Determining how color and form are integrated within macaque V1 neurons through combined neurophysiology and computational modeling

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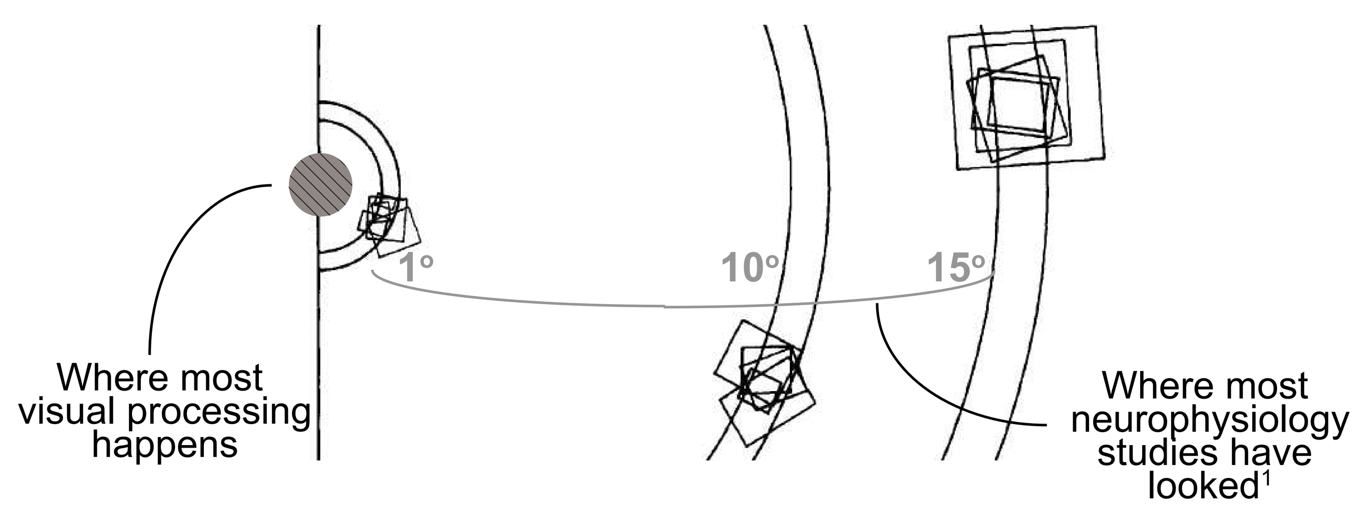
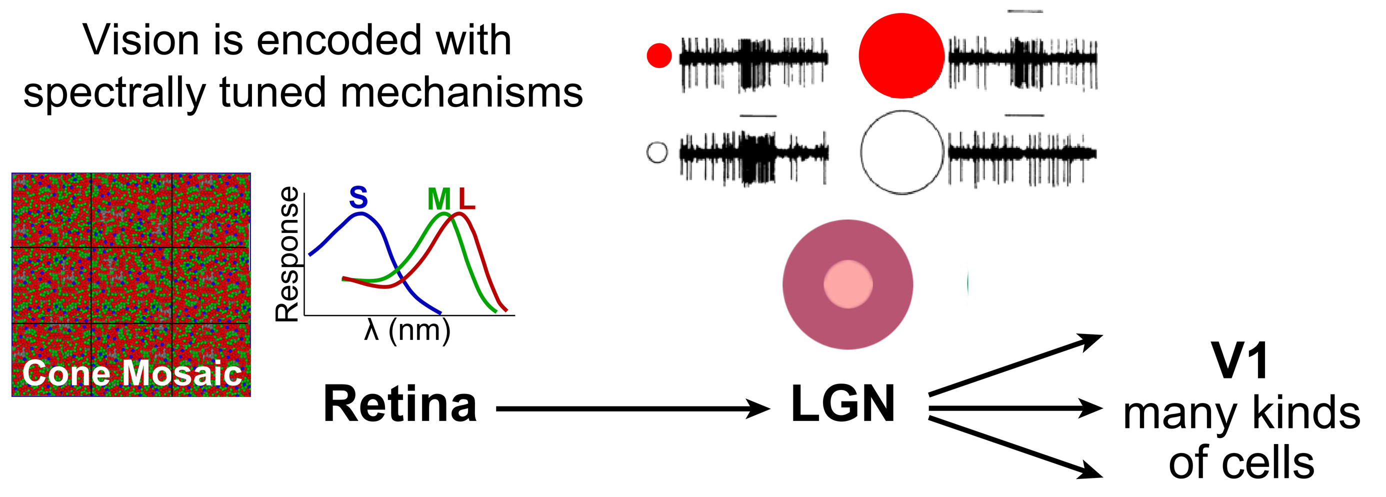
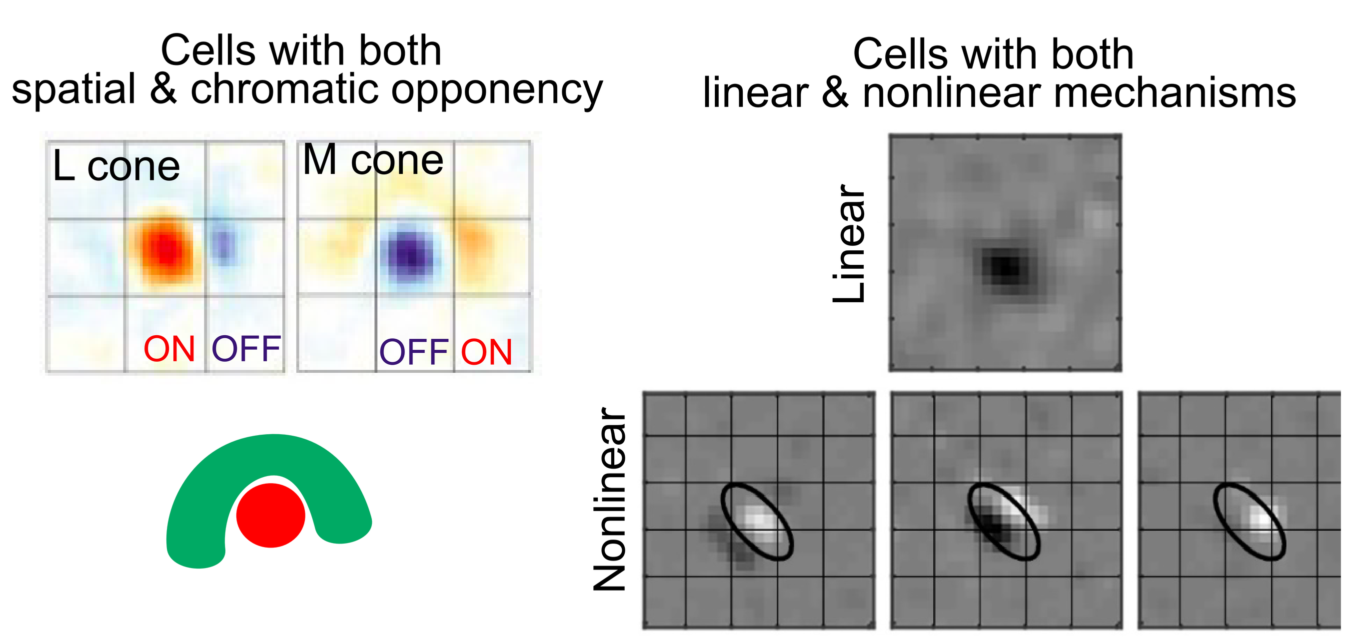
Background

