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Attention-Dependent Representation of a Size Illusion in Human V1

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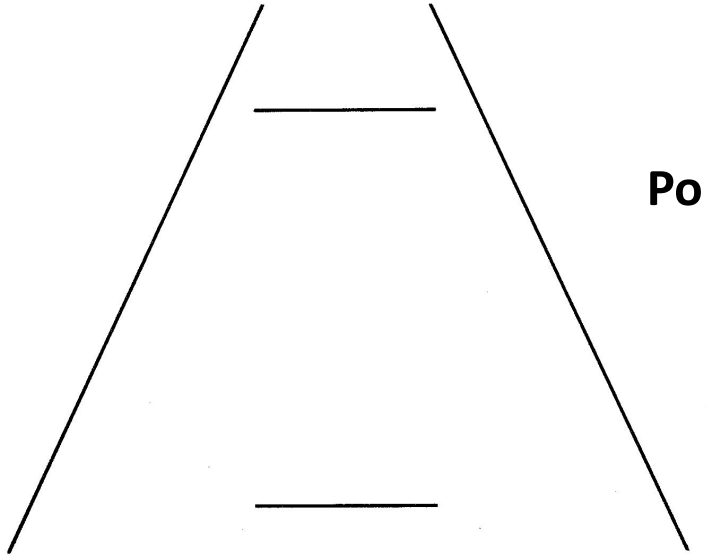
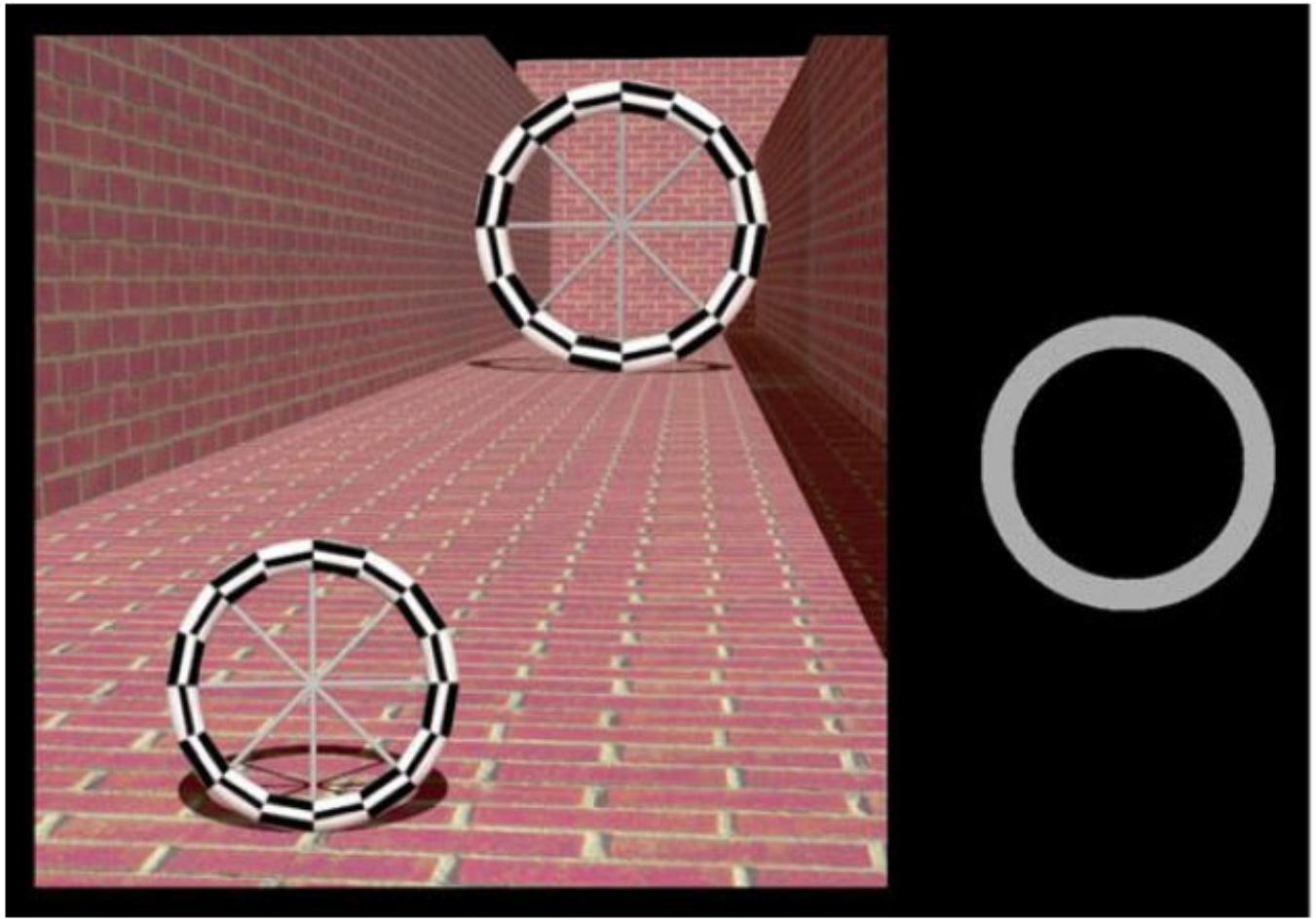
Working definitions



