# Researchers develop method for mapping neuron clusters

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A team of scientists has developed a method for identifying clusters of neurons that work in concert to guide the behavior. Their findings, which appear in the journal *Neuron*, address a long-standing mystery about the organization of the prefrontal cortex (PFC)—one of the most recently evolved parts of the primate brain that underlies complex cognitive functions.

"We have established a method to find functional groupings of neurons based on co-fluctuation of their responses," says Roozbeh Kiani, an assistant professor in NYU's Center for Neural Science and one of the study's authors. "In doing so, we show that PFC neurons are organized into spatially contiguous maps, much like their counterparts in sensory cortices. The widely accepted notion that orderly spatial maps are restricted to sensory cortices, therefore, needs revision."

"Our methodology is closely related to the techniques that led to the discovery of functional networks in brain imaging studies," adds William Newsome, a professor of neurobiology at Stanford University and a Howard Hughes Medical Institute Investigator. "There is, however, a crucial difference. We extend the methodology to cellular scale and demonstrate that it can be used for identifying networks at a neuronal level. By suggesting a potential neural substrate for functional networks in macro-scale brain imaging we bridge a critical gap in our knowledge."

The research focused on the "parcellation" of PFC neurons: how these cells are grouped together to perform specific functions. The scientists showed that the discovered subnetworks in the prefrontal cortex are linked to the decision-making behavior but seem to have distinct roles: one subnetwork better represents upcoming choices and another one seems to keep track of past choices.

Previous studies that explored spatial organization of neurons in the prefrontal cortex predominantly focused on the average responses of neurons by examining them one at a time. They missed the organization of the network "forest" for the neuron "trees". In the *Neuron* paper, the researchers outlined a vastly different method. In it, they focused on the correlated activity of large numbers of simultaneously recorded neurons to spot the larger "topography" of the network—and how their groupings may be linked to the behavior. Specifically, they applied clustering algorithms that discover natural divisions in the matrix of response correlations to divide the recorded neural population.

"This technique provides an innovative, but straightforward, way to delineate cortical networks," observers Kiani. "The subnetworks in the PFC are stable across behavioral tasks and are apparent even in the spontaneous fluctuations of neural responses. They seem to be largely defined by the intrinsic connectivity of neurons in the local network. Therefore, they provide an objective basis for dividing the cortex into constituent subnetworks, offering a common standard across experiments."

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