Bayesian Inference by Visuomotor Neurons in Prefrontal Cortex

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Background

Different brain regions represent variations in perceptual expectations[1]

Confounded experimental designs: perceptual choice or motor plan?

[1]Rao, V., DeAngelis, G. C., & Snyder, L. H. (2012). Neural correlates of prior expectations of motion in the lateral intraparietal and middle temporal areas. Journal of Neuroscience, 32(29), 10063-10074.

Question:
How does the brain integrate perceptual priors with sensory signals?
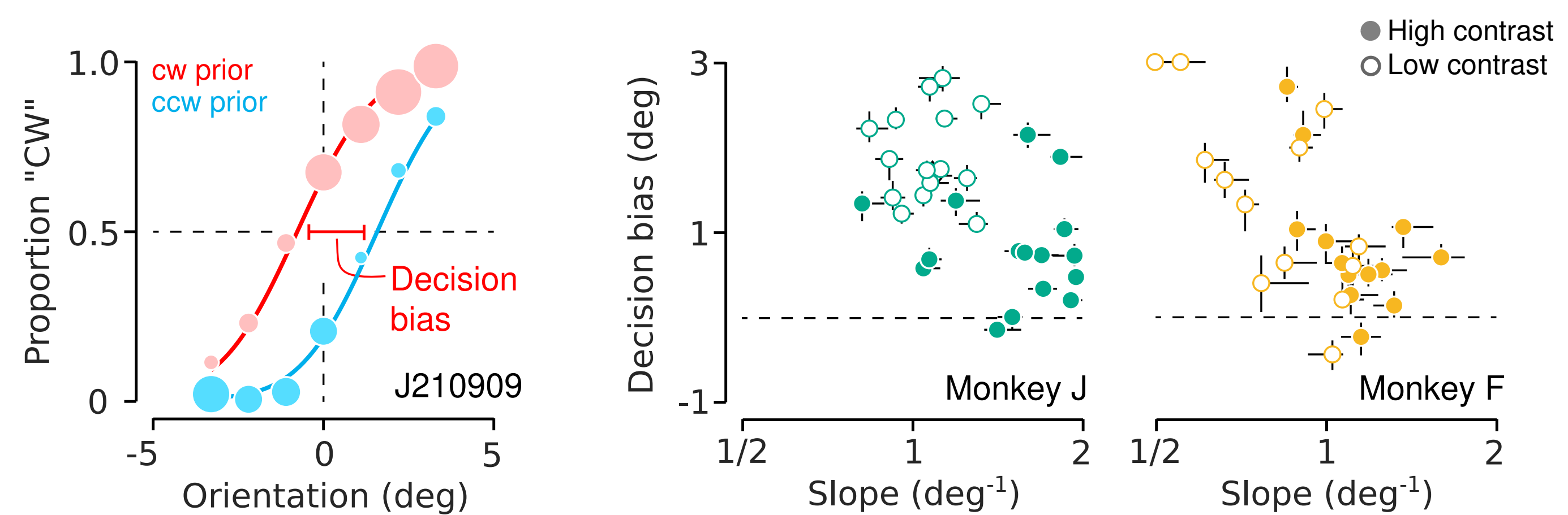
Behavioral task
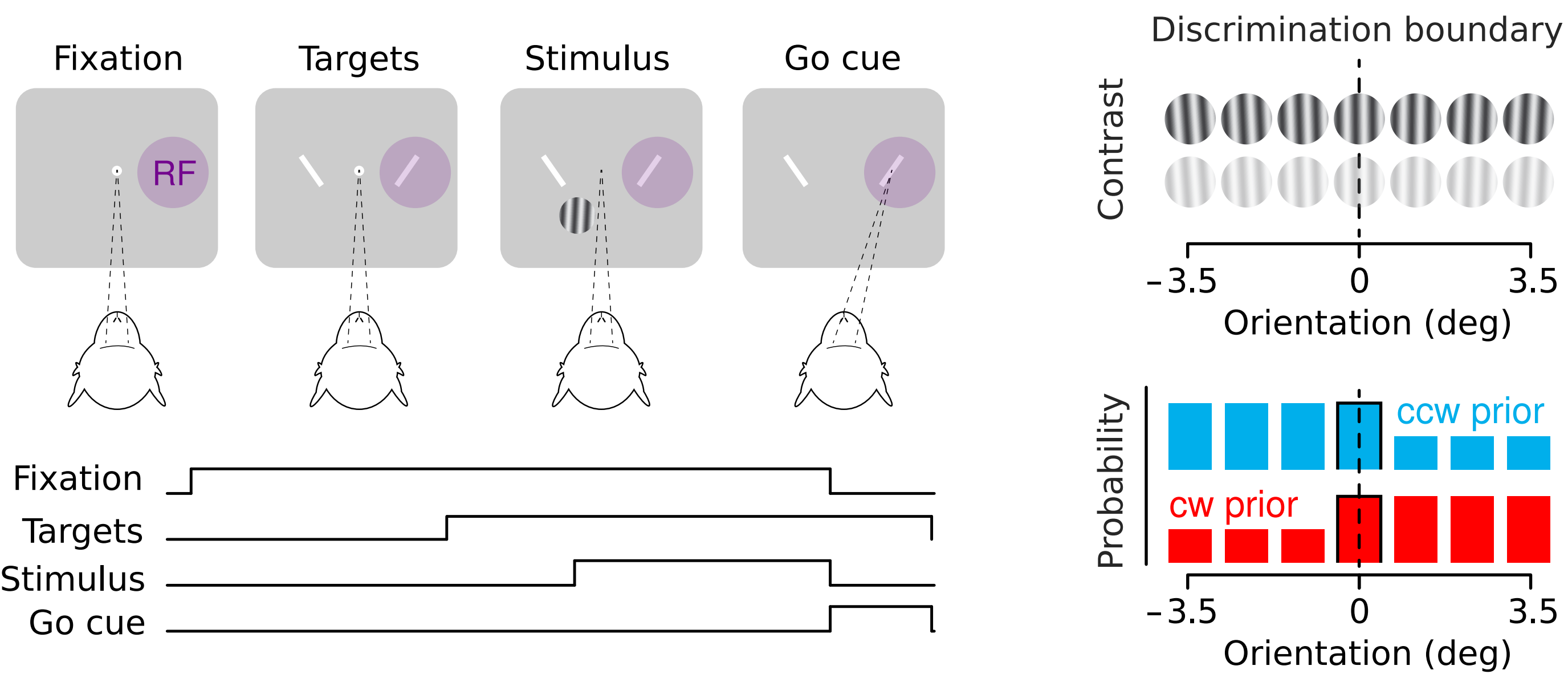
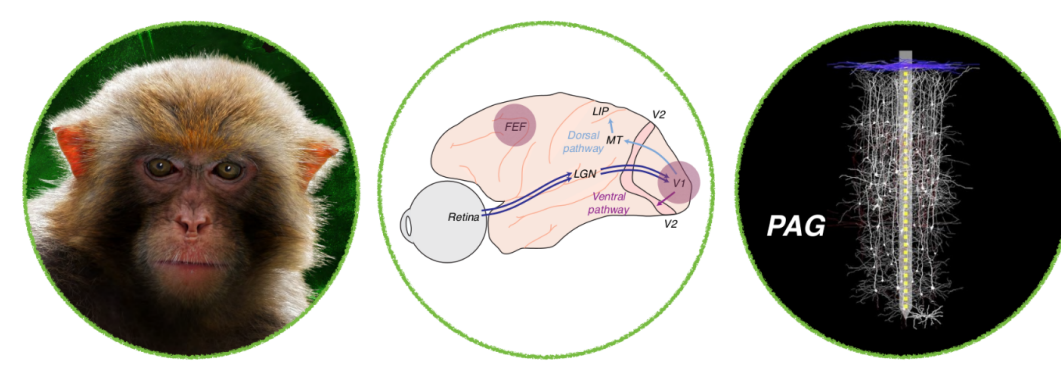Two mapping rules distinguish perceptual from motor response activity
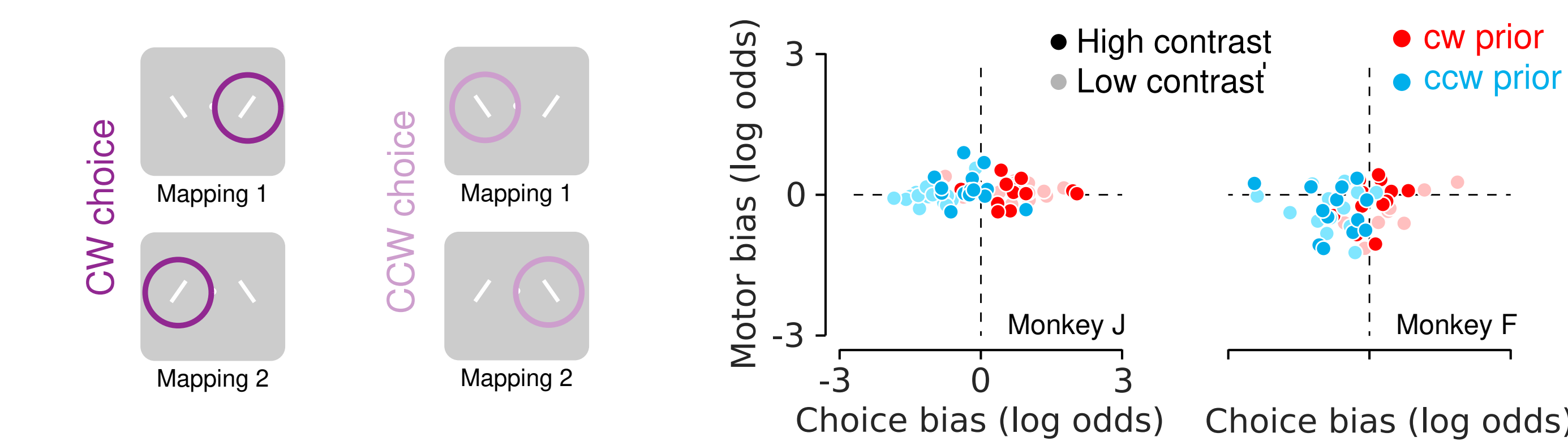
Behavioral results

