

Hierarchical effects of contrast and motion coherence in early visual cortex

Dan Birman, Justin Gardner
Department of Psychology, Stanford University
danbirman@stanford.edu

1. Introduction



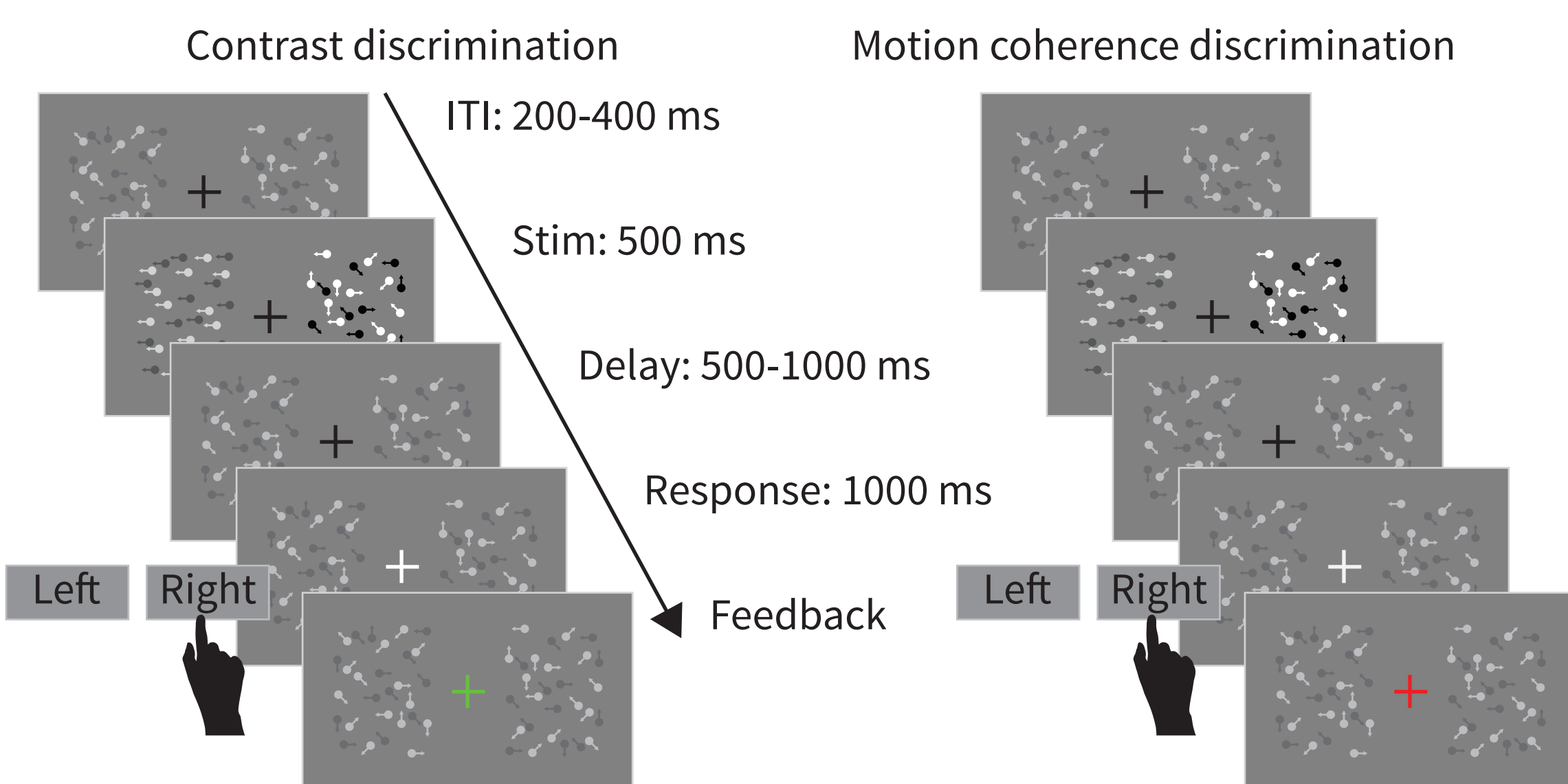
An existing model of **contrast** discrimination suggests early visual cortex may be sufficient to explain behavioral performance¹.



