ABOUT BCS
RESEARCH
ACADEMICS
PEOPLE

- **Faculty**
- Staff
- Researchers
- Postdocs
- Graduate Students
- Undergrad Students

NEWS & EVENTS
DIVERSITY & OUTREACH
GIVING

jn BCS Website

jn BCS People

jn MIT Wide

SEARCH

People / Faculty

James J. DiCarlo, M.D., Ph.D.
Associate Professor of Neuroscience

Department Head

Department of Brain and Cognitive Sciences
Building: 46-6161
Lab: DiCarlo Lab
Email: dicarlo@mit.edu

Neuronal mechanisms underlying object recognition

The research goal of our laboratory is to understand the mechanisms underlying visual object recognition. Specifically we seek to understand how sensory input is transformed by the brain from an initial representation (essentially a photograph on the retina), to a new, remarkably powerful form of representation -- one that can support our seemingly effortless ability to solve the computationally difficult problem of object recognition. We are particularly focused on patterns of neuronal activity in the highest levels of the ventral visual stream (primate inferior temporal cortex, IT) that likely directly underlie recognition. At these high levels, individual neurons can have the remarkable response property of being highly selective for object identity, even though each object's image on the retinal surface is highly variable -- for example, due to changes in object position, distance, pose, lighting and background clutter. Understanding the creation of such neuronal responses by transformations carried out along the ventral visual processing stream is the key to understanding visual recognition.

To approach these very difficult problems, the work of our laboratory is directed along three main lines: 1) characterize the computational usefulness of patterns of IT neuronal activity for supporting immediate visual object recognition, 2) test and develop computational theories of how visual input is transformed along the ventral processing stream from a pixel-wise representation, to a powerful representation in IT, 3) understand the spatial organization of this representation. Our primary research approaches are: neurophysiology in awake, behaving non-human primates, functional brain imaging (fMRI), human psychophysics, and computational modeling. Across all of these endeavors we aim to develop innovative methods and tools to facilitate this work in our laboratory and others. Our approaches are often synergistic with those of other MIT laboratories, and this has greatly enhanced our progress.

Because recognition is critical to so much of behavior, the understanding we seek will fundamentally influence the way we think about how the brain processes sensory information, and, more generally, principles of cortical information processing. Our goal is to use this understanding to inspire artificial vision systems, to aid the development of visual prosthetics, to provide guidance to molecular approaches to repair lost brain function, and to obtain deep insight into how the brain represents sensory information in a way that is highly suited for cognition and action.

Pinto N, Doukhan D, DiCarlo JJ, Cox DD. A High-Throughput Screening Approach to Discovering Good Forms of Biologically Inspired Visual Representation. PLoS Comput Biol 5(11): e1000579. doi:10.1371/journal.pcbi.1000579 (2009)

Li N, Cox DD, Zoccolan D, DiCarlo JJ. What response properties do individual neurons need to underlie position and clutter "invariant" object recognition? J Neurophysiol. 2009 Jul;102(1):360-76.

Zoccolan D, Oertelt N, DiCarlo JJ, Cox DD. A rodent model for the study of invariant visual object recognition. Proc Natl Acad Sci U S A. 2009 May 26;106 (21):8748-53.

Li N, DiCarlo JJ. Unsupervised natural experience rapidly alters invariant object representation in visual cortex. Science. 2008 Sep 12;321(5895):1502-7.

Additional Publications