# 260-2015-08-28-levels

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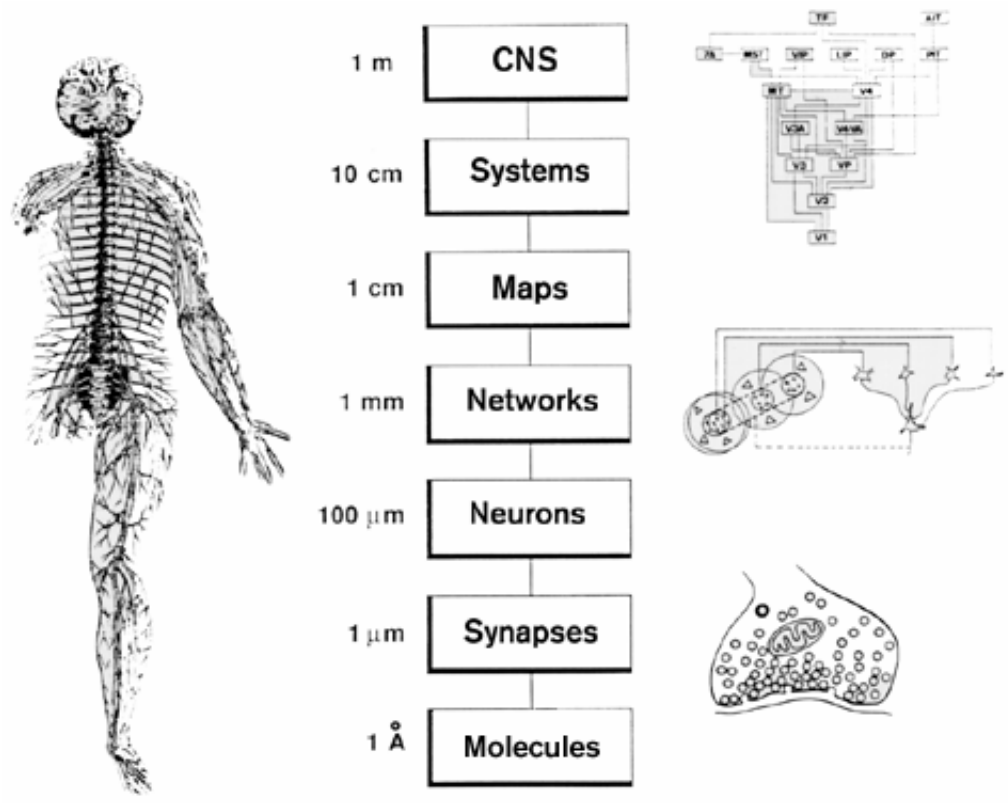
2015-08-27 12:26:22

# Today's Topics

- Levels of analysis in the study of brain and behavior
- Spatial
- Temporal
- Case Studies
- Systems Thinking

# Spatial resolution




http://ai.ato.ms/MITECS/Images/churchland.figure1.gif

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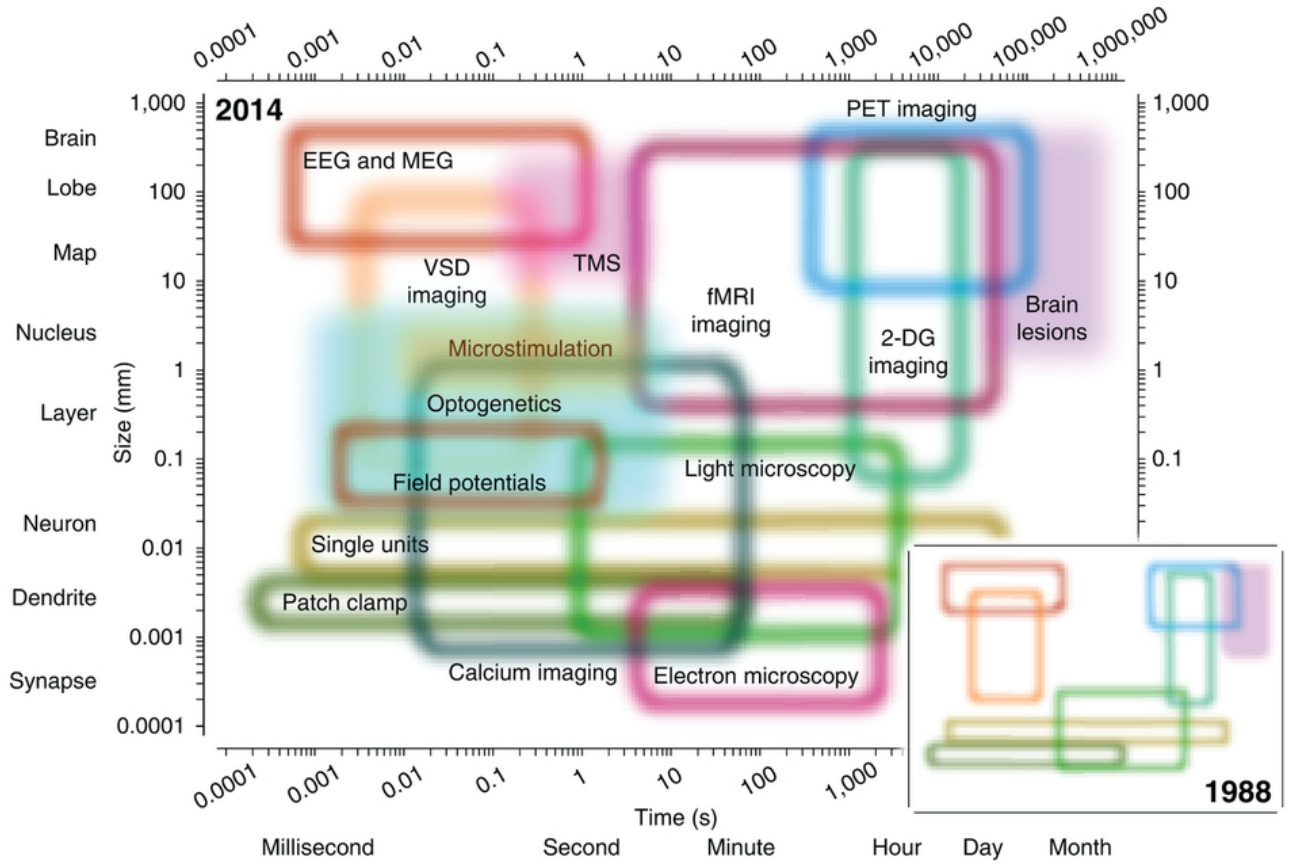
# Spatial and Temporal Resolution

