Mechanisms behind 'Mexican waves' in the brain are revealed by scientists

November 18 2014

Credit: Rice University

Scientists have revealed the mechanisms that enable certain brain cells to persuade others to create 'Mexican waves' linked with cognitive function.

Ultimately, the team say their work may help researchers understand more about normal brain function and about neurocognitive disorders such as dementia.

Neurons are cells in the brain that communicate chemical and electrical information and they belong to one of two groups- inhibitory or excitatory. While much is known about excitatory neurons, the role of inhibitory neurons is still being debated.

Inhibitory neurons can vibrate and they are equipped with mechanisms that enable them to persuade networks of other neurons into imitating their vibrations - setting off 'Mexican waves' in the brain. The scientists believe these collective, oscillating vibrations play a key role in cognitive function. Their research sheds light on how inhibitory neurons use different communication processes to excitatory neurons, which share information via an internal pulsing mechanism.

This study was carried out by Imperial College London and the Max Planck Institute for Brain Research. It is published today in the journal *Nature Communications*.

Dr Claudia Clopath, co-author from the Department of Bioengineering at Imperial College London, said: "These brain cells are similar to spectators in a football stadium, encouraging others into imitating them in a Mexican wave. We suspect that there is a very close relationship between the collective vibrations that they set off and many important cognitive functions. When the vibrations are degraded so that the wave is disrupted, we think it may contribute to neurocognitive disorders such as dementia. Our hope is that ultimately our research will lead to new insights into these disorders and how they can be treated."

The researchers developed a mathematical model showing the two mechanisms that inhibitory neurons need in order to convince others to join them in their rhythmical vibrations. The first is the mechanism that enables the inhibitory neurons to vibrate on their own, known as sub threshold resonance.

The second mechanism is a nanoscopic hole known as a gap-junction. There are many of these on the surface of the inhibitory neuron and they allow neurons to communicate directly with one another, enabling inhibitory neurons to set off a collective vibration.

The fact that inhibitory neurons are able to determine how and when whole networks of neurons will vibrate suggests that they are much more important in brain function than scientists had previously thought, say the researchers.

Now that the team have described the mechanisms behind these vibrations, the next step will see them carrying out research on inhibitory neurons to fully understand why vibrations are important for cognitive functions. The team believe that there may ultimately be a way to manipulate inhibitory neurons to improve how they vibrate, which might one day lead to better treatments for people with neurocognitive diseases.

More information: "Oscillations emerging from noise-driven steady state in networks with electrical synapses and subthreshold resonance", published 18 November 2014 in Nature Communications journal.

Provided by Imperial College London