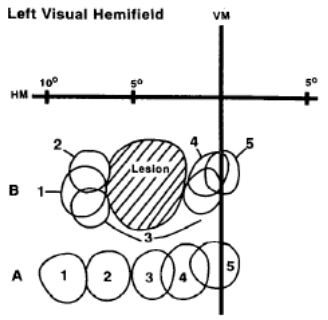
How are brain maps shifted and transformed?

Josh Wallman

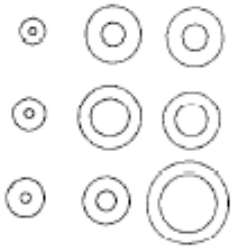
- Much work has established how the point-to-point representation of the world onto the cortex develops, and how it is refined by experience. But maps change.
- **Long time-scales:** Lesions or sensory alterations can cause maps to shift locally.
- **Short time-scales:** When eyes move or the locus of attention shifts, local maps can shift rapidly.
- One possible mechanism for these local map-shifts is gain-fields. Mathematical models can explain shifts and scale changes in maps (e.g. Salinas & Abbott, 1997).
- **But more dramatic map transformations exist:** The visual and tactile receptive fields that are normally aligned in bimodal parietal neurons can be separated by having a monkey view his hand on a displaced video monitor; the visual receptive fields change in size and position tracking the video image of the hand.
- Understanding these map transformations could be the missing link between neurons responding to stimuli in particular locations and those responding to particular objects wherever they are located. This, in turn, could mark the boundary between what we see and what we can imagine.

Effect of retinal lesion



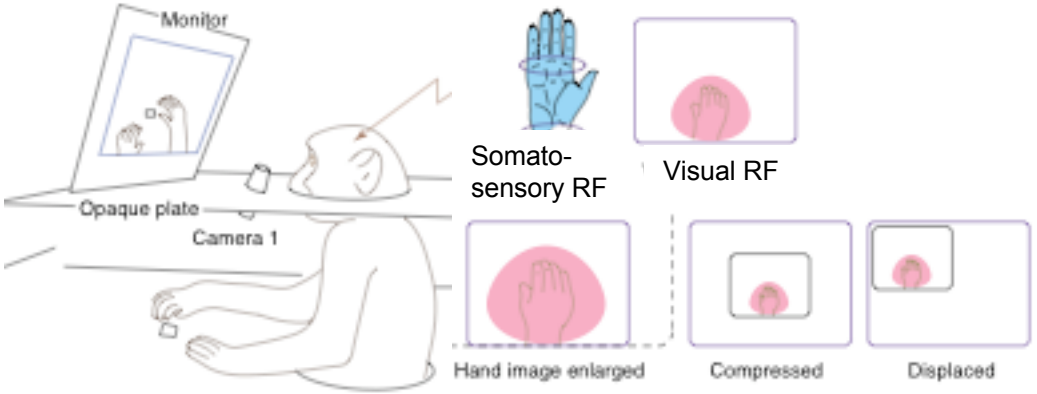
Kaas, 1991

Effect of gain field on RF center



Andersen et al., 1990

Effect of visuo-tactile dissociation on visual receptive fields



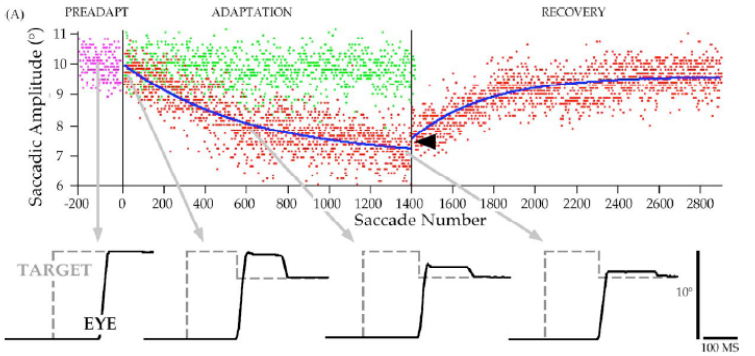
Maravita & Iriki (2004)

Incorporation of tool into visual RF

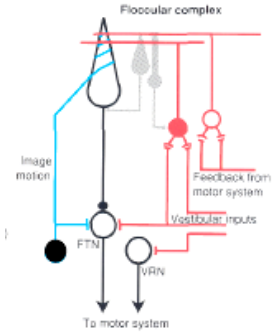
Is motor adaptation a servo-mechanism or reinforcement learning? Is there any difference?

Josh Wallman

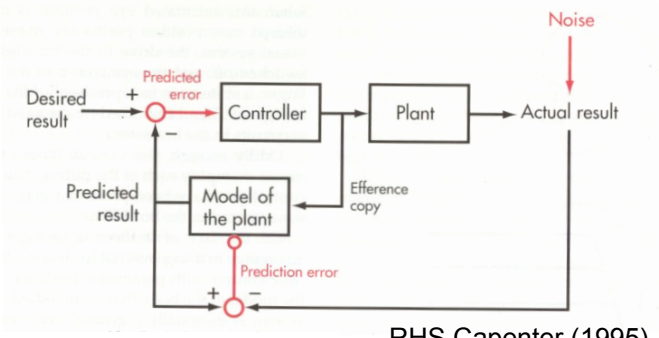
- Motor systems (e.g., hand or eye) adapt to systematic changes in the environment (e.g., magnifying lenses, prisms, force-fields).
- These adaptations are frequently described as simple forms of learning, but are explained using engineering concepts such as error signals, forward and inverse models, rather than psychological concepts such as reinforcement.
- Although both servo-mechanisms and reinforcement learning can explain parametric feedback control of mechanical and biological systems (Sutton & Barto, 1998), there are important differences:
  - Reinforcement learning involves exploration; servo-mechanisms act to reduce error signals.
- So, how similar are motor adaptations to reinforcement learning?
  - Is there reinforcement? What might it be?
  - Do schedules of reinforcement have similar effects on motor adaptation as in classical or operant conditioning?
  - Do more variable responses facilitate learning?
  - Are motor adaptations specific to the environmental context, as conditioned responses are specific to conditioned stimuli?
- Addressing these issues may clarify whether “learning” is a biological or a linguistic category.



Hopp & Fuchs 2004



Raymond et al. (1996)



RHS Capenter (1995)