Identifying the layers in the human lateral geniculate nucleus using quantitative and functional MRI
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SUMMARY
The lateral geniculate nucleus (LGN), a part of the thalamus, acts as a relay between retina and visual cortex. Imaging the LGN and its M and P layers has been of great interest due to their role in cognitive and clinical phenomena. LGN consists of 6 layers all of which are monocular neurons, receiving input from a single eye:
- M = Magnocellular
- P = Parvocellular
- C = Contralateral Eye
- I = Ipsilateral Eye

Previous fMRI research manipulated the stimulus characteristics to bias M and P differentially (Denison et al., 2014; Zhang et al., 2015). However, hilum could be mistaken as M layers with stimulus-dependent fMRI techniques (DeSimone & Schneider, 2019). We employed MRI techniques at 3T that were not dependent on stimulus characteristics:
1) Quantitative MRI method (qMRI). Müller-Axt et al. (2021) found shorter longitudinal relaxation time (qT1) for P than M at 7T, indicating more myelination in the P layers with higher cell density.
2) fMRI methods with the same stimuli. Eye-specific stimulation with monocular (Haynes et al., 2005) and dichoptic (Qian et al., 2020) viewing conditions.

METHODS

qMRI RESULTS

Generalized Linear Model (GLM): Contrast between the eyes

fMRI RESULTS

Better signal with MONOCULAR viewing
More consistent results with OPNMF analysis

Orthonormal Projective Non-negative Matrix Factorization (OPNMF): Unsupervised analysis with the number of components (K) defined, producing non-negative weights (W) for voxels and non-negative coefficients (H) for time samples

CONCLUSIONS
Quantitative imaging is promising to segregate the M and P layers.
- Replicated Müller-Axt et al. (2021) at 3T and at the individual level
- Reasonable time for application (~2h)
Functionally identifying the eye-specific layers is not reliable with GLM analysis.
- More consistent classification with OPNMF
- Clusters instead of layers → No contralateral M layer