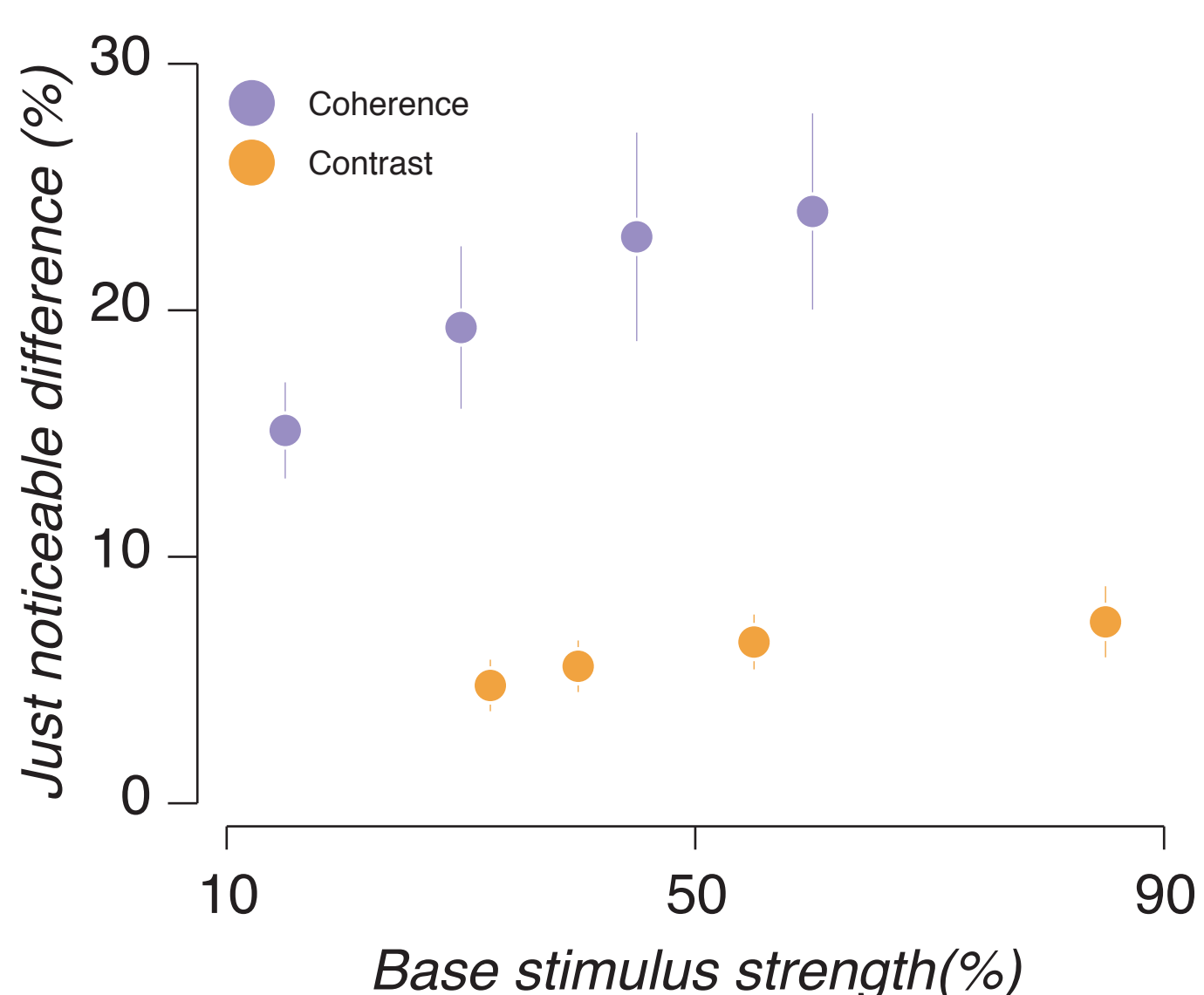
Could that approach also be used to jointly explain **motion coherence** discrimination?

2. Discrimination task

We measured how large of an increment was necessary in each feature to be discriminable.

