

General aspects of information processing in the visual system

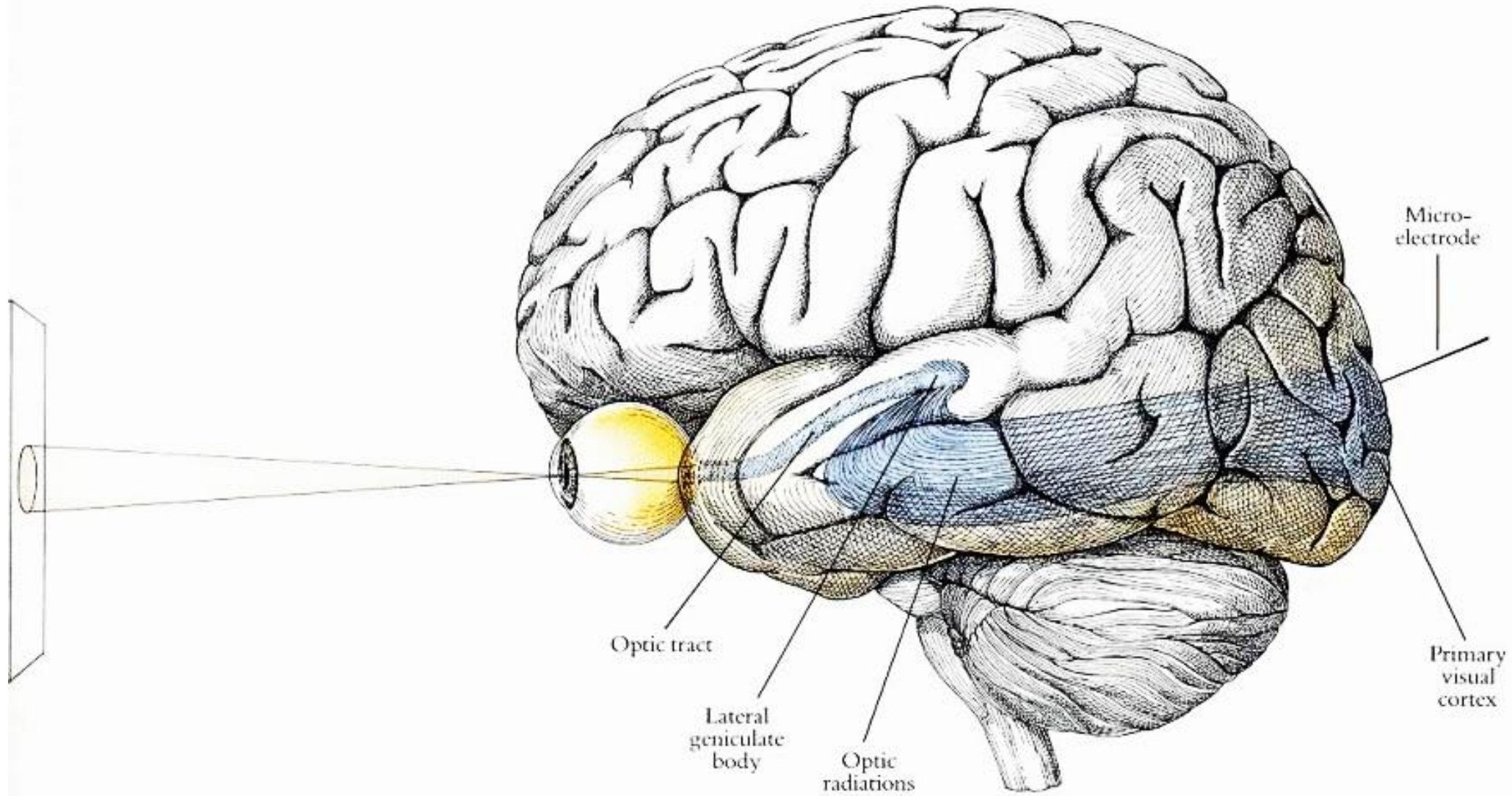
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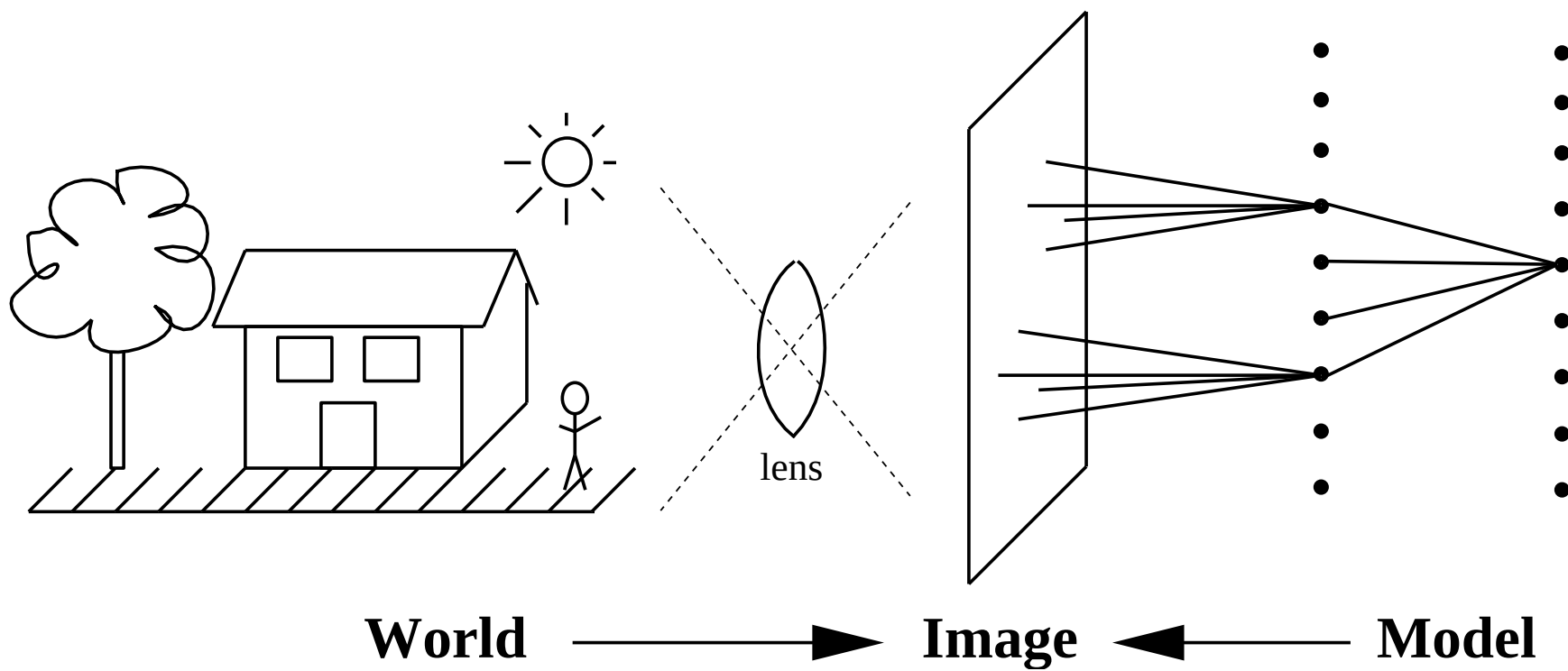
January 11, 2005

