Timing mechanisms for memory formation

January 23 2014

Credit: University of Wisconsin and Michigan State Comparative Mammalian Brain Collections and the National Museum of Health and Medicine

Neuroscientists from the University of Leicester, in collaboration with the Department of Neurosurgery at the University California Los Angeles (UCLA), are to reveal details of how the brain determines the timing at which neurons in specific areas fire to create new memories.

This research exploits the unique opportunity of recording multiple single-neurons in patients suffering from epilepsy refractory to medication that are implanted with intracranial electrodes for clinical reasons.

The study, which is to be published in the academic journal *Current Biology*, is the result of collaboration between Professor Rodrigo Quian Quiroga and Dr Hernan Rey at the Centre for Systems Neuroscience at the University of Leicester and Professor Itzhak Fried at UCLA.

The work follows up on the group's research into what was dubbed the 'Jennifer Aniston neurons' – neurons in the hippocampus and its surrounding areas within the brain that specifically fire in an 'abstract' manner when we see or hear a certain concept - such as a person, an animal or a landscape - that we recognise.

Professor Quian Quiroga said: "The firing of these neurons is relatively very late after the moment of seeing the picture, or hearing the person's name, but is still very precise. These neurons also fire only when the pictures are consciously recognised and remain silent when they are not.

"Our research shows that there is a specific brain response that marks the timing of the firing of these neurons. This response shortly precedes the neuron's firing and is only present for the consciously recognised pictures - being absent if the pictures were not recognised.

"This brain response thus reflects an activation that provides a temporal window for processing consciously perceived stimuli in the hippocampus and surrounding cortex. Given the proposed role of these neurons in memory formation, we argue that the brain response we found is a gateway for processing consciously perceived stimuli to form or recall memories."

Dr Hernan Rey, first author of the study, added: "This time-keeping may indeed be critical for synchronizing and combining multisensory information involving different processing times. This, in turn, helps in creating a unified conceptual representation that can be used for memory functions."

Professor Quian Quiroga's work is specifically concerned with examining how information about the external world - what we see, hear and touch - is represented by neurons in the brain and how this leads to the creation of our own internal representations and memories.

For example, we can easily recognize a person in a fraction of a second, even when seen from different angles, with different sizes, colours, contrasts and under strikingly different conditions. But how neurons in the brain are capable of creating such an 'abstract' representation, disregarding basic visual details, is only starting to be known.

Provided by University of Leicester