The Skimm on What makes us Smart
Chapters 6-9 & associated lectures/readings

QUOTE OF THE WEEK

"Nature in her unfathomable designs had mixed us of clay and flame, of brain and mind, that the two things hang indubitably together and determine each other's being but how or why, no mortal may know." – William James – in Principles of Psychology (1918)

1. WHAT MAKES US SMART?

It's not really that straightforward. Einstein's brain is kinda different from the average brain, but not much. To understand what makes us smart, we need to look beyond large brain regions (aka, gross anatomy) and consider how little neurons are wired (how they are connected to one another).

1a. THE STORY.

The brain can be divided into the **hindbrain**, **midbrain**, and **forebrain**. The forebrain includes the **cerebral cortex** (**occipital, parietal, temporal, frontal lobes**) and some **subcortical** areas (basal ganglia, **limbic** system). Each brain region supports different psychological functions. In other words, some psychological behaviors can be localized to different regions of the cortex (but don't oversimplify this! complex behaviors require many areas working together).

1b. REMIND ME.

The brain is made up of ~86 billion **neurons** and a similar number of **glia** cells. Neurons communicate with each other via **electrical** and **chemical** transmission. Electrical activity is generated by **ions** and results in **action potentials**. Chemical transmission occurs via **neurotransmitters** (think glutamate, GABA, dopamine). One consequence of wiring is the maps that are created in the brain for different systems. For example, we have what's called a somatosensory **homunculus**, where adjacent points on the skin surface remain adjacent in the **cortex** and some regions of skin that we use a lot have more cortex devoted to them (e.g., hands and other parts…). Also, the cortex is malleable (read: **Plastic**). So, after amputation, there are changes in the homunculus.

1c. So…IF the CORTEX IS PLASTIC, WHAT DOES THAT MEAN?

Well, this gets back to the **nature-nurture question** and **epigenetics**. Genes and environments combine to produce our neural architecture and behavior. We can study this interaction using **behavioral genetics**. Early life experiences tend to have especially impactful influences on our brain's structure/function and **epigenetics** provides a framework for understanding how the environment influences **gene expression** (that subsequently affects **phenotypes**).

1d. theSKIMM.

Why are we each individual? It starts with a difference in our neural and chemical pathways. These differences are both biological and experience based. Experience changes our brain chemistry and neural wiring, producing changes in neural circuits and in whole brain areas (such as Einstein's inferior **parietal** lobe).

2. REPEAT AFTER ME…

2a. What to say when your aunt tells you that you're only using "10% of your brain."

Let's put it this way – The brain represents about 3% of our body's weight and uses about 20% of the body's energy. Trust me, we are "using" virtually every part of the brain most of the time. How else do you think we would do things like breath, move, balance, see, or hear? Not to mention, drive a car, do a math problem, or talk….

2b. What to say when you hear that glia are just "glue" that hold the brain together.

Quit giving glia a bad rap! These cells do a lot! They form myelin sheaths, digest debris of dead neurons, provide nutritional support from blood vessels, and help regulate the composition of extracellular fluid.

2c. What to say when your mom tells you to stop being so "right brained."

Hey mom, that sure is a vast oversimplification. Research shows that we use both sides of our brain in a complementary way, and the **corpus callosum** ensures that both **hemispheres** are in constant communication. Although each hemisphere may be specialized for certain cognitive functions, that does not mean it is working alone *or* that the degree of specialization is the same for everyone. #wholebrained

2d. What to say when your friend tries to tell you her depression is "in her genes."

Well, partly. Although there is some evidence that genes (a **predisposition** or a diathesis) can lead to the development of a particular mental illness, there is usually also an environmental factor (**stressor**) involved as well. Not to mention epigenetics. It *may* be more accurate to say it's in her biology.

3. THINGS TO KNOW (i.e., vocab)

3a. Terms: Action potential, adoption study, all-or-none principle, amygdala, axon, behavioral genetics, brain stem, cell membrane, central nervous system, cerebellum, cerebrum, contralateral, dendrites, depolarization, diffusion, dopamine, EEG, epigenetics, frontal lobe, fMRI, GABA, gene, genotype, glia, glutamate, hippocampus, ion channels, limbic system, myelin sheath, nervous system, neurons, neurotransmitter, occipital lobe, parietal lobe, peripheral nervous system, PET imaging, phenotype, plasticity, resting membrane potential, sodium-potassium pump, soma, somatosensory homunculus, split brain patient, synapses, temporal lobe, threshold of excitation, twin studies

3b. Some Names: Ramon y Cajal, D.O. Hebb, Hodgkin & Huxley, Phineas Gage (again)

3c. (But these aren't the only things that are important!)