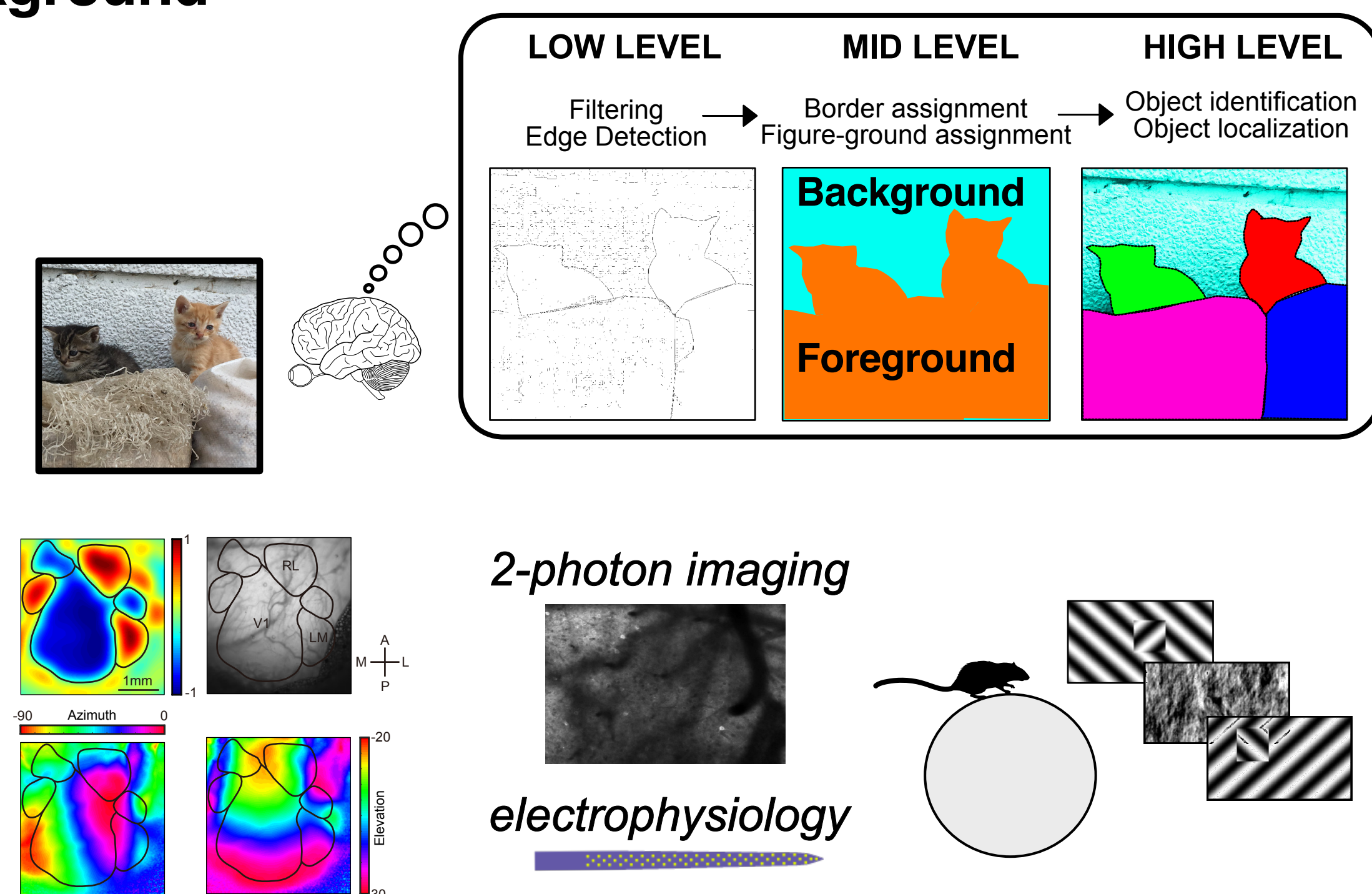


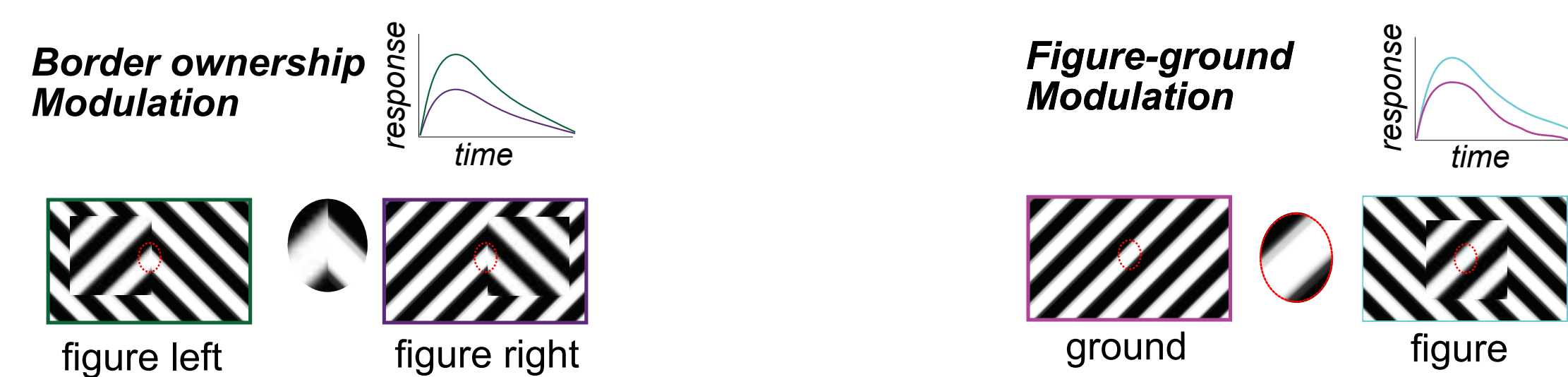
Background



► How does the mouse visual system segment visual objects?

► What constitutes a visual object for a mouse?

