Independent mechanisms for implicit ensemble learning and explicit ensemble perception?

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INTRODUCTION

ENSEMBLE PERCEPTION (EXPLICIT)
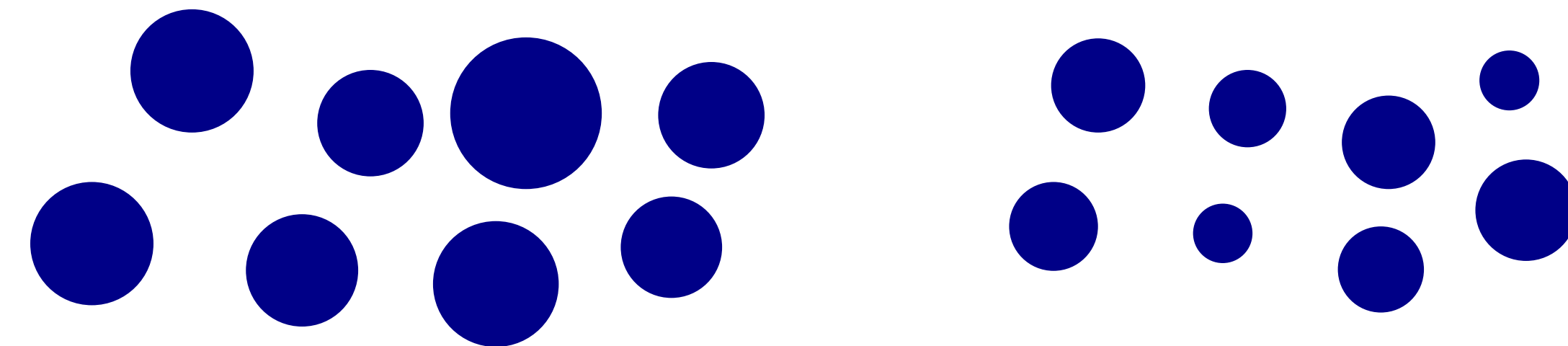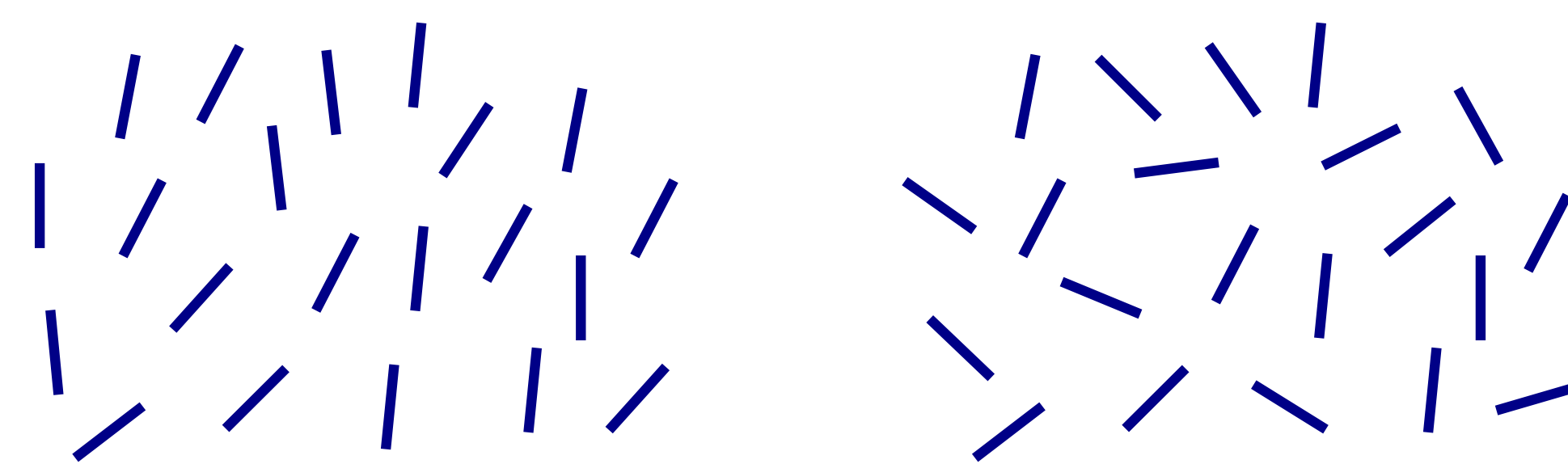
Ensemble perception refers to the visual system's ability to represent similar items using summary statistics such as the average size.

**Perceived average:**

Perceived variance:

Perceived skewness and kurtosis:

No discriminability of speed distributions varying in skewness or kurtosis and no discriminability of orientation distributions (Atchley and Anderson,1994; Dakin and Watt, 1996).

How can we assess the representation of a feature distribution?

A successful implicit method was based on role reversals in visual search: RT's are slower if the previous distractor becomes the target.

