Mapping Spatial Frequency Preferences in the Human Visual Cortex

William F. Broderick[1], Noah C. Benson[2], Eero P. Simoncelli[1,3], and Jonathan Winawer[2]

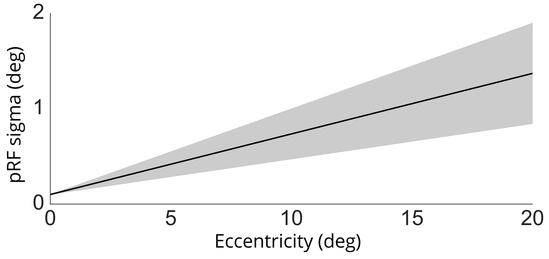
1. New York University Center for Neural Science 2. New York University Department of Psychology 3. Howard Hughes Medical Institute

Contact: wfb229@nyu.edu

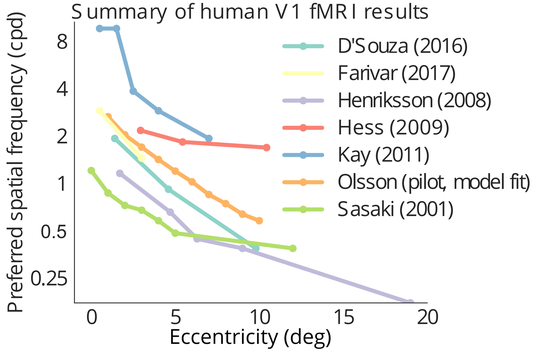
NYU NEUROSCIENCE

How do spatial frequency preferences change with eccentricity?

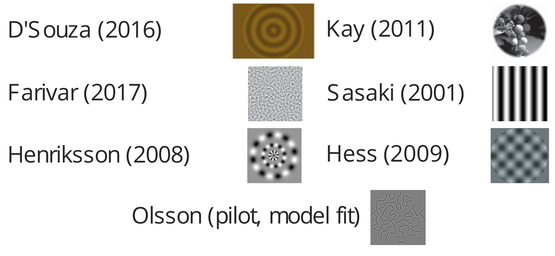
- V1 population receptive field size grows linearly with eccentricity[1]



- Previous results show peak spatial frequency decreases with eccentricity, but actual numbers vary by two to three octaves!



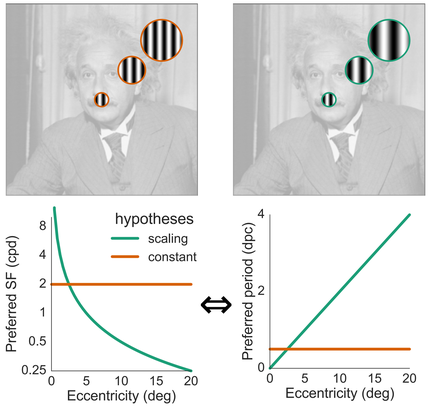
- Variability perhaps due to inconsistent stimuli



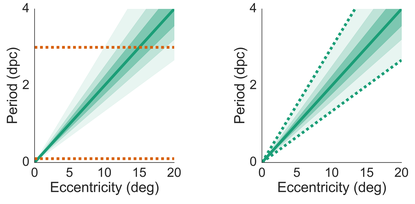
Extreme Possibilities

SF preferences constant across visual field

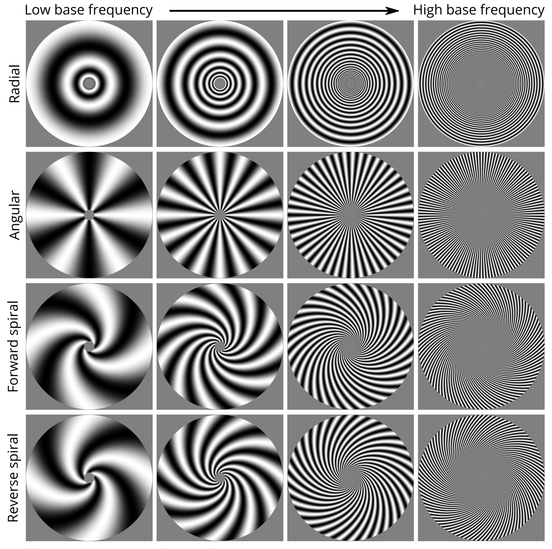
SF preferences scale with eccentricity / receptive field size



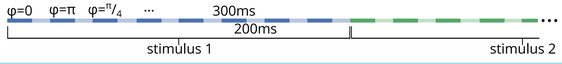
Traditional full-field stimuli are inefficient



