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Inscopix Community research has dived to the deepest depths of the brain, begun to explore the mysteries of the frontal cortex, and branched into exciting new paradigms and animal models!

See Inscopix community science in action for yourself in some of the following publications from 2015 and 2016.
Optimally orchestrating complex behavioral states, such as the pursuit and consumption of food, is critical for an organism’s survival. The lateral hypothalamus (LH) is a neuroanatomical region essential for appetitive and consummatory behaviors, but whether individual neurons within the LH differentially contribute to these interconnected processes is unknown.

Homeostasis is a biological principle for regulation of essential physiological parameters within a set range. Behavioural responses due to deviation from homeostasis are critical for survival, but motivational processes engaged by physiological need states are incompletely understood. We examined motivational characteristics of two separate neuron populations that regulate energy and fluid homeostasis by using cell-type-specific activity manipulations in mice.
Time-locked sequences of neural activity can be found throughout the vertebrate forebrain in various species and behavioral contexts. From “time cells” in the hippocampus of rodents to cortical activity controlling movement, temporal sequence generation is integral to many forms of learned behavior. However, the mechanisms underlying sequence generation are not well known. Here, we describe a spatial and temporal organization of the songbird premotor cortical microcircuit that supports sparse sequences of neural activity.

The prefrontal cortex (PFC) plays a key role in controlling goal-directed behavior. Although a variety of task-related signals have been observed in the PFC, whether they are differentially encoded by various cell types remains unclear. Here we performed cellular-resolution microendoscopic Ca\textsuperscript{2+} imaging from genetically defined cell types in the dorsomedial PFC of mice performing a PFC-dependent sensory discrimination task.
DISTINCT SPEED DEPENDENCE OF ENTORHINAL ISLAND AND OCEAN CELLS, INCLUDING RESPECTIVE GRID CELLS

Chen Sun, Takashi Kitamura, Jun Yamamoto, Jared Martin, Michele Pignatelli, Lacey J. Kitch, Mark J. Schnitzer, Susumu Tonegawa

PNAS

July 13th, 2015

Entorhinal–hippocampal circuits in the mammalian brain are crucial for an animal’s spatial and episodic experience, but the neural basis for different spatial computations remain unknown. Medial entorhinal cortex layer II contains pyramidal island and stellate ocean cells. Here, we performed cell type-specific Ca\(^{2+}\) imaging in freely exploring mice using cellular markers and a miniature head-mounted fluorescence microscope.

ENTORHINAL CORTICAL OCEAN CELLS ENCODE SPECIFIC CONTEXTS AND DRIVE CONTEXT-SPECIFIC FEAR MEMORY

Takashi Kitamura, Chen Sun, Jared Martin, Lacey J. Kitch, Mark J. Schnitzer, Susumu Tonegawa

Neuron

September 23rd, 2015

Forming distinct representations and memories of multiple contexts and episodes is thought to be a crucial function of the hippocampal-entorhinal cortical network. The hippocampal dentate gyrus (DG) and CA3 are known to contribute to these functions, but the role of the entorhinal cortex (EC) is poorly understood.
HIPOCAMPAL ENSEMBLE DYNAMICS TIMESTAMP EVENTS IN LONG-TERM MEMORY
Alon Rubin, Nitzan Geva, Liron Sheintuch, Yaniv Ziv

*eLife Sciences*

December 18th, 2015

The capacity to remember temporal relationships between different events is essential to episodic memory, but little is currently known about its underlying mechanisms. We performed time-lapse imaging of thousands of neurons over weeks in the hippocampal CA1 of mice as they repeatedly visited two distinct environments. Longitudinal analysis exposed ongoing environment-independent evolution of episodic representations, despite stable place field locations and constant remapping between the two environments.

VISUALIZATION OF CORTICAL, SUBCORTICAL AND DEEP BRAIN NEURAL CIRCUIT DYNAMICS DURING NATURALISTIC MAMMALIAN BEHAVIOR WITH HEAD-MOUNTED MICROSCOPES AND CHRONICALLY IMPLANTED LENSES
Shanna L Resendez, Josh H Jennings, Randall L Ung, Vijay Mohan K Namboodiri, Zhe Charles Zhou, James M Otis, Hiroshi Nomura, Jenna A McHenry, Oksana Kosyk, Garret D Stuber

*Nature Protocols*

February 25th, 2016

Genetically encoded calcium indicators for visualizing dynamic cellular activity have greatly expanded our understanding of the brain. However, owing to the light-scattering properties of the brain, as well as the size and rigidity of traditional imaging technology, in vivo calcium imaging has been limited to superficial brain structures during head-fixed behavioral tasks.
CALCIUM IMAGING OF SLEEP–WAKE RELATED NEURONAL ACTIVITY IN THE DORSAL PONS

Julia Cox, Lucas Pinto, Yang Dan

Nature Communications

February 25th, 2016

The dorsal pons has long been implicated in the generation of rapid eye movement (REM) sleep, but the underlying circuit mechanisms remain poorly understood. Using cell-type-specific microendoscopic Ca2+ imaging in and near the laterodorsal tegmental nucleus, we found that many glutamatergic neurons are maximally active during REM sleep (REM-max), while the majority of GABAergic neurons are maximally active during wakefulness (wake-max).

DIRECT IMAGING OF HIPPOCAMPAL EPILEPTIFORM CALCIUM MOTIFS FOLLOWING KAINIC ACID ADMINISTRATION IN FREELY BEHAVING MICE


Frontiers in Neuroscience

February 29th, 2016

Prolonged exposure to abnormally high calcium concentrations is thought to be a core mechanism underlying hippocampal damage in epileptic patients; however, no prior study has characterized calcium activity during seizures in the live, intact hippocampus. We have directly investigated this possibility by combining whole-brain electroencephalographic (EEG) measurements with microendoscopic calcium imaging of pyramidal cells in the CA1 hippocampal region of freely behaving mice treated with the pro-convulsant kainic acid (KA).

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