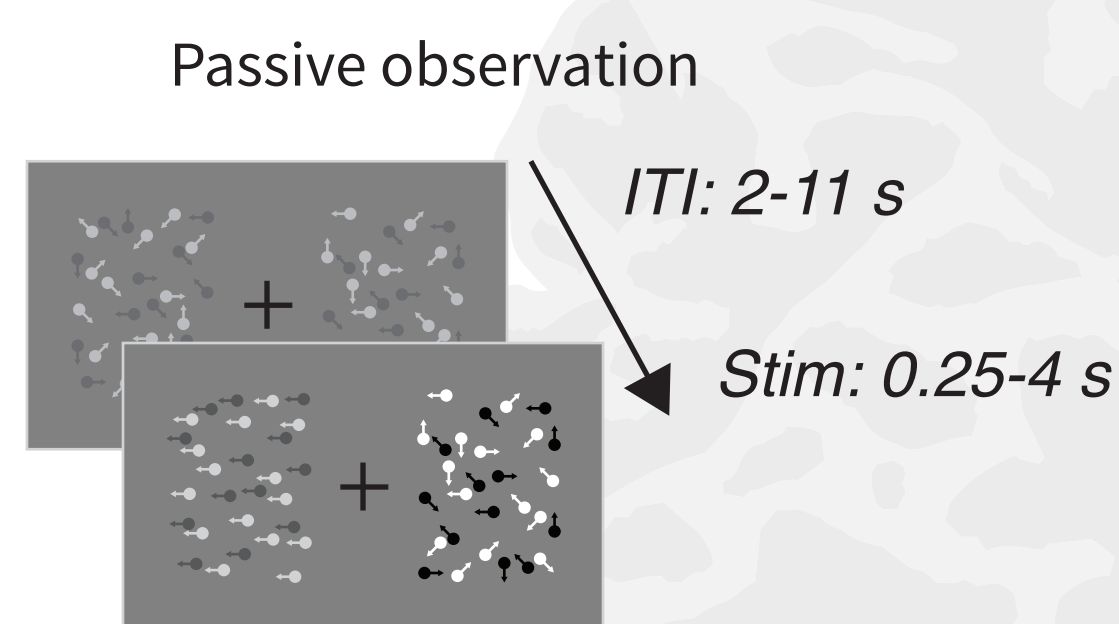


Just noticeable differences (n=21)

