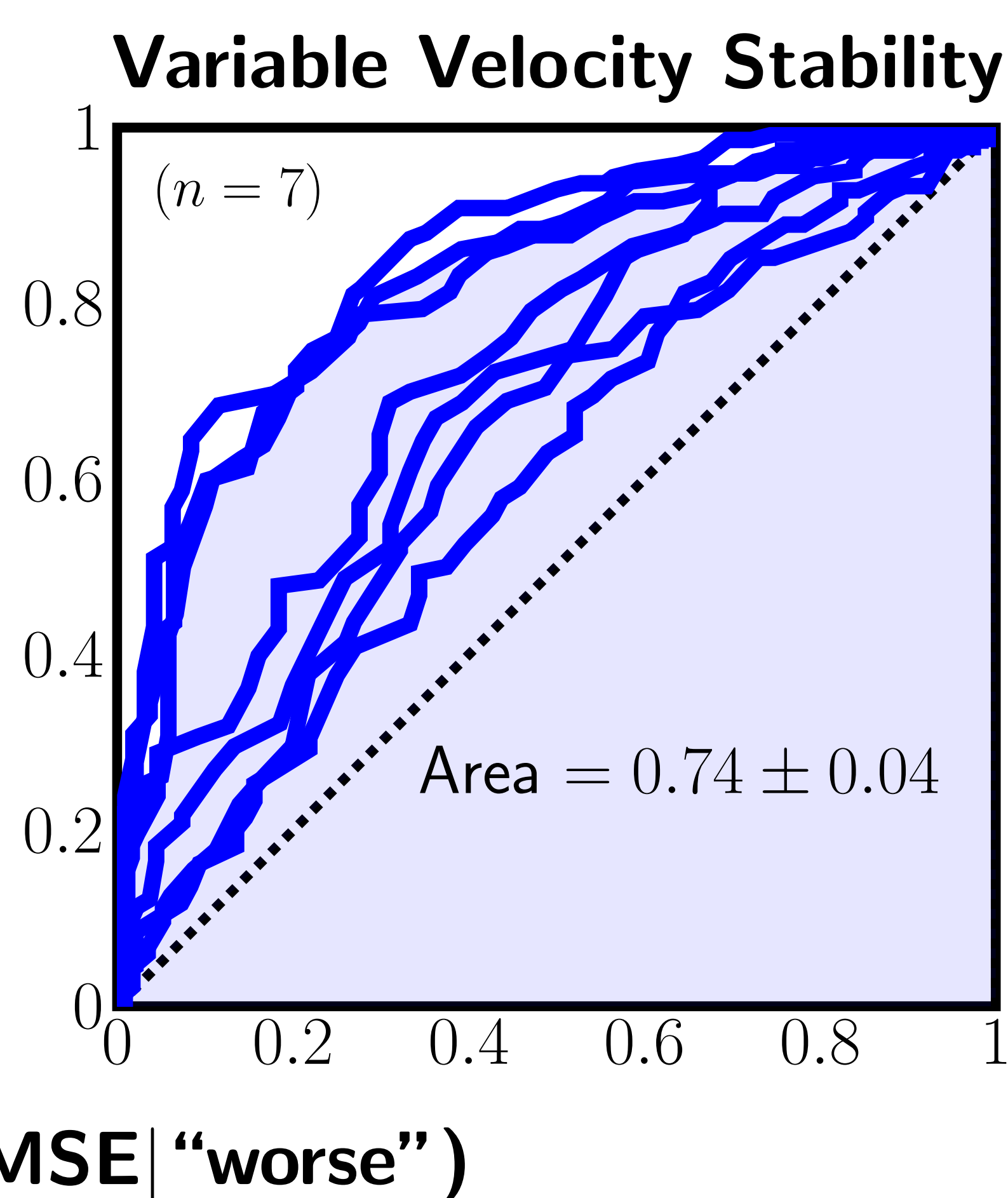
