Carrots and sticks fail to change behaviour in cocaine addiction

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A pile of cocaine hydrochloride. Credit: DEA Drug Enforcement Agency, public domain

People who are addicted to cocaine are particularly prone to developing habits that render their behaviour resistant to change, regardless of the potentially devastating consequences, suggests new research from the

University of Cambridge. The findings may have important implications for the treatment of cocaine addiction as they help explain why such individuals take drugs even when they are aware of the negative consequences, and why they find their behaviour so difficult to change.

"Addiction does not happen overnight but develops from behaviour that has been repeated over and over again until individuals lose control," said Dr Karen Ersche from the Department of Psychiatry, who led the research.

In a study reported today in the journal *Science*, Dr Ersche and colleagues tested 125 participants, of whom 72 were addicted to cocaine and 53 had no history of drug addiction, on their inclination to develop habits. They found that people with cocaine addiction were much more likely than healthy participants to make responses in an automatic fashion, but only if they had previously been rewarded for responding in the same way. The addicted individuals simply continued repeating the same responses they had previously learned, regardless of whether their actions made sense or not.

In a different context, however, where participants had to perform an action to avoid electrical shocks, people with cocaine addiction did not develop habits. In fact, they were much less inclined than the control participants to make an effort to avoid the electric shock in the first place.

"Our experiments highlight the particular difficulties faced when it comes to changing behaviour in people with cocaine addiction: they are highly responsive if their behaviour is rewarded - for example a 'high' from drug use - but then quickly switch to autopilot, becoming unable to change that behaviour in light of different consequences," said Dr Ersche. "By contrast, when cocaine users are facing adversity, they are less inclined than healthy people to do something about it.

"These findings have significant implications for the treatment of people with cocaine addiction. Clearly punitive approaches are ineffective, as the prospect of something bad happening to them won't make cocaine users more likely to change their behaviour. Interventions that build on their particular strength in developing habits, by training the implementation of more desirable habits to replace drug-taking habits, are likely to be more effective. Our findings also suggest that cocaine users would need to be actively protected from - rather than simply warned about - adverse consequences, because they will likely fail to avoid them if left to their own devices."

There is currently no medical treatment for cocaine addiction - most individuals are treated with talking or cognitive therapy. According to Dr Ersche, the results show that a different approach to treating cocaine addiction might be of enhanced benefit to cocaine users. The researchers are now aiming to better understand the brain systems underlying cocaine users' proneness to habits and their lack of avoidance, and to use this knowledge to develop more effective treatments for cocaine addiction.

In the first experiment conducted by Ersche and her colleagues, participants were asked to learn the relationship between pictures, and a correct response was rewarded with points. After a long training period, participants were informed that some pictures were no longer worth any points. Participants with cocaine addiction were less likely to take on board the information about the change in reward, and were also more likely to continue responding in an automatic way, regardless of whether they were rewarded or not.

In a second experiment, the same participants were shown two different pictures on a screen, which they learned to associate with receiving an electric shock. Participants were then taught a strategy on how they could avoid the shocks by pressing a foot pedal. Those participants with

cocaine addiction were less good at avoiding the electric shocks in the first place, possibly due to learning and/or motivational impairment, and subsequently did not develop avoidance habits.

More information: "Carrots and sticks fail to change behavior in cocaine addiction," *Science*, DOI: 10.1126/science.aaf3700

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