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Hallucinogens: LSD, Peyote, Psilocybin, and PCP

Hallucinogenic compounds found in some plants and mushrooms (or their extracts) have been used—mostly during religious rituals—for centuries. Almost all hallucinogens contain nitrogen and are classified as alkaloids. Many hallucinogens have chemical structures similar to those of natural neurotransmitters (e.g., acetylcholine-, serotonin-, or catecholamine-like). While the exact mechanisms by which hallucinogens exert their effects remain unclear, research suggests that these drugs work, at least partially, by temporarily interfering with neurotransmitter action or by binding to their receptor sites. This *InfoFacts* will discuss four common types of hallucinogens:

- **LSD** (d-lysergic acid diethylamide) is one of the most potent mood-changing chemicals. It was discovered in 1938 and is manufactured from lysergic acid, which is found in ergot, a fungus that grows on rye and other grains.
- **Peyote** is a small, spineless cactus in which the principal active ingredient is mescaline. This plant has been used by natives in northern Mexico and the southwestern United States as a part of religious ceremonies. Mescaline can also be produced through chemical synthesis.
- **Psilocybin** (4-phosphoryloxy-*N*,*N*-dimethyltryptamine) is obtained from certain types of mushrooms that are indigenous to tropical and subtropical regions of South America, Mexico, and the United States. These mushrooms typically contain less than 0.5 percent psilocybin plus trace amounts of psilocin, another hallucinogenic substance.
- **PCP** (phencyclidine) was developed in the 1950s as an intravenous anesthetic. Its use has since been discontinued due to serious adverse effects.

How Are Hallucinogens Abused?

The very same characteristics that led to the incorporation of hallucinogens into ritualistic or spiritual traditions have also led to their propagation as drugs of abuse. Importantly, and unlike most other drugs, the effects of hallucinogens are highly variable and unreliable, producing different effects in different people at different times. This is mainly due to the significant variations in amount and composition of active compounds, particularly in the hallucinogens derived from plants and mushrooms. Because of

their unpredictable nature, the use of hallucinogens can be particularly dangerous.

- **LSD** is sold in tablets, capsules, and, occasionally, liquid form; thus, it is usually taken orally. LSD is often added to absorbent paper, which is then divided into decorated pieces, each equivalent to one dose. The experiences, often referred to as "trips," are long; typically, they end after about 12 hours.
- **Peyote.** The top of the peyote cactus, also referred to as the crown, consists of disc-shaped buttons that are cut from the roots and dried. These buttons are generally chewed or soaked in water to produce an intoxicating liquid. The hallucinogenic dose of mescaline is about 0.3 to 0.5 grams, and its effects last about 12 hours. Because the extract is so bitter, some individuals prefer to prepare a tea by boiling the cacti for several hours.
- **Psilocybin.** Mushrooms containing psilocybin are available fresh or dried and are typically taken orally. Psilocybin (4-phosphoryloxy-*N,N*-dimethyltryptamine) and its biologically active form, psilocin (4-hydroxy-*N,N*-dimethyltryptamine), cannot be inactivated by cooking or freezing preparations. Thus, they may also be brewed as a tea or added to other foods to mask their bitter flavor. The effects of psilocybin, which appear within 20 minutes of ingestion, last approximately 6 hours.
- **PCP** is a white crystalline powder that is readily soluble in water or alcohol. It has a distinctive bitter chemical taste. PCP can be mixed easily with dyes and is often sold on the illicit drug market in a variety of tablet, capsule, and colored powder forms that are normally snorted, smoked, or orally ingested. For smoking, PCP is often applied to a leafy material such as mint, parsley, oregano, or marijuana. Depending upon how much and by what route PCP is taken, its effects can last approximately 4–6 hours.

How Do Hallucinogens Affect the Brain?

LSD, peyote, psilocybin, and PCP are drugs that cause hallucinations, which are profound distortions in a person's perception of reality. Under the influence of hallucinogens, people see images, hear sounds, and feel sensations that seem real but are not. Some hallucinogens also produce rapid, intense emotional swings. LSD, peyote, and psilocybin cause their effects by initially disrupting the interaction of nerve cells and the neurotransmitter serotonin.[1] Distributed throughout the brain and spinal cord, the serotonin system is involved in the control of behavioral, perceptual, and regulatory systems, including mood, hunger, body temperature, sexual behavior, muscle control, and sensory perception. On the other hand, PCP acts mainly through a type of glutamate receptor in the brain that is important for the perception of

pain, responses to the environment, and learning and memory.

There have been no properly controlled research studies on the specific effects of these drugs on the *human* brain, but smaller studies and several case reports have been published documenting some of the effects associated with the use of hallucinogens.