ENSEMBLE LEARNING (IMPLICIT)

3-4 Learning trials: Constant distractor distribution
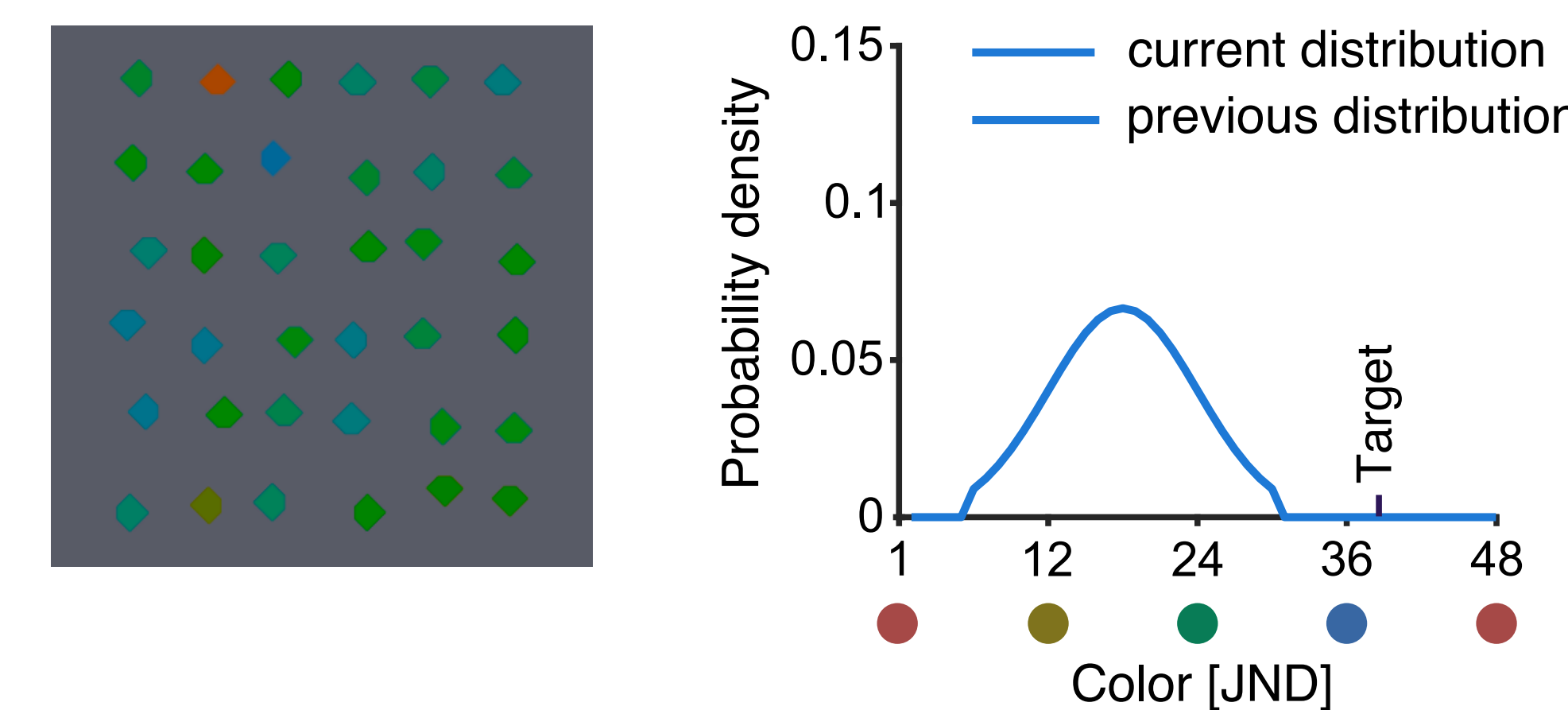
1-2 Test trials: Target probed around the previously learned distribution

Implicit encoding of the distribution shape.
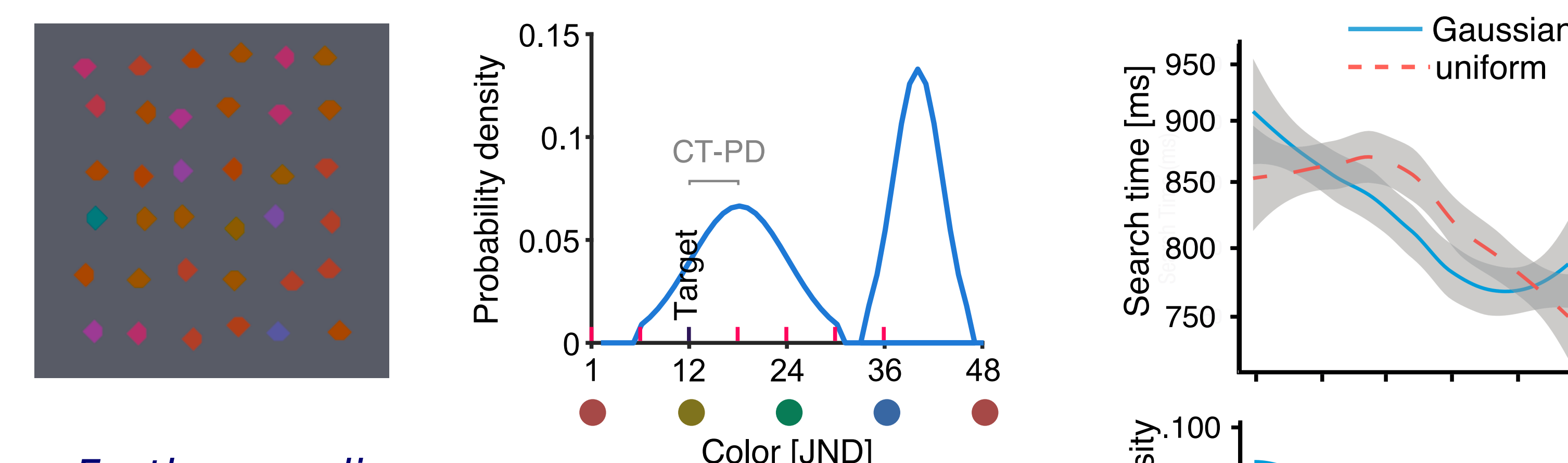
Further readings:

Chetverikov et al. (2016). Building ensemble representations: How the shape of the preceding distractor distributions affects visual search. *Cognition*

RESEARCH QUESTION & GOALS

Why do the implicit ensemble learning & explicit ensemble perception methods lead to different results?