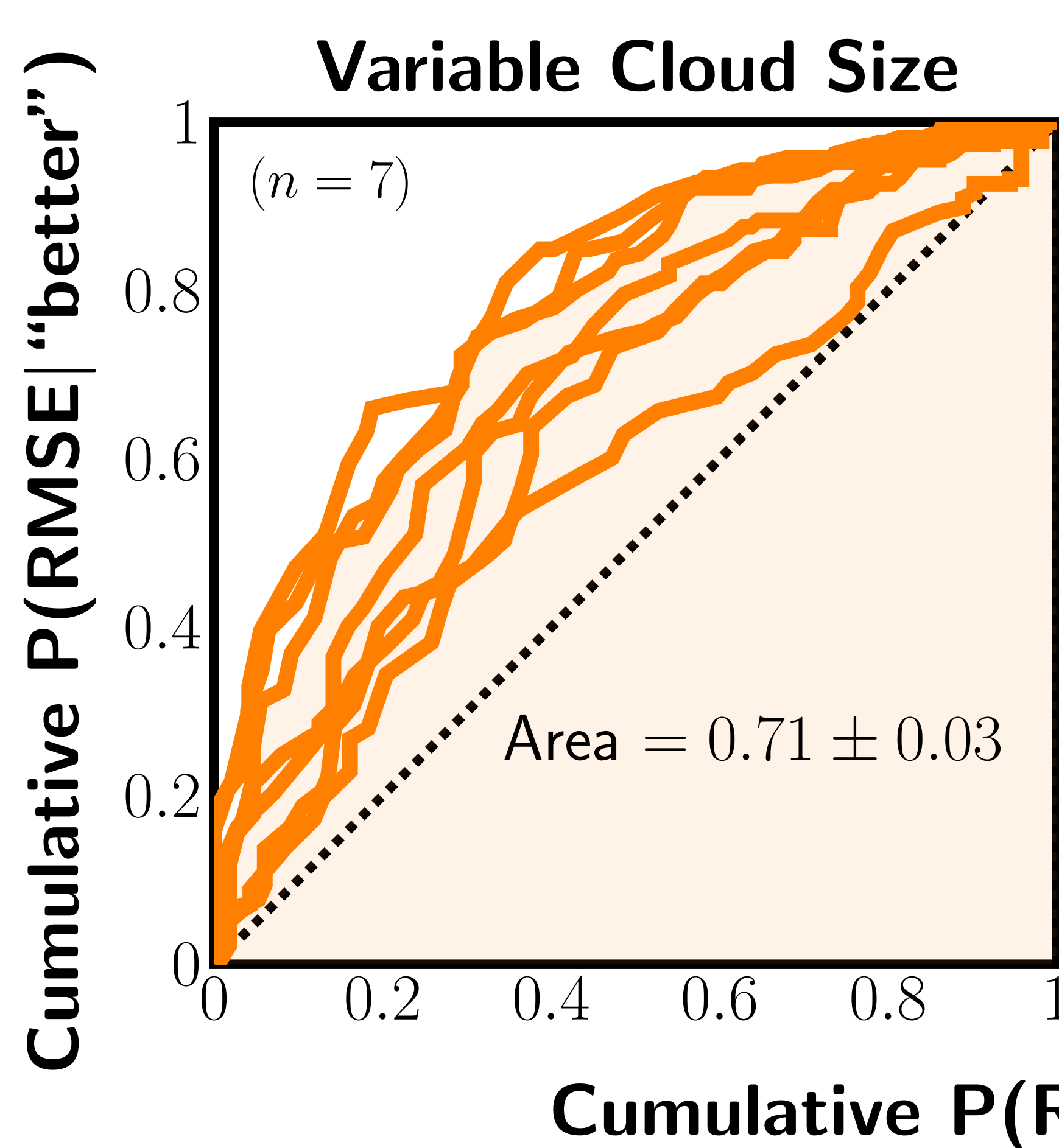
duration manipulation