Outline

- Principles of information processing constrain the design of the visual system.
 - retina
 - LGN
 - V1
- Lab assignment



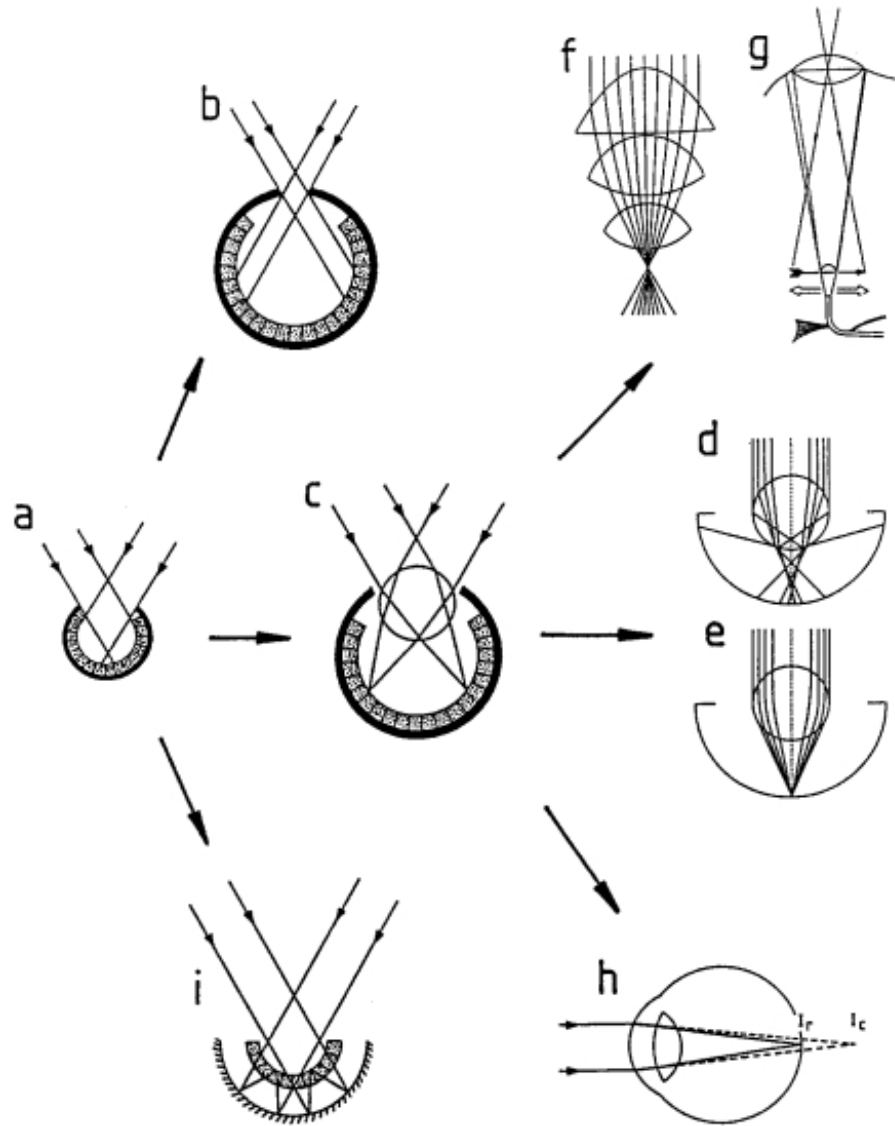
Vision as inference

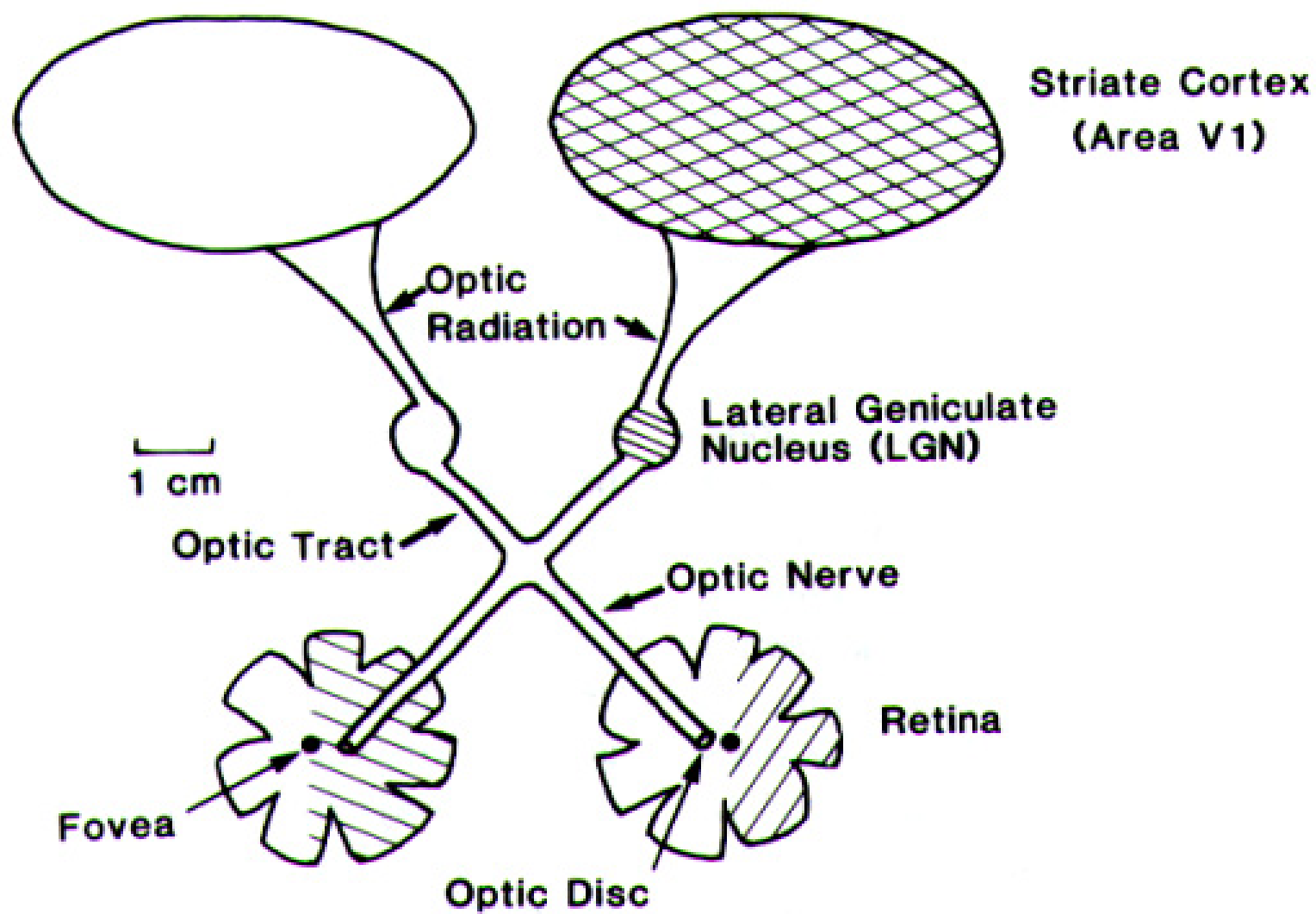


THE EVOLUTION OF EYES

Michael F. Land

Russell D. Fernald

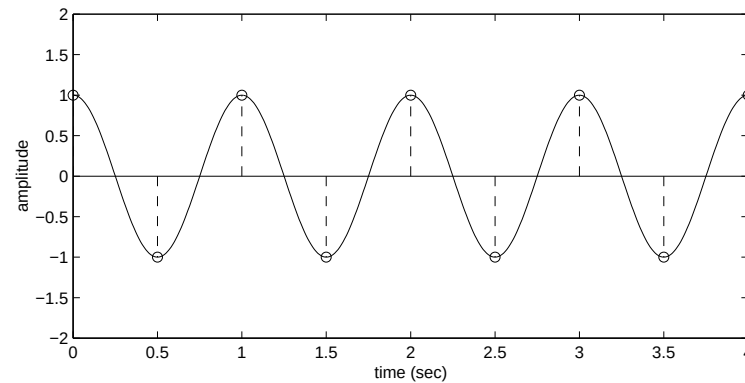




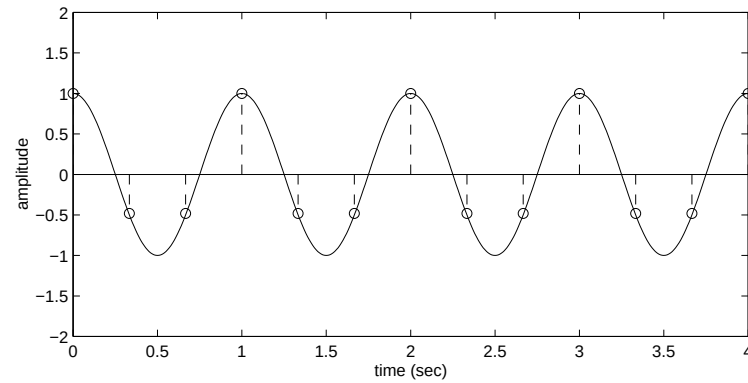
Sampling and aliasing

The Nyquist sampling theorem:

