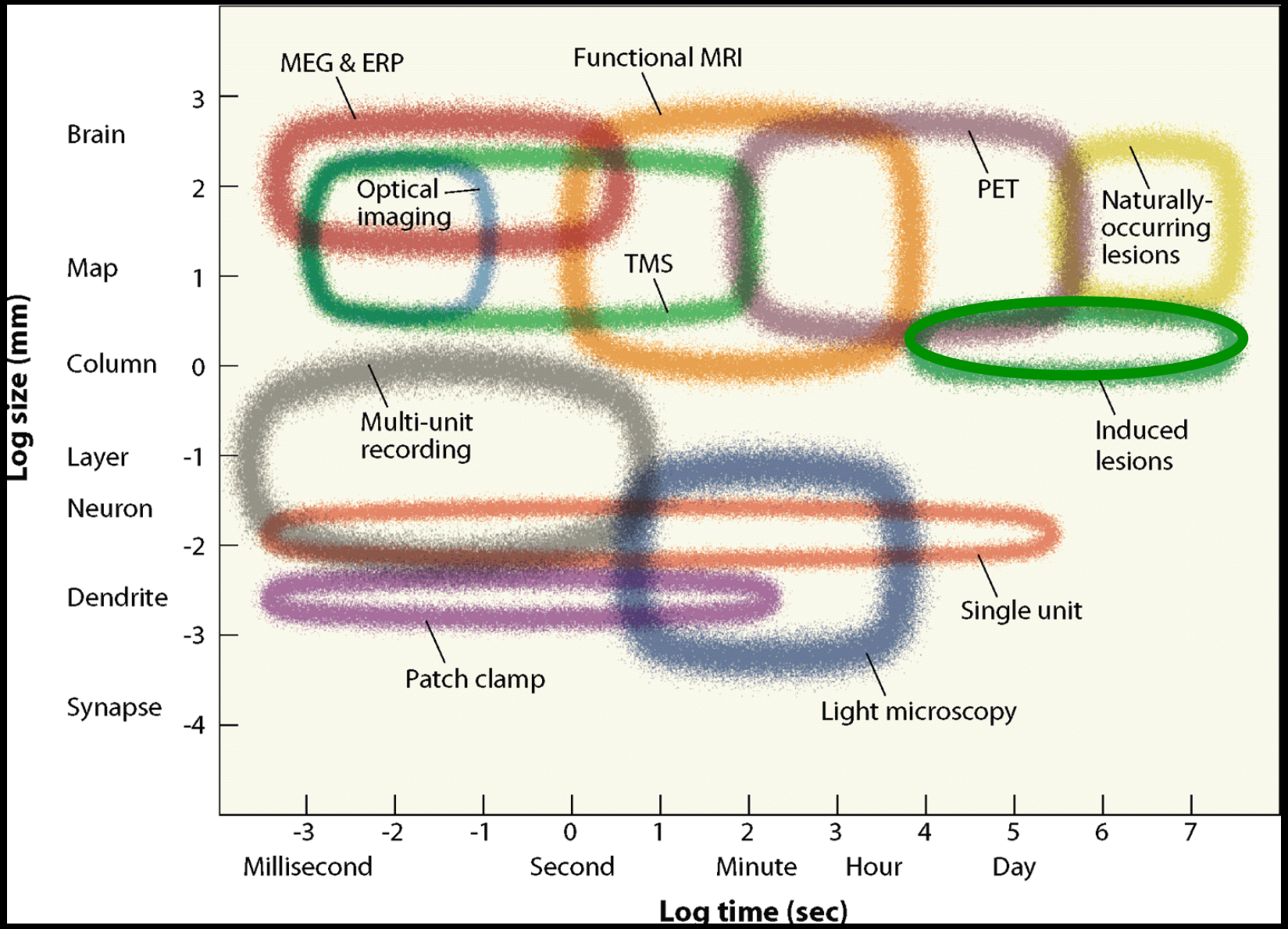
Neuropsychological Experiments:

- Pluses:
  - » Allows you to dissociate between different mental processes
  - » Can tell you something about the brain structures *necessary* for a task

- Minuses:
  - » Great variability among patients, can be difficult to relate structure-to-function with precision.
  - » Can only observe the processes that interest you *in absence*, not *in action*.
  - » Practically, studies can be difficult (need to have infrastructure & collaborators)


