11.8: Psychoactive Drugs

Art in a Cup

Who knew that a cup of coffee could also be a work of art? A talented barista can make coffee look as good as it tastes. If you are a coffee drinker, you probably know that coffee can also affect your mental state. It can make you more alert and may improve your concentration. That’s because the caffeine in coffee is a psychoactive drug. In fact, caffeine is the most widely consumed psychoactive substance in the world. In North America, for example, 90 percent of adults consume caffeine daily.

Figure \(\PageIndex{1}\): Murano Coffee with decoration on the surface.

Psychoactive drugs are substances that change the function of the brain and result in alterations of mood, thinking, perception, and/or behavior. Psychoactive drugs may be used for many purposes, including therapeutic, ritual, or recreational purposes. Besides caffeine, other examples of psychoactive drugs include cocaine, LSD, alcohol, tobacco, codeine, and morphine. Psychoactive drugs may be legal prescription medications (e.g., codeine and morphine), legal nonprescription drugs (e.g., alcohol and tobacco), or illegal drugs (cocaine and LSD).
Advertising for legal psychoactive drugs is ubiquitous.

Cannabis (or marijuana) is also a psychoactive drug, but its status is in flux, at least in the United States. Depending on the jurisdiction, cannabis may be used recreationally and/or medically, and it may be either legal or illegal. Legal prescription medications such as opioids are also used illegally by increasingly large numbers of people. Some legal drugs, such as alcohol and nicotine, are readily available almost everywhere, as illustrated by the sign pictured in Figure \(\PageIndex{2}\).

### Classes of Psychoactive Drugs

Psychoactive drugs are divided into different classes according to their pharmacological effects. Several classes are listed below, along with examples of commonly used drugs in each class.

- **Stimulants** are drugs that stimulate the brain and increase alertness and wakefulness. Examples of stimulants include caffeine, nicotine, cocaine, and amphetamines such as Adderall.
- **Depressants** are drugs that calm the brain, reduce anxious feelings, and induce sleepiness. Examples of depressants include ethanol (in alcoholic beverages) and opioids such as codeine and heroin.
- **Anxiolytics** are drugs that have a tranquilizing effect and inhibit anxiety. Examples of anxiolytic drugs include benzodiazepines such as diazepam (Valium), barbiturates such as phenobarbital, opioids, and antidepressant drugs such as sertraline (Zoloft).
- **Euphoriants** are drugs that bring about a state of euphoria, or intense feelings of well-being and happiness. Examples of euphoriants include the so-called club drug MDMA (ecstasy), amphetamines, ethanol, and opioids such as morphine.
- **Hallucinogens** are drugs that can cause hallucinations and other perceptual anomalies. They also cause subjective changes in thoughts, emotions, and consciousness. Examples of hallucinogens include LSD, mescaline, nitrous oxide, and psilocybin.
- **Empathogens** are drugs that produce feelings of empathy, or sympathy with other people. Examples of empathogens include amphetamines and MDMA.
Many psychoactive drugs have multiple effects so they may be placed in more than one class. An example is MDMA, pictured below, which may act both as a euphoriant and as an empathogen. In some people, MDMA may also have stimulant or hallucinogenic effects. As of 2016, MDMA had no accepted medical uses, but it was undergoing testing for use in the treatment of post-traumatic stress disorder and certain other types of anxiety disorders.

Mechanisms of Action

Psychoactive drugs generally produce their effects by affecting brain chemistry, which in turn may cause changes in a person's mood, thinking, perception, and/or behavior. Each drug tends to have a specific action on one or more neurotransmitters or neurotransmitter receptors in the brain. Generally, they act as either agonists or antagonists.

- **Agonists** are drugs that increase the activity of particular neurotransmitters. They might act by promoting the synthesis of the neurotransmitters, reducing their reuptake from synapses, or mimicking their action by binding to receptors for the neurotransmitters.

- **Antagonists** are drugs that decrease the activity of particular neurotransmitters. They might act by interfering with the synthesis of the neurotransmitters or by blocking their receptors so the neurotransmitters cannot bind to them.

