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Scientists Explore Consciousness

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An international team of scientists led by a University of Leicester researcher has carried out a scientific study into the realm of consciousness. The scientists have made a significant step into the understanding of conscious perception, by showing how single neurons in the human brain reacted to perceived and nonperceived images.

University of Leicester bioengineer Dr Rodrigo Quian Quiroga is spearheading this study which is opening new possibilities of exploring a hitherto relatively unchartered scientific area.

The team have today published a paper in an international journal, the *Proceedings of the National Academy of Sciences* revealing new discoveries in the field of consciousness studies.

Dr Quian Quiroga said: “There has been much interest in recent years in consciousness, which is considered by many as one of the major scientific challenges to be solved, or at least addressed in a scientific -rather than just philosophical- way.

“In fact, there are a few centres, journals and conferences dedicated to this topic. The problem with consciousness is that it is very hard to be defined and it implicates too many different things. For this reason, several researchers started to specify more clearly what they mean by consciousness (even if this is a limited view of the whole issue) and think about ways to study it in a scientific way. This approach was championed by the late Francis Crick and my former supervisor at Caltech, Christof Koch.

”Following this line, the paper in PNAS asks how the activity of single neurons in the human brain can reflect conscious perception.

“Recordings were done in epileptic patients candidates of curative surgery in which intracranial electrodes are implanted to establish the location of the epileptic focus and evaluate the potential outcome of the surgery. Patients usually stay for 1 or 2 weeks in the guard and this gives us the extraordinary opportunity to perform experiments and study how neurons in the human brain respond to different perceptual and behavioural tasks.

”In this particular study we showed pictures in a computer screen very briefly, at the threshold of conscious recognition. Subjects had to report whether they recognized or not the particular picture showed in each trial. The key point is that, since the pictures are shown very briefly, for exactly the same visual input sometimes the subjects reported recognizing the picture and sometimes not recognizing it. Then we could ask whether the neurons fire according to the subjects' conscious perception or the actual visual inputs.

”We found that the neurons we recorded responded to the conscious perception in an "all-or-none" way by dramatically changing their firing rate only when the pictures were recognized.

“For example, a neuron in the hippocampus of one patient fired very strongly to a picture of the patient's brother when recognized and remained completely silent when it was not, another neuron behaved in the same manner with pictures of the World Trade Centre, etc.

“Interestingly, based on the firing of these neurons it was possible to predict far above chance whether a picture was recognized or not. Another interesting observation is that a picture flashed very briefly generated nearly the same response -if recognized- as when shown for

much longer periods of time. This means that a single snapshot as brief as 33 ms was sufficient to trigger strong neuronal responses far outlasting the stimulus presentation, signalling the conscious perception of the picture shown."

Dr Quian Quiroga said the study had important implications. Potential applications of this discovery include the development of Neural Prosthetic devices to be used by paralysed patients or amputees. A patient with a lesion in the spinal cord (as with the late Christopher Reeves), can still think about reaching a cup of tea with his arm, but this order is not transmitted to the muscles.

The idea of Neural Prostheses is to read these commands directly from the brain and transmit them to bionic devices such as a robotic arm that the patient could control directly from the brain.

Dr Quian Quiroga's work showing that it is possible to read signals from the brain is a good step forward in this direction. But there are still clinical and ethical issues that have to be resolved before Neural Prosthetic devices can be applied in humans.

In particular, these would involve invasive surgery, which would have to be justified by a clear improvement for the patient before it could be undertaken.

Dr Quian Quiroga's discovery has far-reaching implications not only for the development of neuronal prostheses, but for treatment of patients with pathologies involving the hippocampal formation, such as epilepsy, Alzheimers and schizophrenia and for further understanding of how perceptions and memories are represented in the brain.

Source: University of Leicester