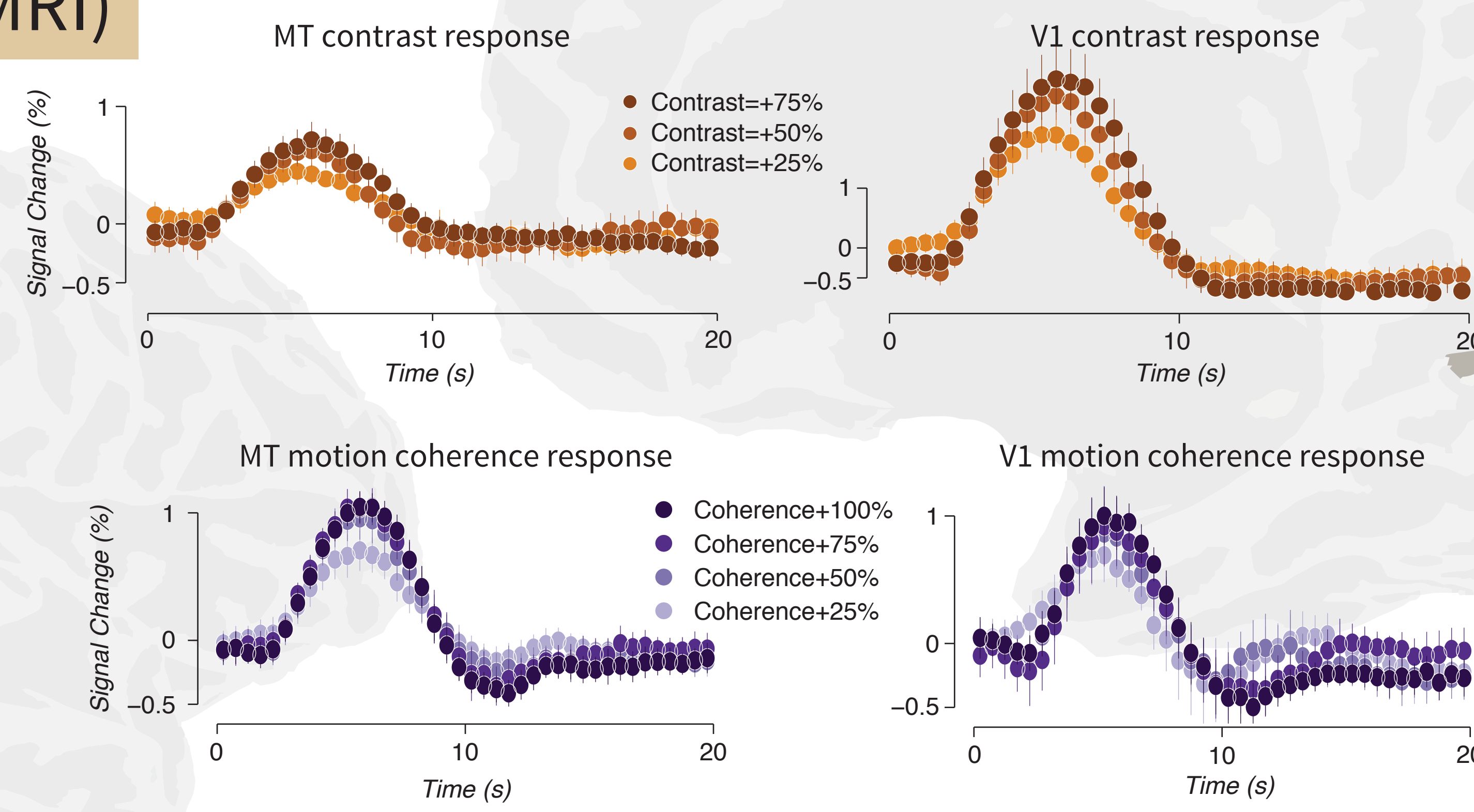


3. Cortical measurements (fMRI)

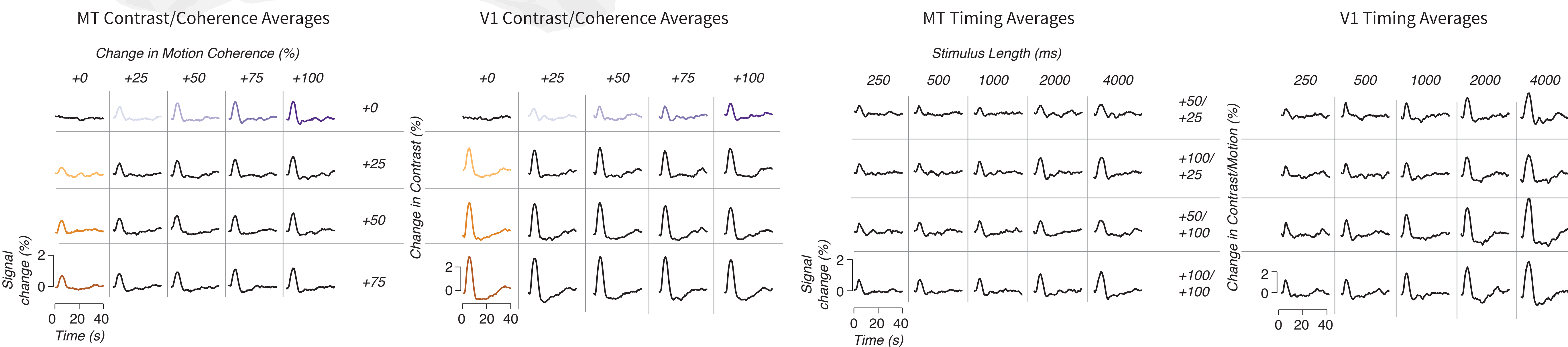
Cortical responses were measured during discrimination and passive observation while performing a fixation task.