Compare both methods for judgments of mean, variance and higher order statistics (distribution shape) in a within-subject design.
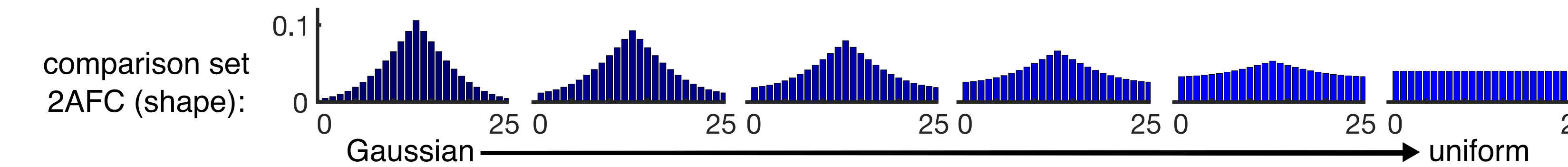
MATERIAL & METHODS

Experiment	Learning trials	Test trials	Methods
Exp.1	Search	Search	Implicit
Exp.2	Search	2AFC (mean)	Explicit
Exp.3	Search	2AFC (SD)	Explicit
Exp.4	Search	2AFC (shape)	Explicit

Gaussian feature distribution in Exp. 1
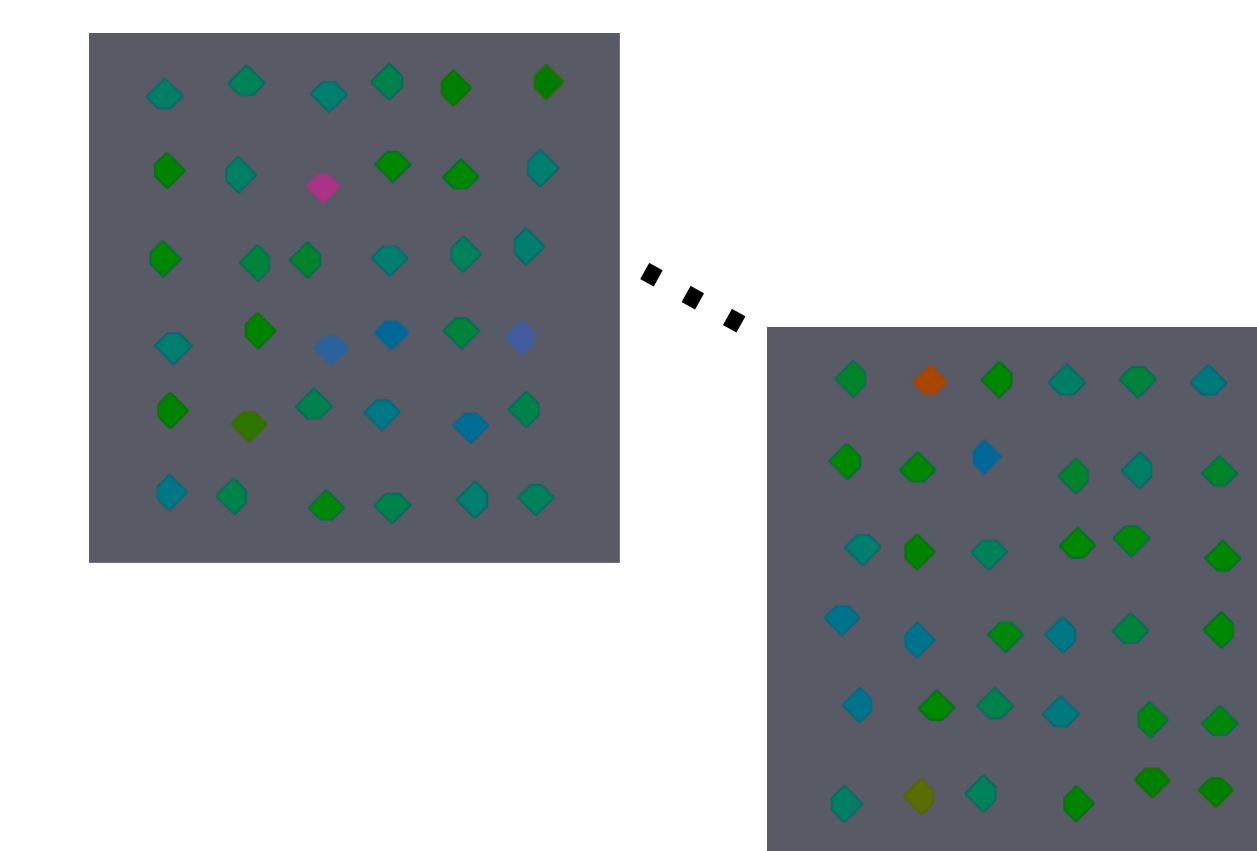
test set: same as learning set