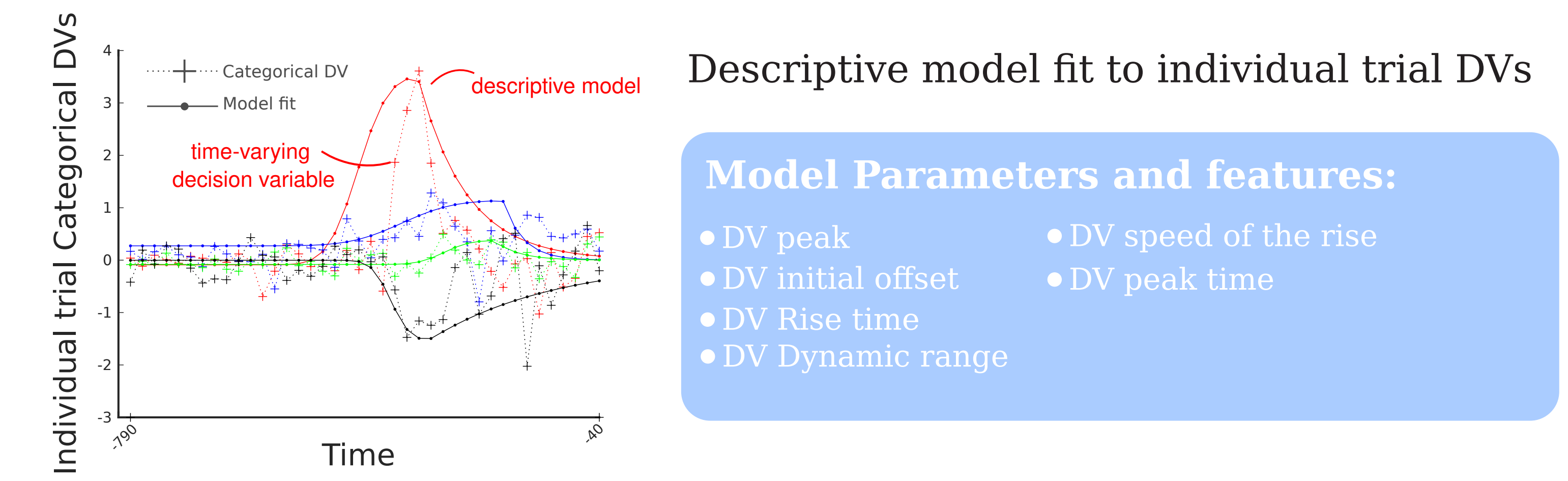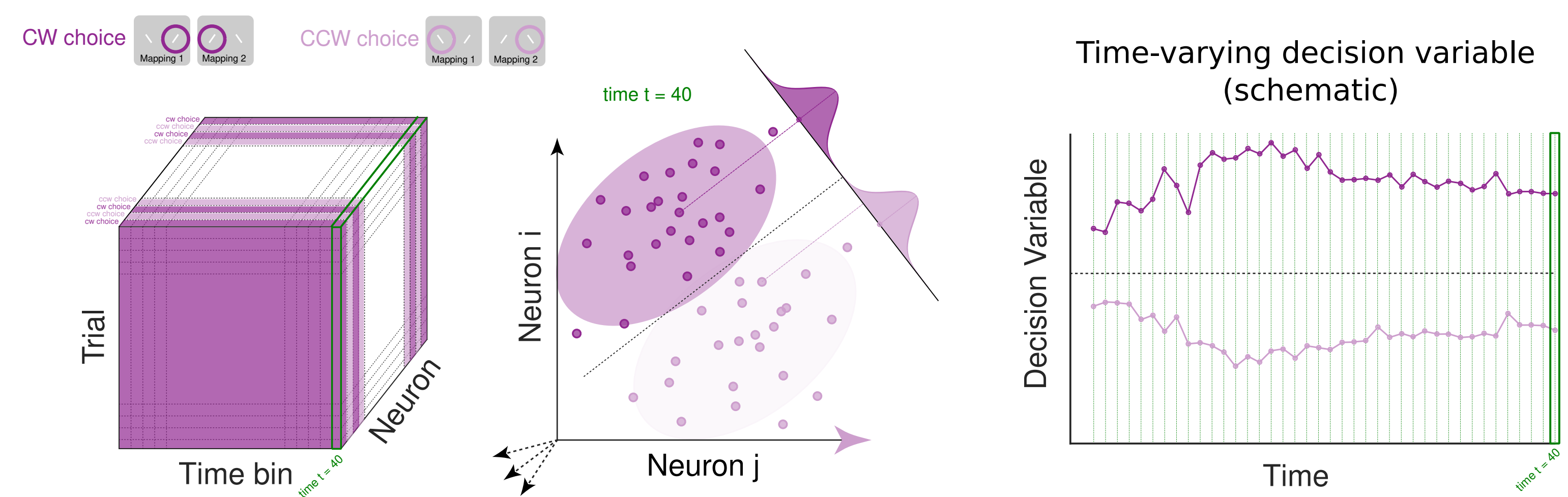Behavior shows bias towards the prior with more perceptual uncertainty

