The Brain's Response to Stimulants

Hi, my name's Sara Bellum. Welcome to my magazine series exploring the brain's response to drugs. In this issue, we'll investigate the fascinating facts about stimulants. Some of this information was only recently discovered.

Have you eaten any chocolate or drunk any soda lately? If you have, there's a good chance you gave your body a dose of a stimulant -- caffeine, which is also in coffee.

Eating or drinking a large amount of caffeine can make you feel jittery, nervous, or energetic. That is because caffeine -- like any stimulant -- changes the way your brain works.

But caffeine is just a mild example of a stimulant. Many other stimulant drugs are much stronger -- and some are illegal and very dangerous. Others require a doctor's prescription.

Examples of stronger stimulants include:

- Cocaine: Made from the leaf of the coca plant, this drug often comes in the form of a white powder that some people inhale through their nose.
- Crack: A form of cocaine that can be smoked.
- Amphetamines: Often called "speed," these pills are sometimes prescribed by doctors for medical problems.
- Methamphetamine: A powerful form of amphetamine that comes in clear crystals (called "ice") or powder (called "crank") that is smoked or injected.

Miscommunication in the Brain

Cocaine and amphetamines change the way the brain works by changing the way nerve cells communicate. Nerve cells, called neurons, send messages to each other by releasing special chemicals called neurotransmitters. Neurotransmitters are able to work by attaching to key sites on neurons called receptors.

One of the neurotransmitters affected by cocaine is called dopamine. Dopamine is released by neurons in the limbic system -- the part of the brain that controls feelings of pleasure.

Normally, once dopamine has attached to a nerve cell's receptor and caused a change in the cell, it's pumped back to the neuron that released it. But cocaine blocks the pump, called the dopamine transporter. Dopamine then builds up in the gap (synapse) between neurons.

The result: dopamine keeps affecting a nerve cell after it should have stopped. That's why someone who uses cocaine feels an extra sense of pleasure for a short time.

Cocaine Can Damage the Way the Brain Works

Although cocaine may make someone feel pleasure for a while, later it can damage the ability to feel pleasure. Research suggests that long-term cocaine use may reduce the amount of dopamine or the number of dopamine receptors in the brain.

When this happens, nerve cells must have cocaine to communicate properly. Without the drug, the brain can't send enough dopamine into the receptors to create a feeling of pleasure.

If a long-term user of cocaine or crack stops taking the drug, the person feels an extremely strong craving for it, because without it he or she can't feel nearly as much pleasure.

Cocaine Tightens Blood Vessels

Cocaine causes the body's blood vessels to become narrow, constricting the flow of blood. This is a problem. It forces the heart to work harder to pump blood through the body. (If you've ever tried squeezing into a tight pair of pants, then you know how hard it is for the heart to pump blood through narrowed blood vessels.)

When the heart works harder, it beats faster. It may work so hard that it temporarily loses its natural rhythm. This is called fibrillation, and it can be very dangerous because it stops the flow of blood through the body.

Many of cocaine's effects on the heart are actually caused by cocaine's impact on the brain -- the body's control center.

Scientists Discover Answers

Fortunately, scientists have figured out how to copy the gene that controls the dopamine transporter. This process is called "cloning".

By studying copies of the transporter, scientists may learn more about how cocaine affects it -- and how to prevent those effects. These studies may even lead to the discovery of a treatment for cocaine addiction.

Scientists are already working to create a medications for use as a treatment. This chemical would attach to the dopamine transporter just like cocaine does, but it wouldn't block dopamine's normal movement back into neurons. By attaching to the transporter, the substitute would block the effects of cocaine.

The Search Continues

There's still a lot that scientists don't know about the effects of cocaine and amphetamines on the brain. Maybe someday you'll make the next big discovery.

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National Clearinghouse for Alcohol and Drug Information
P.O. Box 2345
Rockville, MD 20847
1-800-729-6686

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