Clouds in the head

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Many brain researchers cannot see the forest for the trees. When they use electrodes to record the activity patterns of individual neurons, the patterns often appear chaotic and difficult to interpret.

"But when you zoom out from looking at individual cells, and observe a large number of neurons instead, their global activity is very informative," says Mattia Rigotti, a scientist at Columbia University and New York University who is supported by the SNSF and the Janggen-Pöhn-Stiftung. Publishing in *Nature* together with colleagues from the United States, he has shown that these difficult-to-interpret patterns in particular are especially important for complex brain functions.

What goes on in the heads of apes

The researchers have focussed their attention on the activity patterns of 237 neurons that had been recorded some years previously using electrodes implanted in the frontal lobes of two rhesus monkeys. At that time, the apes had been taught to recognise images of different objects on a screen. Around one third of the observed neurons demonstrated activity that Rigotti describes as "mixed selectivity". A mixed selective neuron does not always respond to the same stimulus (the flowers or the sailing boat on the screen) in the same way. Rather, its response differs as it also takes account of the activity of other neurons. The cell adapts its response according to what else is going on in the ape's brain.

Chaotic patterns revealed in context

Just as individual computers are networked to create concentrated processing and storage capacity in the field of Cloud Computing, links in the complex cognitive processes that take place in the prefrontal cortex play a key role. The greater the density of the network in the brain, in other words the greater the proportion of mixed selectivity in the activity patterns of the neurons, the better the apes were able to recall the images on the screen, as demonstrated by Rigotti in his analysis. Given that the brain and cognitive capabilities of rhesus monkeys are similar to those of humans, mixed selective neurons should also be important in our own brains. For him this is reason enough why brain research from now on should no longer be satisfied with just the simple activity patterns, but should also consider the apparently chaotic patterns that can only be revealed in context.

More information: Rigotti, M. et al. (2013). The importance of mixed selectivity in complex cognitive tasks, *Nature* online. doi: 10.1038/nature12160

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