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NEUROSCIENCE 2014

Presentation Abstract

Program#/Poster#:	659.08/VV28
Presentation Title:	Time course of subthreshold activity preceding spike generation in awake behaving mouse hippocampus
Location:	WCC Hall A-C
Presentation time:	Tuesday, Nov 18, 2014, 1:00 PM - 5:00 PM
Presenter at Poster:	Tue, Nov. 18, 2014, 4:00 PM - 5:00 PM
Topic:	++G.04.b. Optogenetics

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Abstract: Neurons are often thought of as coincidence detectors that respond selectively to highly synchronized inputs. Indeed, research in vitro (e.g. in brain slices) has characterized how coincident synaptic inputs sum together within a neuron to drive well-timed spiking, and in vivo highly synchronized spiking across multiple presynaptic neurons is often assumed to drive activity in downstream neurons. However, patterns of inputs and intrinsic activity are very different between neurons in vitro and in awake behaving animals, leaving a major gap in our understanding of how neurons integrate incoming inputs and intrinsic activity to produce a spike in the awake brain. Accordingly, we have examined the time course of subthreshold depolarization preceding spiking in CA1 neurons in awake behaving mice. We performed whole cell patch clamp recordings using an optimized patch clamp robot (Awake Autopatcher) in head-fixed mice navigating through a virtual reality environment. We found that subthreshold depolarizations ramped up over extended periods - as much as fifty to a hundred milliseconds or more -- preceding the time of actual spike generation. Because these extended depolarizing ramps bring cells close to threshold, they could allow subsequent small inputs to rapidly result in spiking. Furthemore, these results may provide insight into the neural network patterns that drive individual neurons to fire in the living brain. (Singer and Talei Franzesi are co-first authors.)

Disclosures: **A.C. Singer:** None. **G. Talei Franzesi:** None. **S.B. Kodandaramaiah:** None. **M. Tsitsiklis:** None. **S. Sharma:** None. **D. Bozic:** None. **S. Batir:** None. **I.R. Wickersham:** None. **G.L. Holst:** None. **C.R. Forest:** None. **C. Börgers:** None. **N.J. Kopell:** None. **E.S. Boyden:** None.

Keyword (s): PATCH CLAMP

HIPPOCAMPUS

IN VIVO

Support: NIH 1R01DA029639

NIH 1DP1NS087724

NIH 1R01NS067199

NIH 1R01EY023173

New York Stem Cell Foundation-Robertson Award