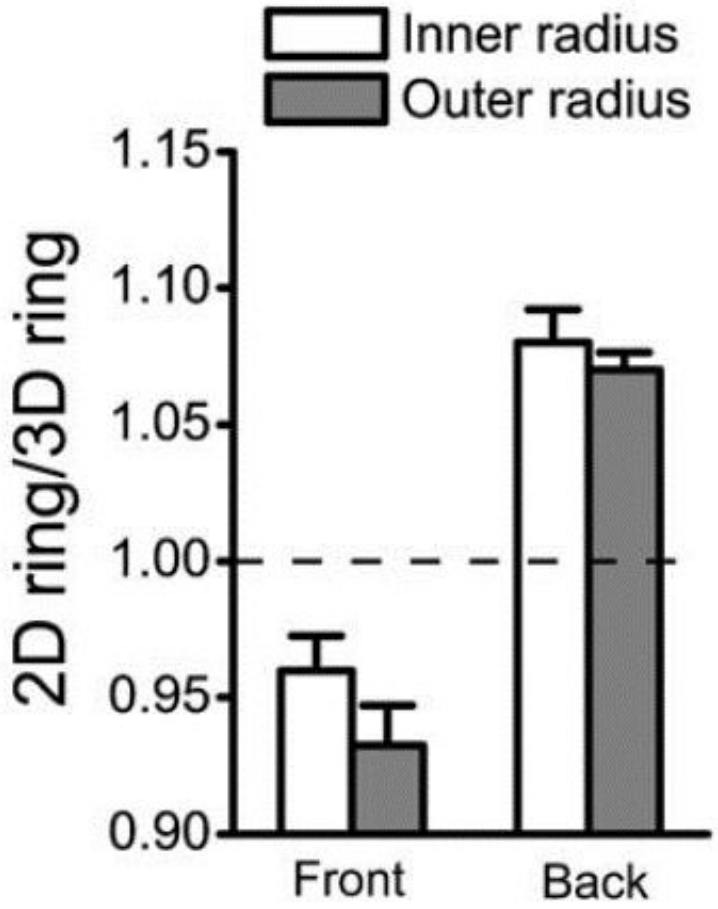
Ponzo illusion

Size constancy is phenomenal rescaling of the retinal size of an object to match distance at which it is perceived

Attention is a set of mechanisms providing a selective access for a part of the input to deeper perceptual processing

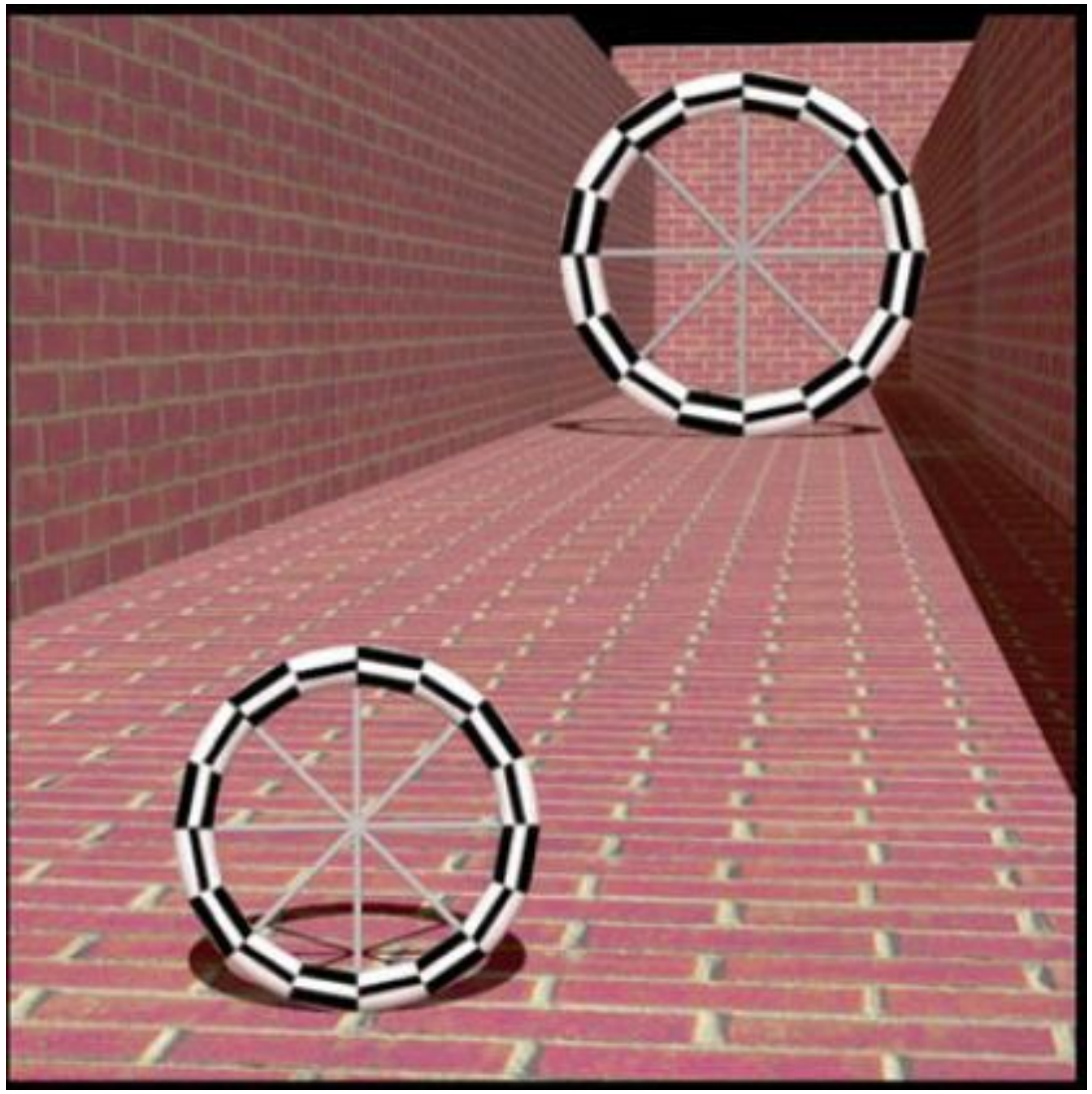


Psychophysical task: Adjust the size of the probe ring to match the size of either the front, or the back ring



