Neural correlates of spatial heterogeneity in size perception

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Perceptual biases can vary dramatically across the visual field even within individuals. The neural basis of this remains unclear.

We developed a task to efficiently map biases in size perception for simple circle stimuli at several locations multiple alternatives perceptual search (MAPS).

On average (n=10) targets were perceived as smaller than the reference (+ve PSE). This effect increased with target eccentricity, which replicates previous reports. Perceptual biases for Delboeuf illusion stimuli went into the opposite direction, that is targets were perceived as larger than the reference.

Importantly, individual spatial patterns of perceptual biases correlated strongly across eccentricities and also modestly between the isolated circle and Delboeuf illusion stimuli.

This suggests that the visual field quadrant where a stimulus was presented was more important than its precise location.

Previous research suggests that perceived size may be inferred from the spatial extent of stimulus representations in early retinotopic cortex. We used functional MRI with population receptive field (pRF) mapping to test whether spatial tuning (pRF size) can explain idiosyncratic biases in size perception.

Participants viewed wedge and ring stimuli filled with natural images. We used a forward modelling approach to estimate the visual field position and the size of the pRF for every voxel in primary visual cortex (V1).

Average pRF size at the corresponding locations in contralateral V1 correlated with the perceptual biases measured in the behavioral experiment (pooled across eccentricities: r=0.41, p=0.0009). In scatter plots above greyscale of contours denotes increasing Mahalanobis distance. Different symbols denote individual participants.

Our findings are consistent with the hypothesis that perceived size is inferred from V1 stimulus representations. Idiosyncrasies in the spatial tuning of neuronal populations in V1 correlate strongly with the individual biases in size perception measured behaviorally.

This suggest that it is possible to reconstruct a person’s subjective experience of a stimulus based on the individual functional tuning properties of their visual cortex.

References