Exp. 1 Results

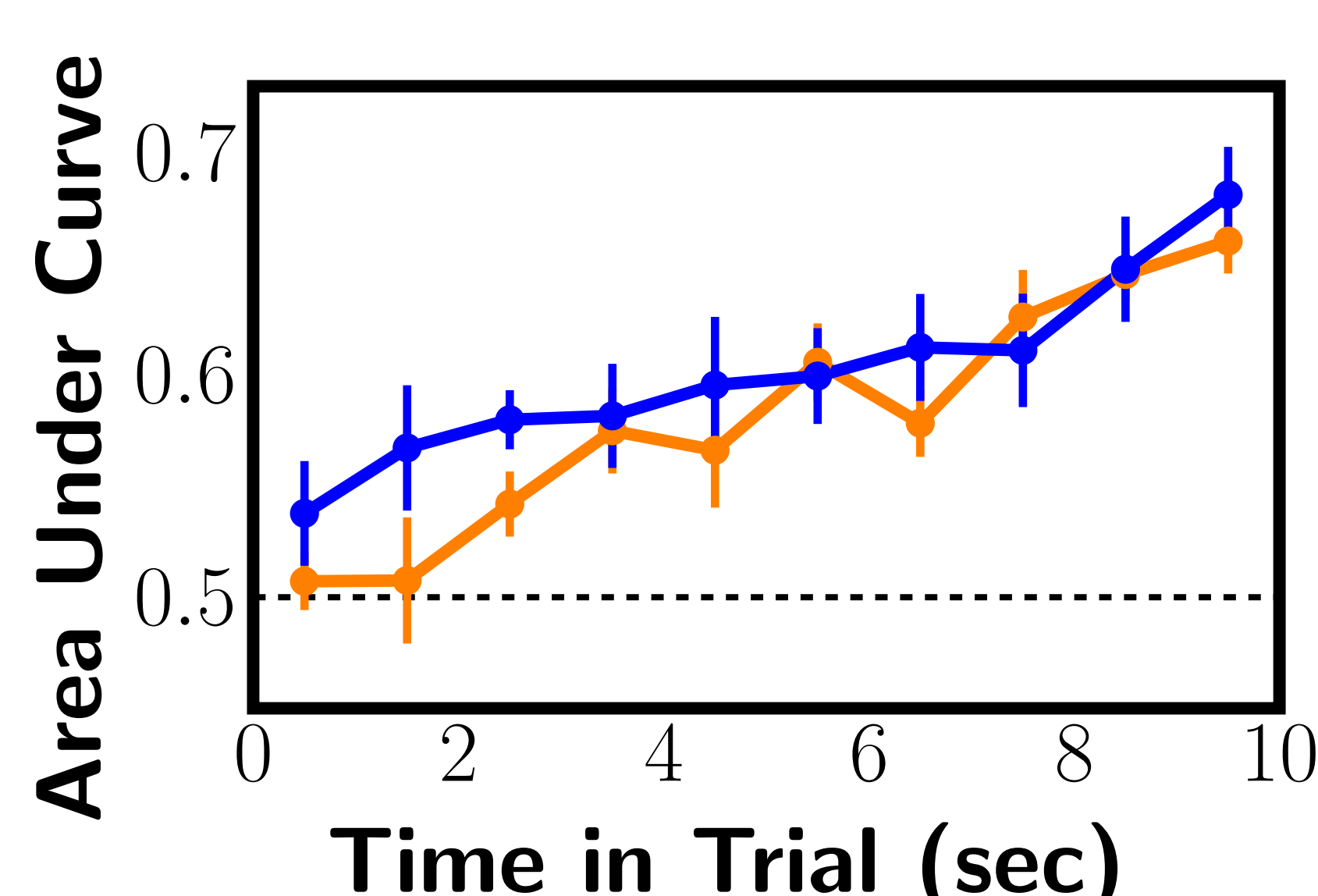


Separation of the high and low confidence error distributions indicates meta-cognitive sensitivity. Index: the area under the quantile-quantile curve (like ROC).



