Session 5: New frontiers

The cerebral imagery of the conscious and non-conscious brain

Stanislas Dehaene, Professor at the *Collège de France* and Inserm-CEA unit Director

Understanding the architecture of the human brain, and the way in which it enables learning and awareness of the external world to occur, poses extraordinary challenges for cognitive neurosciences. Progress made in cerebral imaging has made it possible to view both the anatomy of the brain and its metabolic and electro-physiological activity with unprecedented accuracy. We are also reaching the stage where it is possible to record the activity of a number of small groups of neurons and even single neurons, within animal and human brains. These innovative methods, in combination with experimental paradigms emerging from cognitive psychology, make it possible to view the entire process, in real time, of cognitive operations such as perception of a face, a word or a phrase. A number of innovative experiments have succeeded in distinguishing, within such a process, those stages that are attributable to unconscious perception and those that necessarily involve the conscious brain. The application of this research in a clinical setting, in patients who are comatose, in a vegetative state or minimally conscious, opens up new possibilities, both in understanding and simulation of what consciousness is and diagnosis, and in the future, in the treatment of consciousness disorders.

Instituts thématiques

Inserm

Institut national
de la santé et de la recherche médicale

Pr. Stanislas Dehaene

CURRENT FUNCTIONS

- Director of the Cognitive Neuroimaging INSERM-CEA Unit (Saclay) since 1997
- Professor of Experimental Cognitive Psychology at the Collège de France (2005-)

AREAS OF RESEARCH

Pr. Stanislas Dehaene's interests concern the cerebral bases of specifically human cognitive functions such as language, calculation, and reasoning. The team uses a variety of experimental techniques, such as mental chronometry in normal subjects, cognitive analyses of brain-lesioned patients, and brain-imaging studies with positron emission tomography (PET), functional magnetic resonance imaging (FMRI), and high-density recordings of event-related potentials. Formal models of neuronal networks are also devised and simulated in order to highlight some links between molecular, physiological, imaging, and behavioral data.

Pr. Stanislas Dehaene's main scientific contributions include the study of the organization of the cerebral system for number processing. Using converging evidence from PET, ERPs, fMRI, and brain lesions, Pr. Stanislas Dehaene demonstrated the central role played by a region of the intraparietal sulcus, located on the lateral surface of the parietal lobe of cortex, in the understanding of quantities and arithmetic (the number sense). He was also the first to demonstrate that subliminal presentations of words can yield detectable cortical activations in fMRI, and has used these data to support an original theory of conscious and non-conscious processing in the human brain. With neurologist Laurent Cohen, he also studied the neural networks of reading and demonstrated the crucial role of the left occipito-temporal region of cortex in word recognition (the visual word form area).

HONOURS AND AWARDS

Pr. Stanislas Dehaene is a member of the French Academy of Sciences, a foreign associate of the US Academy of Science, and a member of the Pontifical Academy. His research has been recognized by various awards, including

- Grand Prix Inserm (2013)
- Prize of the Fondation Roger de Spoelberch (2013)
- Chevalier de la Légion d'honneur (2011)
- Dr A.H. Heineken Prize in Cognitive Science (2008)
- Prix Louis D. of the French Academy of Sciences (avec D. Lebihan, 2003)
- Centennial Felllowship of the McDonnell Foundation (1999)

PUBLICATIONS

Pr. Stanislas Dehaene is the author of over 250 scientific publications in major international journals. He has published an acclaimed book (*The Number Sense,* Oxford University Press, 1997), which has been translated in eight languages. He also authored two other books, *Reading in the Brain* (2007) and *Consciousness and the brain* (2014), as well as three television documentaries on the human brain.