Week #10 (April 8 & 13), Robustness
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The idea that biological systems have been selected for robustness has found applications in various domains of biology, from the molecular level to the organismic level. In Wednesday's lecture, we explore this idea as it relates to neuroscience. We will begin with a definition of robustness, followed by a brief survey of how robustness can be an emergent property of systems that exhibit features we have discussed in this course (especially adaptation, gain control, plasticity, and modularity). We will discuss various examples of robustness at the level of molecules, neurons, and neural circuits. A common theme linking many of these examples is that feedback loops tend to confer robustness, whether at the level of gene regulation or at the level of circuit dynamics. We will explore the idea that key features of neural development confer robustness on neural circuits, especially when activity-dependent refinement events fine-tune genetically-encoded patterns of neural connectivity. Finally, we will discuss how robustness may be a useful concept in thinking about the elaboration of neural circuits during evolution.

On Monday we will discuss the following paper in class:

Prinz AA, Bucher D, & Marder E (2004) "Similar network activity from disparate circuit parameters." *Nat. Neurosci.* **7**:1345-52.

Your assignment this week is to write a <u>commentary</u> on this paper. **NOTE WELL**: A commentary was published with the original paper, but we request that you do **not** consult this while writing your own. We obviously have no way to enforce this request, so you are on the honor system here. You are free to read anything else that you think is relevant.

As you are reading, you might consider the following questions.

1. Prinz and colleagues evaluated their 20+ million network simulations for the ability to produce a certain rhythmic pattern of bursting activity. What other criteria might be applied to judge the fitness of a given model?
2. The model neurons were chosen from a subset of those that produced realistic behavior in isolated conditions. To what extent do you think this was necessary? Might it be instructive to include "bad" model neurons?
3. What mechanisms might allow real circuits to seek out sets of parameters that lead to a desired behavior?
4. What caveats does this work raise for those of us doing experiments?

You do not necessarily need to address all of these questions in your written assignment. For guidelines about what we'd like to see in your referee's report, consult the syllabus: www.hms.harvard.edu/bss/neuro/bornlab/nb204/writing-curriculum.htm