Meta-cognitive sensitivity is comparable for obvious & subtle difficulty manipulations, indicating participants monitored their tracking error to determine confidence rather than relying on cues to trial difficulty.

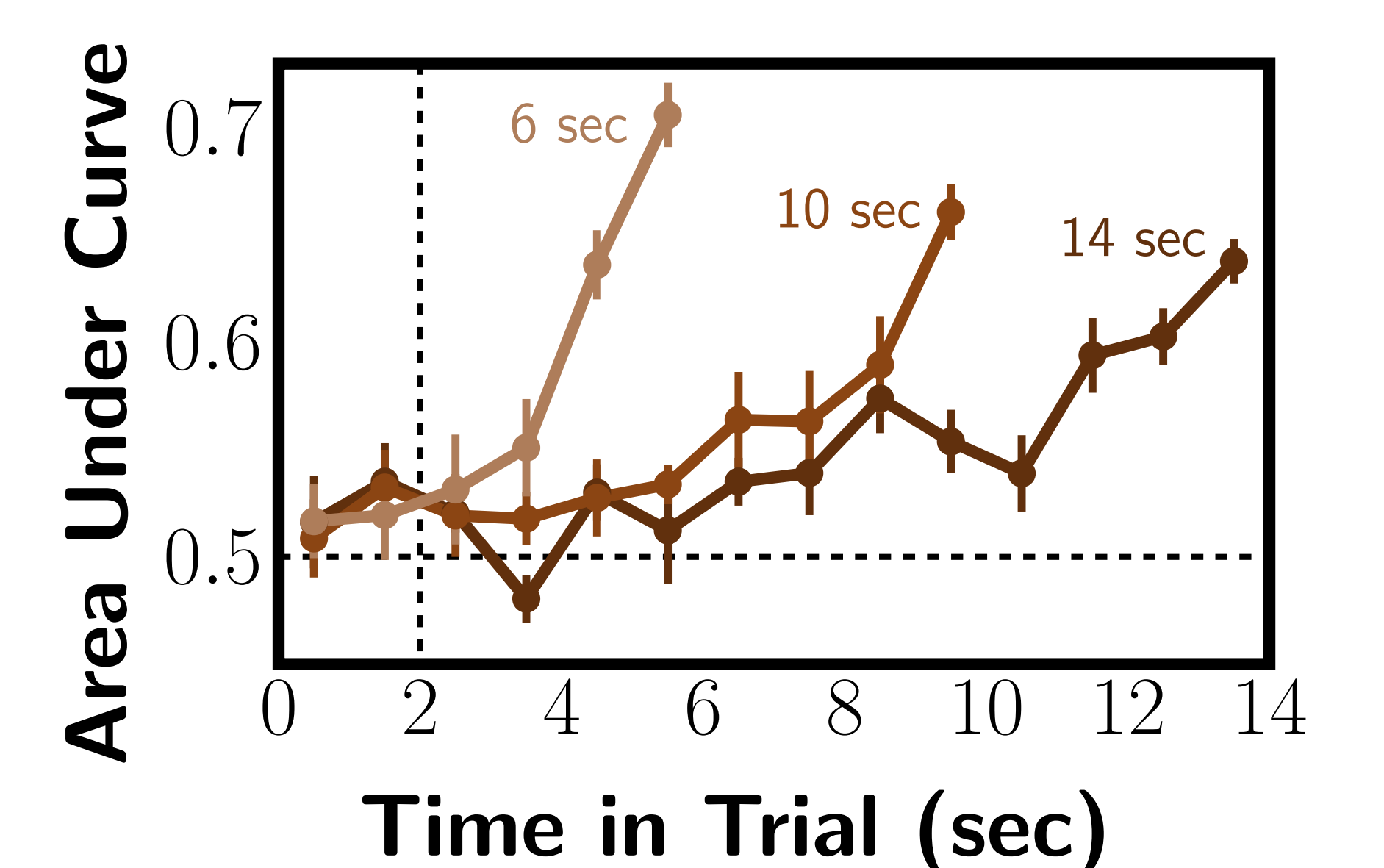