Psychophysical results

fMRI data collection



Data about apparent sizes

Fixate spokes intersection of a still ring (baseline, 20 s) followed by phase flicker (10 s)

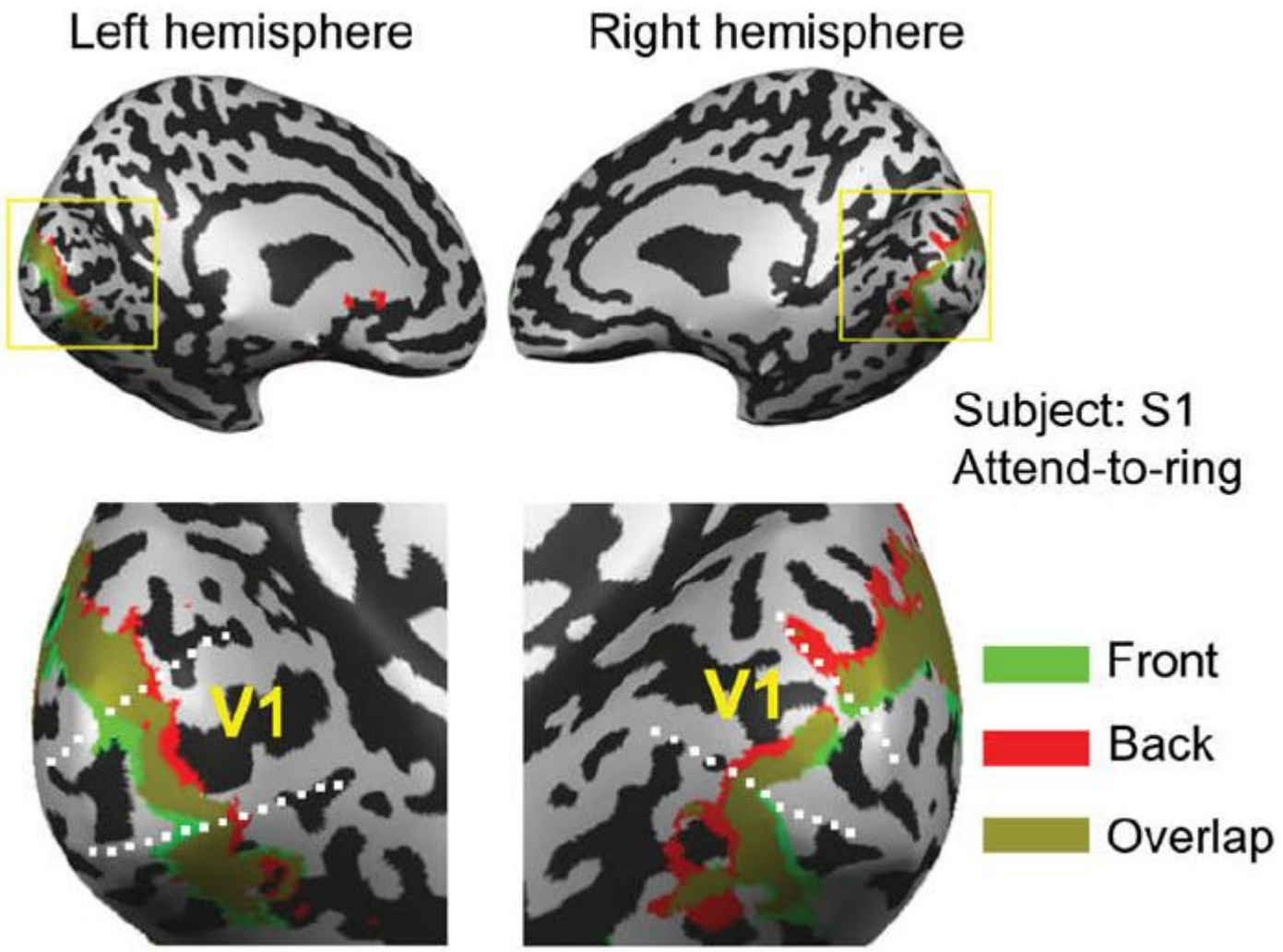
Move to another ring

Attentional manipulation

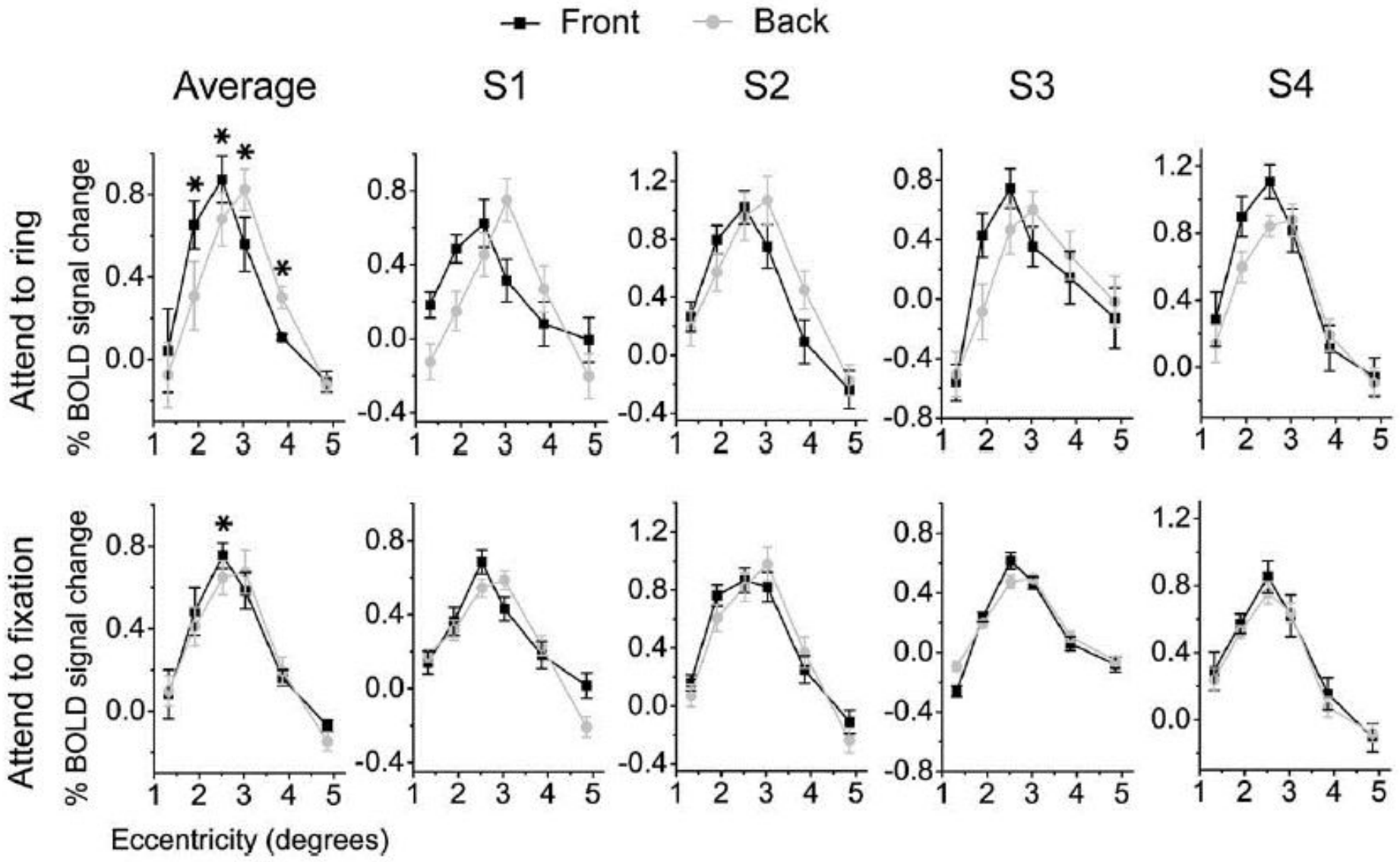
Attention towards rings: Detect a 250-ms flicker pause on a fixated ring

