Press Release

Embedded nerve cells hold the key to brain activity

Scientists from Freiburg propose new approach to unravel the function of the human brain

Understanding complex systems such as the brain of mammals: Dr. **Arvind Kumar** and colleagues from the Bernstein Center and the Cluster of Excellence BrainLinks-BrainTools at the University of Freiburg present a new view on brain function. Much of today's brain research follows an approach that has been in use for decades: An area of the brain is either silenced of augmented in its activity, and the resulting effects in other parts of the brain – or in the whole organ – are measured. While this approach is very successful in understanding how the brain processes input from our senses, a team of scientists from Freiburg argues that it is too simple when trying to understand other brain regions. The team presents their findings in the current issue of the journal "Trends in Neuroscience".

"The traditional approach reduces the brain's enormous complexity by defining relatively arbitrary subunits", Kumar and his colleagues explain. For this abstraction to work, information must flow in one direction only. But this is not what happens in the brain, which is a complex network of smaller sub-networks that allows feedback to preceding units. Even for a network of ten units, unraveling each unit's function would require more than 100,000 individual experimental setups – an impossible task.

"Perhaps, the main question in understanding the brain is not so much how a particular area affects the activity of others, but rather how exactly brain activity can be changed from one state to another", Kumar states. For this

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purpose, the neuroscientists introduced a new quality of nerve cells: their embeddedness. This is a measure for the role that a neuron plays within a network. It combines data about where a nerve cell receives information from, where it connects to, and how much it contributes to the whole network. The researchers combine this idea with the insight that already a limited number of elements within a network can control its overall behavior. Concentrating on these 'driving neurons' promises that even manipulating only a small number of nerve cells will provide new insight about the dynamics within the whole network. The team from Freiburg hopes that this will open new perspectives on understanding the brain, its function – and dysfunction.

Image caption:
For a network of five elements, the combinations to be tested to ascertain each unit's effect are already 52 (shown as orbiting symbols). Hence, this traditional way to investigate brain function is useless in most cases (Image: Grah/BrainLinks-BrainTools, symbols: Mate2code, Creative Commons).

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