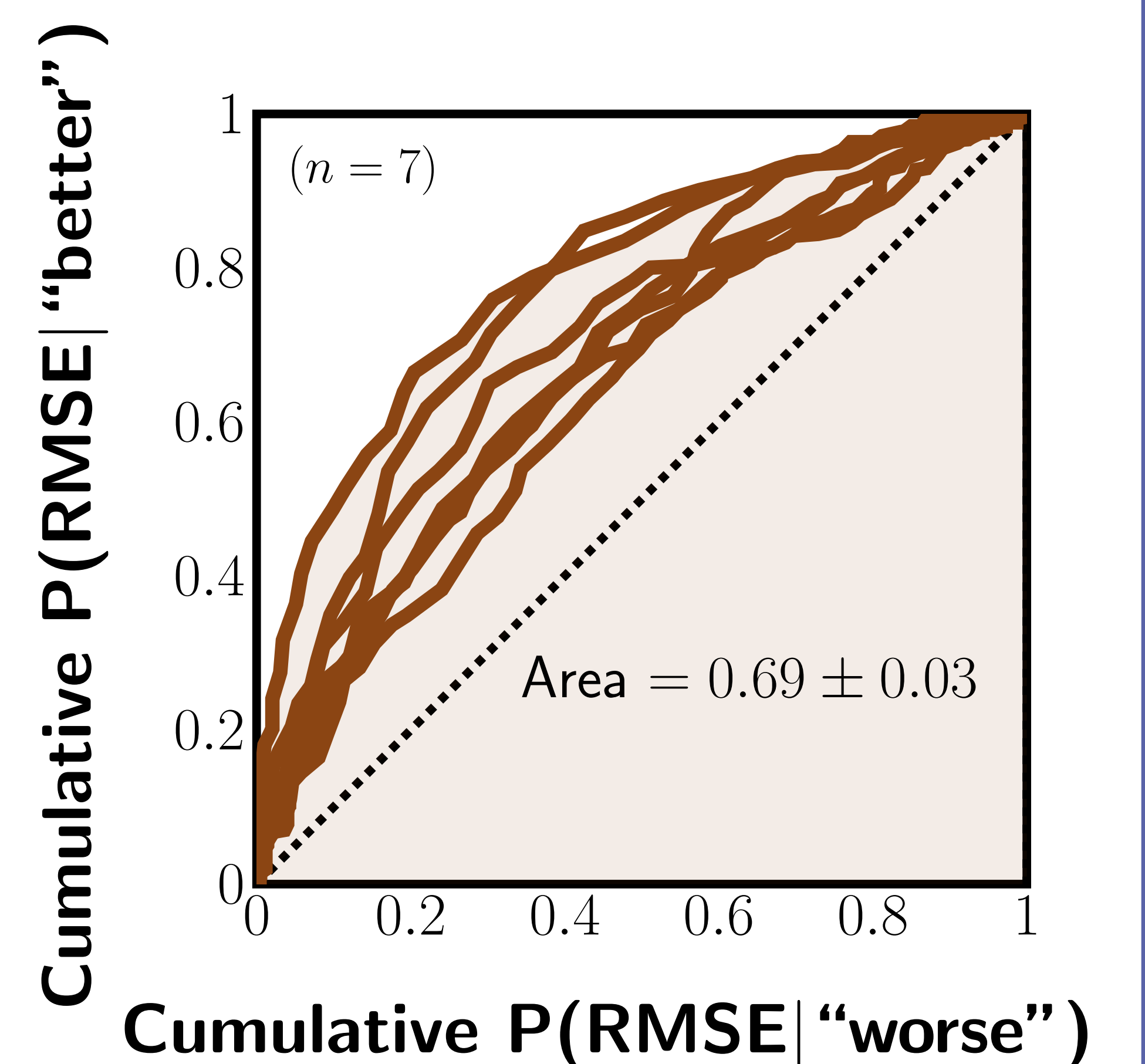
Late error better predictor of confidence. Both optimal and difficulty-heuristic strategies predict flat functions. Can we encourage more equal weighting of error with temporal uncertainty?