Attention away from rings: Detect a small luminance change at a fixation point

fMRI image differences

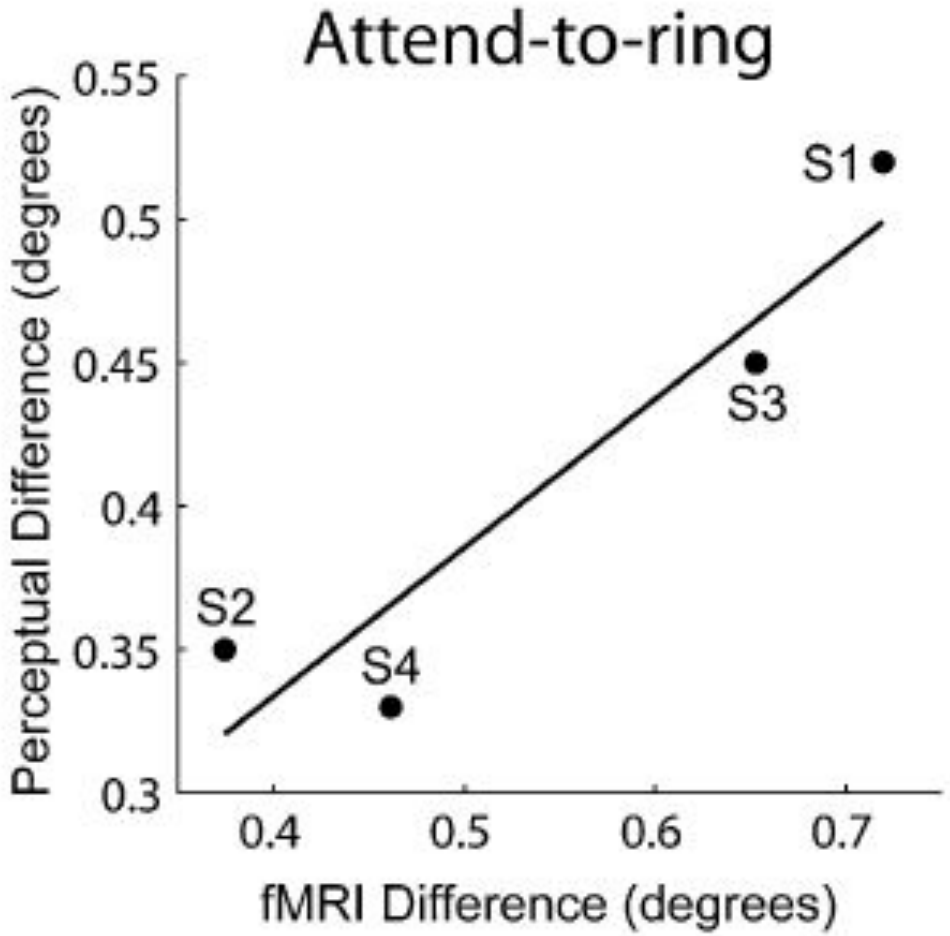


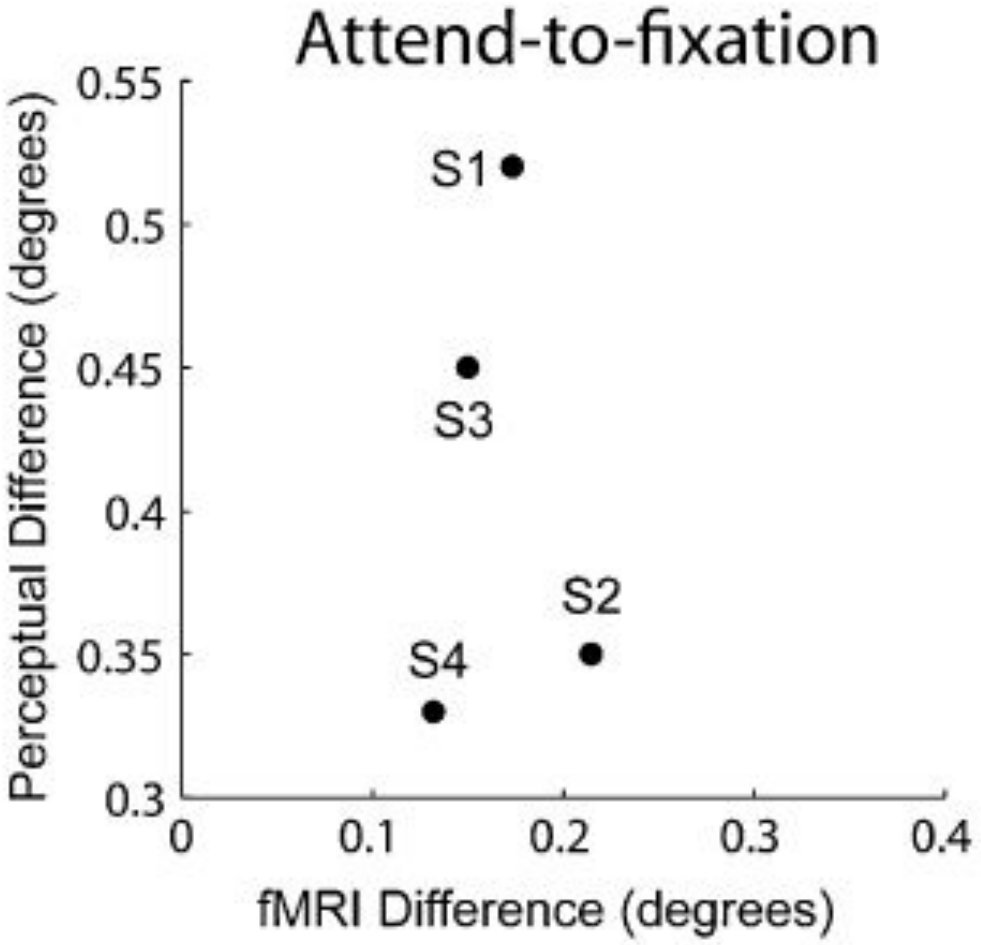