MEG & ERP
Functional MRI
Optical imaging
TMS
PET
Naturally-occurring lesions
Multi-unit recording
Induced lesions
Single unit
Patch clamp
Light microscopy
Brain
Map
Column
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Neuron
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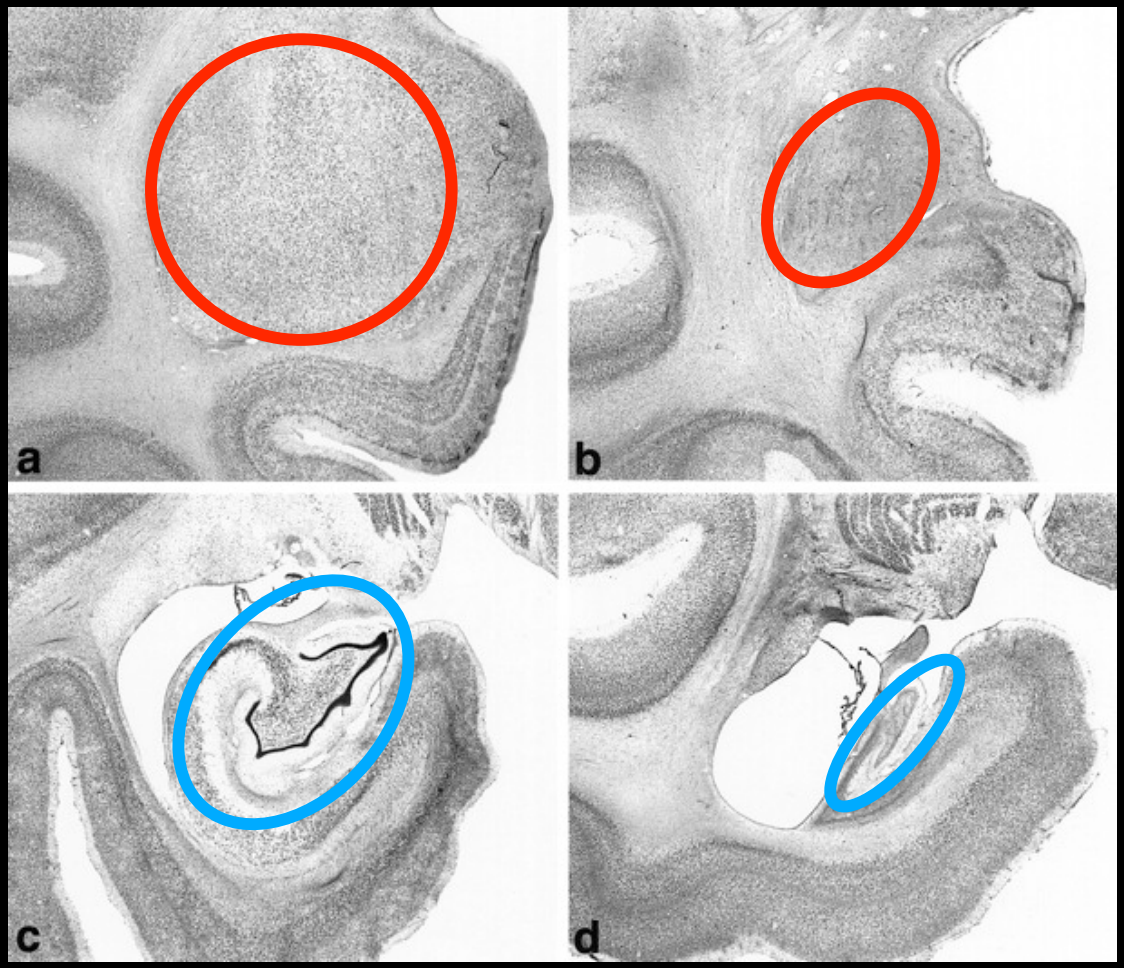
Lesions in animals can be made very precisely