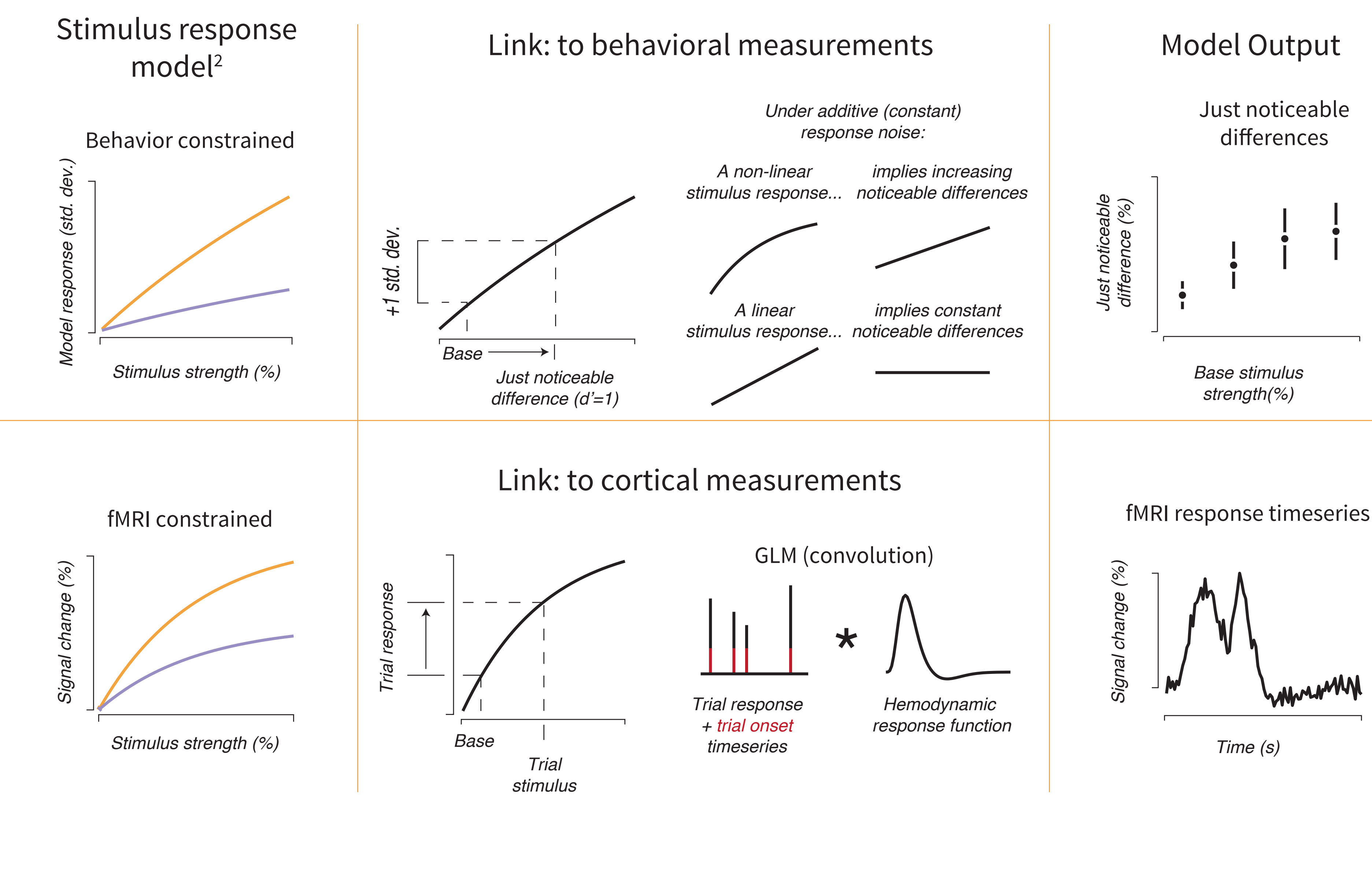
MT



V1

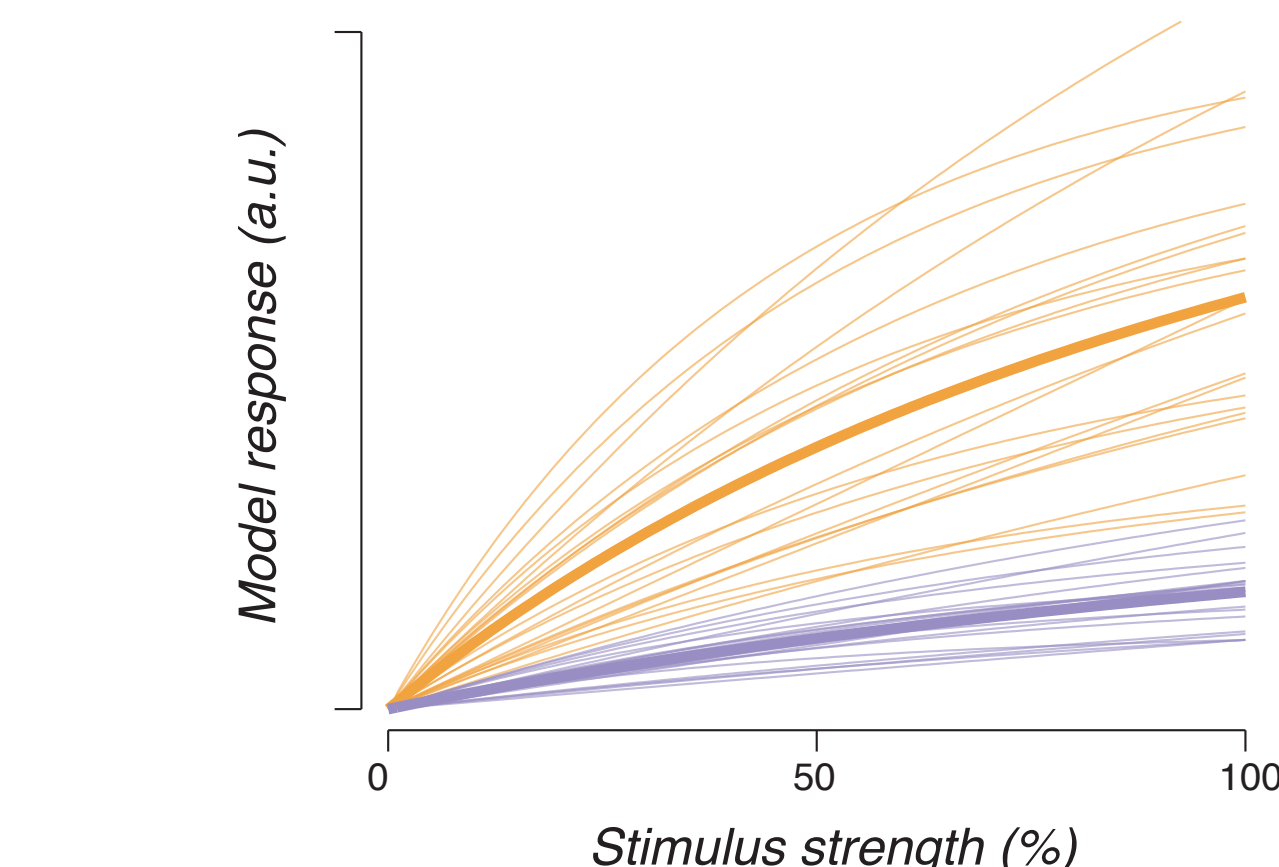