Electrophysiology & Decision Variables

- Measurements in two macaque monkeys
- Multi-electrode recordings in prearcuate gyrus

Decision Variable (DV) estimation from perceptual choice-conditioned activity

Descriptive model fit to individual trial DVs

Model Parameters and features:
- DV peak
- DV initial offset
- DV Rise time
- DV Dynamic range
- DV speed of the rise
- DV peak time

Descriptive model parameters model capture latent perceptual inference process

Single trial model DVs
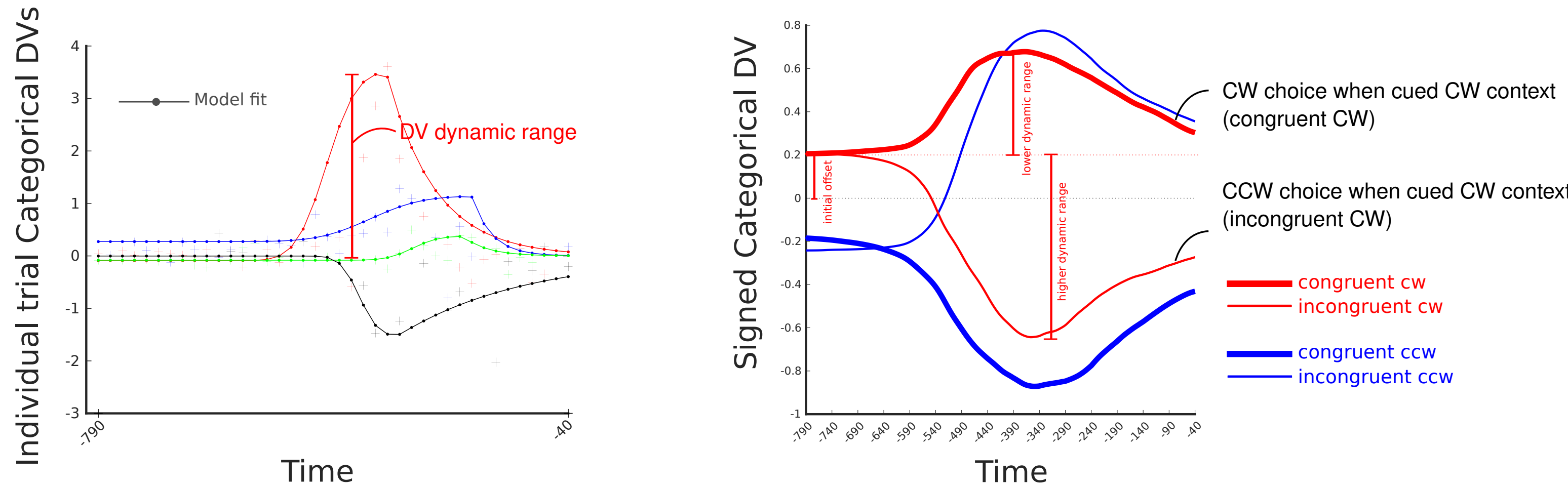

Model fit averages   Actual DV averages
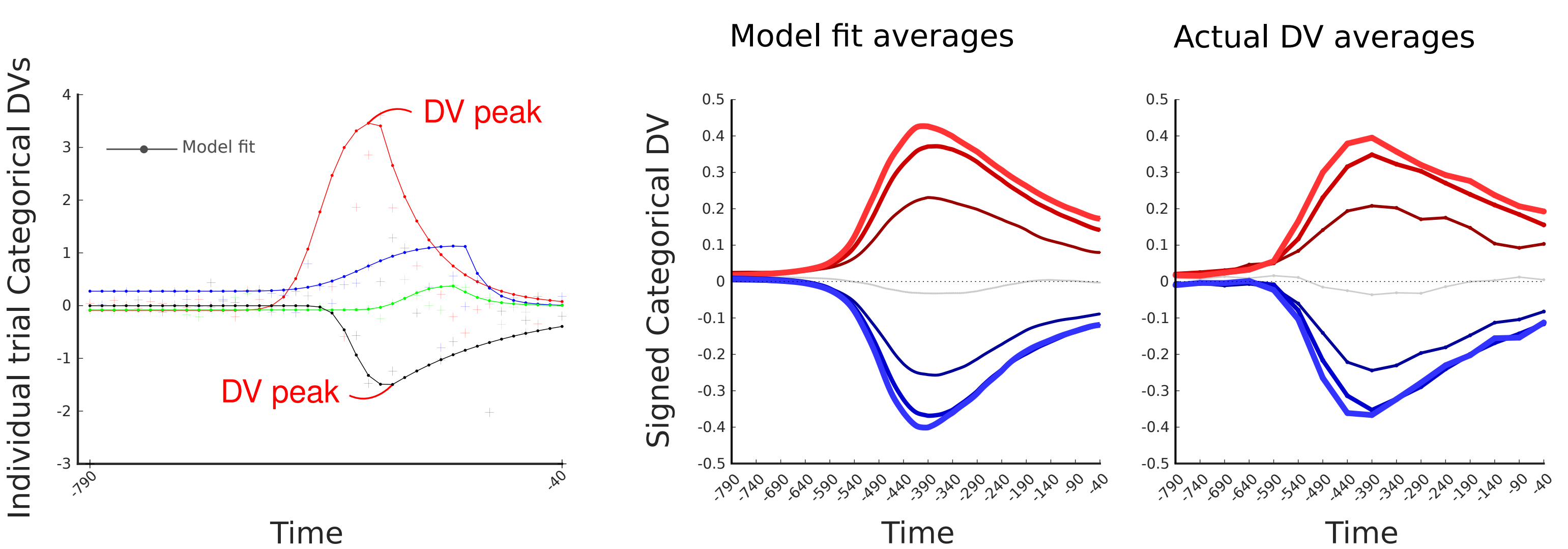
DVs reflect bias & uncertainty