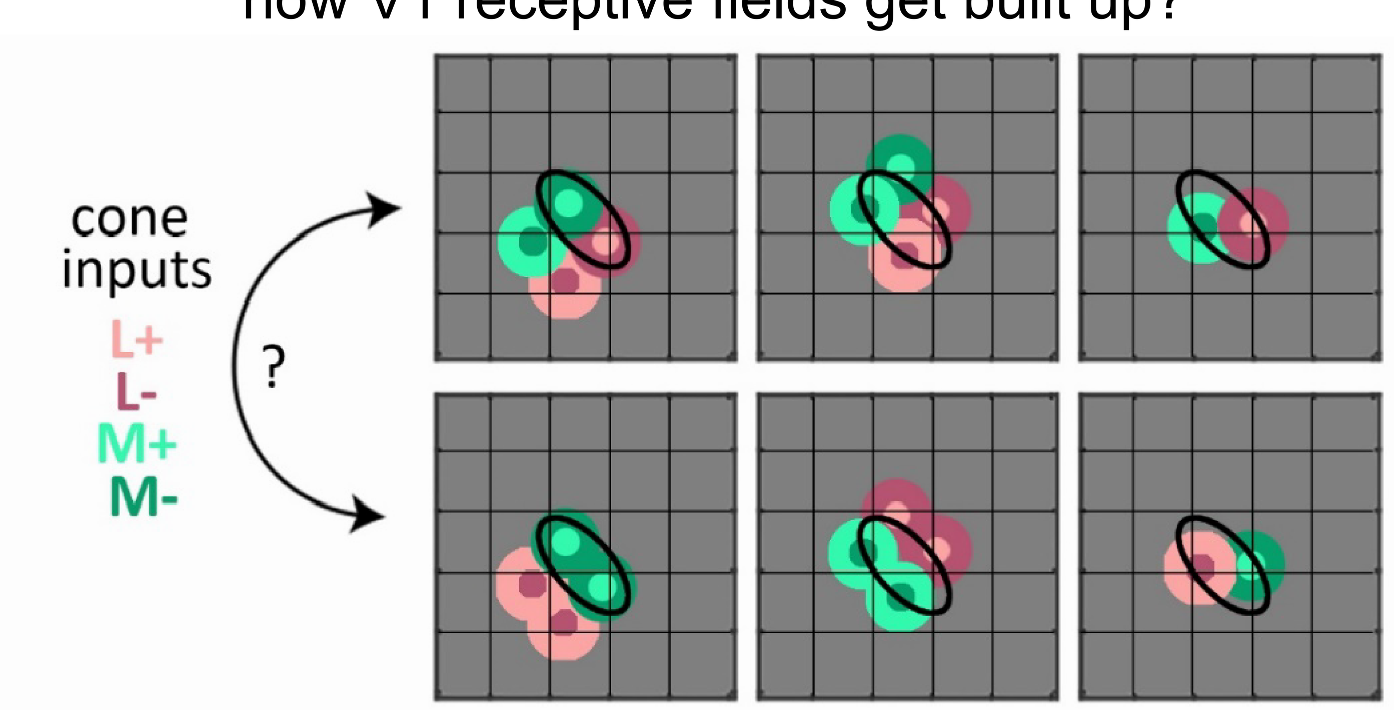
How do V1 receptive fields at the fovea process visual information?