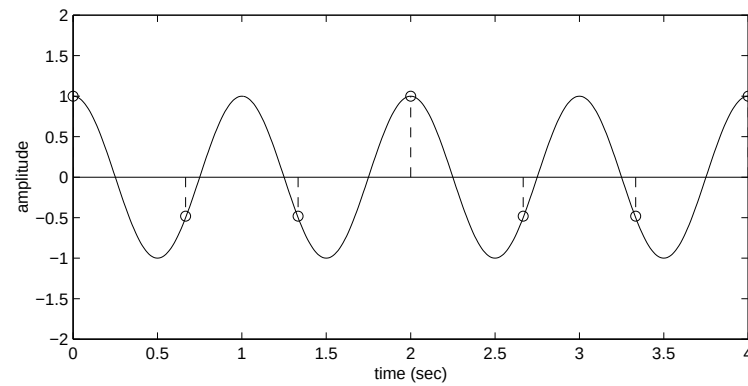
The sampling frequency should be at least twice the highest frequency contained in the signal.



Oversampling:

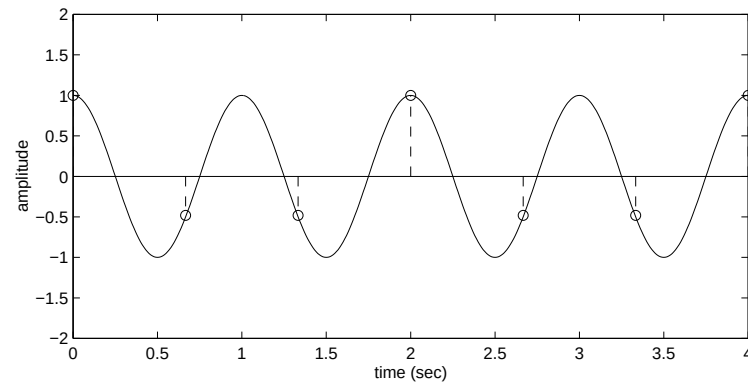


Undersampling (aliasing):

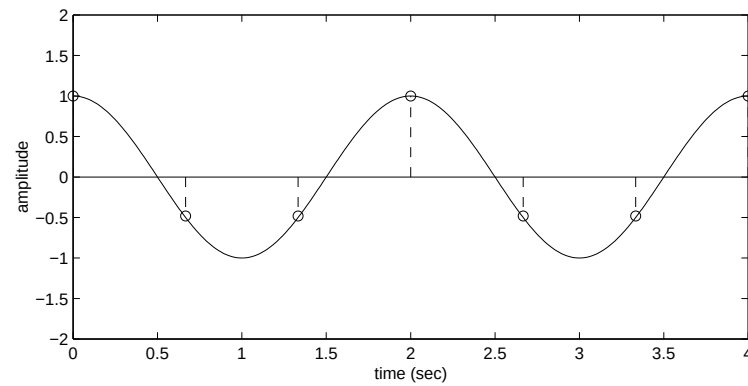


Aliasing

Actual signal:



Alias:



Example: Text

Aliasing:

Welcome to Joe's webpage! $\xrightarrow{\text{subsampling}}$ Welcome to Joe's webpage!

