

# Can cognitive impairments caused by methamphetamine use perpetuate the addiction cycle?

*The repeated use of methamphetamine, or meth, is known to cause significant changes in the brain and cognitive impairments, which might strengthen or perpetuate a user's addiction. Dr Carmela Reichel at the Medical University of South Carolina has conducted extensive research investigating the relationship between motivated meth use, meth-induced cognitive dysfunctions, and relapse. Her work has highlighted a number of cognitive and neural patterns associated with regular methamphetamine use that could increase the risk of relapse for addicts.*

**M**ethamphetamine, also known as meth, is a highly addictive stimulant that first surfaced in the 20<sup>th</sup> century and has since become one of the most abused substances worldwide. The U.S. Drug Enforcement Administration classifies methamphetamine as a Schedule II stimulant, which means that it can only be legally purchased with a nonrefillable prescription. While it is sometimes prescribed in low doses to treat attention deficit hyperactivity disorder (ADHD) or a few other health conditions, the sense of euphoria it typically elicits has resulted in many people becoming addicted to it and purchasing it illegally for recreational use.

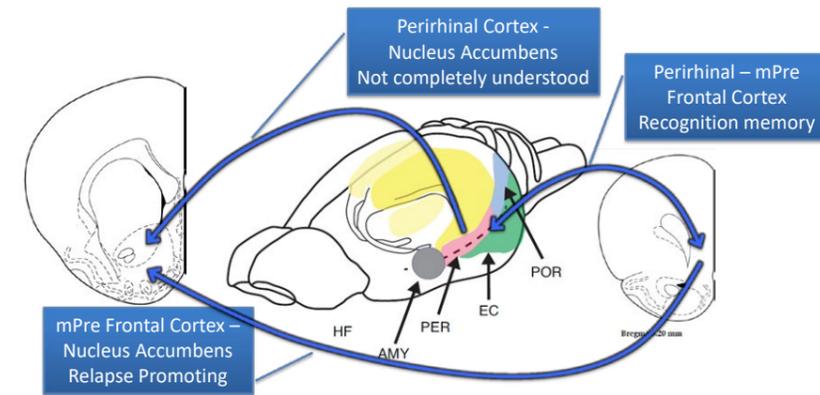
Methamphetamine addiction is a highly detrimental substance use disorder that is often associated with a wide range of psychiatric symptoms, cognitive impairments, and a severe risk of relapse after treatment. Past studies suggest that regular meth consumption can adversely affect a number of cognitive domains, including a user's attention, impulsivity, and memory. However,

the relationship between meth-related cognitive impairments, addiction, and relapse is still poorly understood.

Dr Carmela Reichel, Associate Professor at the Medical University of South Carolina, has been conducting research investigating the cognitive and neural underpinnings of meth addiction, as well as other substance use disorders, for several years. Her research is helping to identify impairments caused by repeated meth use that could perpetuate the addiction cycle and increase the risk of relapse in regular users.

## THE EFFECTS OF REGULAR METH USE ON ATTENTION, MEMORY, AND IMPULSE CONTROL

Past research in the fields of neuroscience and psychology has repeatedly highlighted the adverse effects that continuous meth intake can have on specific brain regions and the cognitive functions associated with these regions. The most pronounced and enduring effects of repeated meth use are on the brain's executive functions, which include a variety of cognitions associated with decision-making, attentional control, and working memory. Additionally, past findings suggest that meth consumption can impair people's ability to recall events planned or in the past of their life (i.e. their procedural and episodic memory) and to mentally process information. All of these cognitive functions are typically associated with activity in cortical and subcortical brain structures, which appear to undergo significant



Brain regions that seem to be compromised after meth use are the the prefrontal cortex, the nucleus accumbens core and the perirhinal cortex. Damages to these regions result in memory impairment, loss of impulse control and bias to drug-related stimuli.

maladaptive changes as a result of continuous meth consumption.

A brain region that appears to be compromised after meth use is the perirhinal cortex (PRH), which is an important neural substrate that allows people to recognise things that they observed in the past (i.e. recognition memory), while also directing the flow of information into and out of the parahippocampal structure. Other structures that are impacted by repeated meth use are the medial prefrontal cortex (mPFC), which is known to mediate inhibitory control over risky behaviours (e.g. drug overconsumption), and the nucleus accumbens core (NAcore), an area that regulates reward-related behaviours.

Combined, damage to these brain regions results in significant memory impairments, a loss of control over impulses, and a bias to drug-related stimuli (e.g. objects associated with meth consumption) that might make addicts more prone to relapse.

## METH-INDUCED MEMORY DEFICITS COULD FUEL THE ADDICTION CYCLE

Dr Reichel has carried out a number of studies investigating the effects that repeated meth use can have on memory and ways to restore those memory processes affected by meth.

In addition, she explored the possible links between these effects and the high risk of relapse associated with meth addiction, which could ultimately help to devise more effective treatments for meth use disorders.

In her studies, Dr Reichel observed that repeated meth intake can dysregulate the PRH, which is involved

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in recognition memory. She thus hypothesised that meth addicts sometimes struggle with recognition memory due to a loss of communication between PRH projection neurons and the mPFC. Moreover, she proposed that the neural pathway containing prelimbic (PL) outputs of the mPFC that project to the NAcore region is adversely affected by meth use, which increases the relevance of drug-related cues, leading to high relapse rates.

Distinct pathways seem to mediate the characteristic impairments in object recognition (PRH-mPFC) and the high risk of relapse (PL-NAcore) seen in meth use disorder. While the PRH-mPFC neural pathway has been the focus of numerous research studies, the effects of the PRH-NAcore pathway on behaviour are still poorly understood. Dr Reichel suggests that this pathway could be the link between meth-induced memory impairments and relapse.

## REVERSING MEMORY DEFICITS TO REDUCE THE RISK OF RELAPSE

After identifying meth-induced brain alterations and cognitive impairments that could perpetuate the addiction cycle, Dr Reichel started



With her work, Dr Reichel hopes to reduce the risk of relapse among individuals who are addicted to meth.

