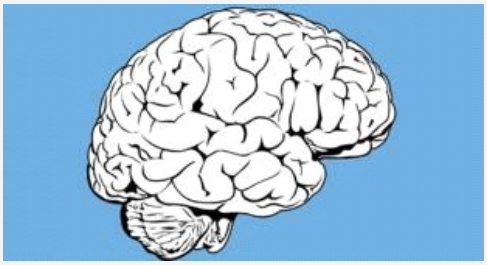
Qualia

Bringing CLARITY to the study of the brain

March 11, 2013 | Author:Summer Allen, Graduate and Postdoc, Brown University



One of the major challenges of modern neuroscience is mapping how neurons are wired together

One of the major challenges of modern neuroscience is mapping how neurons are wired together—especially since most current techniques involve cutting brains into thin sections and reconstructing them on a computer. A new technique called CLARITY may simplify these experiments by making brains transparent so they can be studied without being cut.

I learned about CLARITY at the AAAS Annual Meeting in Boston in February. At the meeting, Dr. Karl Deisseroth talked about the different techniques his lab has developed to help neuroscientists study brain circuits. Deisseroth (along with Ed Boyden and Feng Zhang) may be best known for the discovery of optogenetics. With optogenetics, fiber optic cables turn on light-activated channels (originally found in green algae), which then control the activity of neurons.

Optogenetics is a powerful technique, and several labs are using it to study the circuits that control different behaviors in mice, rats, and monkeys. In his talk, Deisseroth showed how using optogenetics to turn off one percent of neurons in a particular brain area called the nucleus accumbens decreased the number of times rats sought cocaine. He also showed that activating different groups of neurons can either increase or decrease how many times a mouse in a pool of water kicks. This is called the forced swim test and is a rat model for depression: rats who stop swimming are “depressed” (but luckily these defeated rats float and don’t drown). While these optogenetics findings are clearly transformative, one limitation of the technique is that not all the circuits in the brain are mapped out. Optogenetics is useful when you know the particular circuits involved, but for many behaviors (and certainly for many psychiatric diseases) the wiring diagram simply isn’t known.

Enter CLARITY (Clear, Lipid-exchanged, Anatomically Rigid, Imaging/immunostaining compatible, Tissue hYdrogel) a new technique from the Deisseroth lab. With this technique, researchers can generate a 3D view of all the neurons that produce a particular protein and see how these neurons are connected. 3D imaging in complete brains used to be impossible because the fat in the brain does not allow imaging through thick tissue. The Deisseroth lab has solved this problem by making a hydrogel that is infused through the brain. This hydrogel binds to protein but not to fat, meaning strong detergents can be used to get rid of all the fat, leaving only the proteins. The result is stunning: a completely clear brain (as Deisseroth showed, you can even read a passage from famous neuroscientist Ramon y Cajal through it). CLARITY keeps the fine structures of neurons—including the dendritic spines where neurotransmission occurs—intact.

According to Deisseroth, brains prepared with CLARITY are hardy enough for multiple rounds of experiments. This hardiness is especially important when working with rare samples such as human brains. Bringing this point home, Deisseroth showed a 3D image of neurons from a seven year old boy with autism who had drowned. This image just showed all the neurons that made a particular protein (parvalbumin), but the boy’s brain will be used to study several other types of neurons as well.

CLARITY is still in its early days, and time will tell whether it becomes a widely adopted technique, but I look forward to seeing its evolution.

Most Emailed | Most Commented

Last 24 hours This Week This Month

No results found

Categories

- Science Policy (317)
- K-12 Education (138)
- Undergraduate Education (112)
- International Co-operation (86)
- Human Rights (30)
- Public Engagement (153)
- Evolution (66)
- Climate Change (91)
- Energy (65)
- Medicine (163)
- Workforce Development (125)
- Career Development (138)
- Diversity (77)
- Communicating Science (192)
- Biology (168)
- Chemistry (34)
- Earth Sciences (34)
- Engineering (50)
- Physics (43)
- Social Sciences (26)