No aliasing:

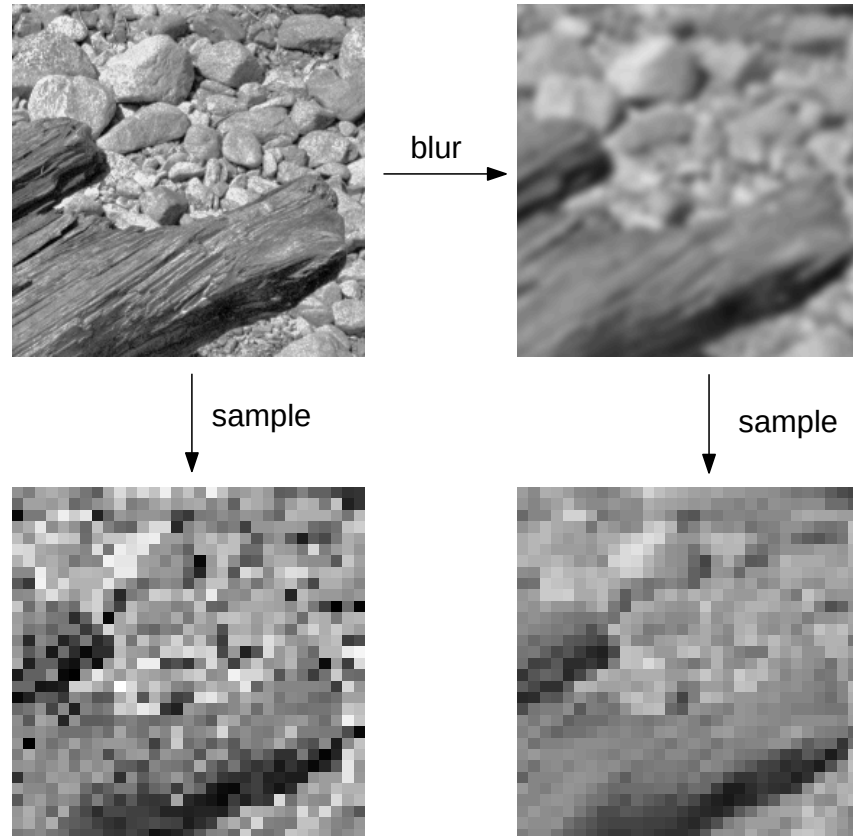
Welcome to Joe's webpage! $\xrightarrow{\text{smoothing}}$

Welcome to Joe's webpage!

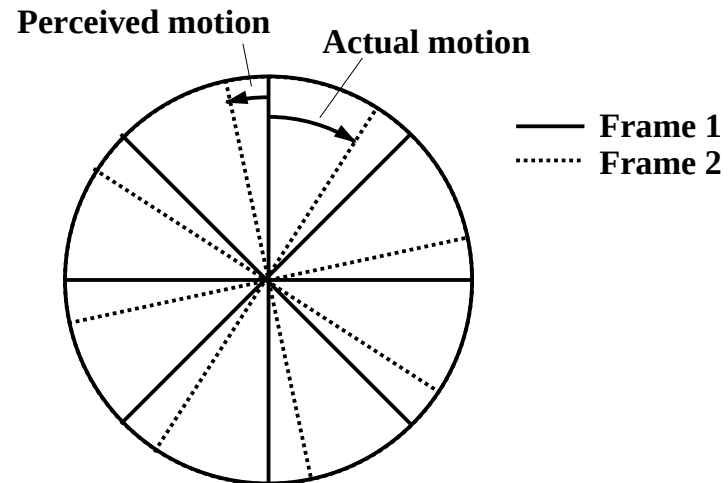
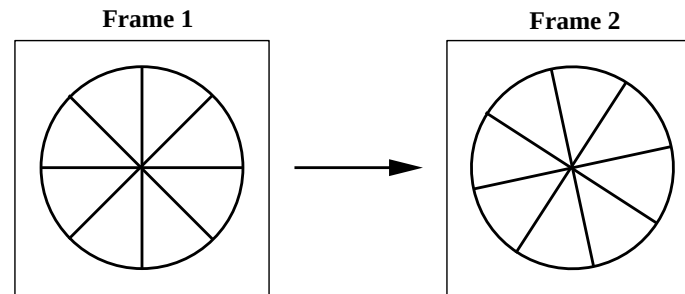
↓ subsampling

Welcome to Joe's webpage!

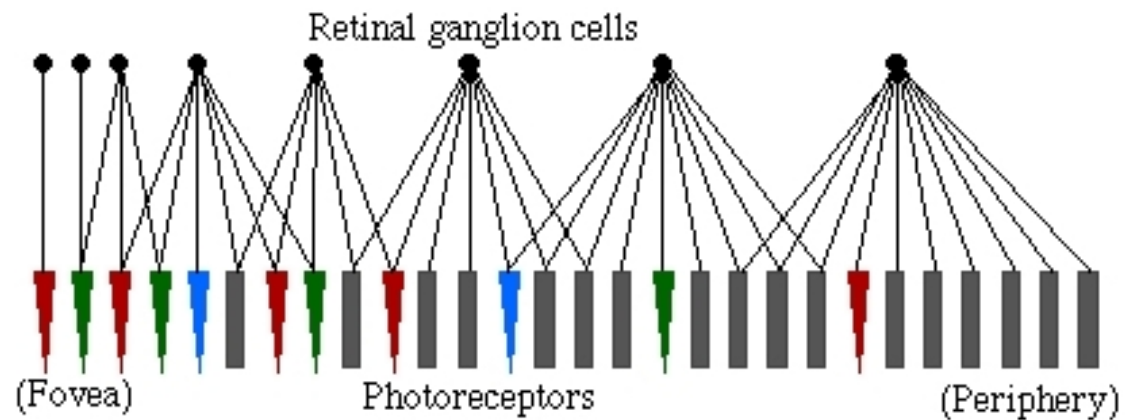
Example: Natural images



(The 'Wagon wheel' effect)

