For press inquiries to NIDA: https://www.drugabuse.gov/news-events/contact-press-office

Background: How Addiction Changes the Brain

Adapted from: https://www.drugabuse.gov/publications/drugs-brains-behavior-science-addiction/drugs-brain

The brain consists of billions of cells, called neurons, which are organized into circuits and networks. Each neuron acts as a switch controlling the flow of information. Opioids and other drugs interfere with the way neurons send, receive, and process signals via the brain's neurotransmitters, leading to abnormal messages being sent through the network.

How does this happen? Our brains are wired to increase the odds that we will repeat pleasurable activities. The neurotransmitter dopamine is central to this. Whenever the reward circuit is activated by a healthy, pleasurable experience, a burst of dopamine signals that something important is happening that needs to be remembered. This dopamine signal causes changes in neural connectivity that make it easier to repeat the activity again and again without thinking about it, leading to the formation of habits. Once the brain feels the rewarding euphoria from opioids, large surges of dopamine are released---"teaching" the brain to seek drugs at the expense of other healthier goals and activities.

This is why a person who misuses drugs eventually feels flat, without motivation, lifeless, and/or depressed, and is unable to enjoy things that were previously pleasurable. Now, the person needs to keep taking drugs to experience even a normal level of reward—which only makes the problem worse, like a vicious cycle. Also, the person will often need to take larger amounts of the drug to produce the familiar high—an effect known as tolerance. This brief video explains why drugs are so hard to quit (the link also offers a readable transcript.)

Understanding key brain circuits

Drugs can alter important brain networks that are necessary for life-sustaining functions and can drive the compulsive drug use that marks addiction. There are three parts of the brain that play a special role in this process.

Reward circuit: The **basal ganglia** play an important role in motivation, including the pleasurable effects of healthy activities like eating, socializing, and sex. They are a key part of what we call the brain's "reward circuit." Opioids and other drugs over-activate this circuit, producing the euphoria. With repeated exposure, the circuit adapts to the presence of the drug, making it hard to feel pleasure from anything else.

Stress Circuit: The **extended amygdala** plays a role in stressful feelings like anxiety, irritability, and unease, which characterize withdrawal after the drug high fades. Over time, a person with an opioid use disorder uses drugs primarily to get temporary relief from this discomfort and not necessarily to get high.

Impulse Control Circuit: The **prefrontal cortex** powers the ability to think, plan, solve problems, make decisions, and exert self-control over impulses. Shifting balance between this circuit and the reward and stress circuits make a person with an opioid use disorder seek the drug compulsively with reduced impulse control. This is also the last part of the brain to mature, making teens most vulnerable to addiction.

(image below from: https://www.drugabuse.gov/publications/drugs-brains-behavior-science-addiction/drugs-brain)

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