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Lab Web Site:

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Education:

- Postdoc., Columbia University Med Ctr, 2015
- Ph.D., Rutgers University, Ph.D., 2008
- B.A., Barnard College, Columbia University, B.A., 1999

Research Interest:

Neural mechanisms of learning and anxiety

One of the basic questions in neuroscience is understanding the integration of external stimuli into dynamic internal states of the brain, such as fluctuating levels of anxiety, which influences learning and memory. Deciphering the nature of these interactions is vital for understanding psychiatric disorders and complex cognition.

In our lab, we combine ideas from learning theory and neuroscience to study circuit-level mechanisms of learning, such as cortical-subcortical communication and the dialogue between excitatory and inhibitory neurons in different internal states. We focus our efforts on interactions between the amygdala, an important center for processing fear and safety information, with structures such as the basal forebrain and the prefrontal cortex. To probe circuit function we use multi-site recordings, optogenetics, pharmacology, anatomical and computational approaches that together highlight how neural communication is altered by anxiety. We study different kinds of learning (by using paradigms that include classical and operant conditioning, learned safety, extinction, fear generalization) as well as innate exploration of safe and aversive environments. Many of these paradigms model the behavior seen in human Anxiety Disorders such as Post Traumatic Stress Disorder (PTSD) and Generalized Anxiety Disorder (GAD).

Selected Publications

- Likhtik E., Paz R. (2015) The amygdala and prefrontal cortex in (mal)adaptive learning. Trends Neurosci, 38:158-166.
- Gore F., Schwartz E.C., Brangers B., C., Aladi S., Stujenske J.M., Likhtik E., Russo M.J., Gordon J.A., Salzman C.D., Axel R. (2015) Neural representations of unconditioned stimuli in basolateral amygdala mediate innate and learned responses. Cell, 162:134-145.
- Likhtik E., Stujenske J.M., Topiwala M.A., Harris AZ Gordon J.A. (2014). Prefrontal entrainment of amygdala activity signals safety in learned fear and innate anxiety. Nature Neuroscience 17: 106-113.
- Stujenske J.M., Likhtik E., Topiwala M.A., Gordon J.A. (2014) Fear and safety engage competing patterns of theta-gamma coupling in the basolateral amygdala. Neuron 83:919-933.

- Likhtik E., Gordon J.A. (2013) A surprised amygdala looks to the cortex for meaning. Neuron 80: 1109-1111..
- Likhtik E., Popa D., Apergis-Schoute J., Fidacaro G.A., Paré D. (2008) Amygdala intercalated neurons are required for expression of fear extinction. Nature 454:642-645.
- Likhtik E., Pelletier J.G., Paz R., Paré D. (2005) Prefrontal control of amygdala. Journal of Neuroscience 25: 7429-7437.
- Quirk G.J., Likhtik E., Pelletier J.G., Paré D. (2003) Stimulation of medial prefrontal cortex

decreases the responsiveness of central amygdala output neurons. Journal of Neuroscience 23:8800-7.