Learning to See with Your Eyes Closed

July 25

Tuesday, 12:30 pm

Billings Building—Rosedale Room

SPEAKER:

Michael C. Crair, Ph.D.

Vice Provost for Research

William Ziegler III Professor of Neuroscience

Professor of Ophthalmology & Visual Science

Yale University

Hosts: PostDocs

For more information contact
Darlene White
daw9085@med.cornell.edu

Publications

Retinal waves prime visual motion detection by simulating future optic flow by Ge et al. https://www.science.org/doi/full/10.1126/science.abd0830

Efferent feedback controls bilateral auditory spontensous activity by Wang et al. https://www.nature.com/articles/s41467-021-22796-8

Mesoscopic Imaging: Shining a Wide Light on Large-Scale Neural Dynamics by Cardin et al., https://www.cell.com/neuron/pdf/S0896-6273(20)30755-8.pdf

Abstract

Activity-dependent neural circuit refinement is an essential developmental process extending across embryonic and postnatal stages in the mammalian central nervous system. Prior to the onset of experience, sensory organs spontaneously generate spatiotemporal patterns of synchronized activity among neighboring neurons. These organized patterns of spontaneous activity are required for the establishment of the initial configuration of functional circuits necessary for early behavior and survival. We demonstrate that endogenous patterns of spontaneous activity instruct axon branch dynamics with sub-cellular precision following Hebb's predictions, summarized as "cells that fire together, wire together" and "out of sync – lose your link". Our observations further suggest that this instructive role of retinal waves in axon remodeling is mediated by synaptic plasticity: patterned spontaneous activity stabilizes and strengthens individual presynaptic sites in subcellular compartments following Hebb's law. These experiments provide the first direct in vivo evidence that endogenous patterns of spontaneous activity drive circuit refinement via Hebbian plasticity rules and elucidate the activity-dependent mechanisms of how functional brain circuits are self-organized even before the onset of sensory experience.

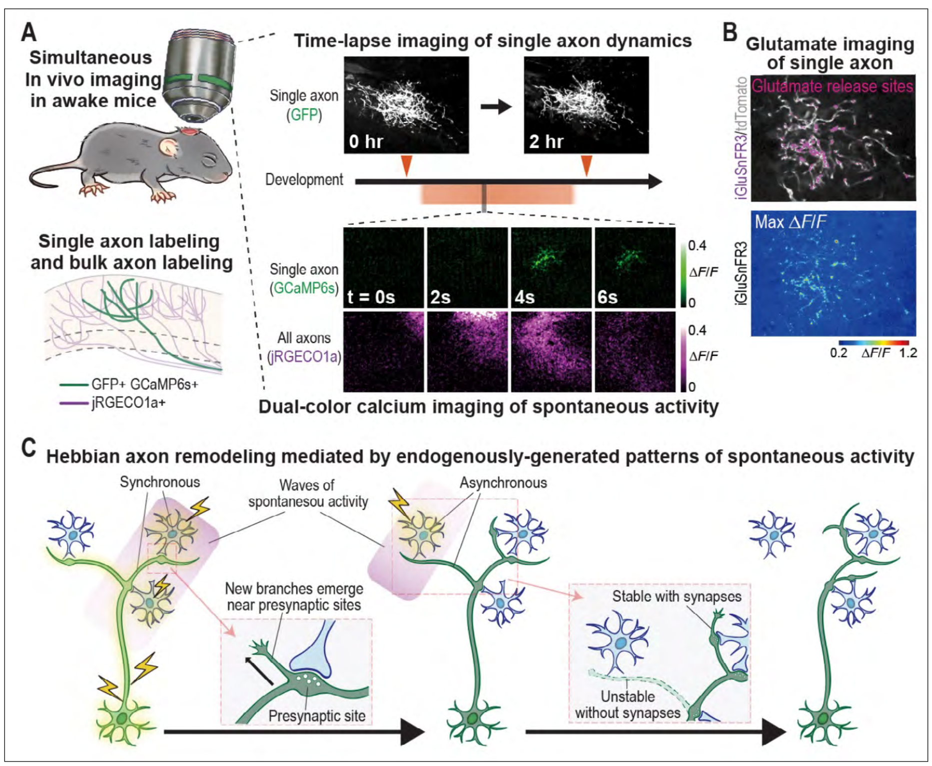

Figure Legend: Hebbian axon remodeling. **(A)** Schematic of simultaneous in vivo two-photon imaging combining time-lapse imaging of a single axon with dual-color calcium imaging of both single axon activity and neighboring axon activities in the awake mouse. **(B)** In vivo glutamate imaging of a single axon. **(C)** Schematic of Hebbian axon remodeling mediated by spatiotemporal patterns of spontaneous activity.