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Cocaine users present alterations in the function and structures of the brain

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A new study published in *Addiction Biology* has shown the presence of alterations in brain functioning and structure in cocaine users. The researchers used three different magnetic resonance imaging techniques to study the brain activation patterns and the integrity of grey and white matter in cocaine users.

In the study, cocaine users performed a gambling task while measurements were taken of their brain activity. The researchers discovered that cocaine users present a state of hyperactivation in the ventral striatum, a deep region of the brain that forms part of the so-called "reward circuit." This circuit is extremely ancient in evolutionary terms and is made up of different interconnected regions that favour basic behaviours like eating and sex.

In the course of the study, cocaine users displayed greater activation than healthy subjects, both when the outcomes obtained in the gambling task were favourable (winning money) and when they were adverse (losing money). This generalised hypersensitivity in the ventral striatum was accompanied by an anomalous activation profile in the prefrontal cortex. This brain region is much more evolved and is tasked with regulating behaviour, being able to inhibit the automatic, impulsive behaviours favoured by the ventral striatum.

The results showed that while in healthy individuals an unfavourable outcome in the gambling task leads to a robust activation of this region, in cocaine users, it remains inactive and does not respond to the adverse

consequences of their behaviour.

The study also revealed structural differences between the brains of users and non-users. Analysis of the volume of grey matter in cocaine users revealed hypertrophy of the caudate nucleus and the orbitofrontal cortex— two areas of the brain that belong to the reward circuit and which have been linked to compulsive behaviours.

Furthermore, analysis of white matter integrity in the same group found increased connectivity in the areas involved in reward processing, but decreased connectivity outside these areas. The bundles of white matter are tasked with transmitting information between distant areas of the brain. In cocaine users these connecting pathways seem to be reinforced among the structures concerned with gratification but degraded among areas that control important cognitive processes like behaviour regulation and attention.

To sum up, the study's results suggest that in cocaine users, there is an alteration of the functional and structural balance between the ventral striatum and the prefrontal cortex. This could lead to difficulties in setting priorities, making decisions and inhibiting inappropriate behaviours. These deficits can explain several symptoms of addiction, such as craving for drugs and self-control issues. The researchers postulate that the fact that not only is there an alteration to the brain's functioning but also to its structure could explain the great difficulties addicts have in giving up drugs and the large numbers of relapses that these patients experience. This gives an insight into the negative impacts on the health and social lives of drug users.

Repeated consumption of substances that produce pleasure and euphoria can lead to addiction. This chronically recurring disorder is characterised by the loss of control in drug use. Scientists are trying to determine why addictions develop and why it is so difficult for users to stop taking

drugs.

More information: Lucía Vaquero et al. Cocaine addiction is associated with abnormal prefrontal function, increased striatal connectivity and sensitivity to monetary incentives, and decreased connectivity outside the human reward circuit, *Addiction Biology* (2016). DOI: 10.1111/adb.12356

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