Dopaminergic drugs cause changes in deep brain areas of Parkinson's patient

November 30 2016

Credit: Hilary Morgan / Alamy

A drug like levodopa, which is used by patients with Parkinson's disease, causes changes in the communication between deep brain areas that are important for learning and behaviour. As a result of this, impulse control disorders such as gambling addiction or hypersexuality can occur. PhD researcher Payam Piray demonstrated this during research carried out at the Donders Institute in Nijmegen. He will defend his doctoral thesis on Thursday 1 December 2016. His research was funded with a grant from the NWO Free Competition.

In Parkinson's disease, the functioning of cells in the substantia nigra of the brain is disrupted. Accumulation of the protein alpha-synuclein plays an important role. The cells gradually die, a dopamine deficit arises in the brain and the regulatory circuits become disrupted. This gives rise to a wide range of symptoms such as tremors and stiffness. The process of protein accumulation and cell mortality cannot be prevented, but the dopamine can be supplemented via drugs. This reduces the symptoms, even though the effect is often only temporary.

Such 'dopaminergic' drugs have their own side effects. The substance levodopa, for example, which is one of the best-known Parkinson drugs, can cause impulse control disorders in patients. These include such disorders as gambling or sexual addiction. Payam Piray investigated the correlation between the use of the drugs and the behavioural changes in the patient.

Learning and behaviour

Piray: 'Using refined computational techniques, we have demonstrated that with the use of dopaminergic drugs, people are no longer able to adequately learn from the positive and negative consequences of their behaviour. With the help of computational and brain scanning techniques, we discovered that these drugs alter the communication between the deep brain areas that are important for learning and behaviour. The exact effect depends on how impulsive a patient is before he or she starts taking the drugs: dopamine-stimulating drugs increase brain communication in people with an impulsive personality, but reduce it in people who are not impulsive by nature.'

This research illustrates the power of combining the computational and brain sciences, says Piray. 'As a consequence, we are able to better understand the brain and behaviour. Nearly all effects in this research could be isolated thanks to the use of computational techniques. Without

those techniques, we might have concluded that dopaminergic drugs have little effect on our brain and behaviour. Now we know how such drugs work in the brain, which consequences they have on behaviour and whom this affects.'

More information: Project page: www.nwo.nl/en/research-and-res … jects/i/83/6983.html

Provided by Netherlands Organisation for Scientific Research (NWO)