Retinotopic organization and functional subdivisions of the human lateral geniculate nucleus and superior colliculus

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The lateral geniculate nucleus (LGN) of the thalamus and the superior colliculus (SC) have been well studied in other primates, but the study of their organization and function in humans has been largely limited to lesion and post-mortem analyses. Here we show that the retinotopic structure of the LGN, including its eccentricity and polar angle magnification factors, can be measured with a 3T MRI scanner and a high-resolution imaging sequence (1.5 × 1.5 × 2 mm voxel size). Sensitivity to stimulus contrast varied throughout the extent of the LGN, and based on this, we attempted to distinguish the magnocellular and parvocellular divisions. In the SC, contralateral activation was observed, but unlike in the LGN, contrast sensitivity was uniform throughout its extent.

Methods

Observers were scanned in three separate sessions, one for each stimulus type (A: stimulus used to map polar angle, B: stimulus used to measure contrast sensitivity, C: stimulus used to map eccentricity). Time series of identically-sized voxels in the visual cortex. The images were registered to correct for motion and scanner drift but were not processed further. For each voxel responsive to the 10% stimulus, the amplitudes are plotted in response to the 100% (left column of pair) and 10% (right column) stimulus. Open circles: CMI < .25. A. Mean LGN time series. B. Histogram of the contrast modulation index CMI = (A100% + A10%) / (A100% + A10%) ≥ 0.25. C. Magnification comparison. D. Spatial specificity. E. Magnification comparison. F. Spatial specificity. G. Magnification comparison. H. Spatial specificity. I. Magnification comparison. J. Spatial specificity. K. Magnification comparison. L. Spatial specificity. M. Magnification comparison. N. Spatial specificity.