Amygdala

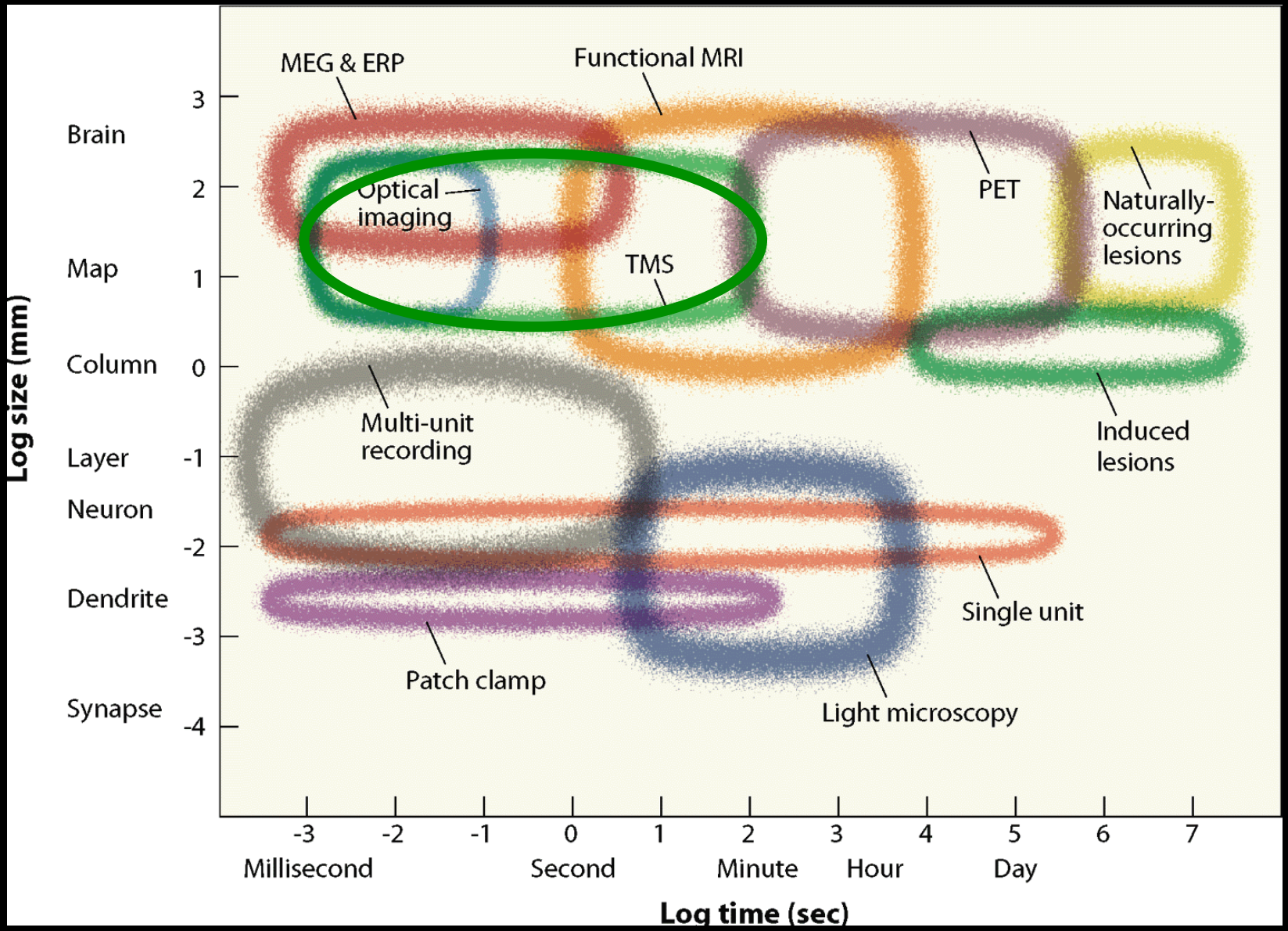
Hippocampus

Normal Monkey

Lesioned Monkey

Induced Lesion Experiments:

