The Chatter of Neurons (w/Video)

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(PhysOrg.com) -- Close your eyes. Extend your arms and let your fingertips explore your surroundings. What textures and shapes do you feel? What can you infer about your immediate environment simply through touch?

Just as your hands glide over surfaces, animals' whiskers collect sensory information from the world around them. When an animal twitches its whiskers, it not only gathers input, but also adjusts its whiskers as a function of that data.

Humans like other animals behave in a dynamic way to survive -- we are constantly modulating our behavior based on changing stimuli so we can act appropriately.

Fascinated by how animals construct internal pictures of their environments, Tansu Celikel, assistant professor of biological sciences, and his fellow researchers in USC College are investigating how sensory interactions occur and are encoded in the brain.

Celikel's lab focuses on the sensory cortex or the region of the brain that receives information from touch receptors. By mapping the neural activity induced by rodent whisker behavior, they hope to understand how the brain collects and organizes sensory input.

While others in the field of neurobiology have studied how neurons function individually, Celikel is elevating the research to a new level by

examining how groups of neurons in the sensory cortex talk to each other and ultimately adapt. Using an electrode array, Celikel is able to simultaneously record many neurons and better capture what an entire population is doing rather than going from one neuron to the next and making inferences about behavior.

"Studying a single neuron's activity to understand how the brain functions is similar to looking at a single shopper in a grocery store and trying to understand the state of the U.S. economy based on how much a single person spends on a given shopping trip," Celikel explained. "Although we can study the plasticity or adaptability of individual neurons, studying neural activity one neuron at a time results in lost information about how the brain functions."

By identifying which cellular processes and regions are affected when neurons reorganize in the face of a changing environment, Celikel's research has many practical implications. For example, the nervous systems of amputees undergo dramatic changes such as phantom limb pain and the inability to integrate artificial limbs with the rest of the body. Celikel believes scientists could control these reactions and thereby allow for artificial limb integration, among other benefits, by finding which regions and mechanisms are involved in the brain's reorganization.

The opportunity to have such an impact is exactly what attracted 2nd year neuroscience doctoral student David Herman to USC College.

"Working in Tansu's lab is cool because we are trying to answer a very important question, 'how does a brain change?,'" Herman said. "This complex question requires a variety of approaches, so we develop skills in a number of fields, including cellular biology, robotics and computational modeling. By combining knowledge from multiple fields we hope to understand how sensory information is represented in the

cortex and how this information changes as the environment and/or the body changes (e.g. amputee). Ultimately, we hope to understand the neurobiology behind diseases states and injury so that we can better treat these conditions."

Many USC College undergrads are equally intrigued by the intricacies of the brain. Since its inception as a major four years ago, neuroscience has become the College's fastest growing major.

According to Celikel, understanding the human brain is one of science's last frontiers, so it's no surprise students are drawn to the field.

"We are living in the neuroscience era," Celikel said. "Without an understanding of the human brain, we will never understand how we exist as people and as social animals. With so many unknowns, neuroscience is a very exciting field because whatever you do, whatever novel approach you take, every novel question you ask, will contribute to the overall knowledge about how humanity exists."

Celikel and his group find they thrive in the field because it integrates so many different branches of the sciences. With neurobiologists, molecular biologists, experimental psychologists and physicists among their ranks, they all strive to understand how the brain processes sensory input -- how humans become human.

Provided by University of Southern California (news : web)