Attentional effects



Activation is shifted away from the center at the ‘back’ condition

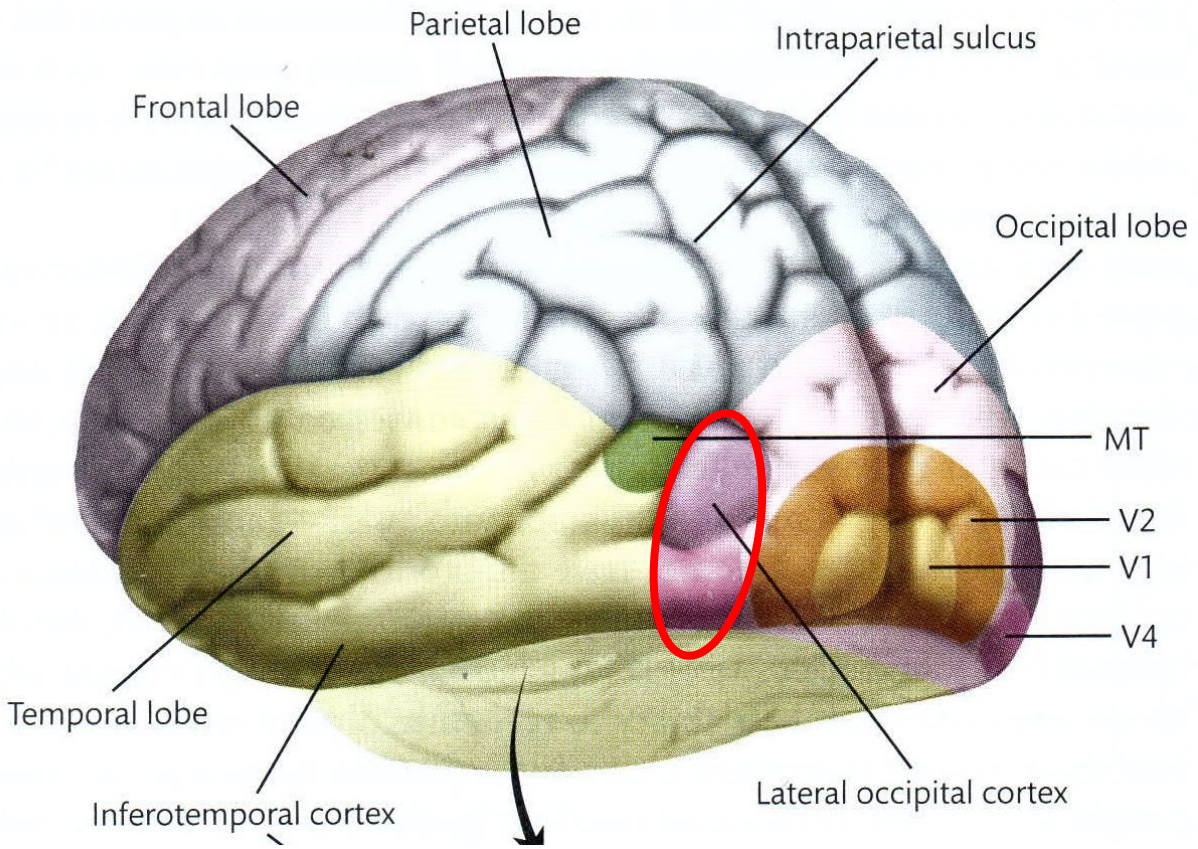
The change in activation is substantially weaker