Consider the example of the neurotransmitter GABA. This is one of the most common neurotransmitters in the brain, and it normally has an inhibitory effect on cells. GABA agonists, which increase its activity, include ethanol, barbiturates, and benzodiazepines, among other psychoactive drugs. All of these drugs work by promoting the activity of GABA receptors in the brain.

Uses of Psychoactive Drugs

You may have been prescribed psychoactive drugs by your doctor. For example, you may have been prescribed an opioid drug such as codeine for pain (most likely in the form of Tylenol with added codeine). Chances are you also use nonprescription psychoactive drugs, such as caffeine for mental alertness. These are just two of the many possible uses of psychoactive drugs.
Medical Uses

Figure \(\PageIndex{4}\): This child is being prepared to receive a general anesthetic prior to surgery

Medical uses of psychoactive drugs include general anesthesia, in which pain is blocked and unconsciousness is induced. General anesthetics are most often used during surgical procedures and may be administered in gaseous form, as in the photo below. General anesthetics include the drugs halothane and ketamine. Other psychoactive drugs are used to manage pain without affecting consciousness. They may be prescribed either for acute pain in cases of trauma such as broken bones; or for chronic pain such as pain caused by arthritis, cancer, or fibromyalgia. Most often, the drugs used for pain control are opioids, such as morphine and codeine.

Many psychiatric disorders are also managed with psychoactive drugs. For example, antidepressants such as sertraline are used to treat depression, anxiety, and eating disorders. Anxiety disorders may also be treated with anxiolytics, such as buspirone and diazepam. Stimulants such as amphetamines are used to treat attention deficit disorder. Antipsychotics such as clozapine and risperidone, as well as mood stabilizers such as lithium, are used to treat schizophrenia and bipolar disorder.

Ritual Uses

Certain psychoactive drugs, particularly hallucinogens, have been used for ritual purposes since prehistoric times. For example, Native Americans have used the mescaline-containing peyote cactus (pictured below) for religious ceremonies for as long as 5,700 years. In prehistoric Europe, the mushroom *Amanita muscaria*, which contains a hallucinogenic drug called muscimol, was used for similar purposes. Various other psychoactive drugs — including jimsonweed, psilocybin mushrooms, and cannabis — have also been used by various peoples for ritual purposes for millennia.
Recreational Uses

The recreational use of psychoactive drugs generally has the purpose of altering one’s consciousness and creating a feeling of euphoria commonly called a “high.” Some of the drugs used most commonly for recreational purposes include cannabis, ethanol, opioids, and stimulants such as nicotine. Hallucinogens are also used recreationally, primarily for the alterations in thinking and perception that they cause.

Some investigators have suggested that the urge to alter one’s state of consciousness is a universal human drive, similar to the drive to satiate thirst, hunger, or sexual desire. They think that the drive to alter one’s state of mind is even present in children, who may attain an altered state by repetitive motions such as spinning or swinging. Some nonhuman animals also exhibit a drive to experience altered states. For example, they may consume fermented berries or fruit and become intoxicated. The way cats respond to catnip (Figure \(\PageIndex{6}\)) is another example.
Addiction, Dependence, and Rehabilitation

Psychoactive substances often bring about subjective changes that the user may find pleasant (for example, euphoria) or advantageous (for example, increased alertness). These changes are rewarding and positively reinforcing, so they have the potential for misuse, addiction, and dependence. **Addiction** refers to the compulsive use of a drug despite the negative consequences that such use may entail. Sustained use of an addictive drug may produce dependence on the drug. **Dependence** may be physical and/or psychological. It occurs when cessation of drug use produces withdrawal symptoms. Physical dependence produces physical withdrawal symptoms, which may include tremors, pain, seizures, or insomnia. Psychological dependence produces psychological withdrawal symptoms, such as anxiety, depression, paranoia, or hallucinations.

Rehabilitation for drug dependence and addiction typically involves psychotherapy, which may include both individual and group therapy. Organizations such as Alcoholics Anonymous (AA) and Narcotics Anonymous (NA) may also be helpful for people trying to recover from addiction. These groups are self-described as international mutual aid fellowships with the primary purpose of helping addicts achieve and maintain sobriety. In some cases, rehabilitation is aided by the temporary use of psychoactive substances that reduce cravings and withdrawal symptoms without creating addiction themselves. For example, the drug methadone is commonly used in the treatment of heroin addiction.