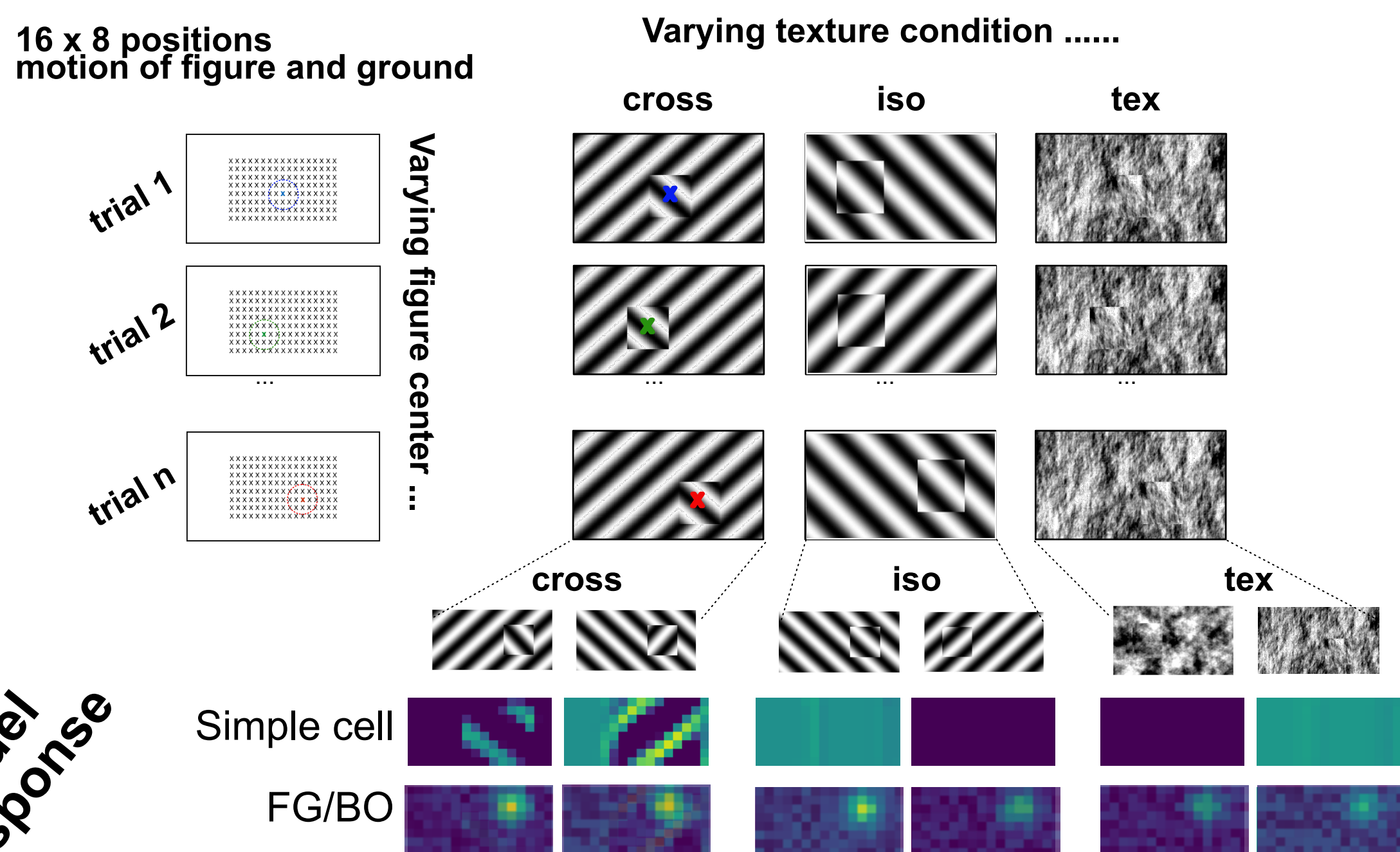
Figure-ground and border-ownership modulation



Evidence for such modulation has been reported across primate thalamus, primary, and higher order visual cortices.