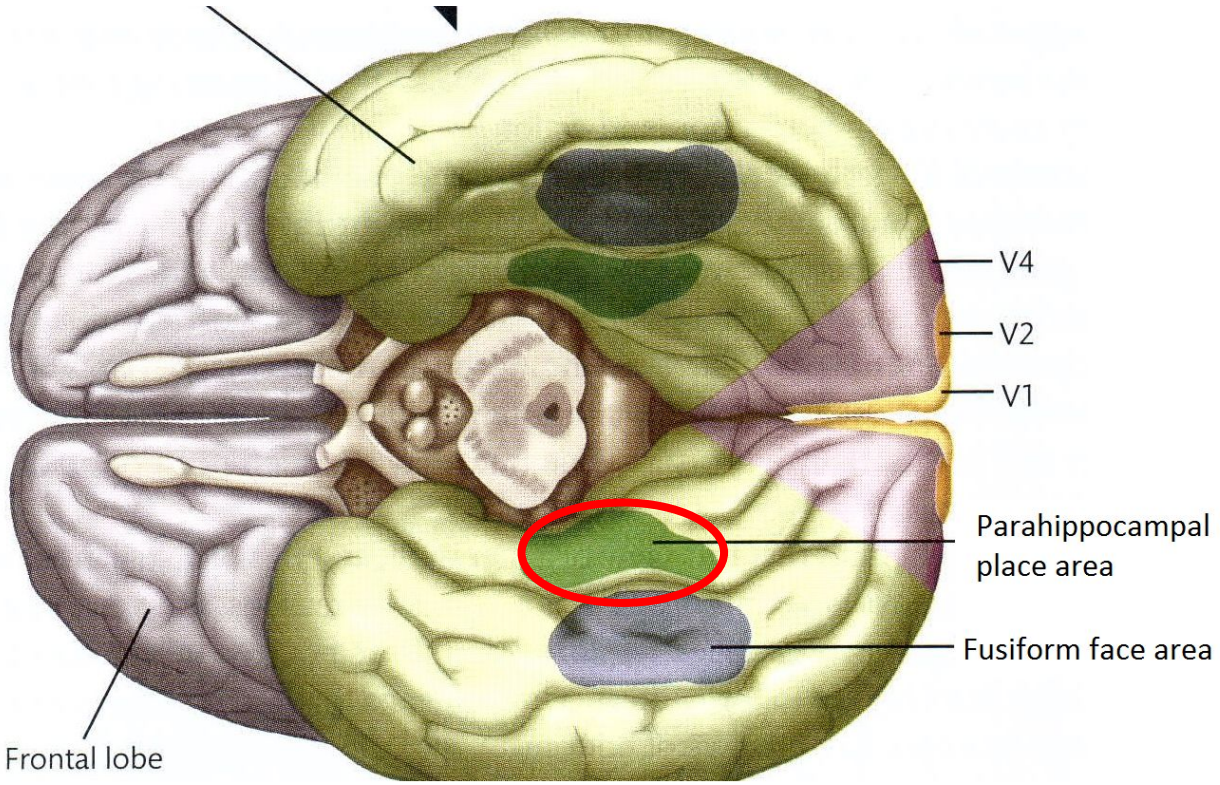




fMRI differences correlate with perceptual difference (illusion magnitude) but only in the ‘attend-to-fixation’ task.

Additional low-resolution fMRI session





Activation in LOC and PPA were found to be decreased under ‘attend-to-fixation’. This suggests that V1 size rescaling is modulated by feedback from higher-level visual fields (presumably associated with representing the properties of *objects* and *scenes*)

Bonus material

How does V1 rescale the size?

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Object-Centered Shifts of Receptive Field Positions in Monkey Primary Visual Cortex