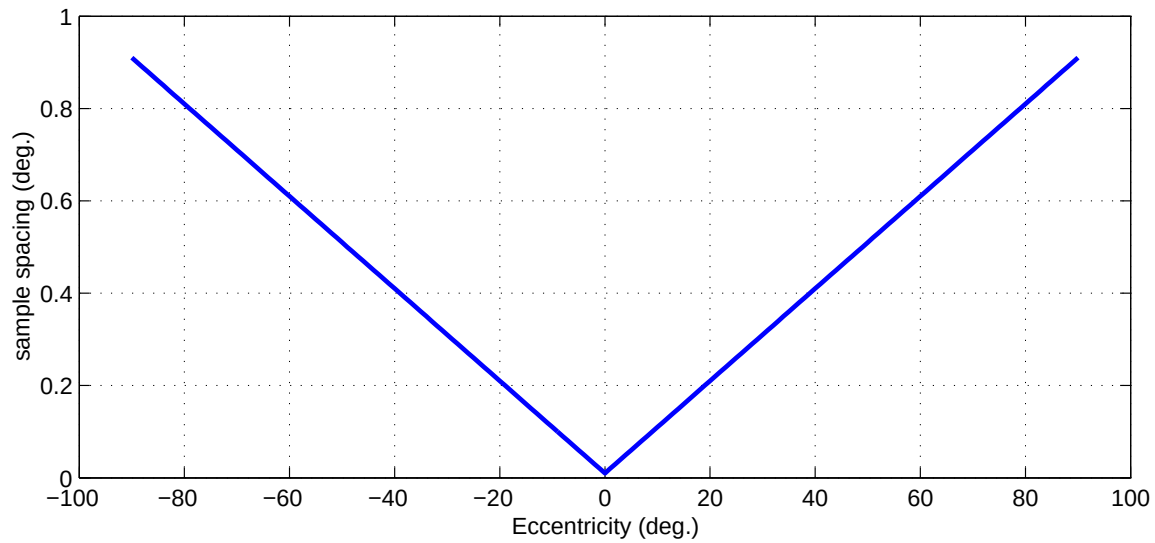


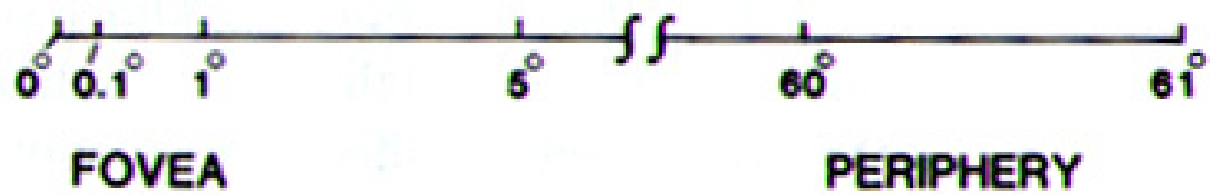
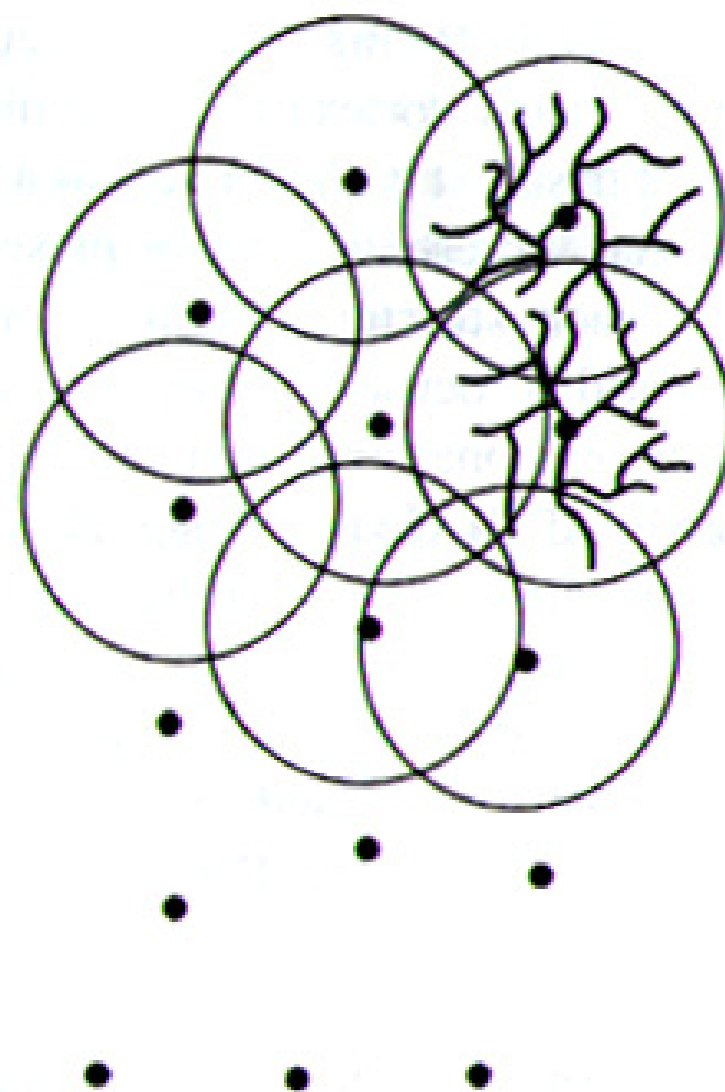
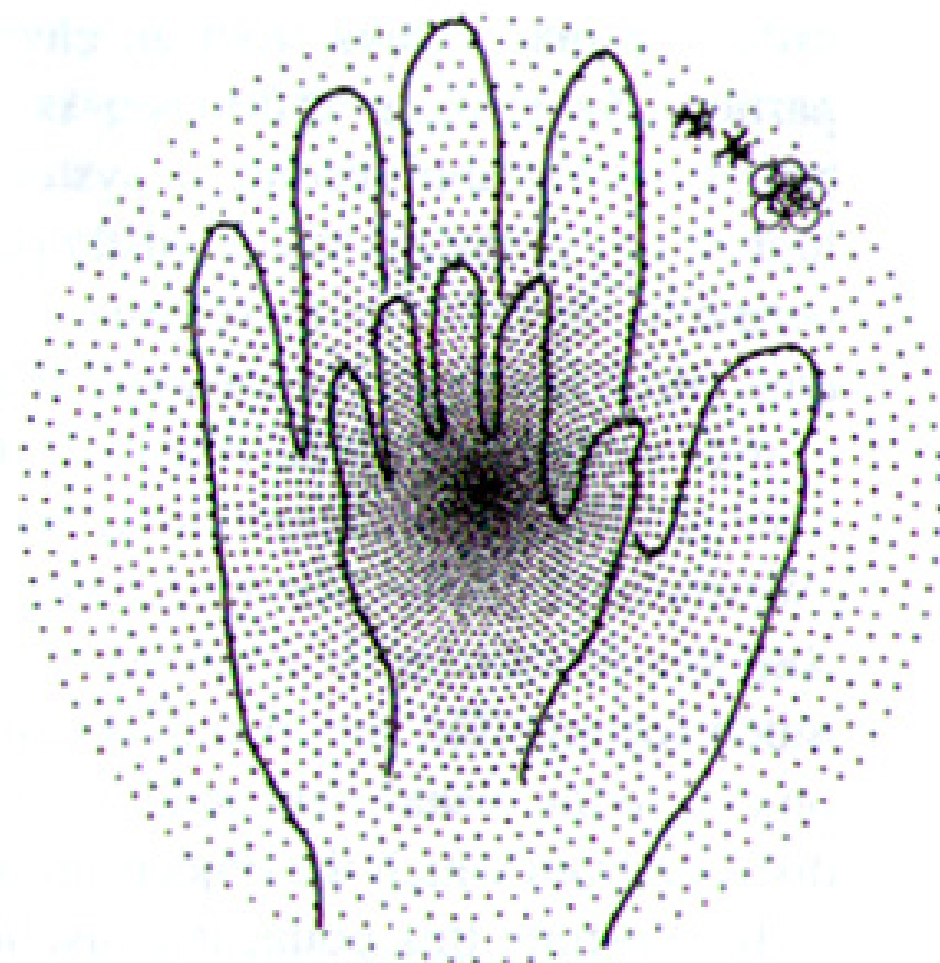
Smoothing and subsampling by retinal ganglion cells

