nih record

Vol. LXVII, No. 20 | NIH RECORD HOME | NIH RECORD ARCHIVES | NIH HOME PAGE | September 25, 2015

cover

next story

# MIT's Boyden Blows It Up to See It Better

**On the front page...**

You don't hear the expression "ground truth" much in biology, which would often settle for "reproducibility," at least in the short term, as a scientific goal. Ground truth is more the territory of physics, so it's no surprise that the lead-off hitter in this season's Wednesday Afternoon Lecture Series was trained in that science.

MIT's Dr. Ed Boyden kicks off the WALS season with a talk on Sept. 2 in Masur Auditorium.

MIT's Dr. Ed Boyden studied physics and electrical engineering at both MIT and Stanford, where he collaborated with Dr. Karl Deisseroth in opening the field known as optogenetics. He has earned the right to stake out ground truths and shared generous portions of that search Sept. 2 in Masur Auditorium before as large a crowd as one could hope to get just a few days prior to Labor Day.

NIH director Dr. Francis Collins opened the talk, touting both the series—"the high intellectual point of our NIH week"—and the speaker: "Ed is an innovator of the highest order."

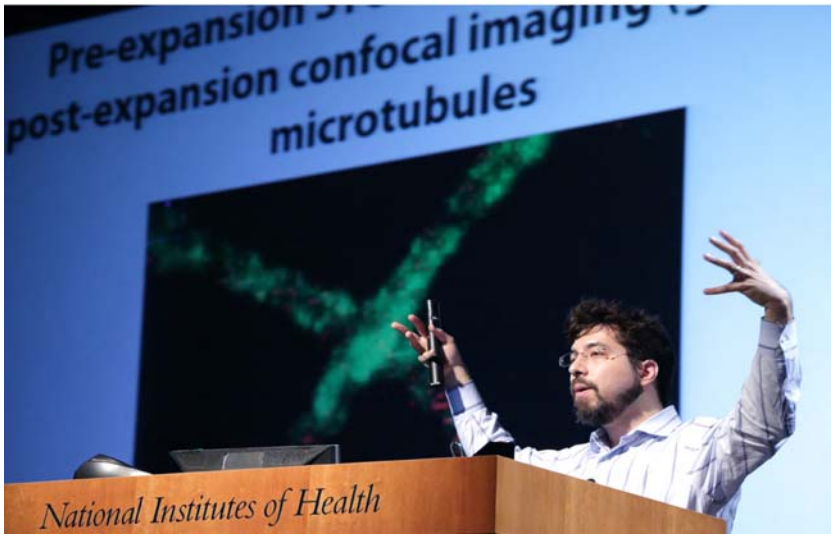
Boyden, who holds six leadership posts at MIT, including teaching a course in "revolutionary ventures" that encourages entrepreneurship, directs a technology group determined to map the pathways from neurons to behavior, from the nanoscale to the macro.

**Continued...**

"Can we map large-scale systems like the brain with molecular precision?" he asked.

Not if you can't see what you're doing.

To solve that problem, his team is pioneering "physical magnification—blowing things up to see them better."




The scientists have found methods to physically inflate cells and tissues using the same chemistry that permits a baby diaper to absorb urine. Sodium polyacrylate swells with the addition of water, up to nearly 5 times its original size. Boyden's team has invented "expansion microscopy," which enables a regular microscope to attain super-resolution images.

Boyden said that work in the 1970s on responsive polymers led to this new approach, wherein specimens are fixed and labeled, forming a swell-able gel that can expand the sample, which is structurally disrupted with enzymes. The addition of water serves as an amplifier.

“Our hope is that one day we can visualize the structure of the genome,” he said. Displaying colorful slides of magnified cells and tissues, he quipped, “I can stare at these all day.”

His wit was also evident when he observed that this process “doesn’t work, of course, in live samples. Expanding something 20 times isn’t compatible with living.”

Boyden (l) leads the MIT Media Lab’s synthetic neurobiology research group, which develops tools for mapping, controlling, observing and building dynamic circuits of the brain. It uses these neurotechnologies to understand how cognition and emotion arise from brain network operation, as well as to enable systematic repair of intractable brain disorders such as epilepsy, Parkinson’s disease and post-traumatic stress disorder.

Not that living specimens are off limits. Boyden and his colleagues are building robots that can perform automated patch-clamping, directed by computer, in the brains of live animals.

The talk, titled “Tools for analyzing and repairing complex biological systems,” covered mapping biological pathways, recording them and lastly controlling them; neurons can be made sensitive to light, using microbial opsins. This enables “single-cell resolution optogenetics.”

Boyden admits, “Controlling the brain is very hard to do.” But you have to start somewhere.

The hour-long talk, accessible only to HHS employees (much of the work is yet unpublished), is online at http://videocast.nih.gov/summary.asp?Live=16892&bhcp=1.—**Rich McManus**

---

back to top of page