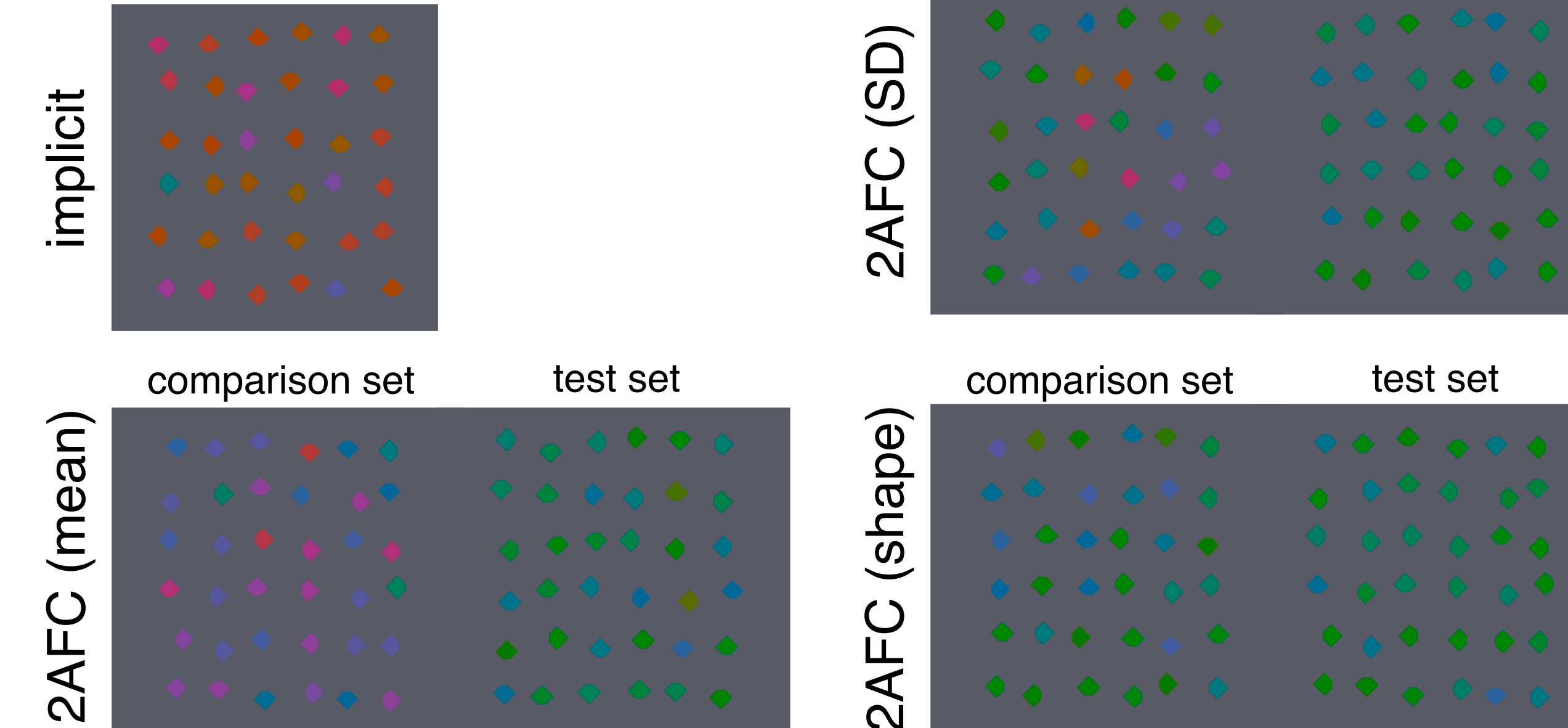comparison set: varies in mean or SD (13 sets) or distribution shape (6 sets):

comparison set 2AFC (shape):

Task:

search for oddly colored diamond and in test trial select set that looks more like the previous search sets
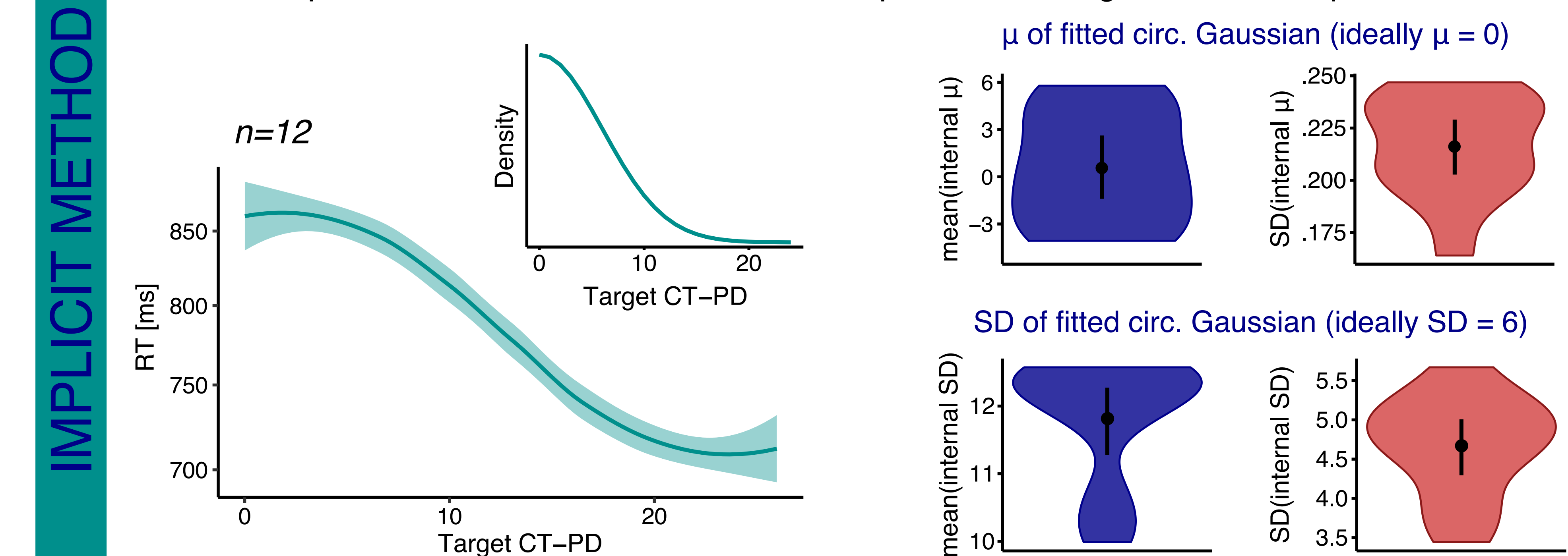
Learning trials:

Test trials:

RESULTS

IMPLICIT METHOD

Fit circular Gaussian to get μ and SD from internal representation ⟶ compare with actual distribution parameters and estimate SD of these parameters to get estimate of precision
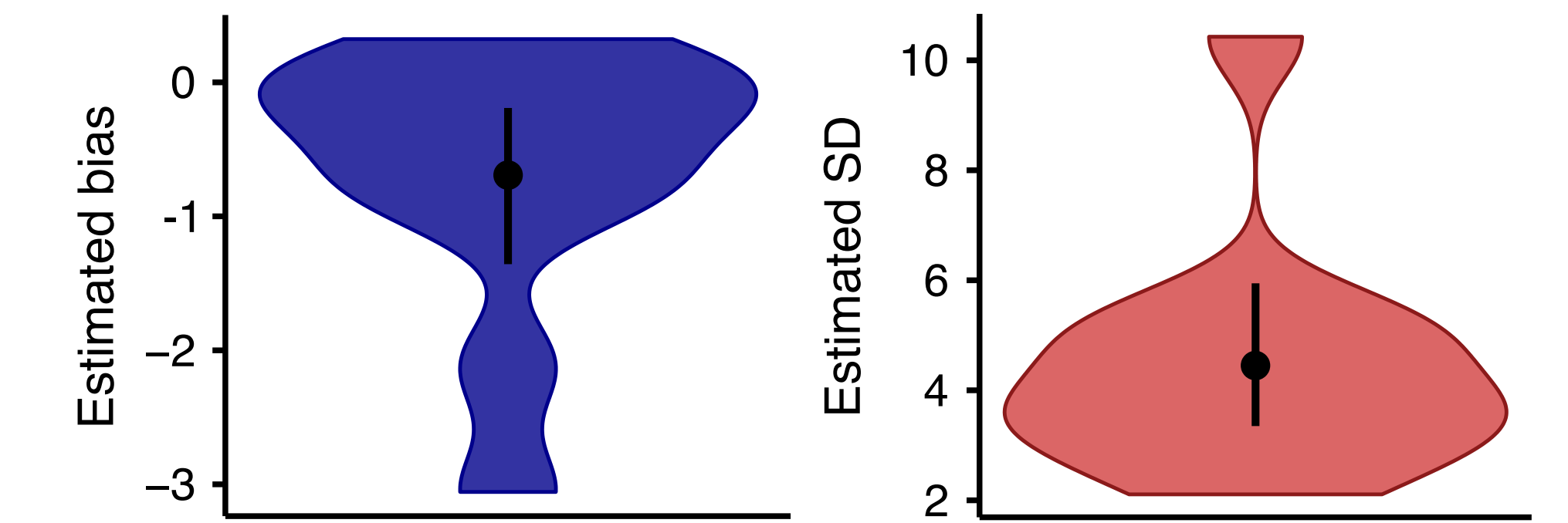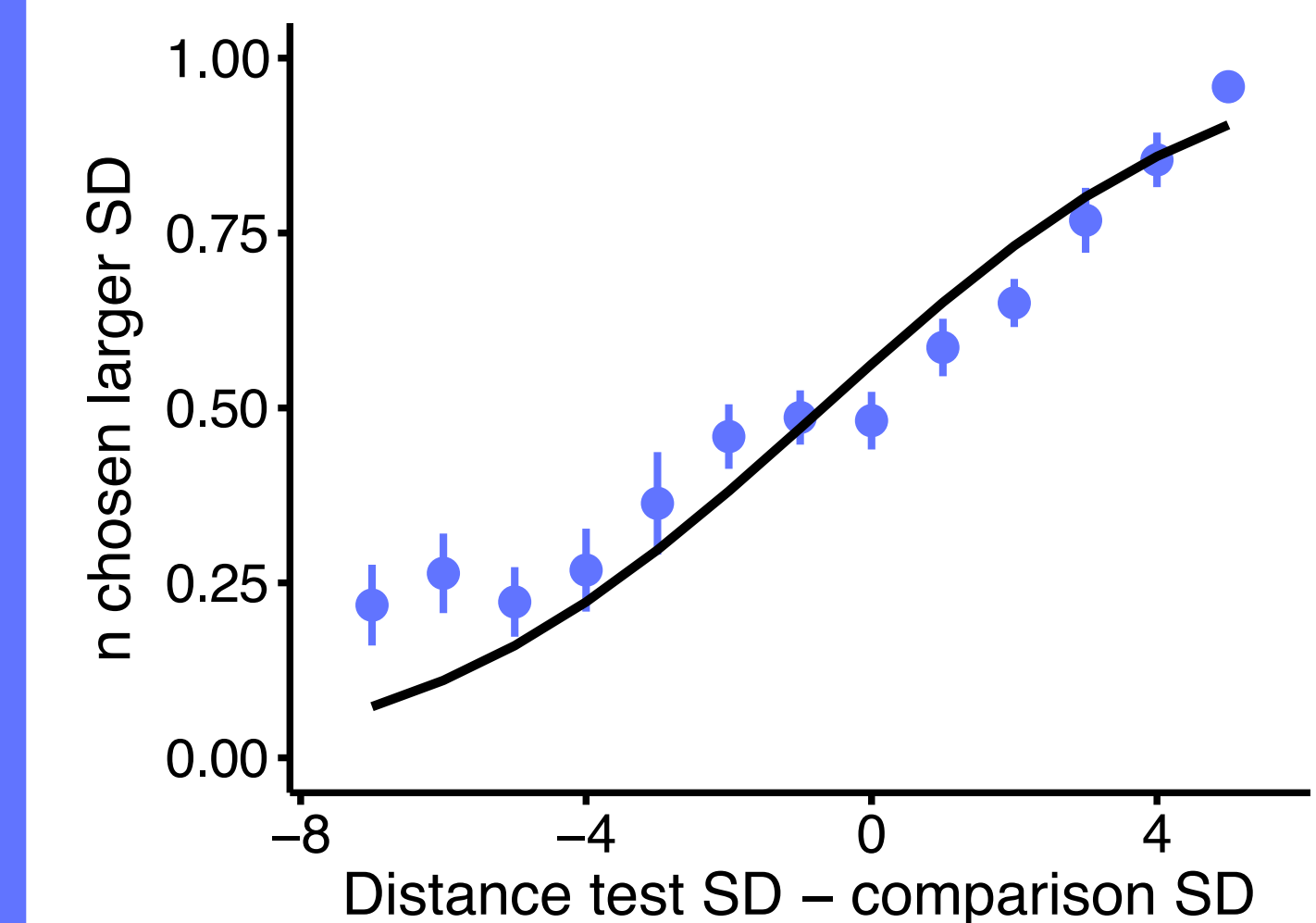