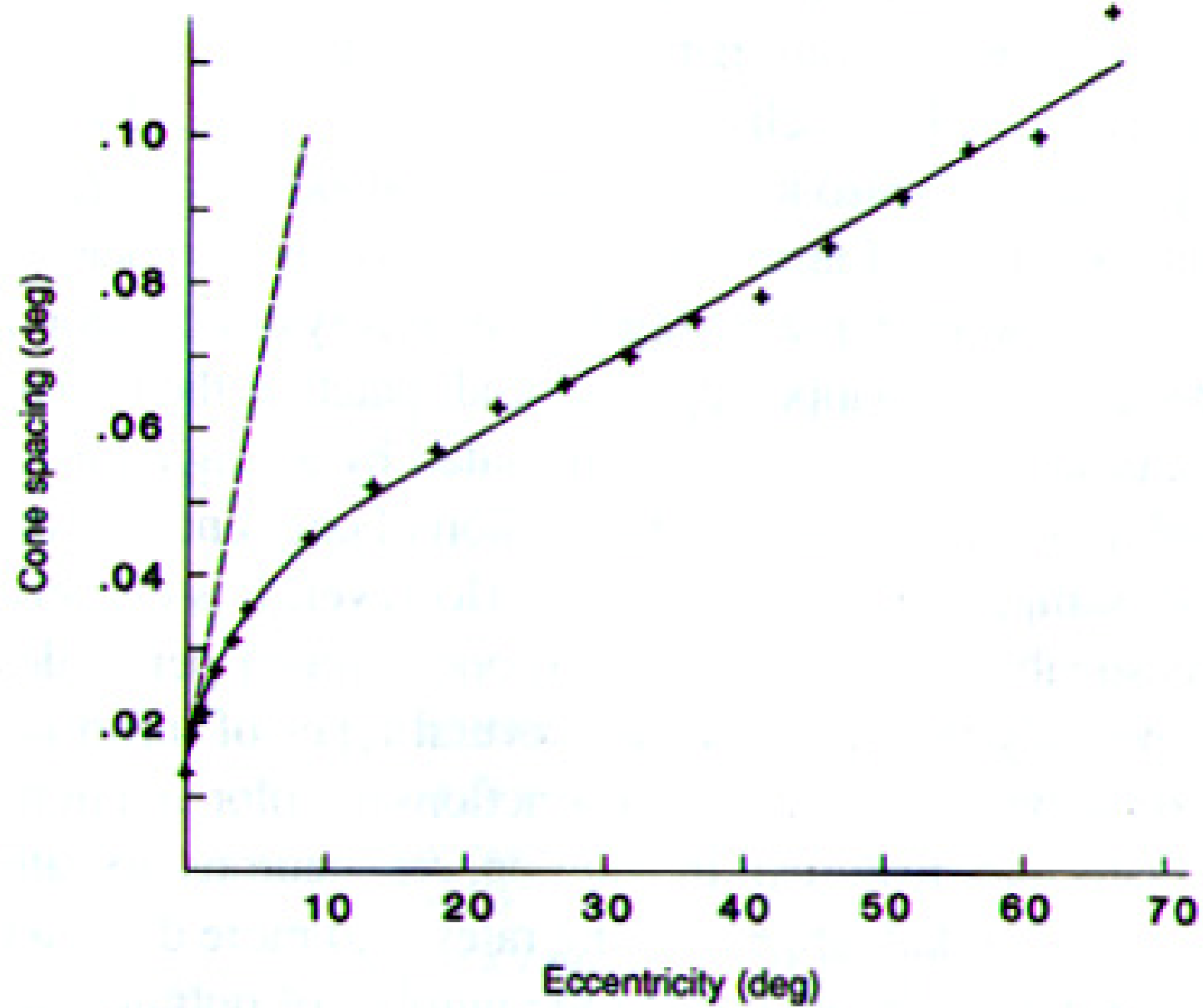


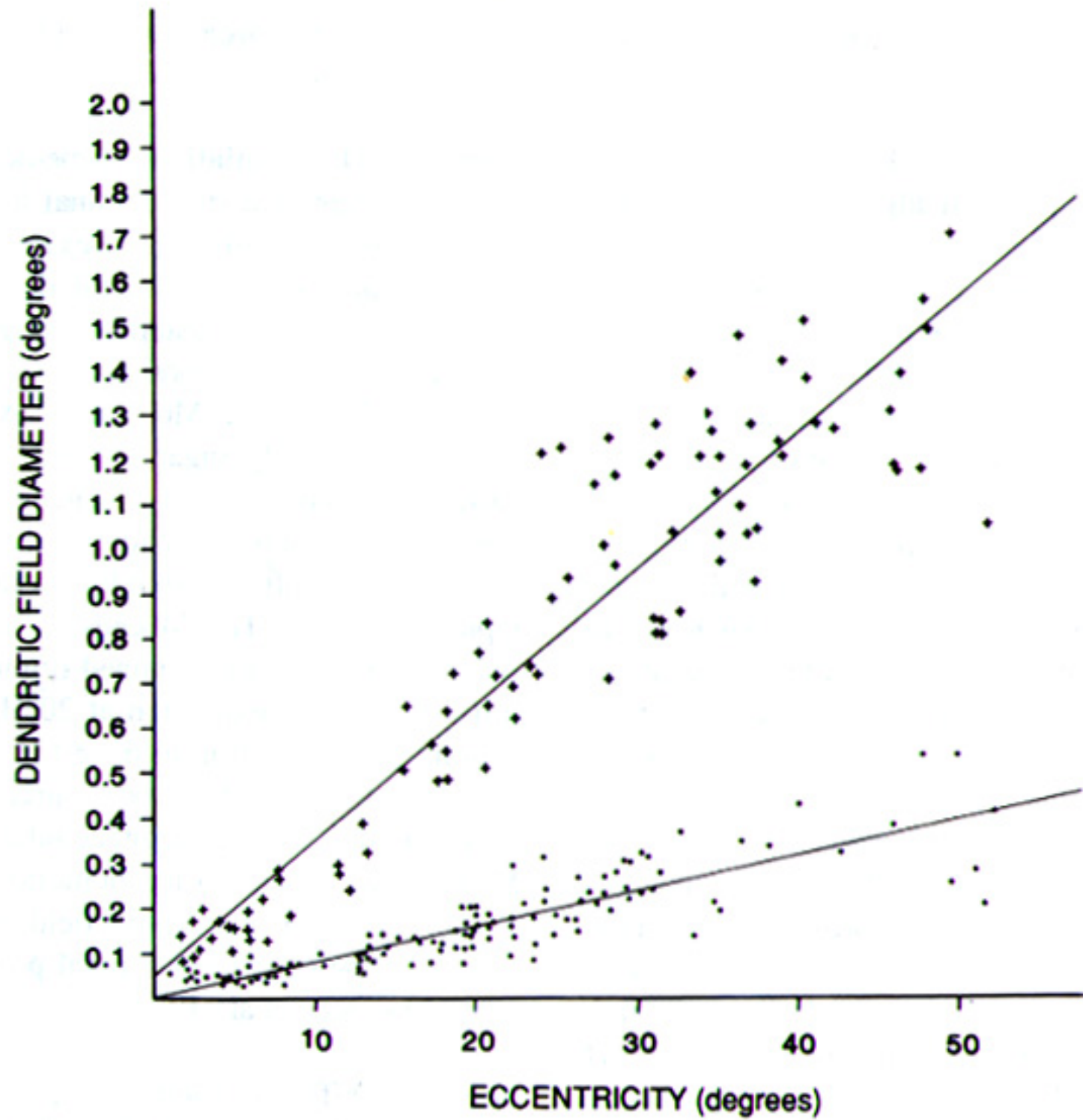
RGC spacing as a function of eccentricity