*Qiu and von der Heydt, 2007 // Zhou, Freedman, and von der Heydt 2000 // Jeurissen, Sefl, Roelfsema 2013 // Jehee, Lamme, & Roelfsema, 2007 // Lamme 1995

Stimuli for assaying FG and BO modulation

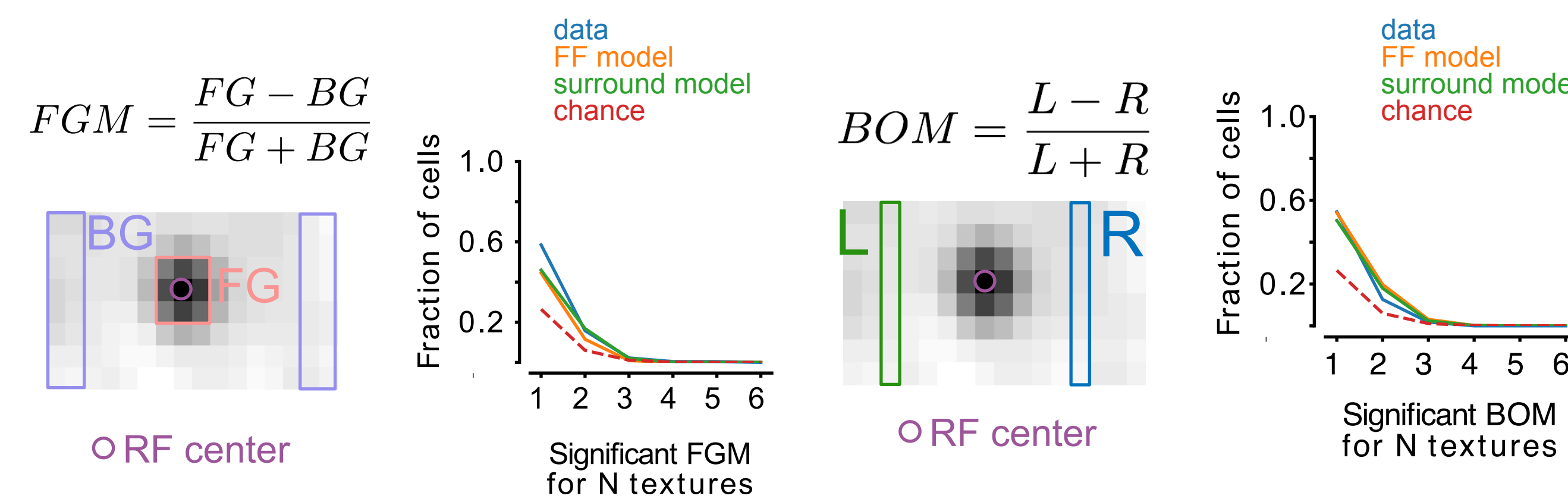


V1