Can we leverage color to investigate how V1 receptive fields get built up?

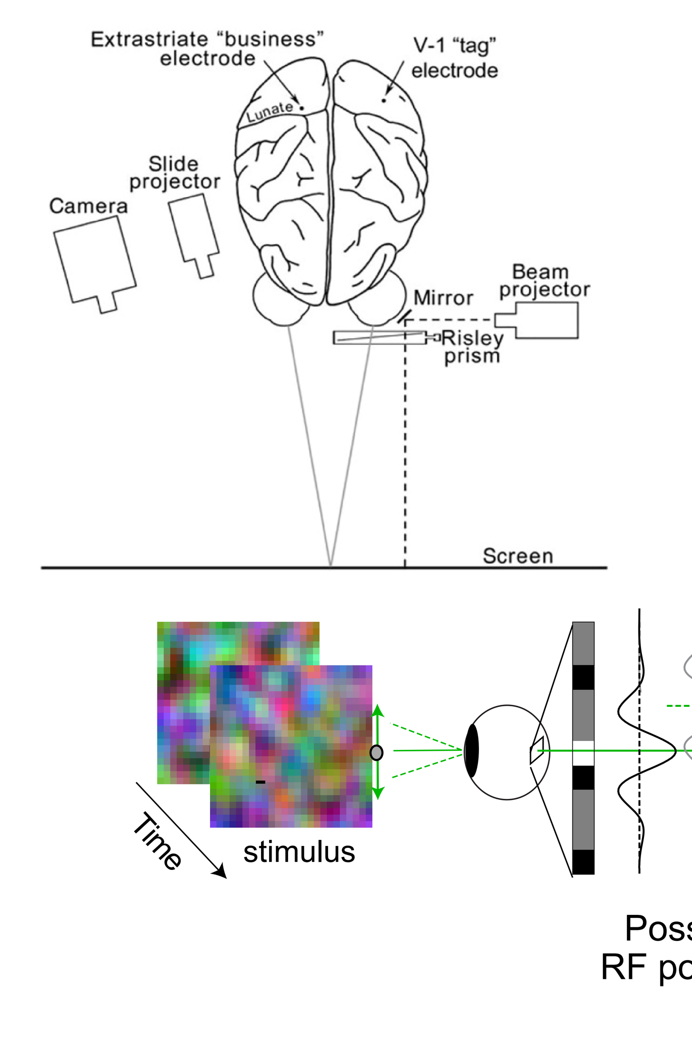


What we need:

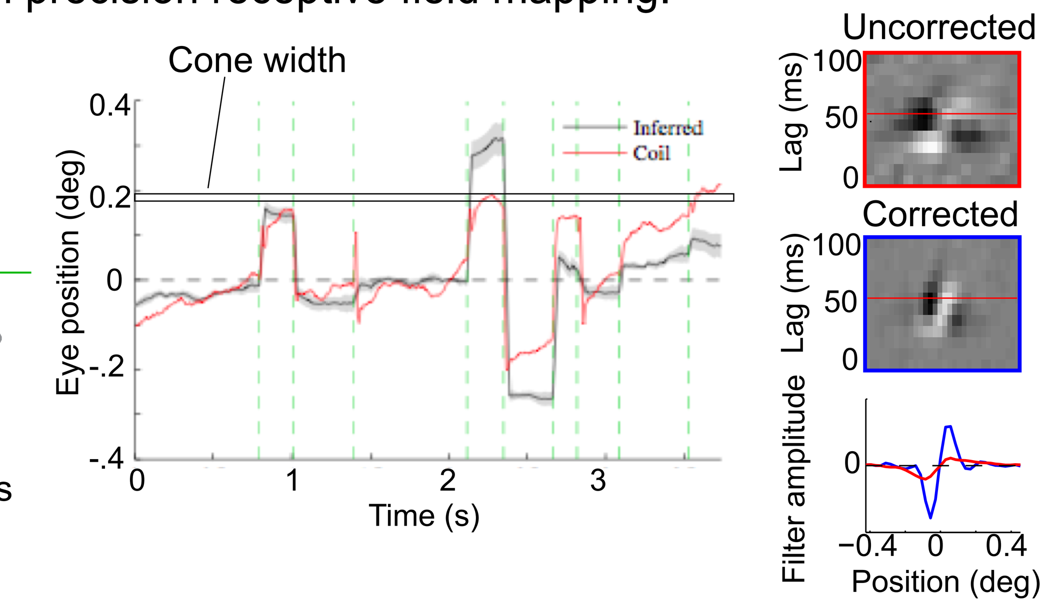
1. Photoreceptor-resolution eye tracking
2. Methods for recovering subunit structure

[1] Hubel, D. H., & Wiesel, T. N. (2004). Brain and visual perception: the story of a 25-year collaboration. OUP.
[2] Conway, B. R. (2001). Spatial structure of cone inputs to color cells in alert macaque V-1. J Neurosci, 21(8), 2768-83.
[3] McFarland JM, Cui Y, Butts DA (2013) Inferring nonlinear neuronal computation.... PLoS Comp Biol 9(7), e1003143.
[4] Hubel, D. H., Wiesel, T. N., et al., (2015). Binocular stereoscopy... Cerebral Cortex, 25(4), 951
[5] McFarland, J. M., Bondy, A. G., et al., (2014). High-resolution eye tracking.... Nat comm, 5(1), 1-12.

