Learning for Life Week 4 Summary 10-17-18

Topic: The Nature of Reward and Decision Making in the Brain

Speakers: Yevgenia Kozorovitskiy PhD and Thorsten Kahnt PhD

Today's session really took us into the basics of neuroscience through a glimpse into the labs of two brilliant junior faculty whose work focuses on reward and decision making in the brain.

Genia explained how her lab utilizes genes from the "toolkit of nature" to study how neurons and synapses operate in the brain. Genes from jelly fish allow for fluorescent labeling of neural pathways in the brain and viral genes are used to manipulate neurons. These are just two of the tools used in Genia's lab to understand neural pathways and the interactions between neurons facilitated by neurotransmitters. Without these basic roadmaps of the brain, treatments like deep brain stimulation (which we heard about last week) would not be possible, because physicians would not understand where to place the electrodes to modulate the disease.

The specific work that Genia's lab is focused on is whether or not the neurohormone oxytocin, which is involved in social affect behavior, directly controls the dopaminergic system. The latter is largely responsible for the human reward system. She described a series of experiments that confirm that indeed, oxytocin is significantly involved in stimulating some dopaminergic neurons while inhibiting others. While at this stage, the science is basic, the implications for clinical application in conditions like autism and post-partum depression are significant.

While most of Genia's experiments utilize mouse brains which have a lot of synergy with the human brain, Thorsten's experiments are performed in humans. He employs functional MRI of the brain to visualize the brain's response to olfactory stimuli or smells. Human subjects are exposed to a range of smells which, when used in a variety of experimental designs, allow Thorsten's team to begin to understand how the brain makes choices, and how it learns from experiences to inform future choices. Much of the decision making in our brain occurs in the orbitofrontal cortex (OFC). Thorsten described how an animal who is given cocaine for three weeks is unable to make choices because it behaves as if the orbitofrontal cortex has been damaged. The animal can no longer imagine the outcomes of its behavior. Although this is not yet proven, this research leads to questions and potential implications for patients who have addiction. We believe that the reward and decision making systems are impacted in patients who have addictions. They may not be able to imagine behaviors other than drinking or using drugs that could result in reward, and may not be able to imagine all the consequences of continued addictive behaviors. A new line of research might investigate the outcomes of stimulation of the OFC of patients with addiction. Might that enhance their ability to make different choices?

Take Home Points:

1. We are just beginning to understand the brain's complexity. Research like that of Genia and Thorsten are critical to mapping the neural systems that control complex behavior and emotion like reward and decision making.
2. Once we understand the underlying neural pathways that control behaviors, we can manipulate these pathways chemically or through tools like deep brain stimulation to improve many diseases.