r = -0.52142 ***
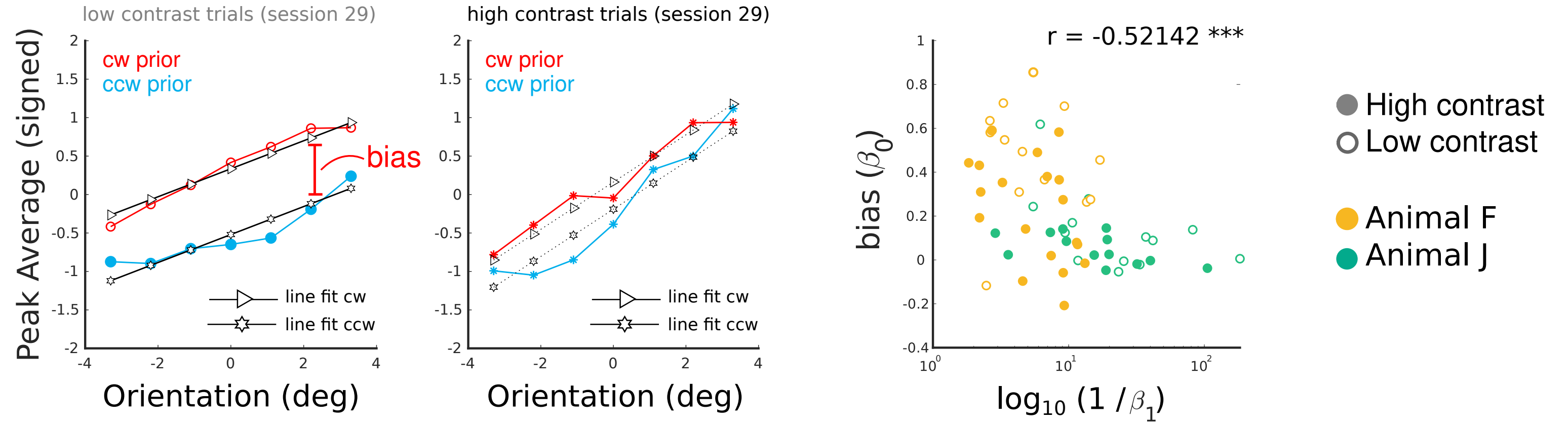
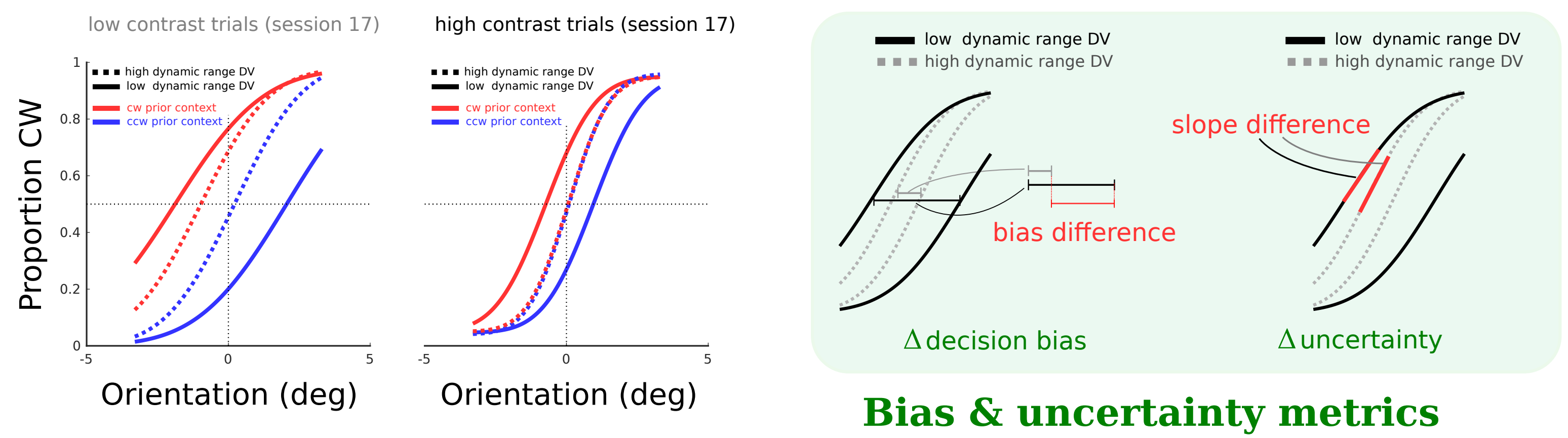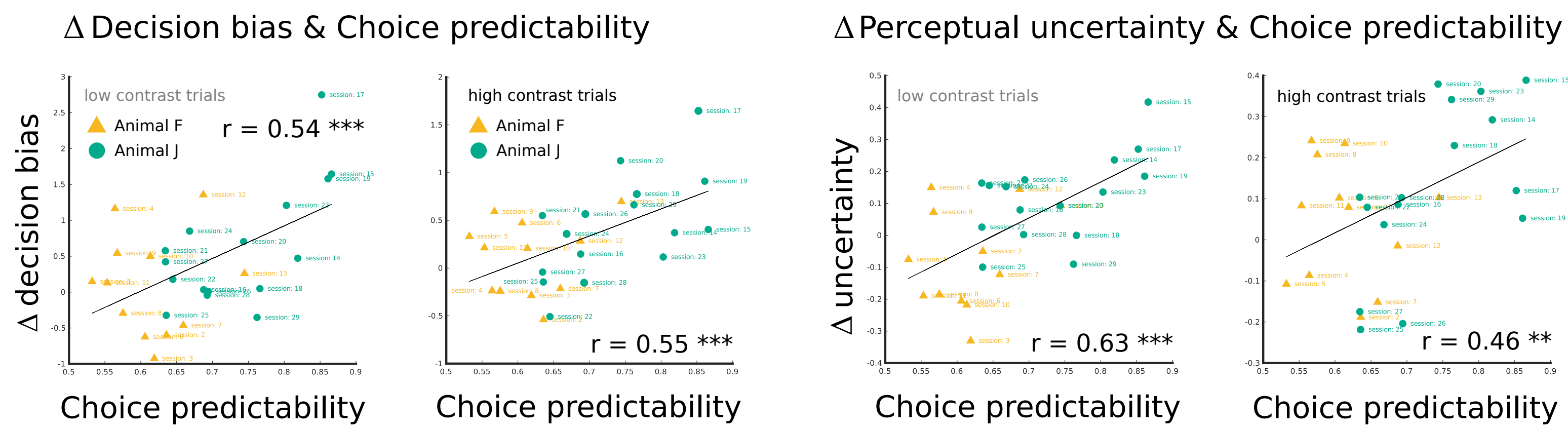## DV dynamic range predicts behavior

Low DV dynamic range trials predict more bias and perceptual uncertainty

Bias & uncertainty metrics

Choice predictability of DVs drives the strength of the behavioral predictions

Δ Decision bias & Choice predictability   ΔPerceptual uncertainty & Choice predictability

r = 0.54 ***   r = 0.55 ***   r = 0.63 ***   r = 0.46 **

Dynamic range of DVs is a signature of the perceptual inference process