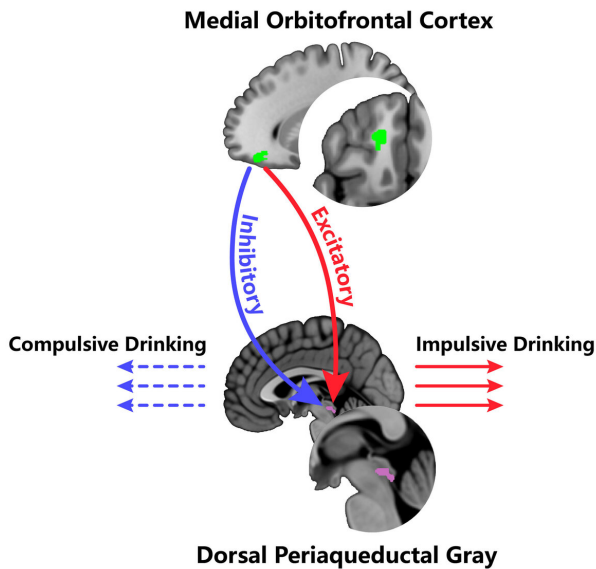


# Neural roots and origins of alcoholism identified

4 February 2021



The medial orbitofrontal cortex – dorsal periaqueductal gray top-down regulations are linked to impulsive and compulsive drinking. Credit: University of Warwick

The physical origin of alcohol addiction has been located in a network of the human brain that regulates our response to danger, according to a team of British and Chinese researchers, co-led by the University of Warwick, the University of Cambridge, and Fudan University in Shanghai.

The medial orbitofrontal cortex (mOFC) at the front of the [brain](#) senses an unpleasant or [emergency situation](#), and then sends this information to the dorsal periaqueductal gray (dPAG) at the brain's core, the latter area processing whether we need to escape the situation.

A person is at greater risk of developing [alcohol](#) use disorders when this information pathway is imbalanced in the following two ways:

- Alcohol inhibits the dPAG (the area of the brain that processes adverse situations), so that the brain cannot respond to negative signals, or the need to escape from danger—leading a person to only feel the benefits of drinking alcohol, and not its harmful side effects. This is a possible cause of compulsive drinking.
- A person with alcohol addiction will also generally have an over-excited dPAG, making them feel that they are in an adverse or unpleasant situation they wish to escape, and they will urgently turn to alcohol to do so. This is the cause of impulsive drinking.

Professor Jianfeng Feng, from the Department of Computer Science at the University of Warwick and who also teaches at Fudan University, says, "I was invited to comment on a previous study on mice for the similar purpose: to locate the possible origins of alcohol abuse. It is exciting that we can replicate these murine models in humans, and, of course, go a step further to identify a dual-pathway model that links alcohol abuse to a tendency to exhibit impulsive behavior."

Professor Trevor Robbins from the Department of Psychology at the University of Cambridge says, "It is remarkable that these neural systems in the mouse concerned with responding to threat and punishment have been shown to be relevant to our understanding of the factors leading to alcohol abuse in adolescents."

Dr. Tianye Jia from the Institute of Science and Technology for Brain-inspired Intelligence at Fudan University, also affiliated with King's College London, says, "We have found that the same neural top-down regulation could malfunction in two completely different ways, yet leading to similar alcohol abuse behavior."

Published in the journal *Science Advances*, the

research is led by an [international collaboration](#), co-  
led by Dr. Tianye Jia from Fudan University,  
Professor Jianfeng Feng from the University of  
Warwick and Fudan University, and Professor  
Trevor Robbins from the University of Cambridge  
and Fudan University.

Provided by University of Warwick

The research team had noticed that previous  
rodent models showed that the mPFC and dPAG  
brain areas could underlie precursors of alcohol  
dependence.

They then analyzed MRI brain scans from the  
IMAGEN dataset—a group of 2000 individuals from  
the UK, Germany, France and Ireland who take  
part in scientific research to advance knowledge of  
how biological, psychological and environmental  
factors during adolescence may influence brain  
development and mental health.

The participants undertook task-based functional  
MRI scans, and when they did not receive rewards  
in the tasks (which produced negative feelings of  
punishment), regulation between the mOFC and  
dPAG was inhibited more highly in participants who  
had exhibited alcohol abuse.

Equally, in a resting state, participants who  
demonstrated a more overexcited regulation  
pathway between the mOFC and dPAG, (leading to  
feelings of needing urgently to escape a situation),  
also had increased levels of alcohol abuse.

Alcohol use disorder (AUD) is one of the most  
common and severe mental illnesses. According to  
a WHO report in 2018, more than 3 million deaths  
every year are related to alcohol use worldwide,  
and harmful alcohol use contributes to 5.1% of the  
global burden of disease. Understanding how  
alcohol addiction forms in the human brain could  
lead to more effective interventions to tackle the  
global problem of alcohol abuse.

**More information:** Tianye Jia et al. Neural  
network involving medial orbitofrontal cortex and  
dorsal periaqueductal gray regulation in human  
alcohol abuse, *Science Advances* (2021). [DOI:  
10.1126/sciadv.abd4074](https://doi.org/10.1126/sciadv.abd4074)

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