Dopamine-producing areas of the brain inspire creativity

April 26 2018

An international research team led by scientists from MedUni Vienna's Center for Medical Physics and Biomedical Engineering in collaboration with Goldsmiths University London has uncovered the secret of the "Aha!-moment". When people solve a puzzle through a flash of insight, the mood-enhancing substance dopamine is released and deep-brain structures are activated. The researchers were able to identify the nucleus accumbens, a core structure in the basal forebrain, as the central area for the Aha!-moment.

"This area of the brain is closely associated with a flash of insight or moment of sudden enlightenment and can explain the ecstatic joy that goes with solving a creative problem. "Let us take the example of Archimedes, who jumped out of his bath shouting 'Eureka'," says Martin Tik from MedUni Vienna's Center for Medical Physics and Biomedical Engineering. Lead investigator Christian Windischberger goes on to explain: "By using the very latest functional magnetic resonance imaging at ultra-high field, we are able to look deep into the brain and to carry out a detailed investigation to ascertain which areas are active during problem-solving."

The nucleus accumbens is particularly activated during problem-solving and the associated Aha!-moment. It is part of a dopaminergic network that is activated when joy or reward are experienced. Dopamine is in turn responsible for communication between this network and other areas of the brain that are associated with important functions such as emotions, memory processes or alertness. "Apart from activation of

areas of alertness, language processing and memory, our research results showed sudden and significantly greater activation of the nucleus accumbens when the solving of a puzzle is accompanied by an Aha!-moment and hence a moment of intense joy and relief."

The study was conducted at the Medical University of Vienna and involved 30 volunteers. They were asked to solve difficult word puzzles, such as finding a word that can be logically combined with three predetermined words (e.g. "house", "bark", "apple" – the answer was "tree" – tree-house, tree bark, apple tree). Over the course of the study, the participants each worked on 48 such puzzles. As soon as they had found the answer, they pressed a button and reported their Aha!-experience.

Dopamine as the key for curiosity and willingness to learn

It was demonstrated that dopamine not only serves as a messenger substance during reward processes – sex, food or money, for example – but is also necessary for tackling demanding problems in a targeted and motivated way, expressing itself in the form of curiosity and willingness to learn.

"Our results indicate a close correlation between dopamine, exhilaration and creativity. Our results provide the neural mechanisms explaining why the solution with an accompanying Aha! experience is more salient, facilitates long-term memory storage and reinforcement. An Aha!-moment is therefore more than just a simple feeling of joy or relief but is a special form of fast retrieval, combination, and encoding process. In future studies we want to investigate how we can help patients by means of brain stimulation (transcranial magnetic stimulation , TMS), for example in severe psychiatric disorders, to experience these

moments.

More information: Martin Tik et al. Ultra-high-field fMRI insights on insight: Neural correlates of the Aha!-moment, *Human Brain Mapping* (2018). DOI: 10.1002/hbm.24073

Provided by Medical University of Vienna