- Pluses:
  - » Same pluses as naturally-occurring lesion experiments
  - » And with *greater spatial precision*
  - » Can also do reversible inactivations
- Minuses:
  - » Same minuses as naturally-occurring lesion experiments
  - » Can *only* do in animal models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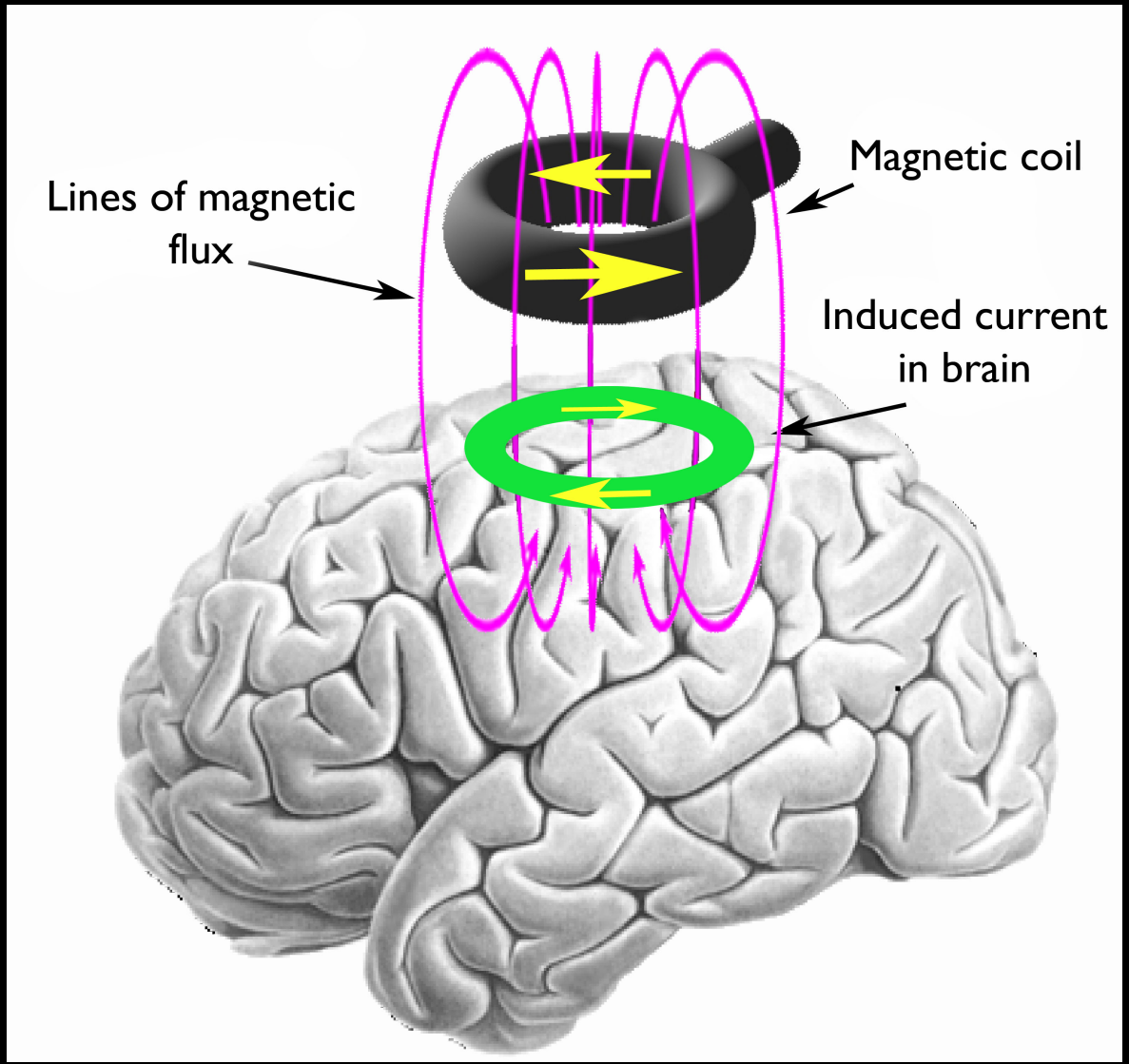
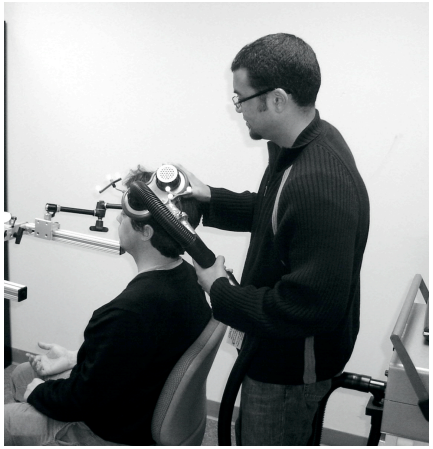
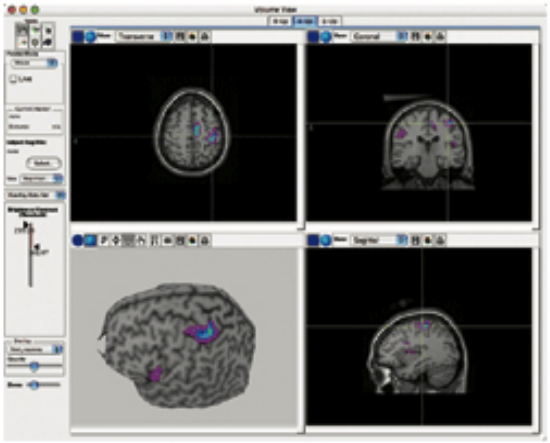
Transcranial Magnetic Stimulation (TMS)

- Based on Faraday Principle
- Rapidly fluxing magnetic field
- Induces current in underlying cortex
- Noninvasive
- Permits focal manipulation of cortical activity