1. Neurophysiological recordings to measure eye movements

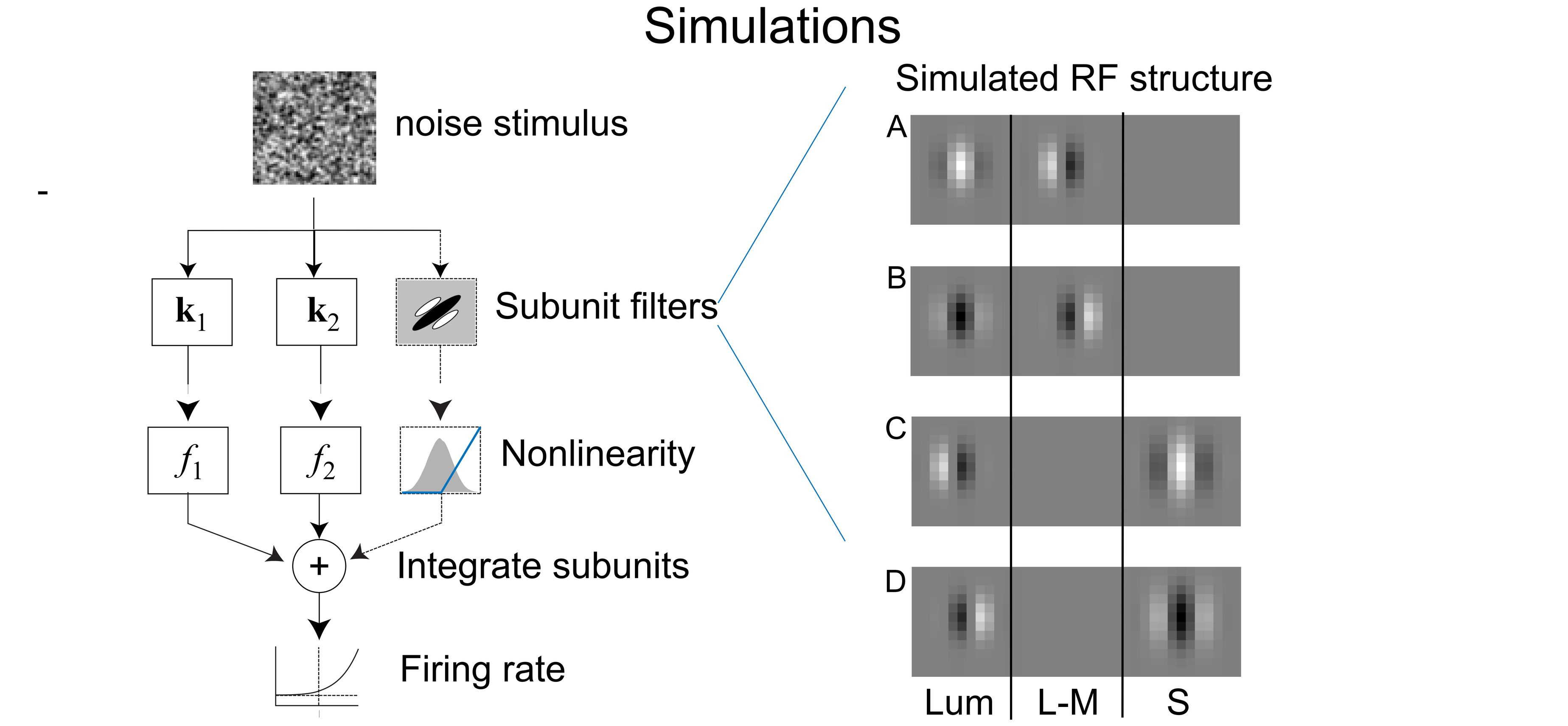


Typically, we relate changes in neural responses to changes in stimulus location while keeping eye position fixed. But we can also relate changes of activity to changes in eye position while keeping the stimulus fixed[4]. With a large enough array of neural recordings tiling a section of the visual field, we can measure eye position at **millisecond** and **arcminute** resolution[5]. We can then know the stimulus position on the retina at photoreceptor resolution, affording high precision receptive field mapping.