μ of fitted circ. Gaussian (ideally μ = 0)

SD of fitted circ. Gaussian (ideally SD = 6)

RESULTS

Fit psychometric function ⟶ extract mean (bias) and SD (inverse of slope) of the underlying Gaussian distribution

EXPLICIT METHOD

2AFC mean

n=12
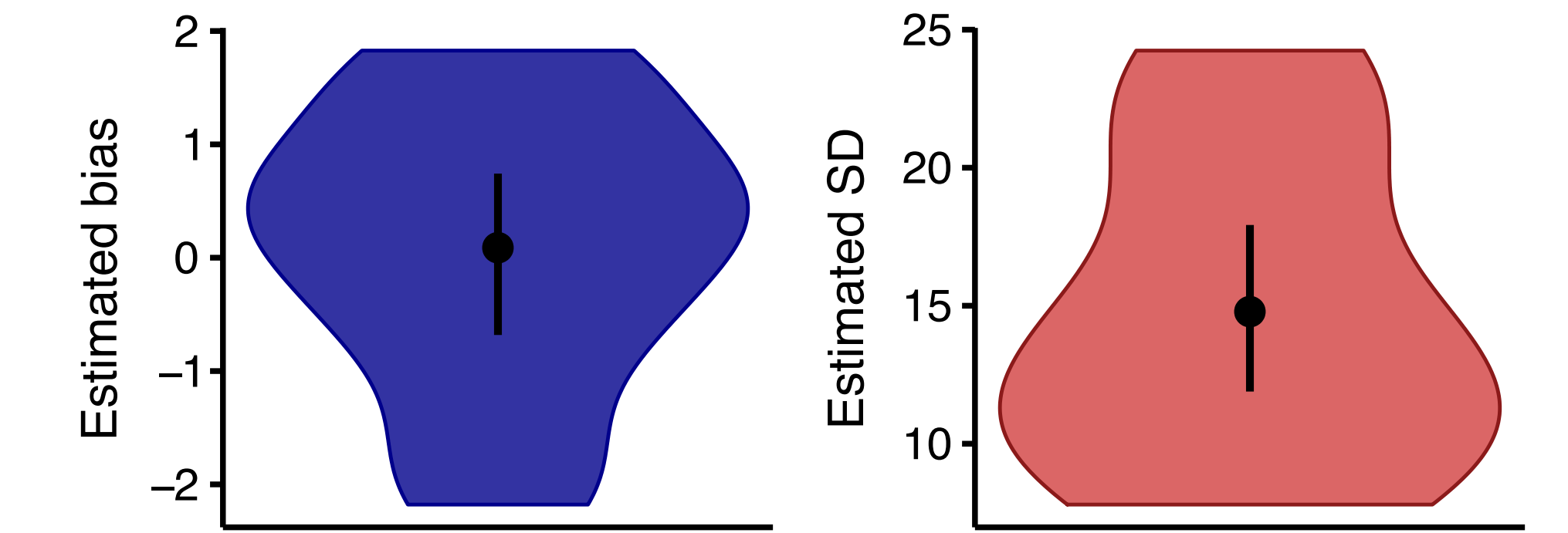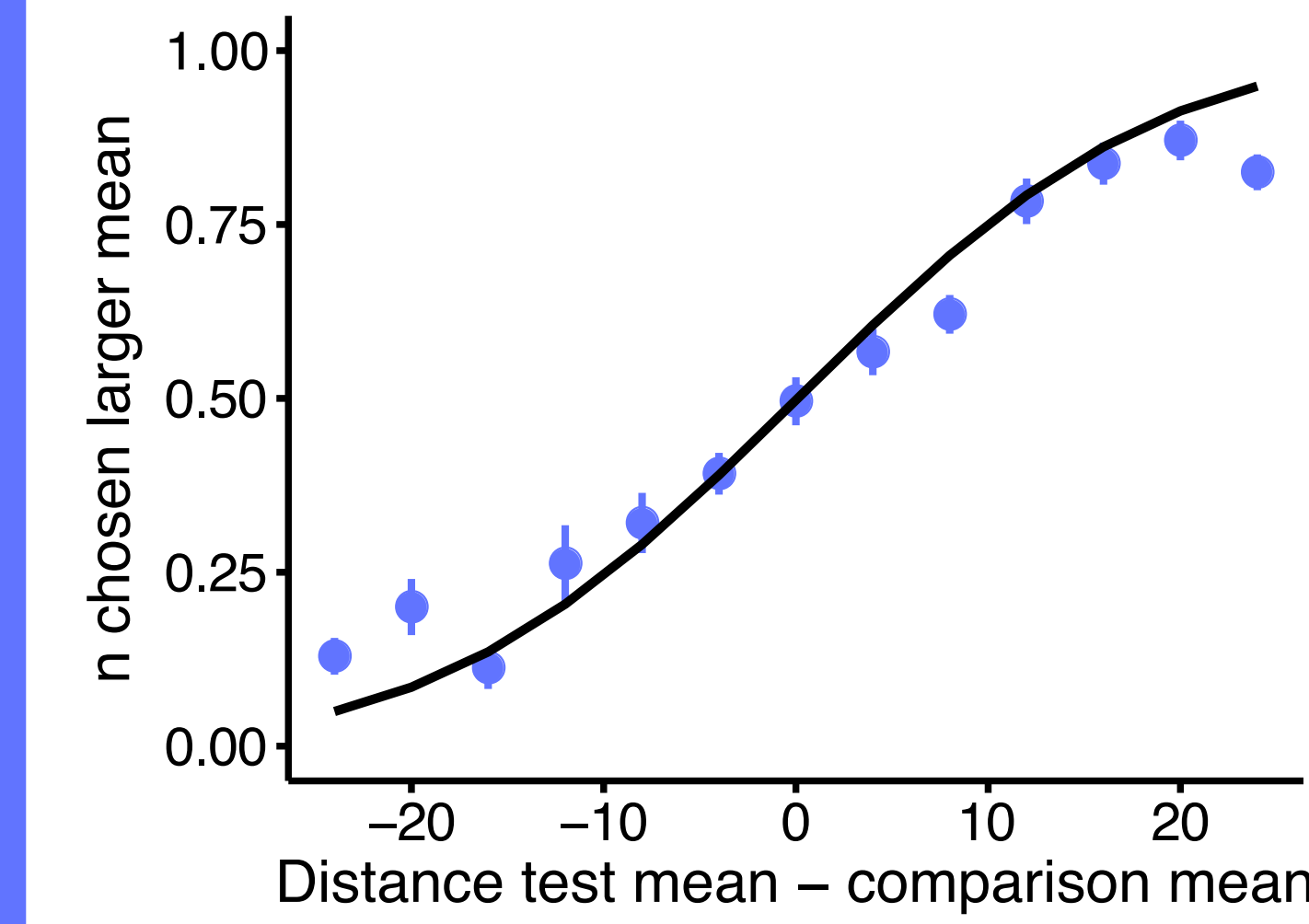