Feature: Human Biology in the News

Currently, in the United States, a lot of media attention is being given to a rising tide of opioid addiction and overdose deaths. **Opioids** are drugs derived from the opium poppy or synthetic versions of such drugs. They include illegal drug heroin and prescription painkillers such as codeine, morphine, hydrocodone, oxycodone, and fentanyl. In 2016, fentanyl received wide media attention when it was announced that an accidental fentanyl overdose was responsible for the death of rock-music icon Prince. Fentanyl is an extremely strong and dangerous drug, said to be 50 to 100 times stronger than morphine, making the risk of overdose death from fentanyl very high.

The dramatic increase in opioid addiction and overdose deaths has been called an opioid epidemic. It is considered to be the worst drug crisis in American history. Consider the following facts:

- In 1999, there were more than twice as many accidental deaths from motor vehicle crashes than from drug overdoses. By 2014, these causes of accidental death were reversed, with close to 40 percent more accidental deaths from drug overdoses than car crashes. The majority of these drug overdose deaths were from heroin and opioid painkillers.
- In 1999, the stimulant drug cocaine killed about twice as many people as did heroin. By 2014, deaths from heroin were up by 439 percent. During the same interval, deaths from cocaine also rose slightly but were a much smaller proportion of all drug deaths than those caused by heroin.

The opioid epidemic in the United States has occurred in all demographic groups, including every ethnic, age, gender, and socioeconomic category. What has caused this epidemic? The answer appears to be an equally dramatic increase in the medical use of prescription painkillers. In 1991, about 76 million prescriptions were written for painkillers. In 2011, the number of prescriptions for these drugs had risen to 219 million, an almost three-fold increase. During these same two decades, Mexican drug cartels began shipping huge amounts of heroin to the United States. Heroin became cheaper and easier to buy than prescription painkillers. Many people who became addicted to prescription opioids...
switched to heroin. About 80 percent of new heroin users in 2014 reported started out misusing prescription painkillers.

Doctors, public health professionals, and politicians have all called for new policies, funding, programs, and laws to address the opioid epidemic. Changes that have already been made include a shift from criminalizing to medicalizing the problem, an increase in treatment programs, and more widespread distribution and use of the opioid-overdose antidote naloxone (Narcan). Opioids can slow or stop a person's breathing, which is what usually causes overdose deaths. Naloxone helps the person wake up and keeps them breathing until emergency medical treatment can be provided.

Review

1. What are psychoactive drugs?
2. Identify six classes of psychoactive drugs and an example of a drug in each class.
3. Compare and contrast psychoactive drugs that are agonists and psychoactive drugs that are antagonists.
4. Describe two medical uses of psychoactive drugs.
5. Give an example of a ritual use of a psychoactive drug.
6. Why do people generally use psychoactive drugs recreationally?
7. Define addiction.
8. Identify possible withdrawal symptoms associated with physical dependence on a psychoactive drug.
9. Why might a person with a heroin addiction be prescribed the psychoactive drug methadone?
10. The prescription drug Prozac inhibits the reuptake of the neurotransmitter serotonin, causing more serotonin to be present in the synapse. Prozac can elevate mood, which is why it is sometimes used to treat depression. Answer the following questions about Prozac.
   A. Is Prozac an agonist or an antagonist for serotonin? Explain your answer.
   B. Is Prozac a psychoactive drug? Explain your answer.

11. Name 3 classes of psychoactive drugs that include opioids.
12. True or False. All psychoactive drugs are either illegal or available by prescription only.
13. True or False. Anxiolytics might be prescribed by a physician.
14. Name two drugs that activate receptors for the neurotransmitter GABA. Why do you think these drugs generally have a depressant effect?

Explore More

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Learn more about psychiatric drugs that are being researched to treat mental health disorders. In this inspiring TED talk, neurobiologist David Anderson explains how modern psychiatric drugs treat the chemistry of the whole brain and why a more nuanced view of how the brain functions could lead to targeted psychiatric drugs that work better and avoid side effects.
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