- **LSD.** Sensations and feelings change much more dramatically than the physical signs in people under the influence of LSD. The user may feel several different emotions at once or swing rapidly from one emotion to another. If taken in large enough doses, the drug produces delusions and visual hallucinations. The user's sense of time and self is altered. Experiences may seem to "cross over" different senses, giving the user the feeling of hearing colors and seeing sounds. These changes can be frightening and can cause panic. Some LSD users experience severe, terrifying thoughts and feelings of despair, fear of losing control, or fear of insanity and death while using LSD.

  LSD users can also experience flashbacks, or recurrences of certain aspects of the drug experience. Flashbacks occur suddenly, often without warning, and may occur within a few days or more than a year after LSD use. In some individuals, the flashbacks can persist and cause significant distress or impairment in social or occupational functioning, a condition known as hallucinogen-induced persisting perceptual disorder (HPPD).

  Most users of LSD voluntarily decrease or stop its use over time. LSD is not considered an addictive drug since it does not produce compulsive drug-seeking behavior. However, LSD does produce tolerance, so some users who take the drug repeatedly must take progressively higher doses to achieve the state of intoxication that they had previously achieved. This is an extremely dangerous practice, given the unpredictability of the drug. In addition, cross-tolerance between LSD and other hallucinogens has been reported.

- **Peyote.** The long-term residual psychological and cognitive effects of mescaline, peyote's principal active ingredient, remain poorly understood. A recent study found no evidence of psychological or cognitive deficits among Native Americans that use peyote regularly in a religious setting.[2] It should be mentioned, however, that these findings may not generalize to those who repeatedly abuse the drug for recreational purposes. Peyote abusers may also experience flashbacks.

- **Psilocybin.** The active compounds in psilocybin-containing "magic" mushrooms have LSD-like properties and produce alterations of autonomic function, motor reflexes, behavior, and perception.[3] The psychological

consequences of psilocybin use include hallucinations, an altered perception of time, and an inability to discern fantasy from reality. Panic reactions and psychosis also may occur, particularly if a user ingests a large dose. Long-term effects such as flashbacks, risk of psychiatric illness, impaired memory, and tolerance have been described in case reports.

- **PCP.** The use of PCP as an approved anesthetic in humans was discontinued in 1965 because patients often became agitated, delusional, and irrational while recovering from its anesthetic effects. PCP is a "dissociative drug," meaning that it distorts perceptions of sight and sound and produces feelings of detachment (dissociation) from the environment and self. First introduced as a street drug in the 1960s, PCP quickly gained a reputation as a drug that could cause bad reactions and was not worth the risk. However, some abusers continue to use PCP due to the feelings of strength, power, and invulnerability as well as a numbing effect on the mind that PCP can induce. Among the adverse psychological effects reported are—
  - o Symptoms that mimic schizophrenia, such as delusions, hallucinations, paranoia, disordered thinking, and a sensation of distance from one's environment.
  - o Mood disturbances: Approximately 50 percent of individuals brought to emergency rooms because of PCP-induced problems—related to use within the past 48 hours—report significant elevations in anxiety symptoms.[4]
  - o People who have abused PCP for long periods of time have reported memory loss, difficulties with speech and thinking, depression, and weight loss. These symptoms can persist up to one year after stopping PCP abuse.
  - o Addiction: PCP *is* addictive—its repeated abuse can lead to craving and compulsive PCP-seeking behavior, despite severe adverse consequences.

What Other Adverse Effects Do Hallucinogens Have on Health?

Unpleasant adverse effects as a result of the use of hallucinogens are not uncommon. These may be due to the large number of psychoactive ingredients in any single source of hallucinogen.[3]

- **LSD.** The effects of LSD depend largely on the amount taken. LSD causes dilated pupils; can raise body temperature and increase heart rate and blood pressure; and can cause profuse sweating, loss of appetite, sleeplessness, dry mouth, and tremors.

- **Peyote.** Its effects can be similar to those of LSD, including increased body temperature and heart rate, uncoordinated movements (ataxia), profound sweating, and flushing. The active ingredient mescaline has also been associated, in at least one report, to fetal abnormalities.[5]

- **Psilocybin.** It can produce muscle relaxation or weakness, ataxia, excessive pupil dilation, nausea, vomiting, and drowsiness. Individuals who abuse psilocybin mushrooms also risk poisoning if one of many existing varieties of poisonous mushrooms is incorrectly identified as a psilocybin mushroom.

- **PCP.** At low to moderate doses, physiological effects of PCP include a slight increase in breathing rate and a pronounced rise in blood pressure and pulse rate. Breathing becomes shallow; flushing and profuse sweating, generalized numbness of the extremities, and loss of muscular coordination may occur.