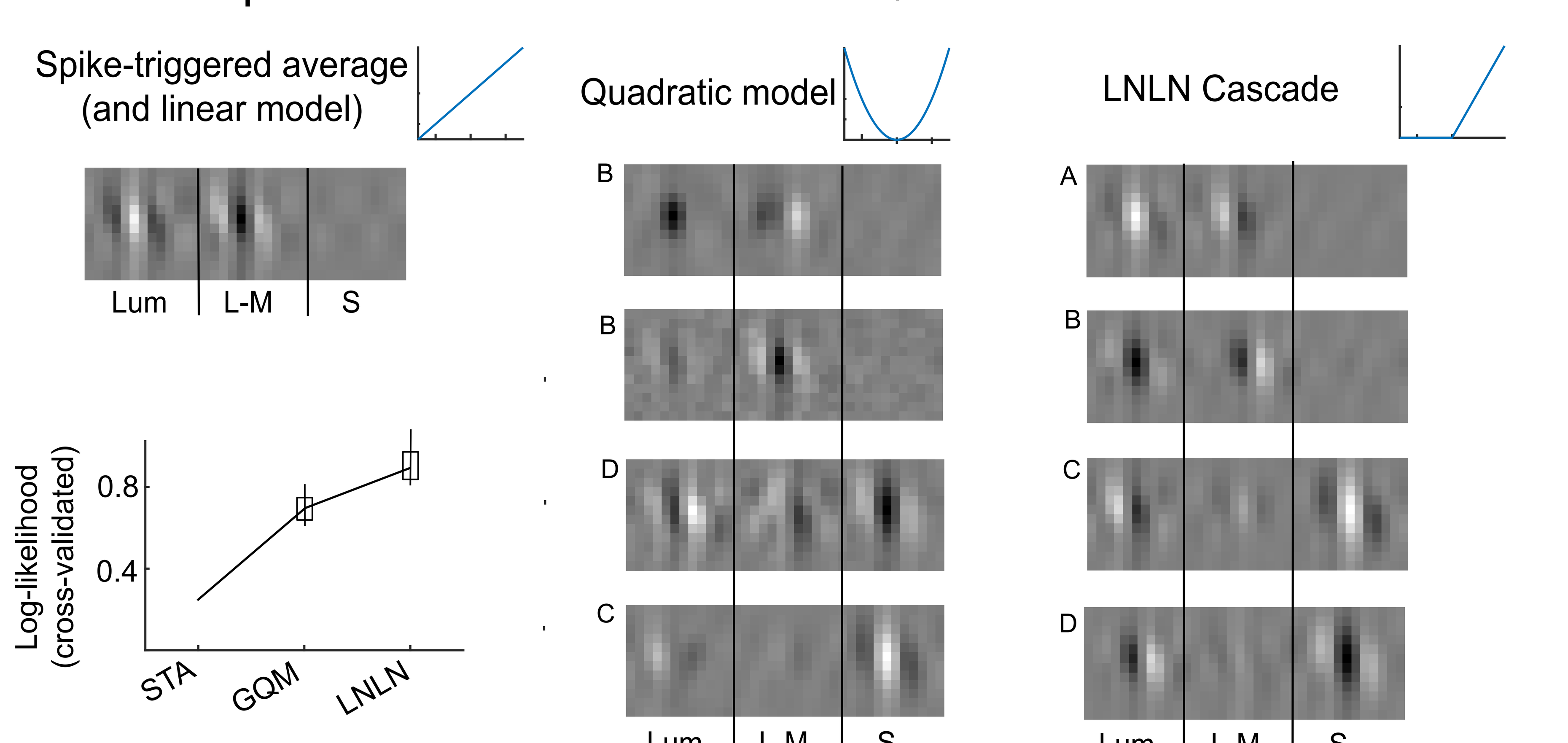


2. Nonlinear models best capture complex receptive field structure

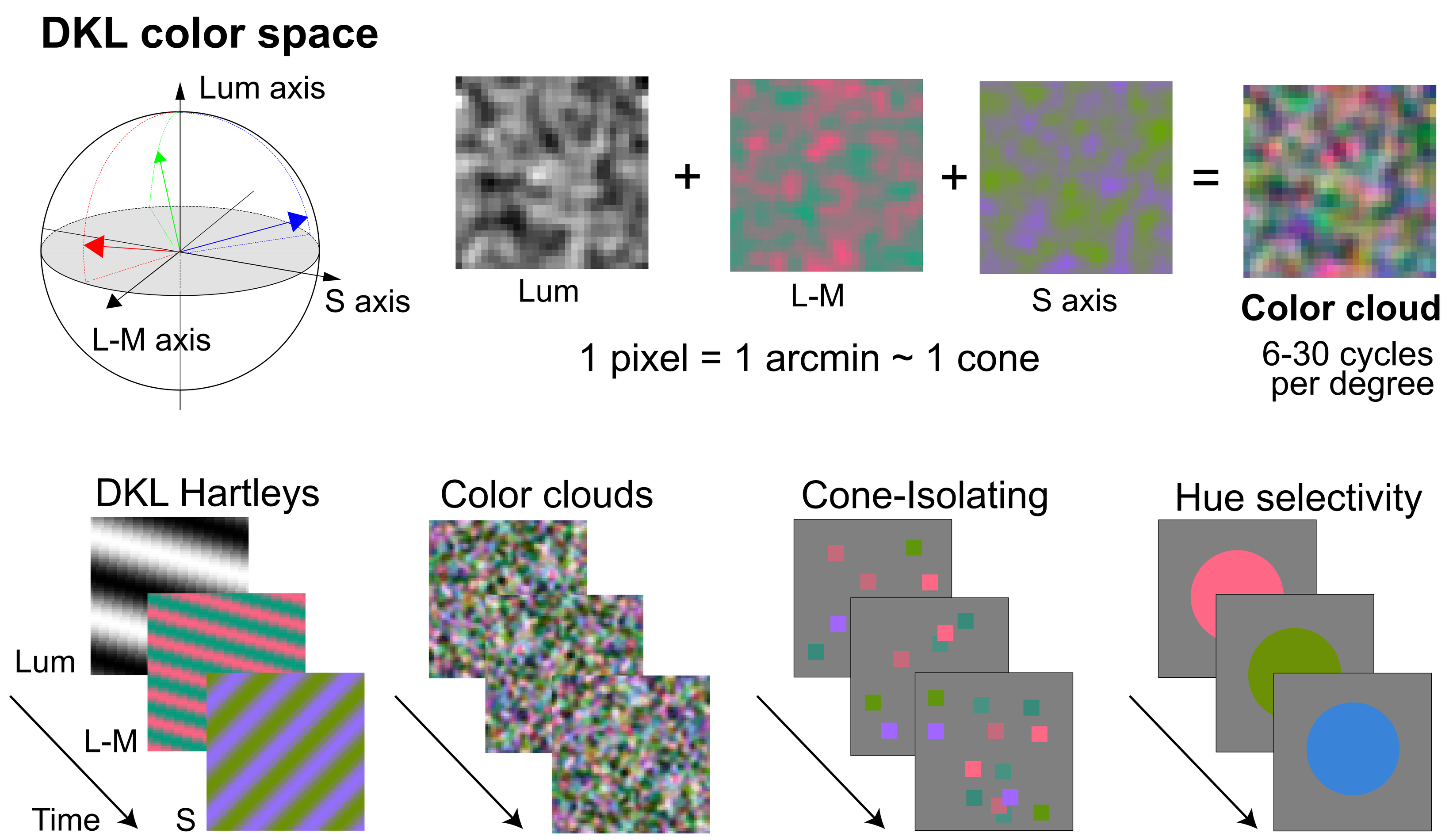
Simulations



What components can different models recover?



Stimulus Design



Preliminary neurophysiology results