Stimuli and Task

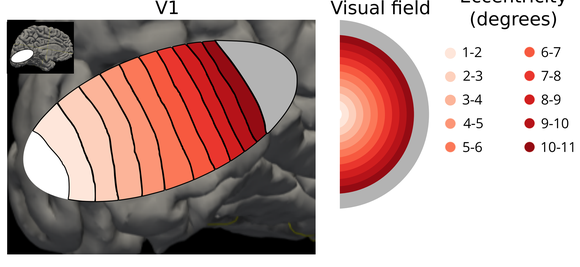


- 40 log-polar gratings, 8 phases each
- Stimuli spanned 1 to 12 degrees
- Stimuli presented once in each of 12 runs in random order
- 1-back task on digit stream at fixation

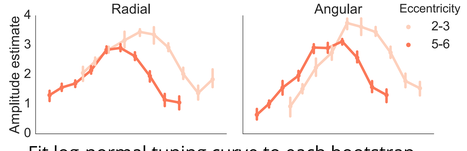


Analysis

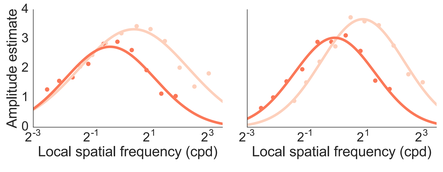
- GLMdenoise[2] to estimate a (bootstrapped) response amplitude per voxel per stimulus
- Bayesian retinotopy[3] to estimate an eccentricity and angle for each voxel's population receptive field



Extract data and average by eccentricity band

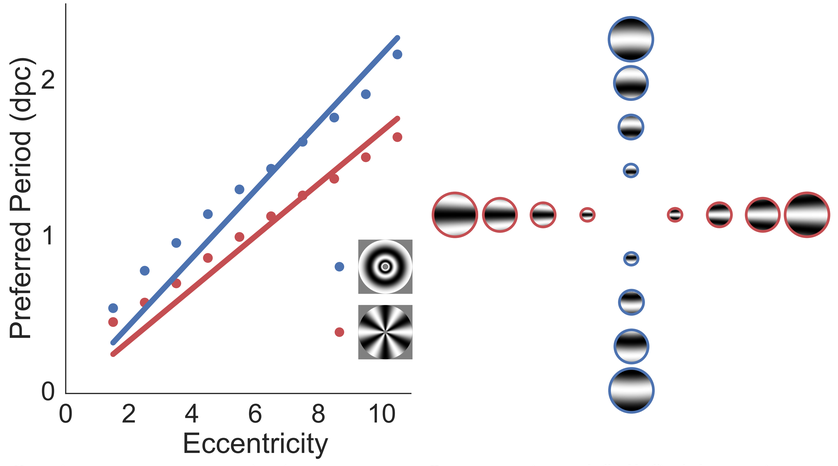


Fit log-normal tuning curve to each bootstrap

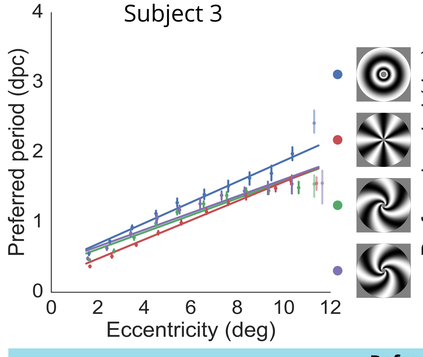


Results

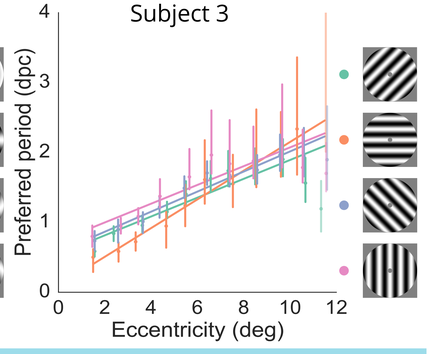
V1 preferred period grows linearly with eccentricity and local orientation information matters



Subjects all show similar patterns, though data quality varies greatly



Conventional full-field gratings produce similar results, but with much larger error bars



References

1. Replotted from Benson, N., Jamison, K. W., Arcaro, M. J., Vu, A., Glasser, M. F., Coalson, T. S., Essen, D. V., Yacoub, E., Ugurbil, K., Winawer, J., Kay, K. (2018). The HCP 7T retinotopy dataset. bioRxiv. http://dx.doi.org/10.1101/308247
2. Kay, K. N., Rokem, A., Winawer, J., Dougherty, R. F., & Wandell, B. A. (2013). GLmdenoise: a fast, automated technique for denoising task-based fmri data. Frontiers in Neuroscience, 7(). http://dx.doi.org/10.3389/fnins.2013.00247
3. Benson NC, Winawer J (2018). The relationship between structure and function in early visual cortex can be quantified by Bayesian analysis of retinotopic organization. In Preparation.