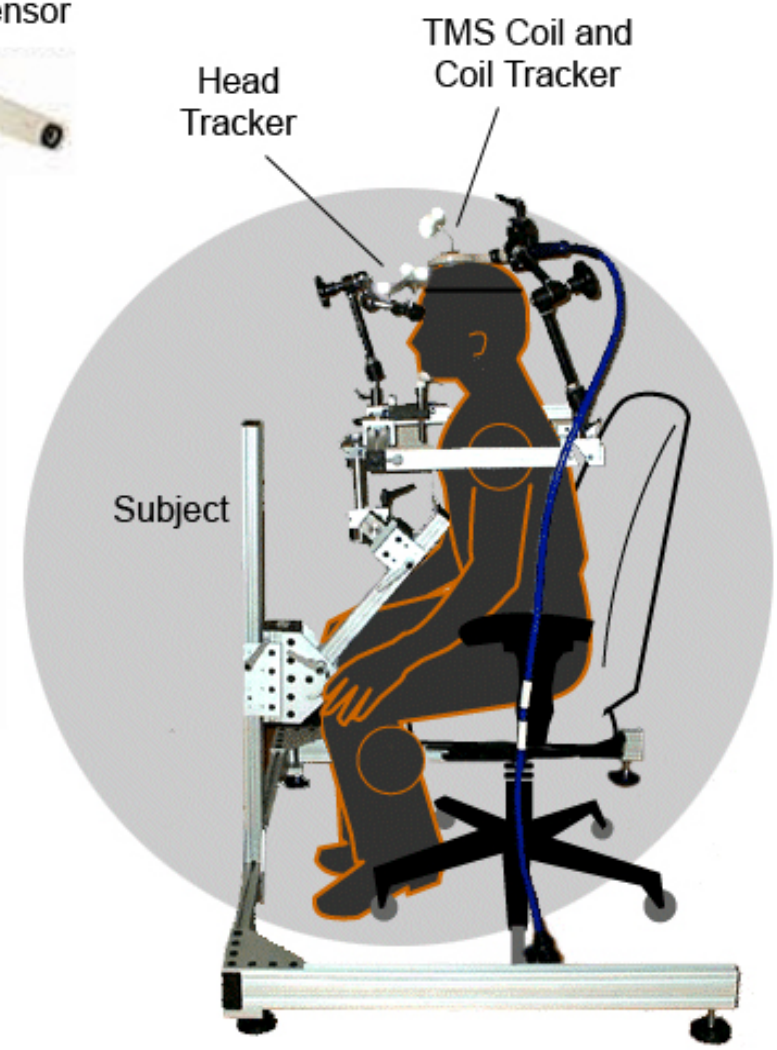
Administration of TMS





Computer Screen

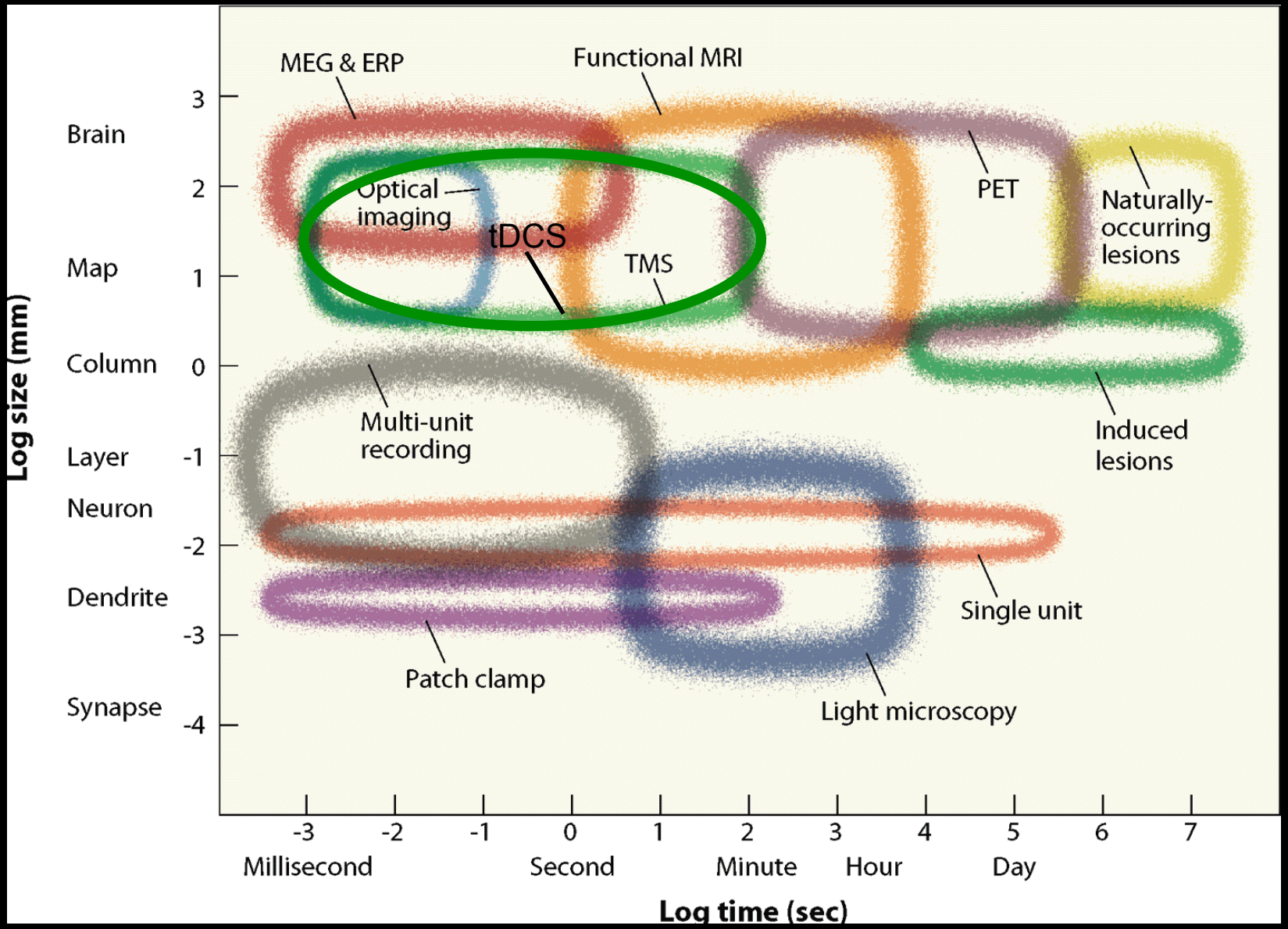
Optical
Position Sensor



TMS:

- Pluses:
  - » Causal: can tell you something about the brain structures *necessary* for a task
  - » Allows you to do *reversible* inactivation in humans
  - » Allows you to test *timecourse* of necessity