(Sejnowski, Churchland, and Movshon 2014)

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# Spatial Resolution in Detail

- Within an individual
    - molecular
        - genetic
        - receptor
    - chemical
        - neurotransmitter
    - cellular
        - neuronal firing

# Spatial Resolution in Detail

- Internal to individuals
  - network
    - lateral inhibition
  - area
  - region
  - system

# Spatial Resolution in Detail

- External to individuals
  - Social
    - Friends, family, teachers, others
  - Non-social
    - neighborhood, school, state/region, country
    - Physical environment

# Temporal Resolution in Detail

- Within one lifetime
  - Microseconds
    - detection position from acoustic stimulation
  - Milliseconds
    - action potential
  - Seconds
    - changes in EEG power
    - short-term memory
  - Minutes
    - synaptic plasticity
  - Hours

# Temporal Resolution in Detail

- Within one lifetime
  - Days
  - Weeks
  - Months
  - Years
    - education & training
    - disease processes
    - cultural change
- Across lifetimes
  - Centuries
    - cultural changes

# Why does this matter?

- Different methods, different levels of analysis.
- Challenge of interpretation.
- Challenge of linking phenomena across levels.

# Case study 1: Poverty and the Brain

- Hanson et al. (2013). Family Poverty Affects the Rate of Human Infant Brain Growth. PLOS One.

http://dx.doi.org/10.1371/journal.pone.0080954

(Hanson et al. 2013)

# Case study 2: Pesticides and the Brain

- Rauh et al. (2012). PNAS. Brain anomalies in children exposed prenatally to a common organophosphate pesticide.

http://dx.doi.org/10.1073/pnas.1203396109

(Rauh et al. 2012)

# Systems Thinking

- Systems are
  - Bounded in space
  - Bounded in time

# Systems Thinking

- Systems have
  - Inputs
  - Outputs
- Systems
  - Have purposes/functions
  - Transform inputs to outputs
  - Operate autonomously

# Your turn

- Pick a system you know something about
- Identify boundaries, inputs/outputs, functions
- Evaluate the levels of analysis important to understanding its function

# Next Time

- Methods in neuroscience research

# References

Hanson, Jamie L., Nicole Hair, Dinggang G. Shen, Feng Shi, John H. Gilmore, Barbara L. Wolfe, and Seth D. Pollak. 2013. “Family Poverty Affects the Rate of Human Infant Brain Growth.” *PLoS ONE* 8 (12): e80954.

Rauh, Virginia A., Frederica P. Perera, Megan K. Horton, Robin M. Whyatt, Ravi Bansal, Xuejun Hao, Jun Liu, Dana Boyd Barr, Theodore A. Slotkin, and Bradley S. Peterson. 2012. “Brain Anomalies in Children Exposed Prenatally to a Common Organophosphate Pesticide.” *Proceedings of the National Academy of Sciences* 109 (20): 7871–76. doi:10.1073/pnas.1203396109.

Sejnowski, Terrence J, Patricia S Churchland, and J Anthony Movshon. 2014. “Putting Big Data to Good Use in Neuroscience.” *Nature Neuroscience* 17 (11). Nature Publishing Group: 1440–41.