Perceptual Learning Readings: Tsodyks and Gilbert, Neural networks and perceptual learning (2004)

Seitz and Watanabe, A unified model for perceptual learning (2004)

[Thanks to Aaron Seitz for many slides of this lecture]



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• Improvements are often very specific to the trained configuration.













Neural Basis of Perceptual Learning

• Specificity of Learning suggests that learning takes place in early sensory cortex, where neurons have such specificity.

• The simplest assumption is that the neural representation (of e.g. orientation, direction) in early sensory cortex (e.g. V1) is changing during learning.

• Electrophysiological studies in awake monkeys to test this hypothesis in auditory and somatosensory cortex (Recanzone et al 199X), and visual cortex MT(Zohary et al 1994), V1 (Schoups et al, 2000, Ghose et al 2001) and V4 (Raiguel et al 2006, Yang & Maunsell 2004)

Orientation discrimination : Perceptual Learning in V1 ?

- Changes are controversial in V1
- Schoups et al (2001) found an increase in the slopes of neurons with flanks at the trained orientation.
- · Ghose et al (2002) found no change.





Plasticity in somatosensory, motor and auditory cortex

• Monkey trained to discriminate the frequency of tactile vibrations applied on the finger show increase in topographic representation of the part of the hand that was stimulated in somatosensory area 3B.

• Similarly, monkeys trained to discriminate tone frequencies show increase in tonotopic representation in A1 for trained frequency (Recanzone et al, 1993).



Orientation discrimination : Perceptual Learning in V4 ?

• Changes are more pronounced in V4 than V1, but still modest.

• Yang and Maunsell, 2004 in V4 : neurons with preferred orientations close to the trained range had stronger response and narrower tuning curves after learning.

• Raiguel et al, 2006, argue on the contrary neurons with flanks at trained range increase their slope after learning.







Learning of the 'decoder': Psychophysical evidence?

- Learning to ignore / filter out irrelevant 'noise' -- Vaina et al (1995)
- 'Perceptual learning improves efficiency by re-tuning the decision template' in a vernier task with positional noise.
- Li, Levi & Klein (2004).
- Petrov et al (2005), show that a model based on 'reweighting' of the read-out can account for psychophysical studies on the effect of a changing context on orientation discrimination.





How do we know what to learn?

- Does learning need feedback?
- What is the influence of reward?
- Does learning need attention?
- How is it related to the task being performed?
- Are there forms of passive learning?
- Can perceptual learning interfere with other learning or induce a deterioration in other tasks?