4. Linking model: overview

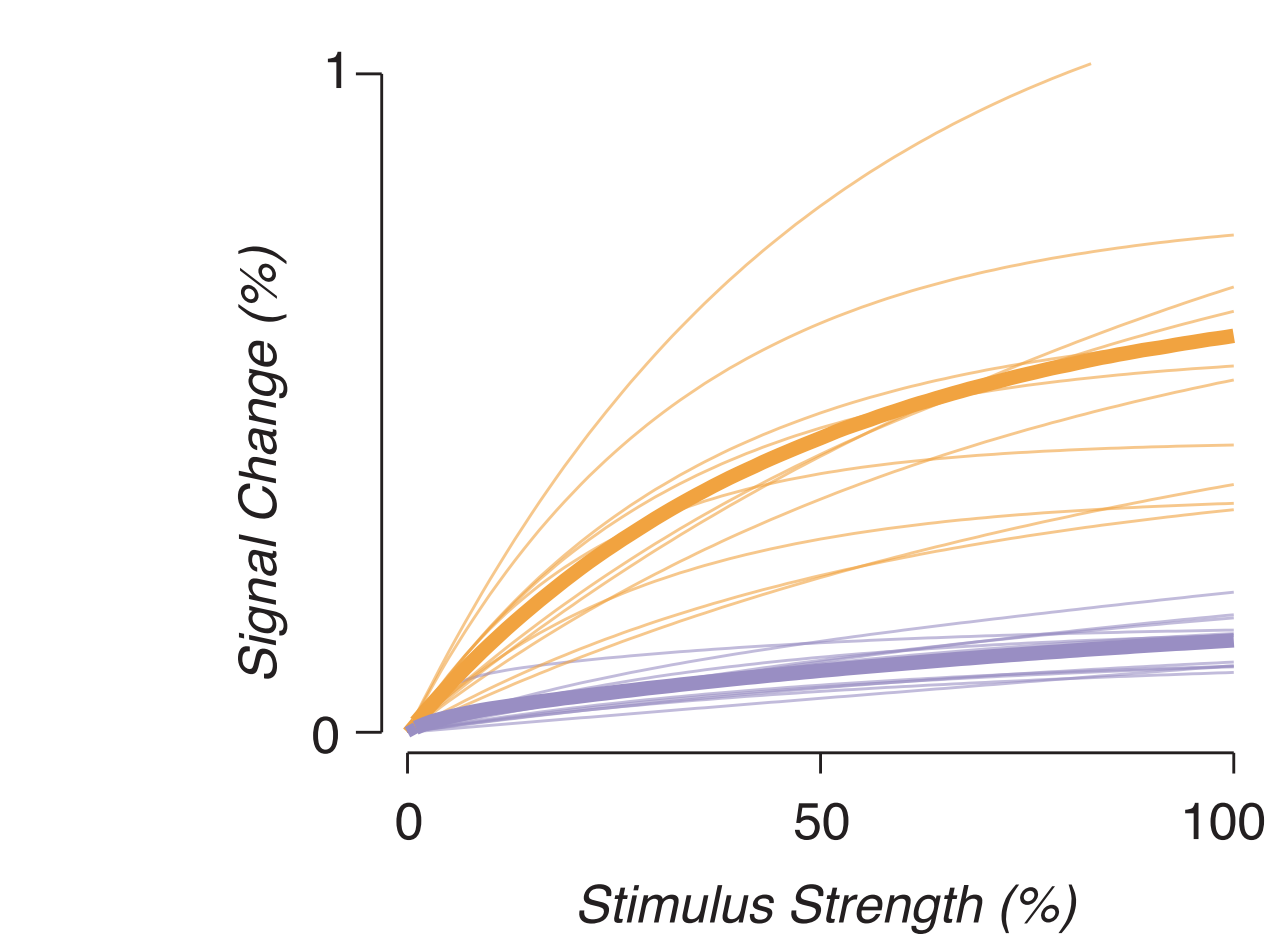


5. Fit to data

Contrast and **motion coherence** response functions constrained by behavior (n=21)