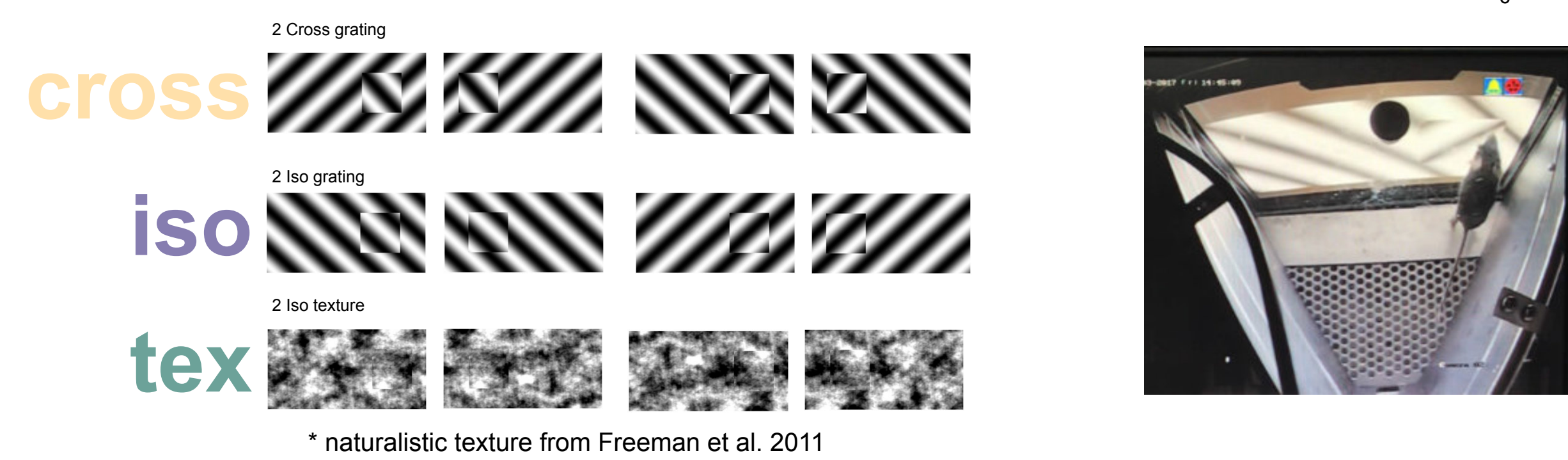
LM

RL

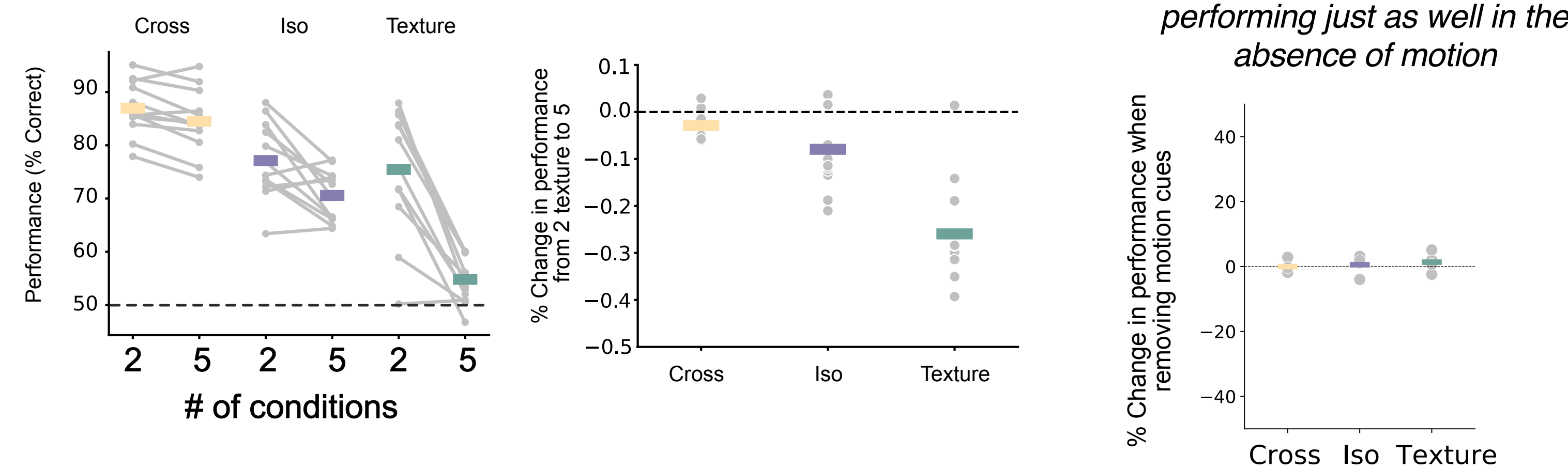
Texture-invariant FG/BO response modulation in single neurons is lacking in rodent visual cortex



Mice can perform a texture-invariant object localization task using a touchscreen paradigm