  - » Good spatial specificity

- Minuses:
  - » Can only reach the dorsal cortical surface
  - » Spatial specificity might allow neural compensation
  - » Need to be cognizant of safety concerns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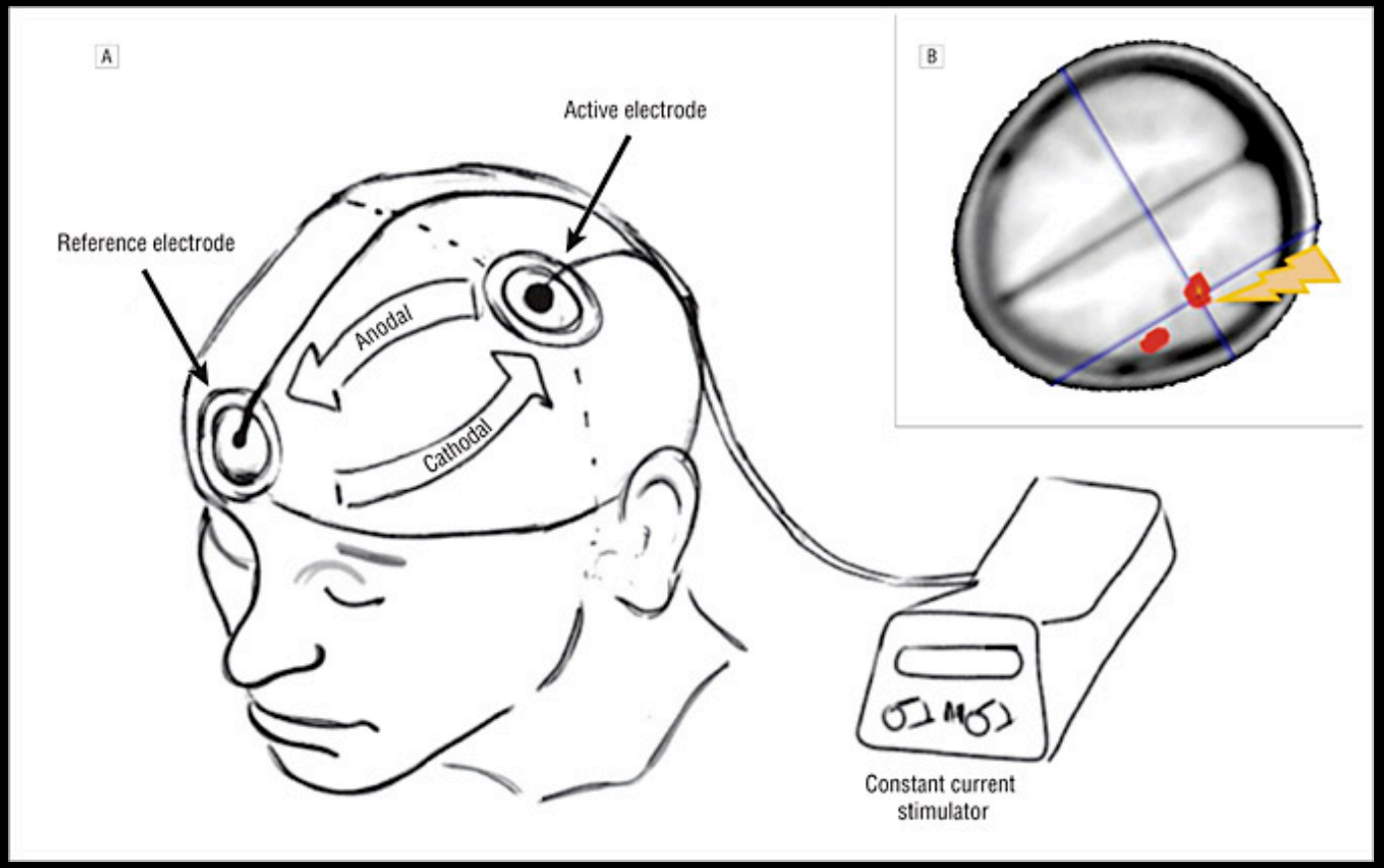
Transcranial direct current stimulation (tDCS)