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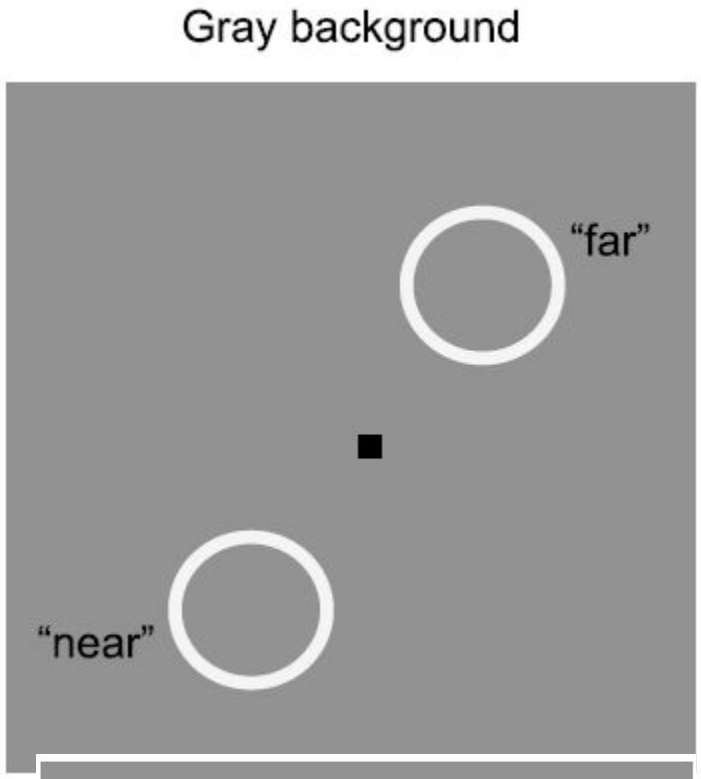
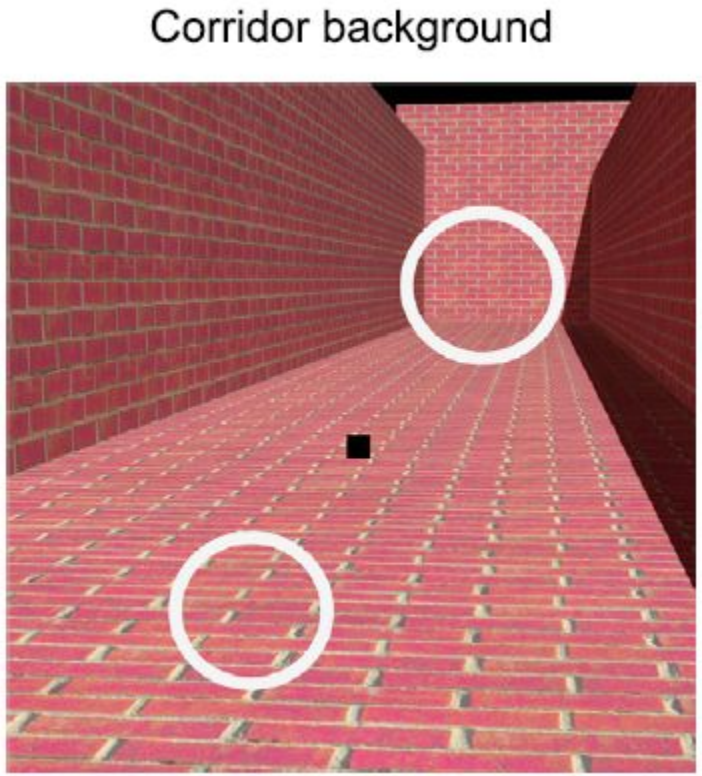
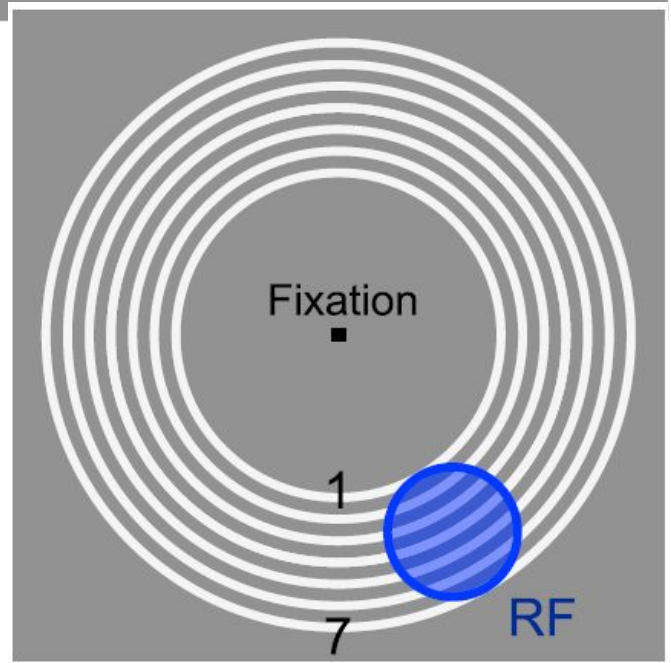
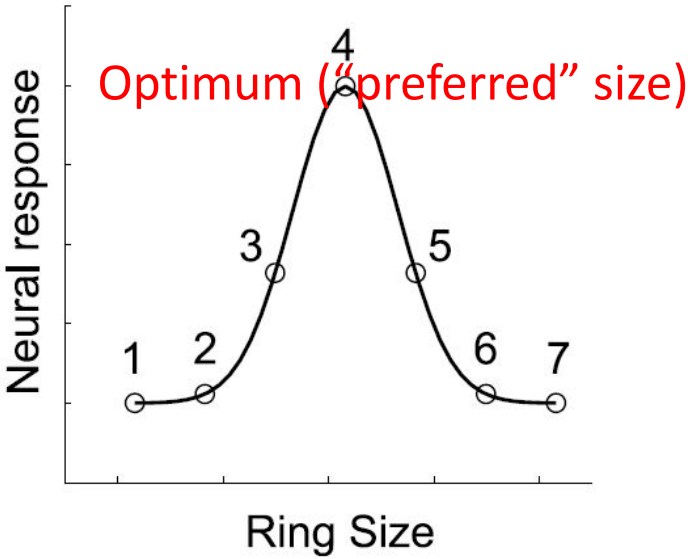








