Outside the body our memories fail us

March 10 2014

Swedish actor Peter Bergared took up the role of a fictional, very eccentric examiner in an experiment by Henrik Ehrsson and colleagues at Karolinska Institutet. Credit: Staffan Larsson

New research from Karolinska Institutet and Umeå University demonstrates for the first time that there is a close relationship between body perception and the ability to remember. For us to be able to store new memories from our lives, we need to feel that we are in our own body. According to researchers, the results could be of major

importance in understanding the memory problems that psychiatric patients often exhibit.

The memories of what happened on the first day of school are an example of an episodic memory. How these memories are created and how the role that the perception of one's own body has when storing memories has long been inconclusive. Swedish researchers can now demonstrate that volunteers who experience an exciting event whilst perceiving an illusion of being outside their own body exhibit a form of memory loss.

"It is already evident that people who have suffered psychiatric conditions in which they felt that they were not in their own body have fragmentary memories of what actually occurred", says Loretxu Bergouignan, principal author of the current study. "We wanted to see how this manifests itself in healthy subjects."

The study, which is published in the scientific journal *PNAS*, involved a total of 84 students reading about and undergoing four oral questioning sessions. To make these sessions extra memorable, an actor (Peter Bergared) took up the role of examiner – a (fictional) very eccentric professor at Karolinska Institutet. Two of the interrogations were perceived from a first person perspective from their own bodies in the usual way, while the participants in the other two sessions experienced a created illusion of being outside their own body. In both cases, the participants wore virtual reality goggles and earphones. One week later, they either underwent memory testing where they had to recall the events and provide details about what had happened, in which order, and what they felt, or they had to try to remember the events while they underwent brain imaging with functional magnetic resonance imaging (fMRI).

It then turned out that the participants remembered the 'out-of-body'

interrogations significantly worse than those experienced from the normal "In body" perspective. This was the case despite the fact that they responded equally well to the questions from each situation and also indicated that they experienced the same level of emotion. The fMRI scans further revealed a crucial difference in activity in the portion of the temporal lobe – the hippocampus – that is known to be central for episodic memories.

"When they tried to remember what happened during the interrogations experienced out-of-body, activity in the hippocampus was eliminated, unlike when they remembered the other situations", says professor Henrik Ehrsson, the research group leader behind the study. "However, we could see activity in the frontal lobe cortex, so they were really making an effort to remember."

The researchers' interpretation of the results is that there is a close relationship between body experience and memory. Our brain constantly creates the experience of one's own body in space by combining information from multiple senses: sight, hearing, touch, and more. When a memory is created, it is the task of the hippocampus to link all the information found in the cerebral cortex into a unified memory for further long-term storage. During the experience of being outside one's body, this memory storage process is disturbed, whereupon the brain creates fragmentary memories instead.

"We believe that this new knowledge may be important for future research on memory disorders in a number of psychiatric conditions such as post-traumatic stress disorder, borderline personality disorder and certain psychoses where patients have dissociative experiences," says Loretxu Bergouignan.

More information: 'Out-of-body hippocampal amnesia', Loretxu Bergouignan, Lars Nyberg & Henrik Ehrsson, *Proceedings of the*

National Academy of Sciences (*PNAS*), online 10-14 March 2014.
www.pnas.org/cgi/doi/10.1073/pnas.1318801111