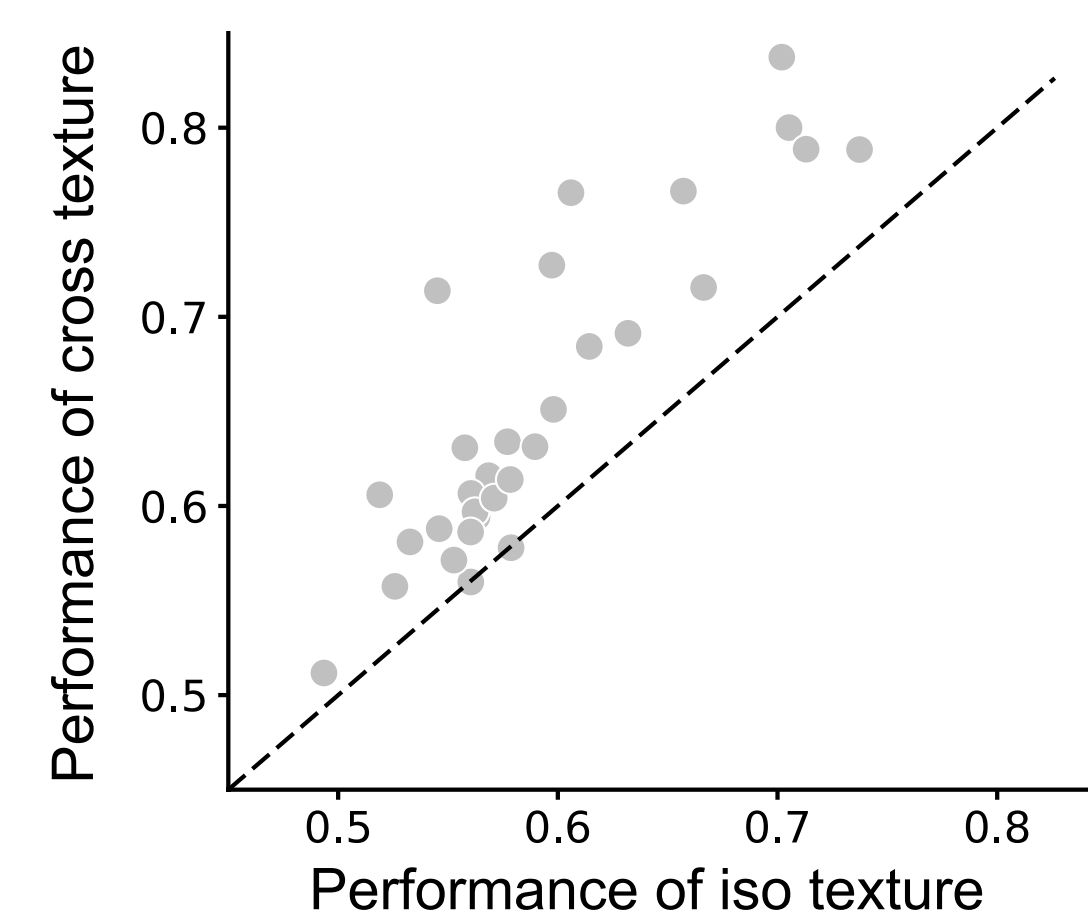


Performance generalizes to unseen orientations and most readily for cross, then iso-oriented, and don't generalize for textures.

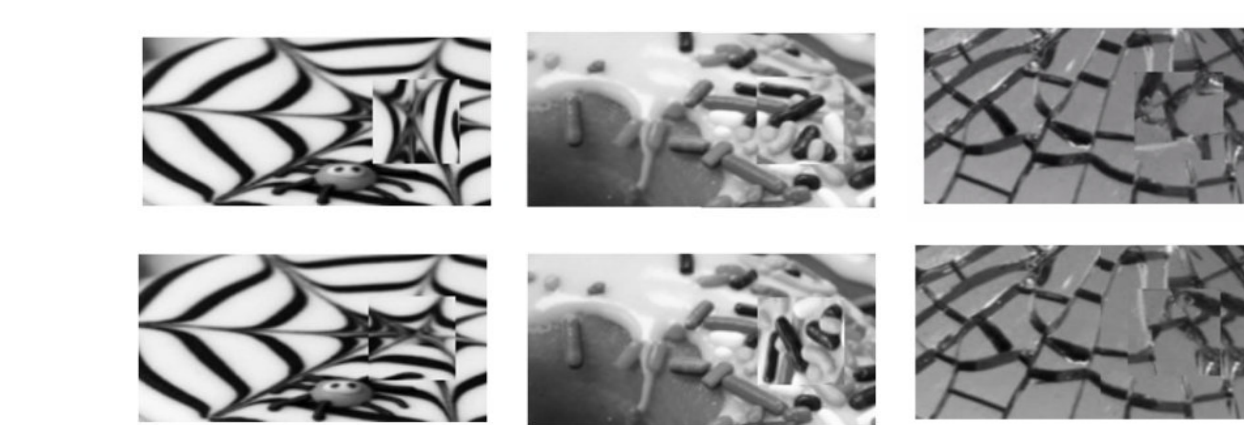


Mice don't use motion cues, performing just as well in the absence of motion

Performance is better on naturalistic textures when there is a cross-oriented (e.g. rotated 90 degrees) difference between foreground and background