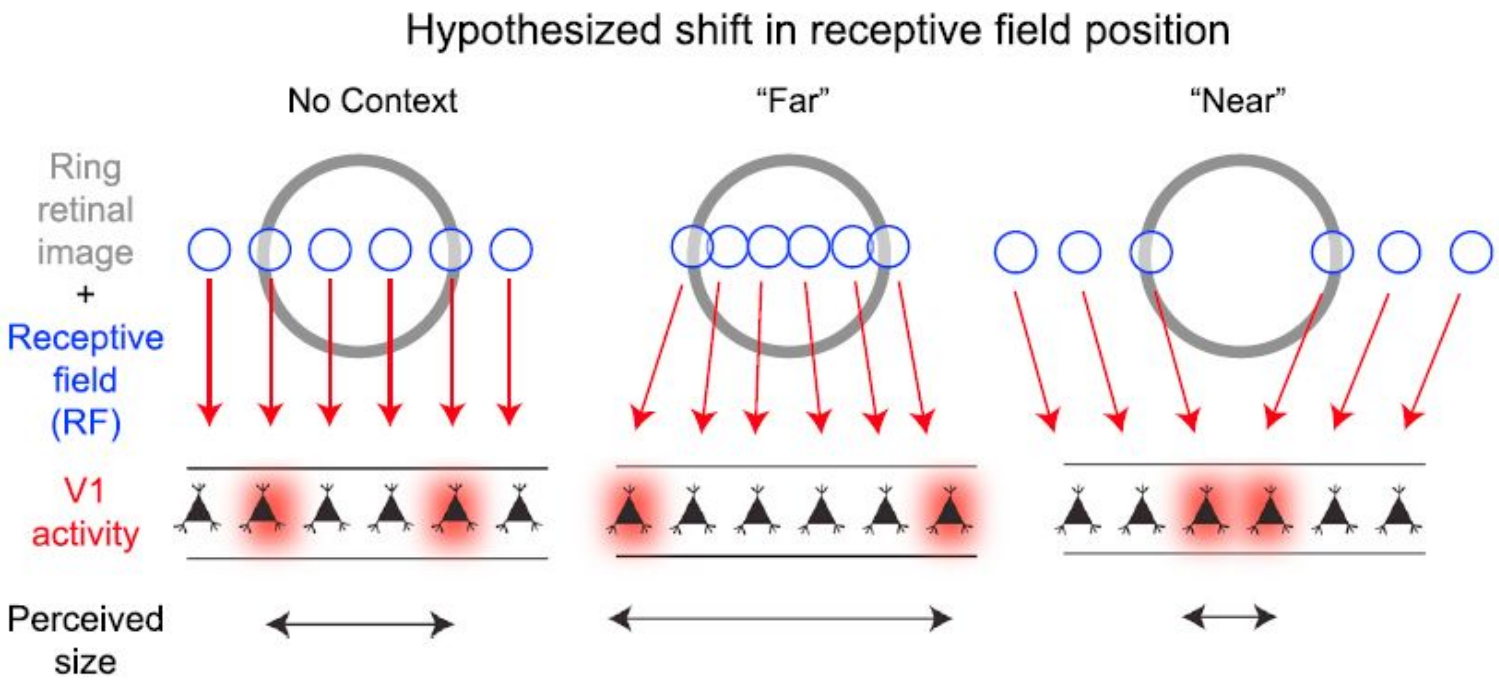
Psychophysics

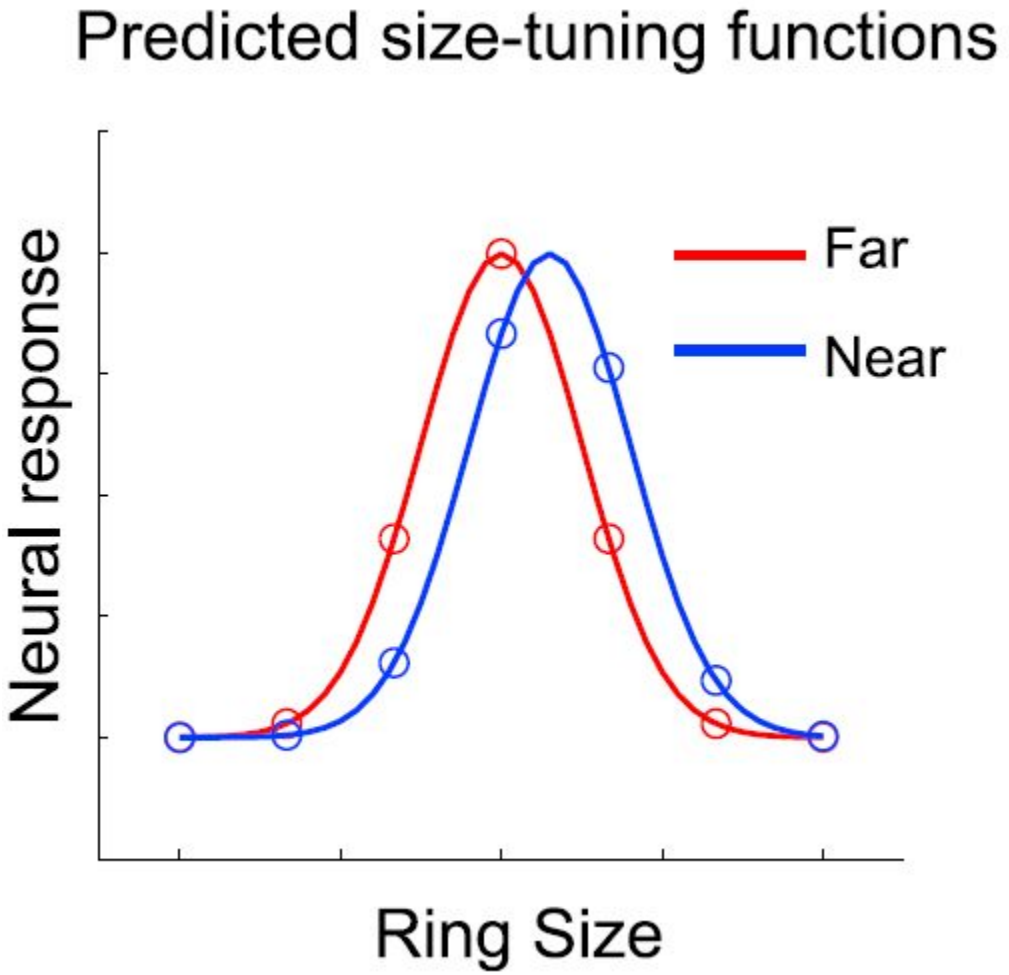
Monkeys (*n* = 2) were trained to fixate a larger ring (on a gray background)
They were then tested both with the gray and with a corridor background

Single-unit recordings

V1 cell responses were recorded
For each cell 7 ring sizes were tested eliciting firing rates around an optimum for their receptive fields (RF)

Predictions





The edge (ring) of a far object should cause more activation in the RF of neurons "preferring" larger sizes

<u>Counterintuitive but logically correct:</u>
This means that that the *far* ring should shift the RF *inwards*. That is, the cell switches to prefer smaller rings to compensate for distance.

Principal result