estimated SD (variability) larger in the explicit method than for the implicit method: $t(11) = -8.78$, $p <.001$.
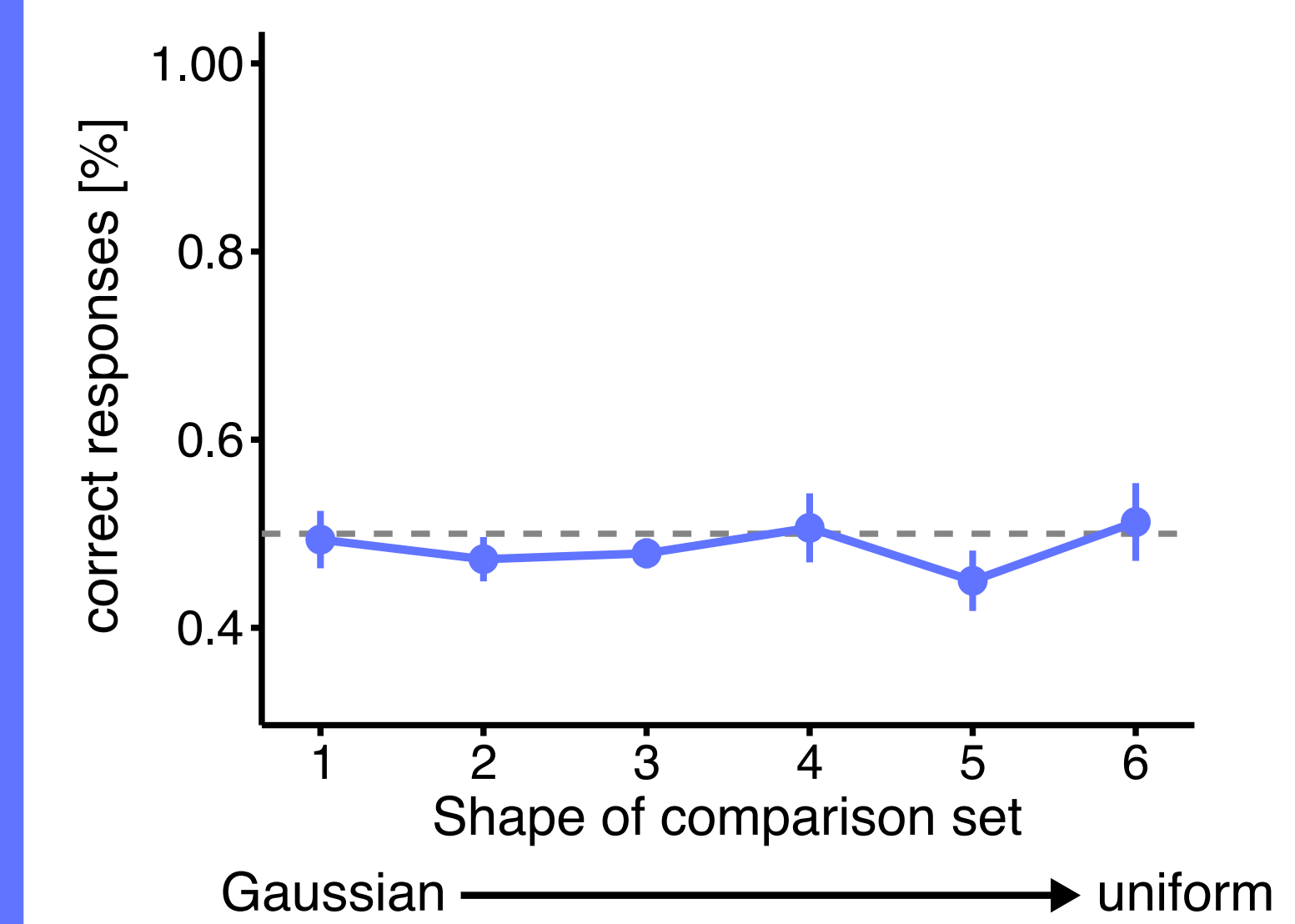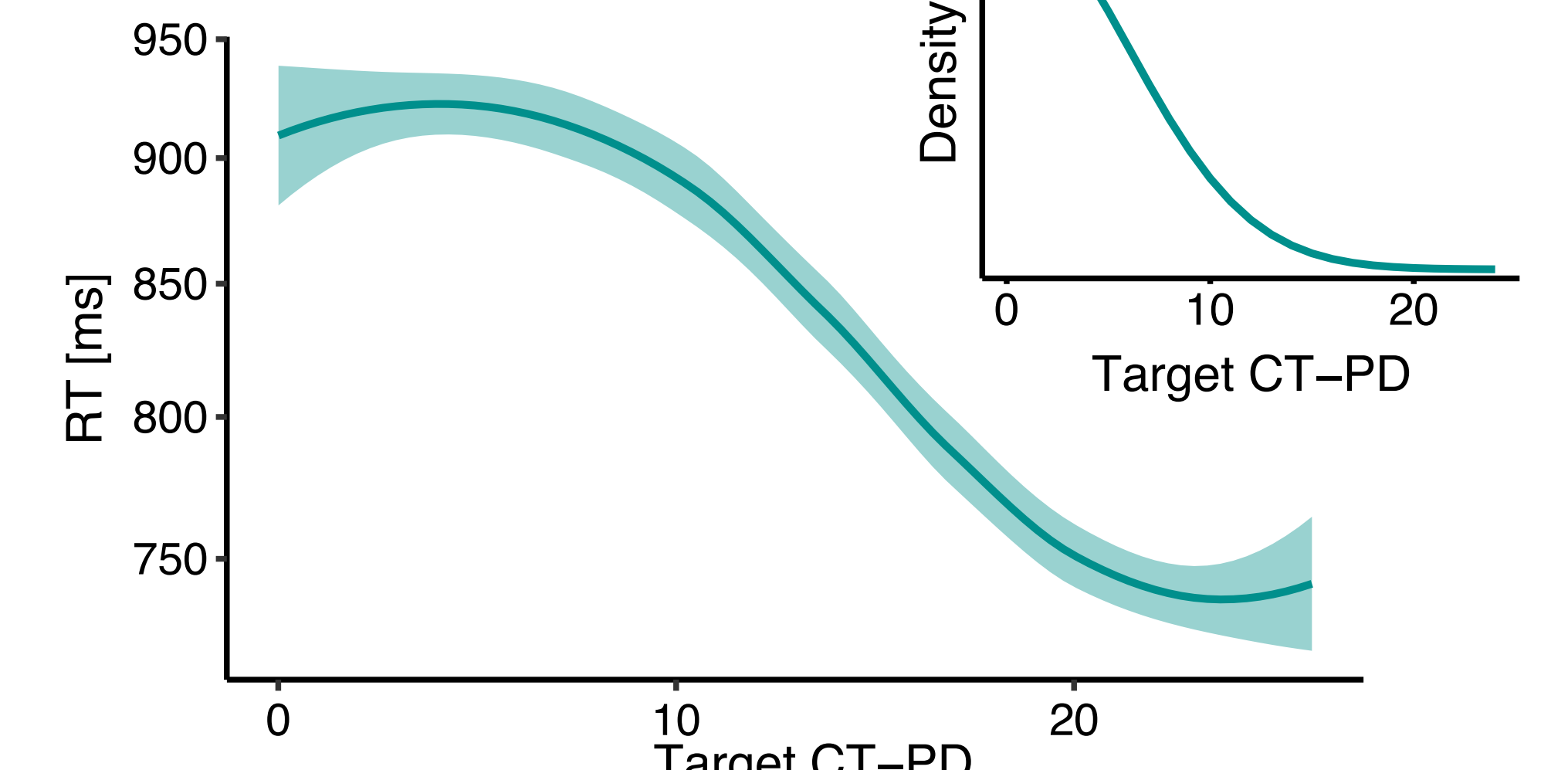
2AFC SD

estimated SD (variability) similar in the explicit method and the implicit method: $t(10) = 0.08$, $p >.05$.

2AFC shape

explicit 2AFC distribution comparison

implicit shape learning

DISCUSSION

- Extracted information of mean and SD through explicit method is noisier than the implicit representation
- Learned distribution shape is not accessible through explicit method but is represented (implicit method)
- Implicit information crucial to act, while explicit information might determine appearance
- ⟶ Decision is not based on the full perceptual representation