Interhemispheric suppression: The case of the missing vertical meridian

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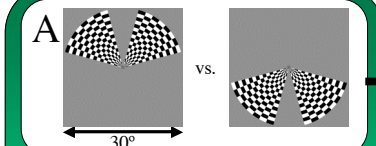
Summary

Bilateral stimuli, mirrored across the vertical meridian, evoke weaker fMRI activations than unilateral stimuli, by 5–10% in the human lateral geniculate nucleus (LGN) and 10–20% in the superior colliculus (SC). This suppression can account for a significant portion of the under-respresentation of the vertical meridian observed in retinotopic maps of these structures.

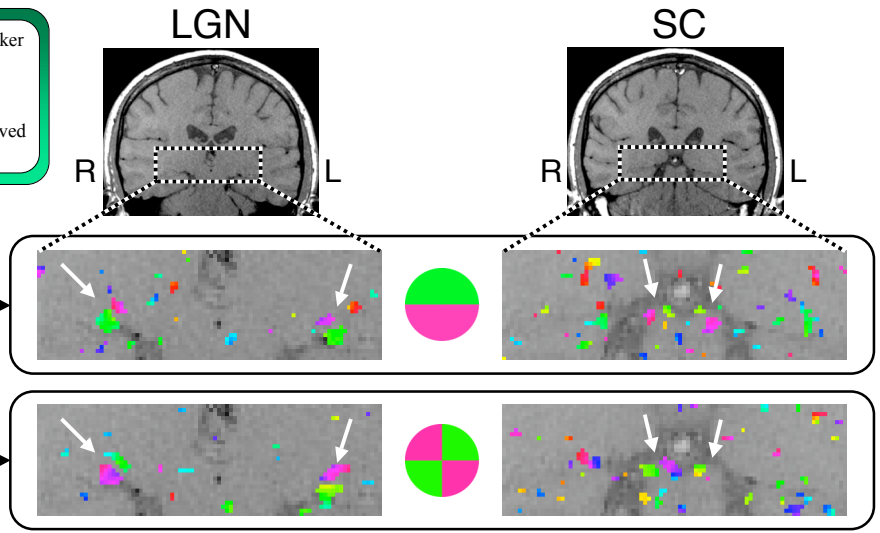
Stimuli



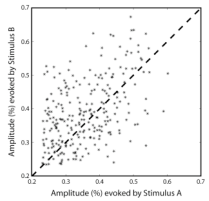
4 Hz contrast-reversing checkerboards, 16 or 17.5 s blocks, 8 cycles per scan. Each quadrant receives the same stimulus pattern, but opposite hemifields are in-phase in A and out-of-phase in B.

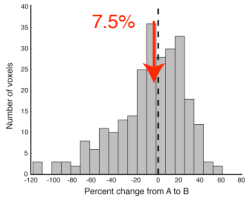
Methods

MRI Procedures: Images were acquired using a 3T Siemens Trio scanner with an 8-channel head coil. 18 interleaved coronal slices (1.9 mm thick, no gap) were acquired with a standard EPI sequence (TR = 2 or 2.5 s, TE = 42 ms, FA = 90°), 192 mm FOV, 128 × 128 matrix (1.5 × 1.5 × 1.9 mm³ voxel resolution), partial phase Fourier = 7/8, GRAPPA parallel imaging with 2× acceleration factor and bandwidth = 752 Hz/px. The most posterior slice was positioned near the posterior edge of the corpus collosum.
Stimuli: Observers maintained fixation while passively viewing the 100% contrast checkerboard patterns. The stimuli patterns in A and B were presented in separate scanning runs, 6 runs each, within the same scanning session.
Analysis: The images were registered and interpolated to twice the resolution in each dimension. 6 scanning runs of 112 or 128 time points for each stimulus were averaged. The first stimulus cycle was omitted and a Fourier analysis was performed on the remaining time series to calculate the phase, amplitude and correlation components of each voxel's response. Responses were thresholded at $r \geq .25$ ($p < .0064$ or .0038). Response amplitudes were compared for each voxel that was jointly activated by both stimuli.

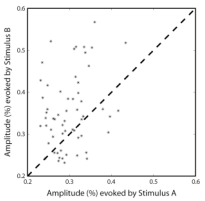


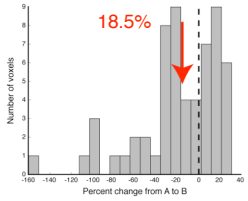
LGN Voxels



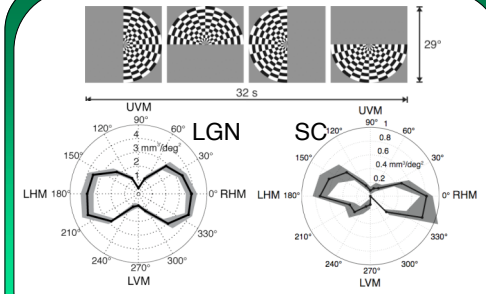


SC Voxels

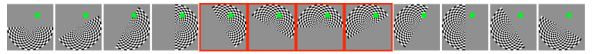


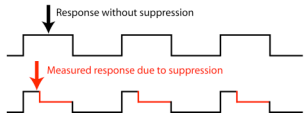


Retinotopy



The distribution of the retinotopic positions of the voxels in the LGN and SC show marked under-respresentations of the vertical meridian.





Responses are suppressed when the contralateral receptive field is also stimulated, causing the phase response and thus the location to be mismeasured. The effect is largest at the vertical meridian, and the resulting retinotopic distribution over all voxels becomes more eccentric for higher levels of suppression.