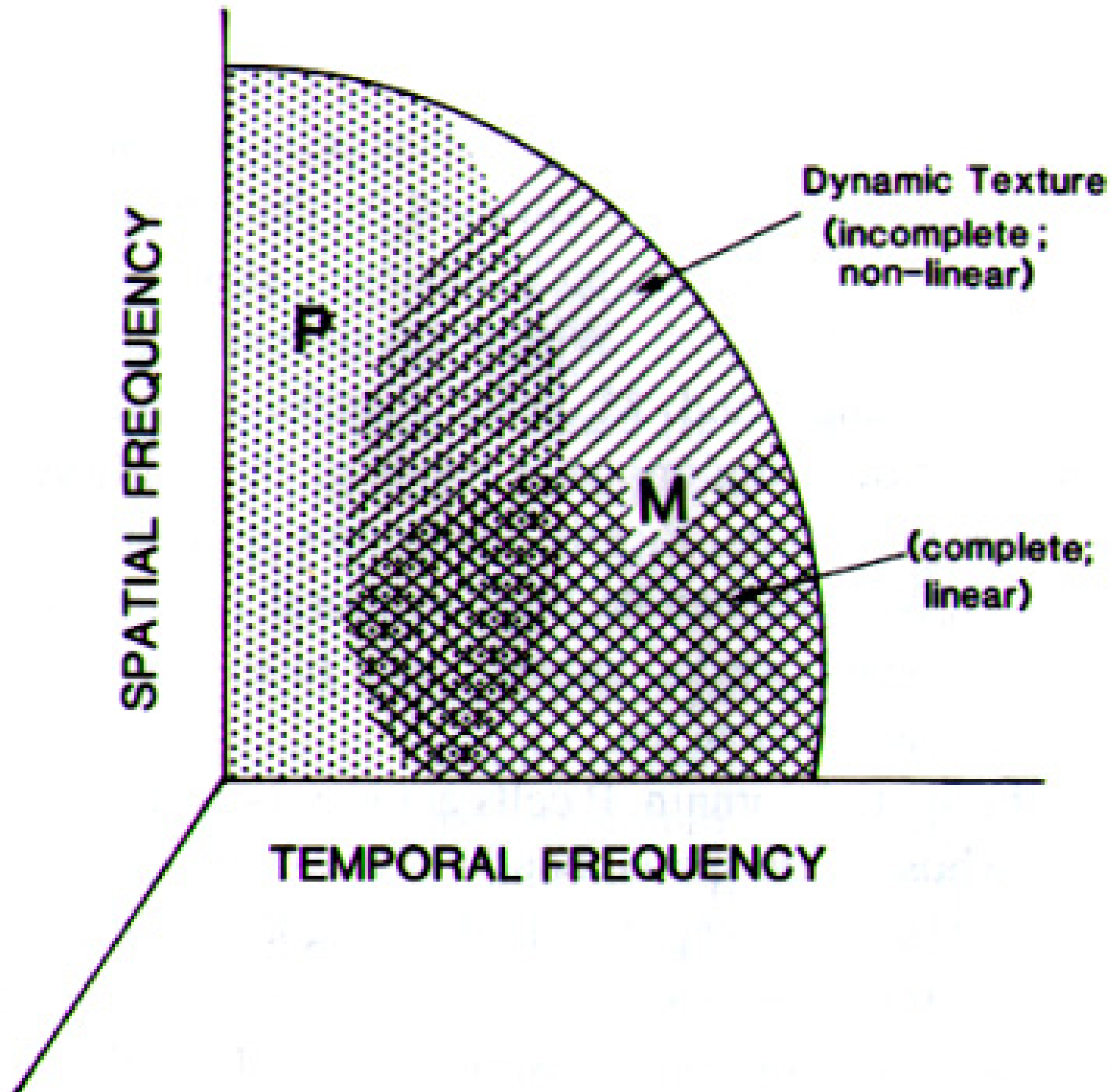
$$\Delta E \approx .01(|E| + 1) \quad (1)$$