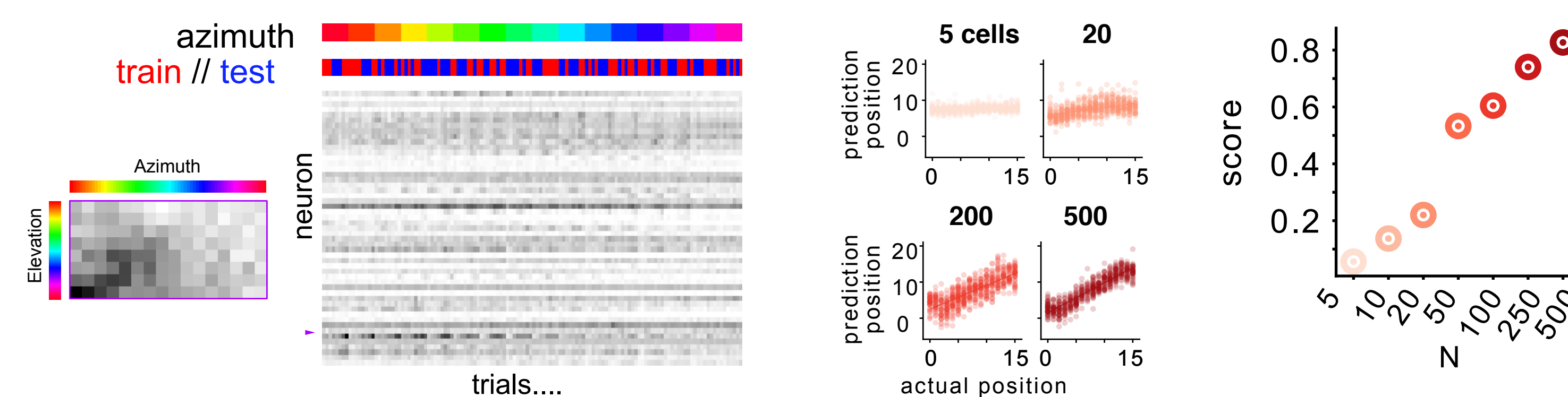


Each point represents performance on a 2-choice discrimination using any one of 30 random textures

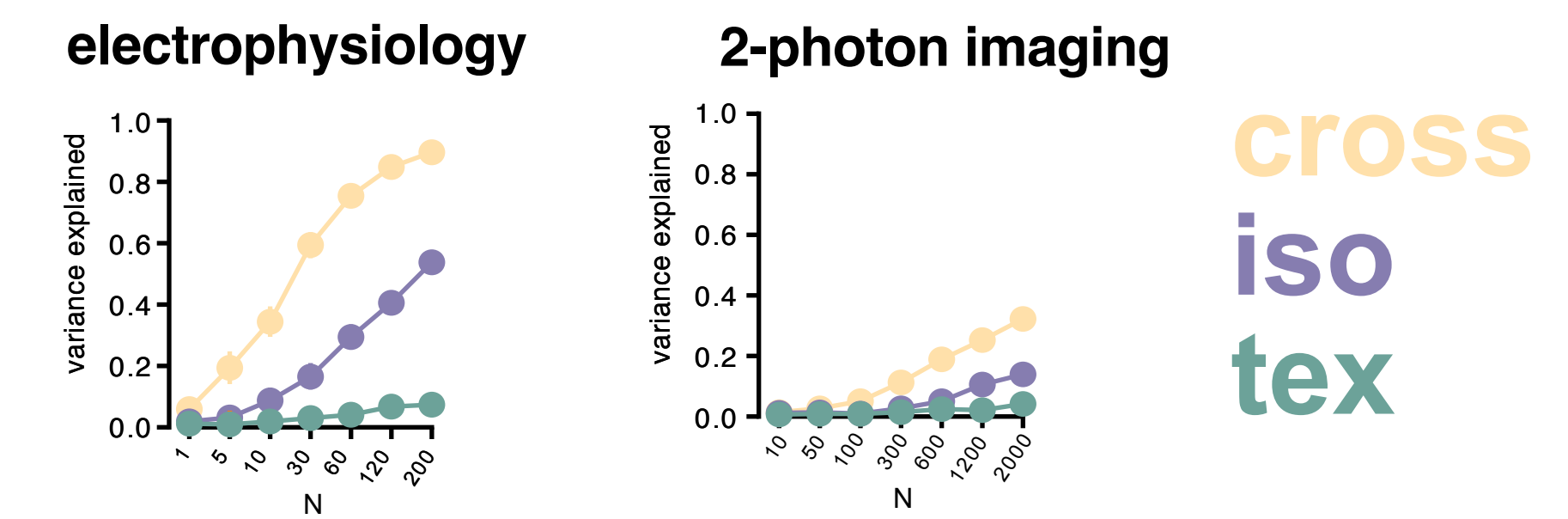


*recall that figure is further defined by motion making it apparent (to us) in both cases