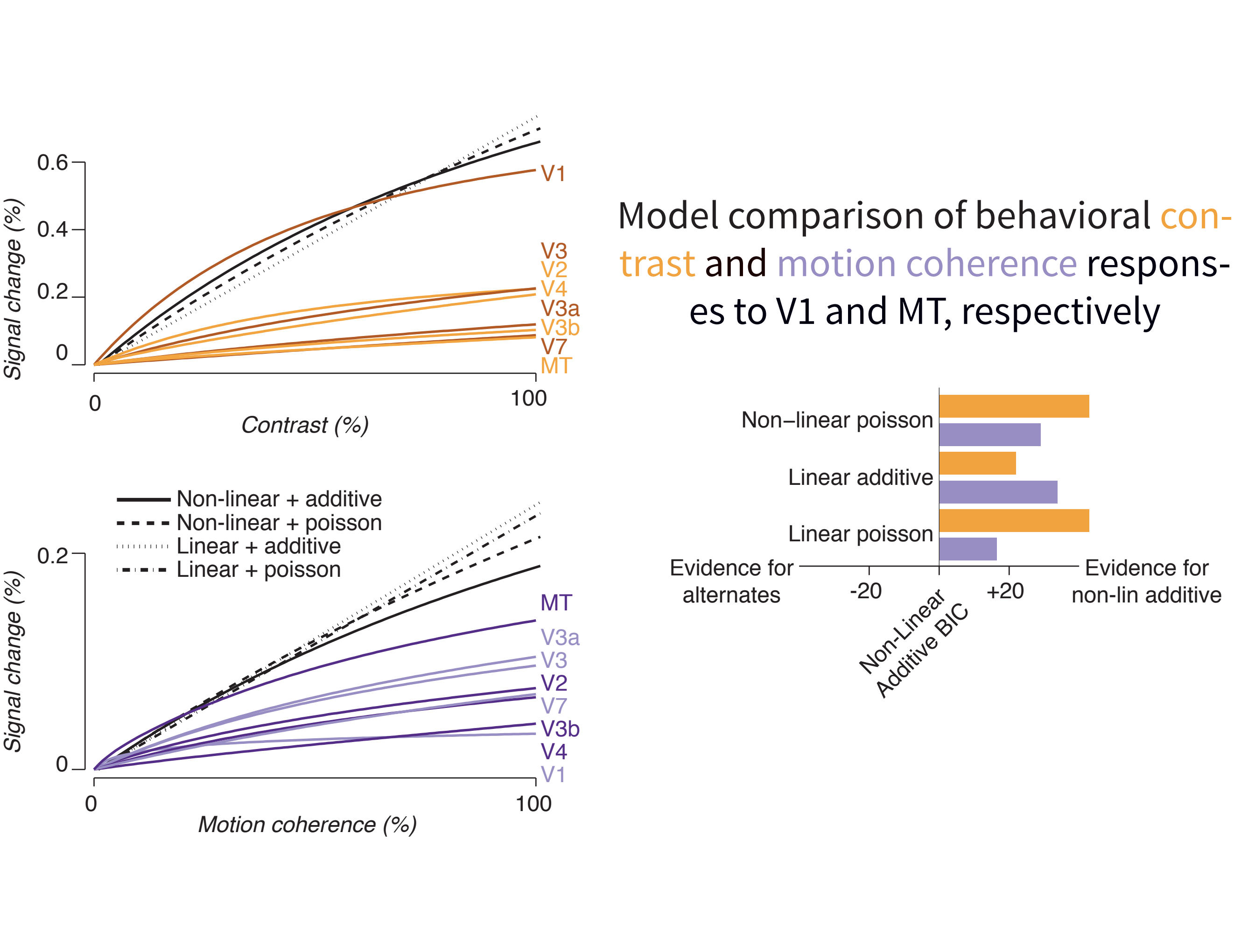


V1 contrast and **MT motion coherence** response functions constrained by fMRI (n=11)



6. Behavior to fMRI comparison

We fit a neural noise⁵ parameter to scale response functions into the same space. Based on previous work¹ we fit this parameter using the functions constrained on V1 and contrast discrimination.



* All data shows mean \pm 95% CI

1. Boynton, G. M., Demb, J. B., Glover, G. H., & Heeger, D. J. *Vision Research* (1999).

2. Non-linear response functions were modeled using an exponential: $Response(s) = \alpha - \alpha e^{-\kappa \cdot s}$

3. V5/MT is thought to respond linearly to increasing motion coherence (see also 4). Rees, G., Friston, K., & Koch, C. (2000). A direct quantitative relationship between the functional properties of human and macaque V5. *Nature neuroscience*, 3(7), 716-723.

4. Simoncelli, E. P., & Heeger, D. J. *Vision Research* (1998).

5. Previous reported values for neural noise in a similar model of contrast discrimination were 0.064% and 0.016% for distributed and focal attention. Pestilli, F., Carrasco, M., Heeger, D. J., & Gardner, J. L. *Neuron* (2011).

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