

# Long-Term Effects of Drugs on the Brain

## Drugs and Alcohol

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So, why are drugs so bad? After all, the high or rush only lasts a little while, right? What else could be happening in the brain of a person who abuses drugs? Consider that the brain is continuously changing. After all, learning occurs because neurons are forming new synapses. Scientists say that the brain is plastic and call this “neuroplasticity.” That doesn’t mean the brain is made of a chemical plastic like a credit card, but it refers to the brain’s ability to modify connections in response to experience. When a person learns something or has new experiences, some new synapses may form or existing synapses may get stronger. Other synapses may disappear.

When a person takes drugs repeatedly, the brain changes in response to this experience. If a person takes drugs and then stops, he or she will crave the drug. In other words, the individual will have a strong desire to take more of the drug. Scientists can actually see evidence of cravings in the brain. If someone addicted to cocaine sees pictures of drug paraphernalia, PET scans show that a part of the brain that is important for emotional memory (called the amygdala) is activated, and the person reports feelings of drug craving. If he or she sees a video with mountains, trees, and animals, the amygdala is not stimulated. Thus, just seeing pictures of drugs or things associated with drugs can trigger an uncontrollable urge for drugs.

After taking drugs for a period of time, a person may need to take a higher dose of the drug to have the same experience that he or she did when first taking the drug. This is called tolerance. The brain has adapted to having a certain amount of drug present and does not respond the same way it did initially. That is why people who abuse and who are addicted to drugs take increasingly higher amounts of an abused drug. Tolerance may develop because the body may become more efficient at eliminating the chemical from the body, or because the cells of the body and brain become less responsive to the effect of the drug.

Scientific studies have shown clearly that certain drugs can cause dramatic changes in the brain, but not all

questions have been answered. Drugs can change the structure of the brain. Perhaps one of the most dramatic long-term effects of a drug is to kill neurons. Many people have heard that drinking alcohol will kill brain cells. It’s true. If alcohol is abused over a period of time, neurons in the brain can die. Some neurons in the brain are more sensitive to alcohol than others. Neurons that make up the mammillary bodies (small round structures on the brain’s undersurface) and hippocampus, areas in the brain that are important for memory, are more vulnerable to the effects of alcohol than are some other neurons in the brain. The neurons in the cerebral cortex, the part of the brain that controls most of our mental functions and endows us with consciousness, may also die if a person frequently abuses alcohol in high doses.

Another drug that can be toxic to neurons is an amphetamine derivative called MDMA, or ecstasy. In rats and nonhuman primates, MDMA damages the axon terminals of neurons that release serotonin, a neurotransmitter that is involved in regulating appetite, sleep, emotions, and so on. In some parts of the brain, the axons of some of these neurons may regenerate (or re-grow) after drug use is stopped, but the new growth of the neurons is not normal. Some areas are not reinnervated (nerve fibers do not grow back into the area), and some areas have abnormally high regrowth of the neurons. Either way, the neurons do not look normal. Studies have not yet been able to determine whether MDMA has this same effect on humans.

Cocaine also changes the brain in ways that may last for a long time. PET scans of human brains have shown that glucose metabolism is reduced even three months after the last use of cocaine. Remember that glucose metabolism is an indicator of how active the brain cells are. If the neurons are using less glucose in certain areas, they are not as active. The changes that cocaine causes in the brain last much longer than the pleasurable feelings it produces. Other drugs cause similar decreases in brain activity. Even two years after the last use of amphetamines, PET images show that the brain of a person who has abused drugs is less active than a person who has never used drugs.

# Long-Term Effects of Drugs on the Brain

## *Drugs and Alcohol*

Scientists, for many reasons, don't know all of the effects that a drug has. First, the brain is such a complicated organ that, despite great scientific advances, understanding all that it does will take many more years. Second, individuals may respond differently to drugs due to genetic and other differences among people. Third, many people who abuse drugs abuse more than one drug. Many individuals who take cocaine, for example, also drink alcohol. The combination of the drugs makes it difficult to determine what the effect of one drug alone may be. Another complication is that people addicted to drugs may have other health problems in addition to their drug problem. People addicted to heroin, for example, spend most of their energy and

activity trying to get their next "fix." Consequently, they do not eat well and may have impaired immune systems. Also, drug-addicted people often suffer from mental illnesses, such as depression. The changes that occur in the brain because of mental illness make it difficult to determine what changes the drugs have caused.

The brain is an incredibly complex organ. This complexity will keep scientists working for many years to understand how the brain works. Someday, scientists will answer questions about what happens in the brain to cause addiction, which will then help scientists understand how to prevent addiction.

Now, answer the answer the following questions:

1. What are some of the ways that drugs cause long-term changes in the brain?
2. How does the brain adapt to the presence of drugs?
3. How may the abuse of drugs relate to the plasticity of the brain?
4. What are some problems that scientists have when they investigate the effects of drugs on the brain?