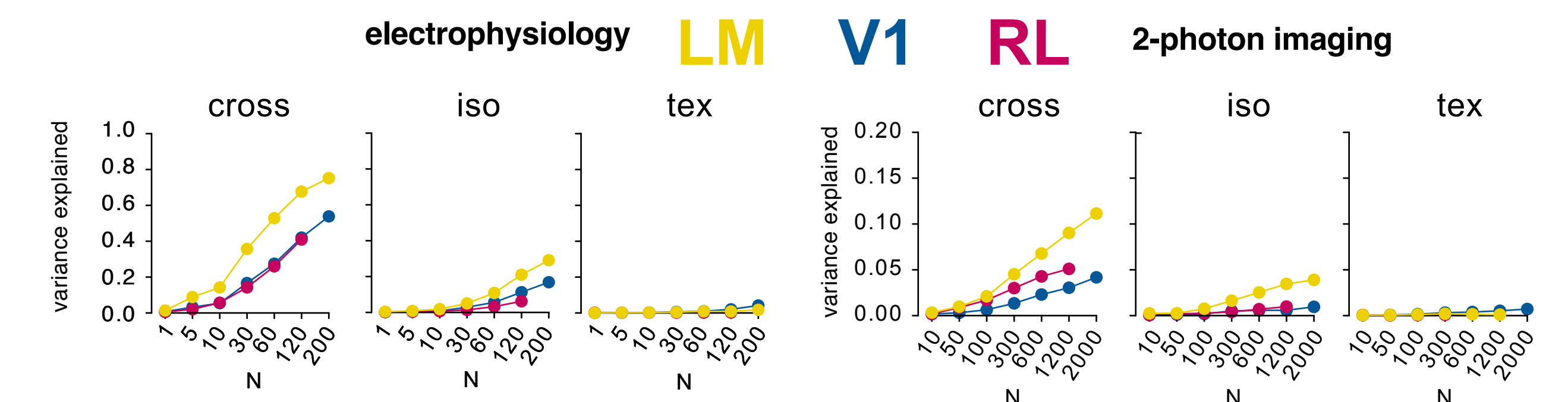
Reading out azimuth position across multiple textures using linear regression from a population of neurons



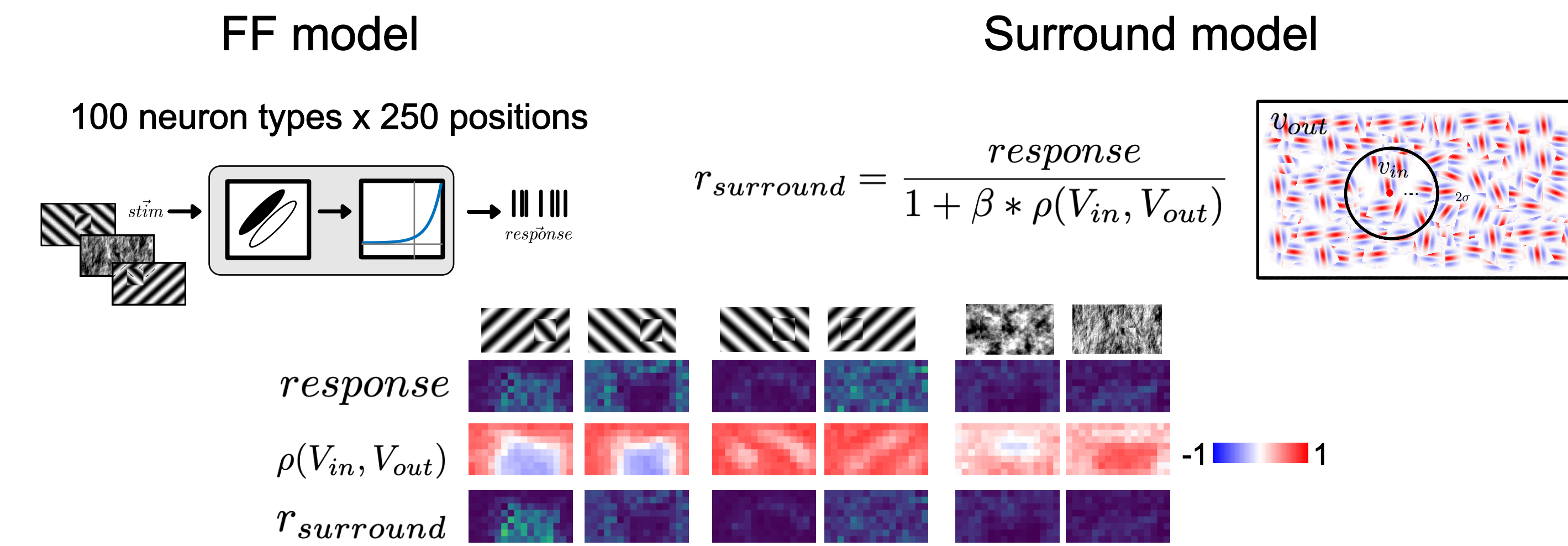
Readout of position using a linear decoder is best for cross-oriented textures, similar to behavioral results



