A fundamental goal in the field of developmental neurobiology is to understand how neural circuits are established during development and how they are refined by experience and altered in disease. Of particular interest are the circuits in the cerebral cortex, a part of the vertebrate brain with a central role in many higher order brain functions, including learning and memory, perception and cognition. Disorders in development of cortical circuits are thought to contribute to the etiology of many neurological diseases. Research in the Zito lab focuses on understanding the activity patterns and signaling mechanisms that drive the formation and loss of synaptic connections during experience-dependent modification of neural circuits and in disease. We use molecular genetic techniques and electrophysiological approaches combined with two-photon imaging technologies that enable both visualization and functional characterization of synaptic connections. I will discuss our latest progress in defining the neural activity-dependent mechanisms that drive structural plasticity of synaptic connections in the cerebral cortex.