  At high doses, blood pressure, pulse rate, and respiration drop. This may be accompanied by nausea, vomiting, blurred vision, flicking up and down of the eyes, drooling, loss of balance, and dizziness. PCP abusers are often brought to emergency rooms because of overdose or because of the drug's severe untoward psychological effects. While intoxicated, PCP abusers may become violent or suicidal and are therefore dangerous to themselves and others. High doses of PCP can also cause seizures, coma, and death (though death more often results from accidental injury or suicide during PCP intoxication). Because PCP can also have sedative effects, interactions with other central nervous system depressants, such as alcohol and benzodiazepines, can also lead to coma.

What Treatment Options Exist?

Treatment for alkaloid hallucinogen (such as psilocybin) intoxication—which is mostly symptomatic—is often sought as a result of bad "trips," during which a patient may, for example, hurt him- or herself.[6] Treatment is usually supportive: provision of a quiet room with little sensory stimulation. Occasionally, benzodiazepines are used to control extreme agitation or seizures.

There is very little published data on treatment outcomes for PCP intoxication. Doctors should consider that acute adverse reactions may be the result of drug synergy with alcohol.[7] Current research efforts to manage a life-threatening PCP overdose are focused on a passive immunization approach through the development of anti-PCP antibodies.[8] There are no specific treatments for PCP abuse and addiction, but inpatient and/or behavioral treatments can be helpful for patients with a variety of addictions, including that to PCP.

How Widespread Is the Abuse of Hallucinogens?

According to the National Survey on Drug Use and Health (NSDUH),† there were approximately 1.1 million persons aged 12 or older in 2007 who reported using hallucinogens for the first time within the past 12 months.

LSD

Monitoring the Future Survey††

There were no significant changes in LSD use from 2007 to 2008 for most prevalence periods among the 8th-, 10th-, and 12th-graders surveyed; however, there was a significant increase in past-month use of LSD among 12th-graders. Perceived risk of harm from taking LSD regularly decreased among 12th-graders (from 67.3 percent in 2007 to 63.6 percent in 2008). No other changes were significant, but longer term trends indicate a steady decline in perceived harmfulness of LSD in all three grades. Such changes in attitude could signal a subsequent increase in use, an outcome that would be of great concern after the large decreases seen since the mid-1990s, when LSD use peaked among youth.

LSD Use by Students 2008 Monitoring the Future Survey			
	8th Grade	**10th Grade**	**12th Grade**
Lifetime†††	1.9%	2.6%	4.0%
Past Year	1.3%	1.8%	2.7%
Past Month	0.5%	0.7%	1.1%

National Survey on Drug Use and Health†

In 2007, more than 22.7 million persons aged 12 or older reported they had used LSD in their lifetime (9.1 percent); however, fewer than 620,000 had used the drug in the past year. There was no change between 2006 and 2007 in the number of past-year initiates of LSD.

Peyote and Psilocybin

It is difficult to gauge the extent of use of these hallucinogens because most data sources that quantify drug use exclude these drugs. The Monitoring the Future survey†† reported in 2008 that 7.8 percent of high school seniors had used hallucinogens other than LSD—a group that includes peyote, psilocybin, and others—at least once in their lifetime. Past-year use was reported to be 5 percent.

PCP

Monitoring the Future Survey††

In 2008, 1.8 percent of high school seniors reported lifetime††† use of PCP; past-year use was reported by 1.1 percent of seniors; and past-month use was reported by 0.6 percent. Data on PCP use by 8th- and 10th-graders are not available.

National Survey on Drug Use and Health†

In 2007, 6.1 million persons aged 12 or older reported that they had used PCP in their lifetime (2.5 percent), although only 137,000 persons in the same age group reported use in the past year—this represents a decrease from 187,000 persons in 2006.

Other Information Sources

For more information on Hallucinogens, please visit **www.clubdrugs.org** and **www.teens.drugabuse.gov.**

For street terms searchable by drug name, street term, cost and quantities, drug trade, and drug use, visit **www.whitehousedrugpolicy.gov/streetterms/default.asp.**

† NSDUH (formerly known as the National Household Survey on Drug Abuse) is an annual survey of Americans age 12 and older conducted by the Substance Abuse and Mental Health Services Administration. Copies of the latest survey are available at **www.samhsa.gov** and from NIDA at 877–643–2644.

†† These data are from the 2008 Monitoring the Future survey, funded by the National Institute on Drug Abuse, National Institutes of Health, Department of Health and Human Services, and conducted annually by the University of Michigan's Institute for Social Research. The survey has tracked 12th-graders' illicit drug use and related attitudes since 1975; in 1991, 8th- and 10th-graders were added to the study. The latest data are online at **www.drugabuse.gov.**

††† "Lifetime" refers to use at least once during a respondent's lifetime. "Past year" refers to use at least once during the year preceding an individual's response to the survey. "Past month" refers to use at least once during the 30 days preceding an individual's response to the survey.

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