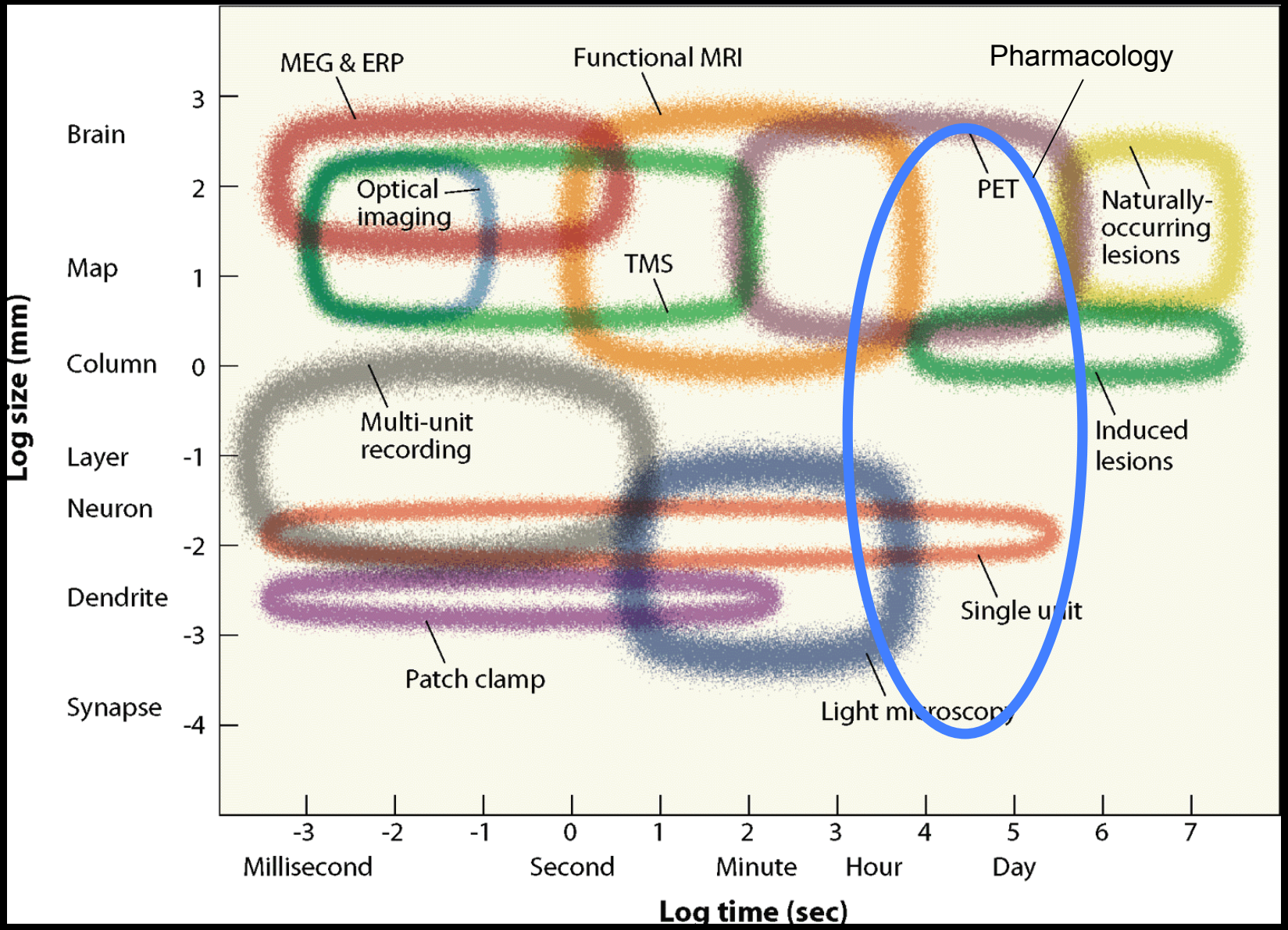


Schlaug, G. et al. Arch Neurol 2008;65:1571-1576.

tDCS:

- Pluses:
  - » Causal: can tell you something about the brain structures *necessary* for a task
  - » Allows you to do both *activation* and *inactivation* reversibly in humans
  - » Greater perceived safety than TMS
  - » Less expensive, more portable set-up than TMS