Exp. 2 Results

Similar meta-cognitive sensitivity observed when tracking difficulty is not explicitly manipulated, supporting Exp. 1 result that participants monitor their tracking error to judge confidence.

Temporal uncertainty did not encourage more equal weighting of error over time. Is the recency effect the only component of the weighting function?



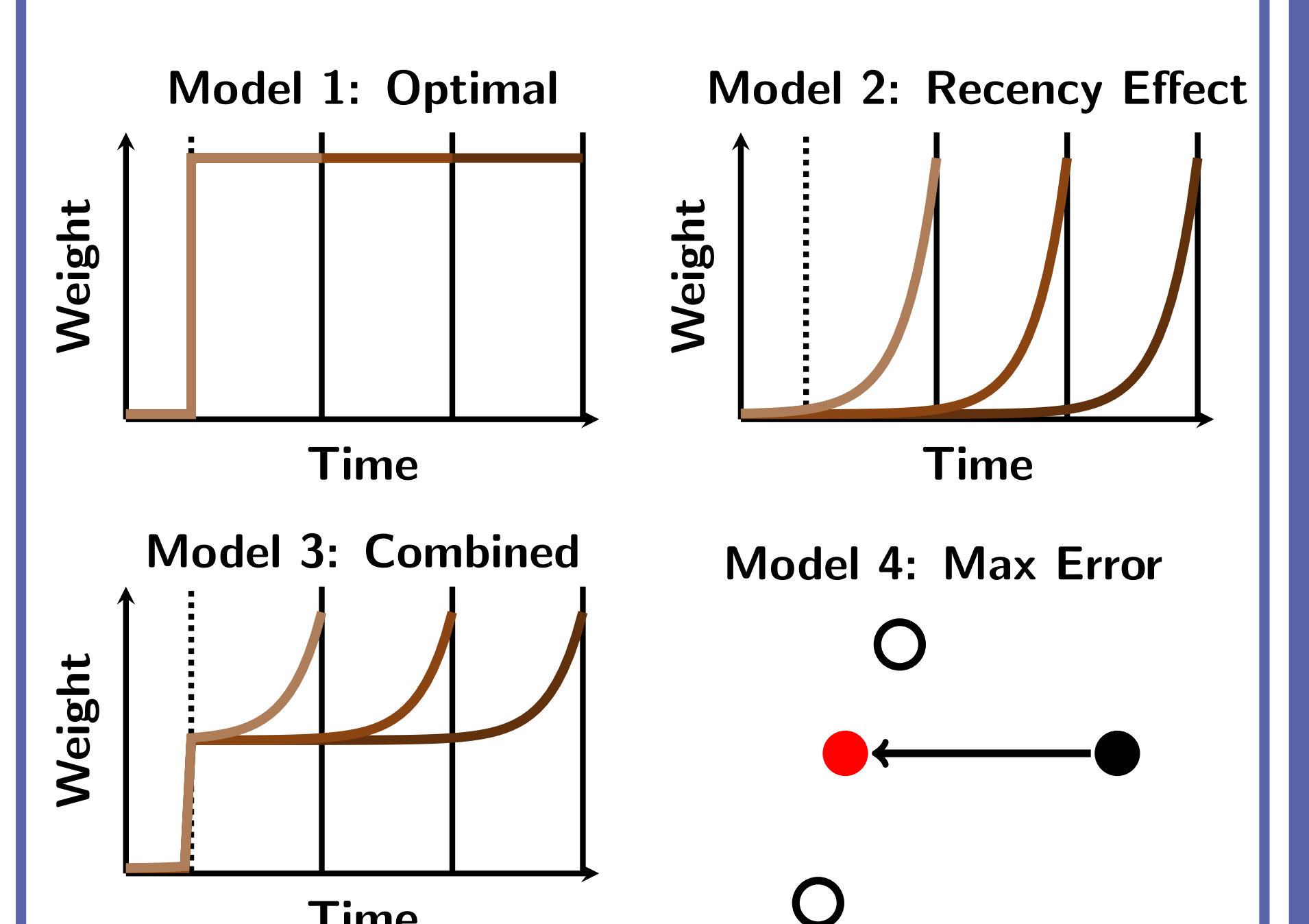
Modelling:

No. Our results are best fit by a model where error after 2 sec counts, but error close to confidence report is over-weighted.

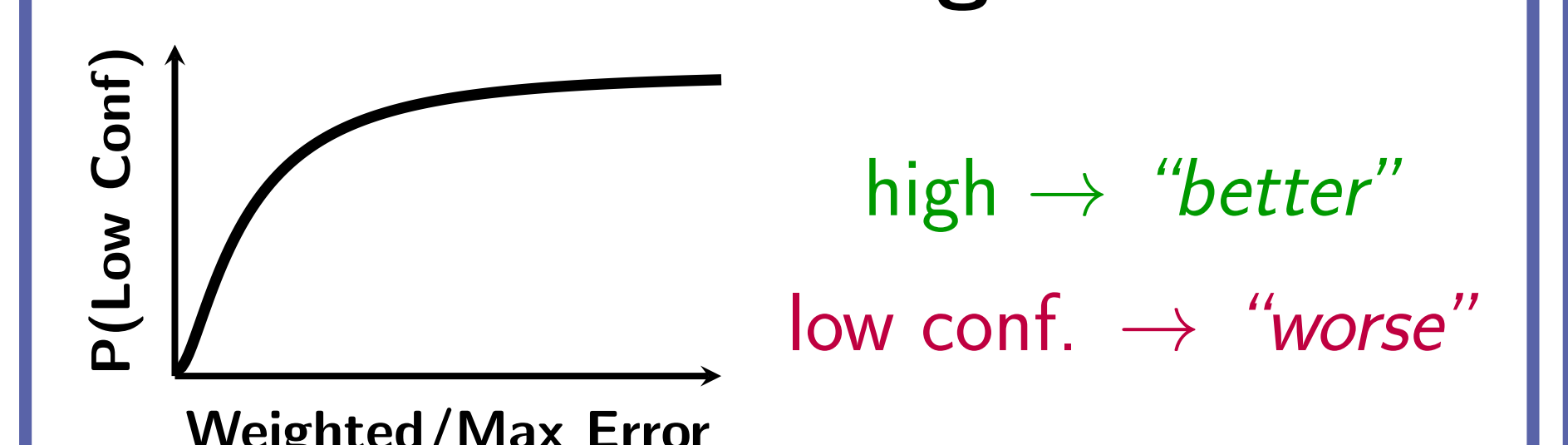
Model Comparison (AIC scores):

model param.	M1 (k = 2)	M2 (k = 3)	M3 (k = 5)	M4 (k = 2)
Subject	876	893	869	867
	850	855	785	852
	760	764	731	801
	769	901	761	776
	886	879	870	871
	795	801	756	798

1. Internal Error Signal



2. Decision Linking Function



References: 1. Barthelmé & Mamassian (2010) *PNAS*
2. de Gardelle & Mamassian (2015) *PLoS ONE*

Funding: NSF BCS-1430262, Correspondence: shannon.m.locke@nyu.edu