Hierarchical effects of contrast and motion coherence in early visual cortex

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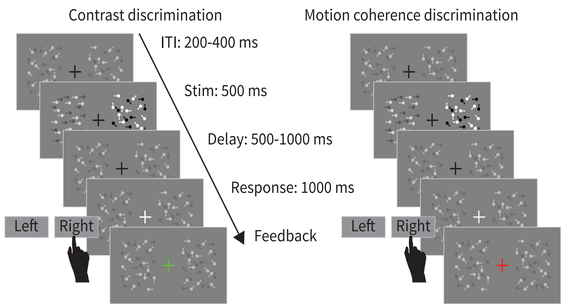
1. Introduction

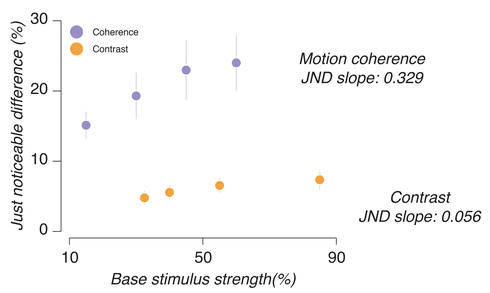
An existing model of contrast discrimination suggests early visual cortex is sufficient to explain behavioral performance[1].

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

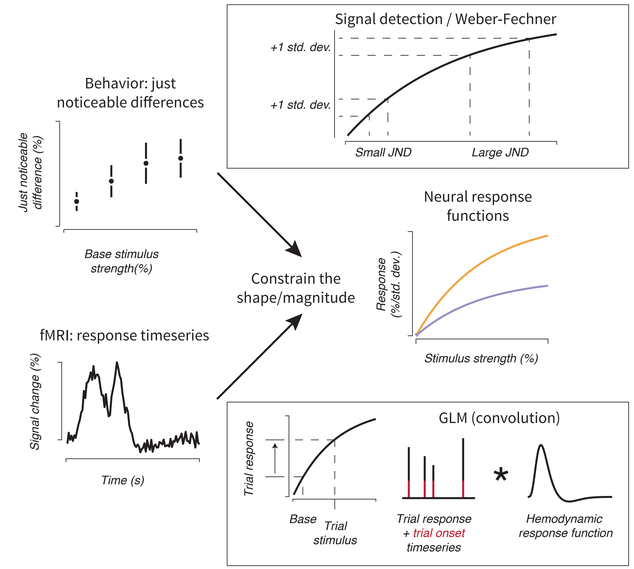
3. Discrimination task



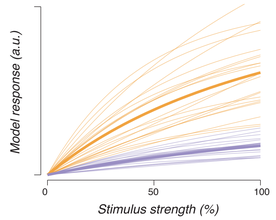
Just noticeable differences (n=21)



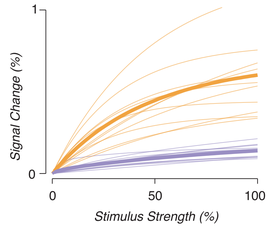
2. Model: neural responses



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

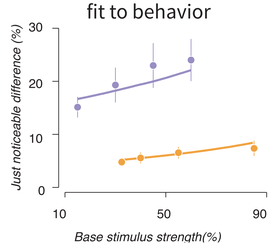


V1 contrast and MT motion coherence response functions constrained by fMRI (n=11)

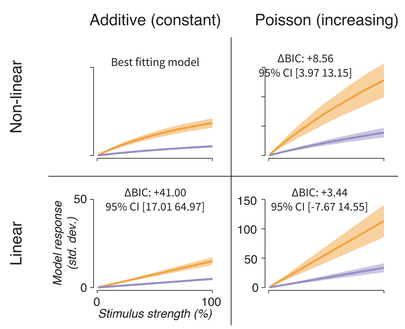


5. Response functions

Non-linear additive model fit to behavior

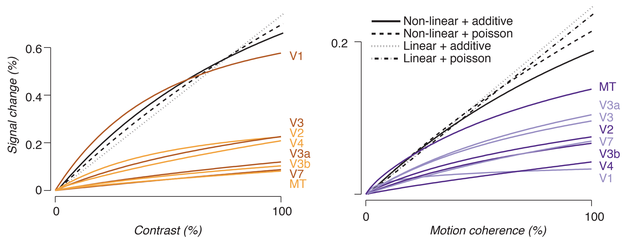


Neural response model variations[3,4]