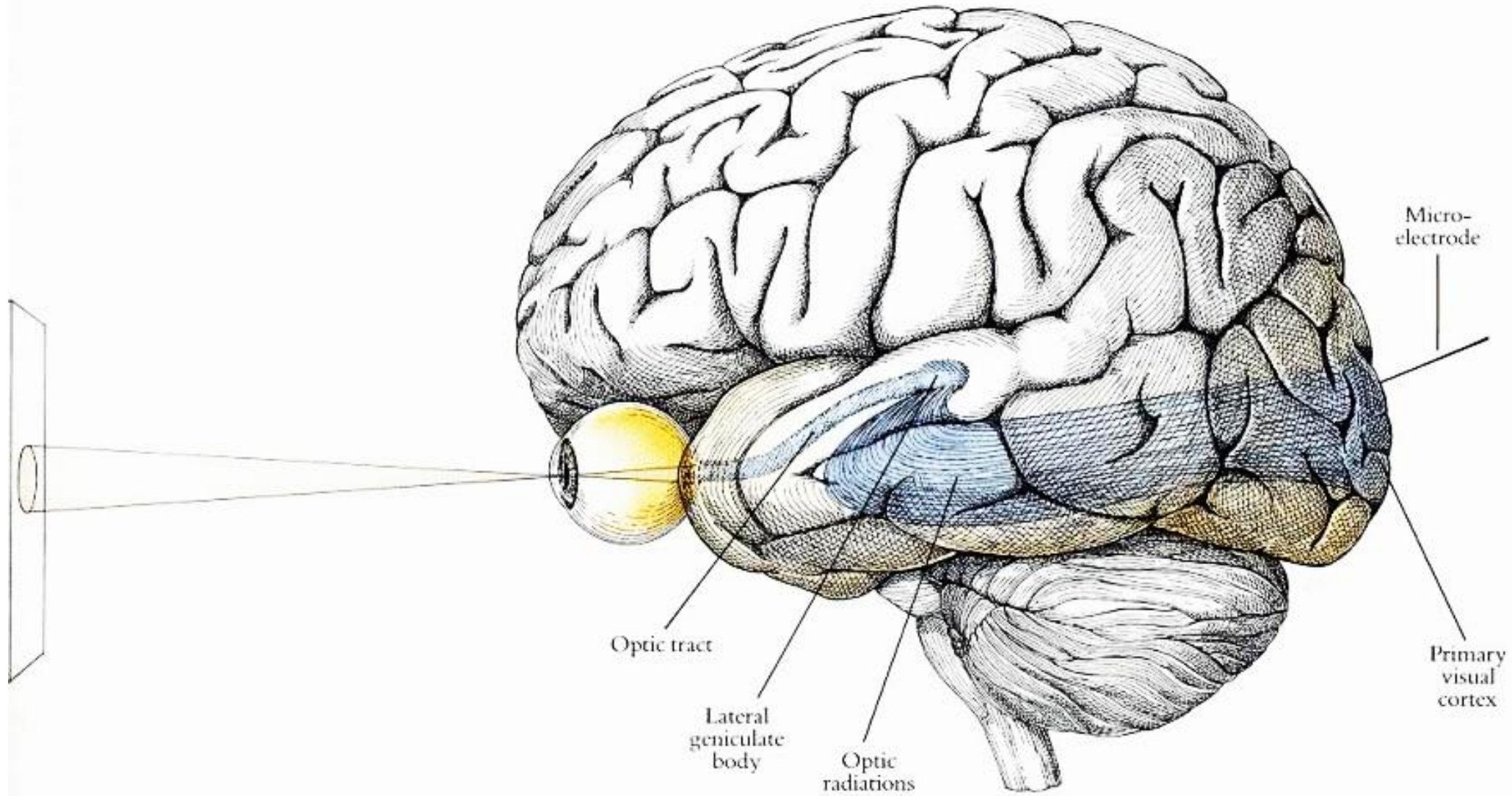


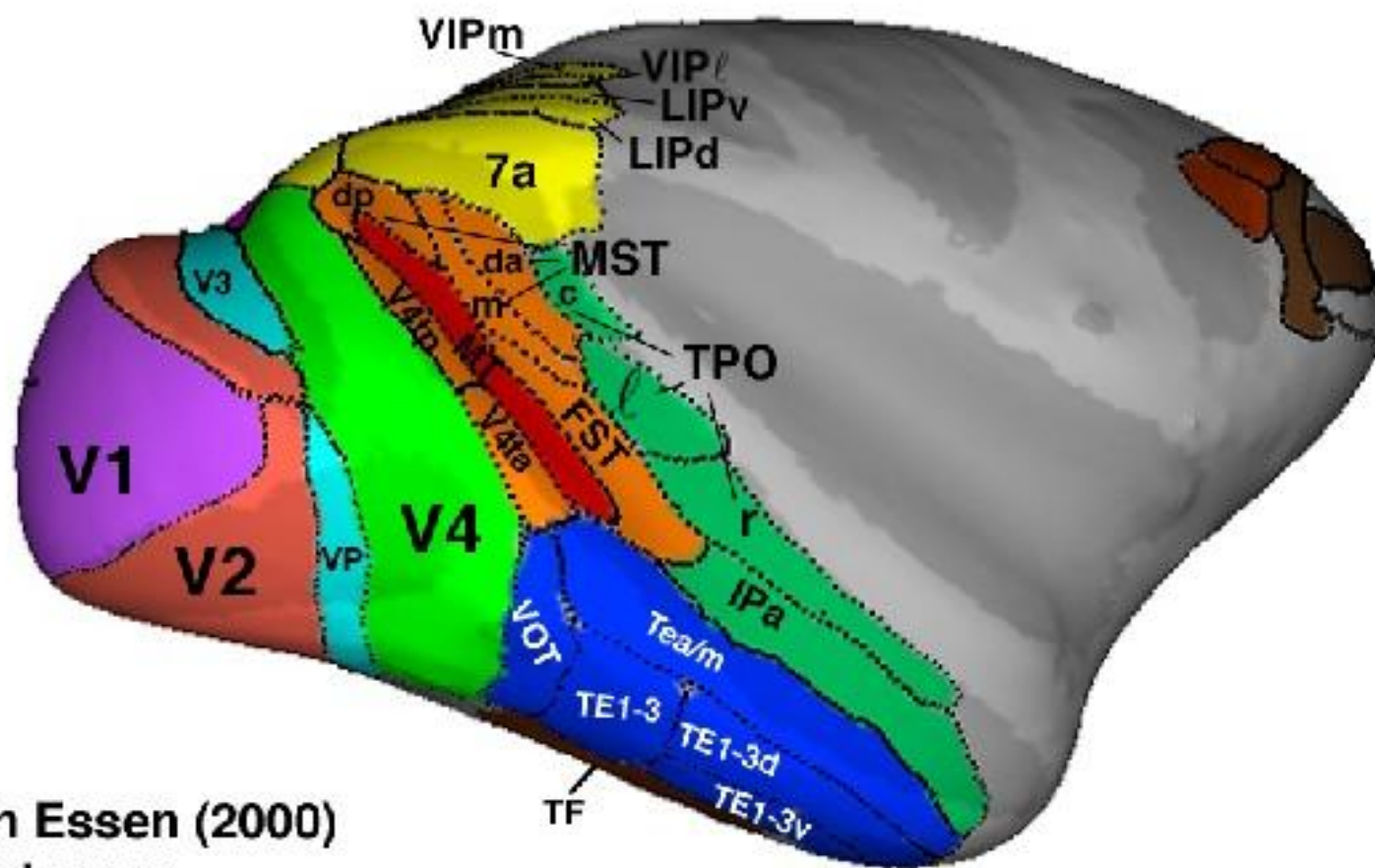












Lewis & Van Essen (2000)
Visual areas

