Radial Bias in the primary visual cortex of Macaques.

Introduction plan

1. Orientation tuning and the organisation of orientation columns

* Hubel and Wiesel- Reported neurons tuned to orientation; reported the columnar architecture of neurons
* Grinvald et al., 1986; Bonhoeffer & Grinvald, 1991- Organisation of columns into cortical pinwheels.

1. Overrepresentation of certain orientations
   1. Oblique effect
      1. Biases for the horizontal and vertical orientations
      2. Many perceptual studies, electrophysiological studies in cats (LGN) and macaque V1
         1. Furmanski and Engel 2000- fMRI and behavioural study- overrepresentation of horizontal and vertical orientations in fMRI signal in Humans- Nature
         2. Li et al, 2003 (Freeman)- Meta-analysis of 4418 neurons from the cat striate cortex- Found more cells tuned to horizontal and vertical orientations. Most cells to horizontal orientations and these cells also show sharper orientation. More simple cells tuned to higher spatial frequencies show this effect- not so much complex cells. Suggests that oblique effect is due to intracortical mechanisms. (See Leventhal 1983 for an alternate explanation) – Journal of Neurophysiology
         3. Essock, 1980- Used class 2 pradigms that look at stimulus encoding and memory to examine the oblique effect in humans. Used 3 Reaction Time tasks (identification, detection and classification) and found that the source of the class 2 oblique effect was due to a greater confusability of the oblique lines when compared to the horizontal and vertical lines. Perception
         4. Mansfield 1974- Showed that there was a neural basis for the oblique effect in the primate primary visual cortex. Anaesthetised rhesus monkeys. 192 microelectrode penetrations- Found a substantial cardinal orientation bias near foveal representation but the biases decreased as we moved peripherally. Suggests that the presence of horizontal and vertical contours in the normal visual environment is enough to promote the oblique effect.
         5. Appelle 1972- Review of the oblique effect- Read for the literature review. – Wherever orientation preference has been examined perceptually, there is the oblique effect- as evidenced by the many different types of test in many different species. Neurological basis also reported.
         6. Hirsch & Spinelli, 1970- Reared cats with one eye viewing only horizontal and one eye viewing only vertical gratings- Found that only horizontal and vertically oriented neurons were present. Science.
         7. Edden et al., 2009- In humans, using MR spectroscopy, MEG and psychophysics found that oblique orientation discrimination was negatively correlated to GABA concentration and gamma oscillation frequencies. This was not the same for vertical orientation discrimination.- Shows GABA inhibition plays an important role in orientation selectivity.
         8. Chui et al., 2008- Used adaptive optics in humans to study cone density. Could only resolve greater than 1 deg ecc. Specifically found a horizontal streak. Less neurons along the vertical meridian.
         9. Hansen and Essock, 2004- When testing with natural scenes, in humans, performance is best for the radial orientations and worst for the horizontal and vertical orientations. Journal of Vision.
      3. These studies look at the absolute orientation of neurons. This may not reflect any relationship with the rf location. Infact, Leventhal suggested that …
   2. Radial Bias
      1. Perceptual studies.
      2. Electrophysiological studies.
      3. Imaging studies/ fMRI studies.
2. Why won’t optical imaging studies show a radial orientation bias?
   1. OI signal == fMRI signal Menon et al., 1995 (Magnetic Resonance in Medicine) Showed that the time course of the signals were equivalent. Stetter et al., 2000 (NeuroImage)- Local and global signals –Local signals that are related to neuronal properties and larger global signals not related- use PCA.
   2. Different spatial scales of the signals.
   3. Radial bias on a larger spatial scale.
   4. Here, we examine this larger spatial scale bias.

**Discussion Plan**

1. Looked at large spatial scale signals, showed radial bias. This is consistent with fMRI studies.
2. Experimental errors-
   1. Estimation of the fovea, estimation of receptive field locations.
3. What do the signals mean? LFP and large spatial scale signals==? Perhaps the inputs to the cortex.
4. Imaging too high up- This is a trade-off. But the signal can still be inputs because …
5. If these signals are indeed inputs to the cortex, then what does it mean?
6. Conclusion.