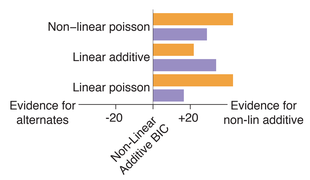


6. Behavior to fMRI

We fit a neural noise[5] parameter to scale response functions into the same space. Based on previous work[1] we fit this parameter using the functions constrained on V1 and constrast discrimination.

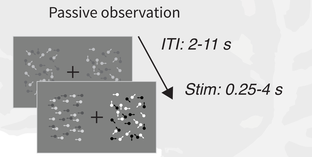


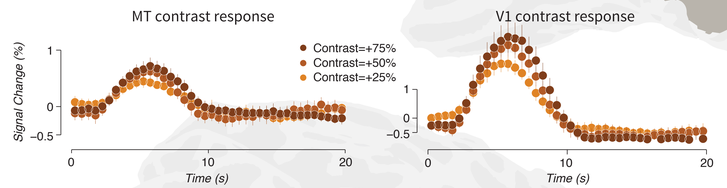
Model comparison of behavioral contrast and motion coherence responses to V1 and MT, respectively

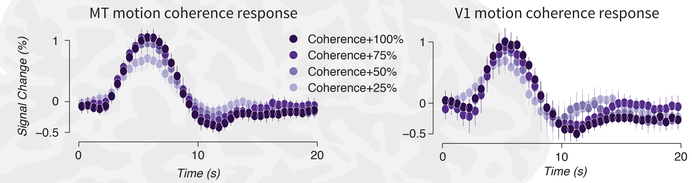


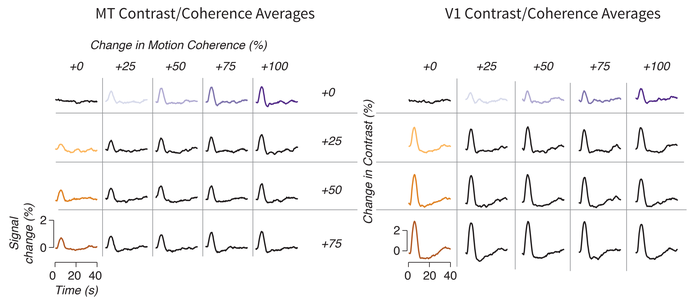
4. Cortical measurements (fMRI)

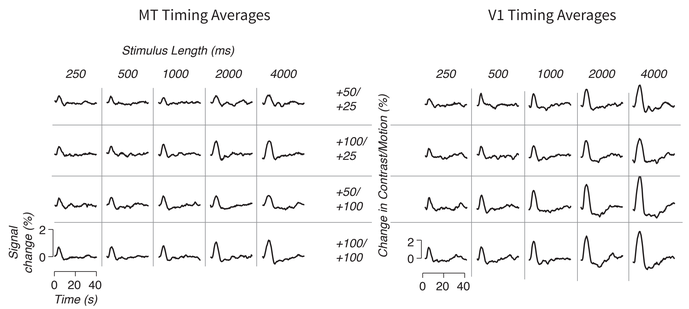
Cortical responses were measured during discrimination and passive observation while performing a fixation task.











All data shows mean ± 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: $Response(s) = \alpha - \alpha e^{-\kappa s}$
3. V5/MT is thought to respond linearly to increasing motion coherence (see also 4). Rees, G., Friston, K., & Koch, C. *Nature neuroscience* (2000).
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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