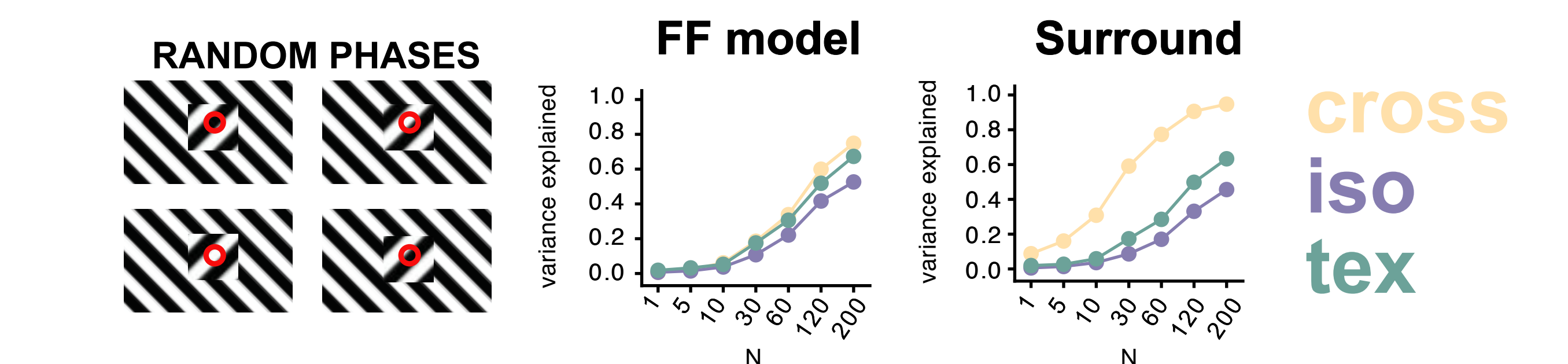
Position information is most prominent in visual area LM



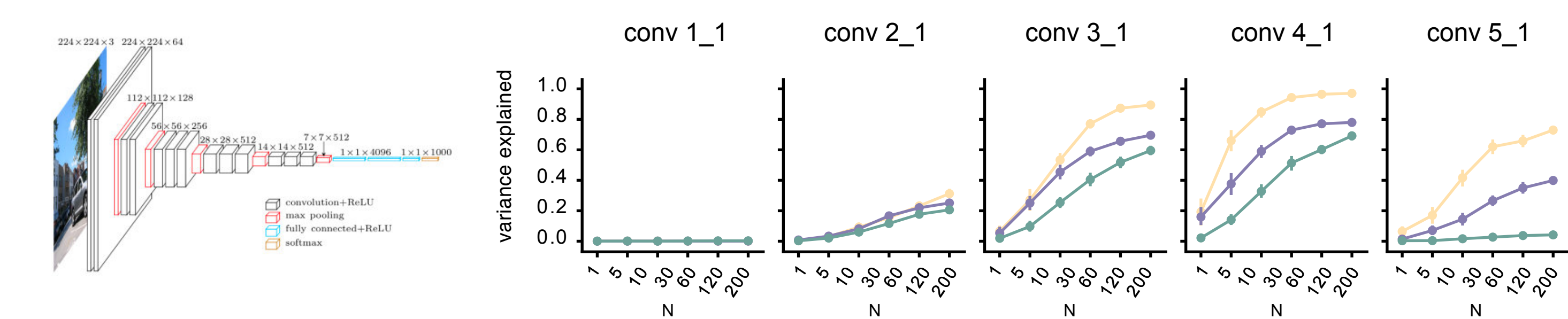
Modeling: how much is explained by feedforward model? Orientation tuned surround inhibition?



neither model (FF or surround) is able to fully explain texture differences in behavior (cross > iso > tex) in a phase-invariant manner



Mid to late layers of a deep network (VGG16) accurately predict the behavioral performance and generalization on the different texture classes (cross > iso > tex)



Conclusions

- Mice lack texture-invariant FG/BO modulation in single neurons
- Cross-orientation contrast is an important cue for segmentation
- Differential coherent motion of figure and ground seems irrelevant to segmentation for mice (key difference from primates)
- Orientation dependent surround interactions are insufficient to capture differences in behavioral performance to texture classes
- Mid to late layers of DNN (VGG16) do capture these differences