- Minuses:
  - » Can only reach the dorsal cortical surface
  - » Less spatially specific than TMS
  - » Less temporal control compared to TMS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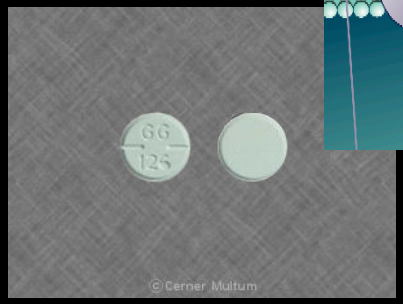
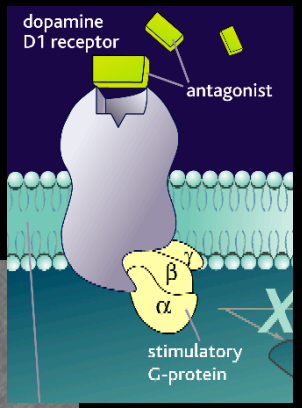
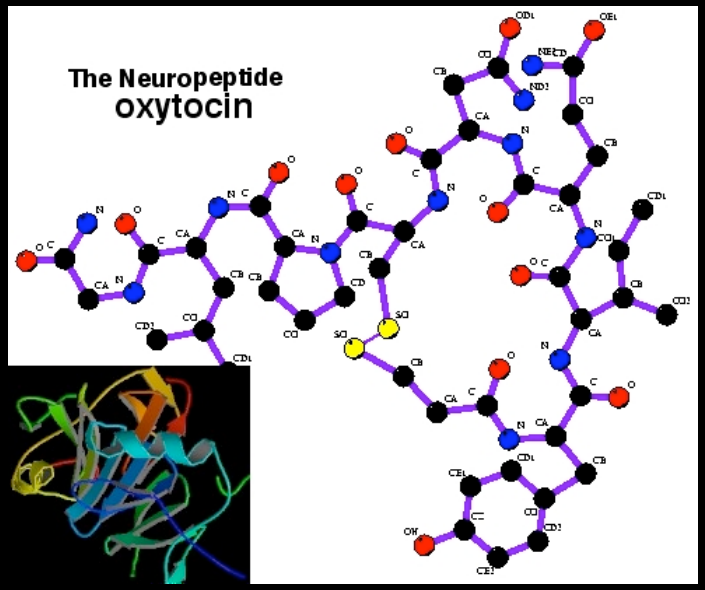
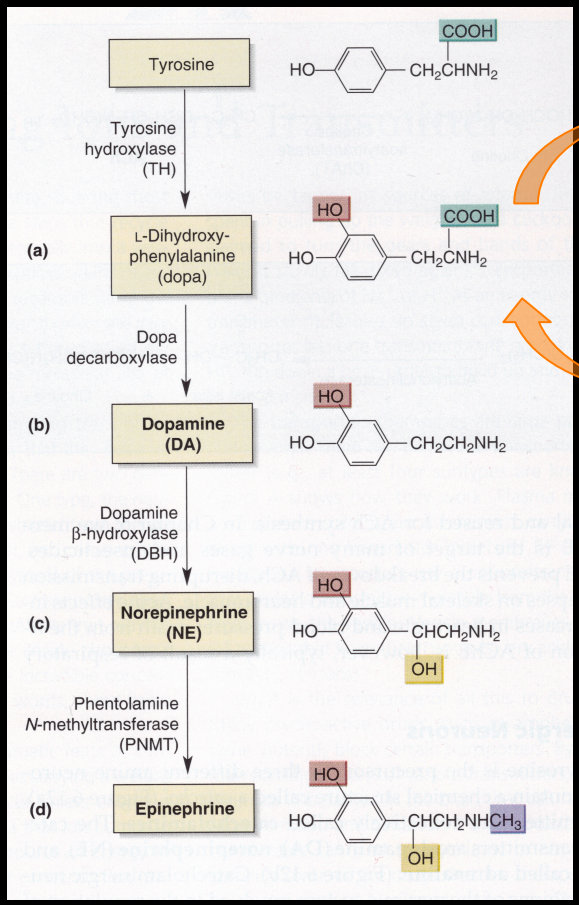
Agonist
Antagonist









Depletion

Loading

Pharmacology:

- Pluses:
  - » Causal: can tell you something about the brain systems *necessary* for a task
  - » Can both *upregulate* and *downregulate* systems
  - » Relevance to health care applications
  - » Complementary to other techniques

- Minuses:
  - » Drugs act at *many* locations simultaneously
  - » Drugs can also have *multiple* actions
  - » Practically, studies can be difficult (usually need a colloborating physician)

Questions?