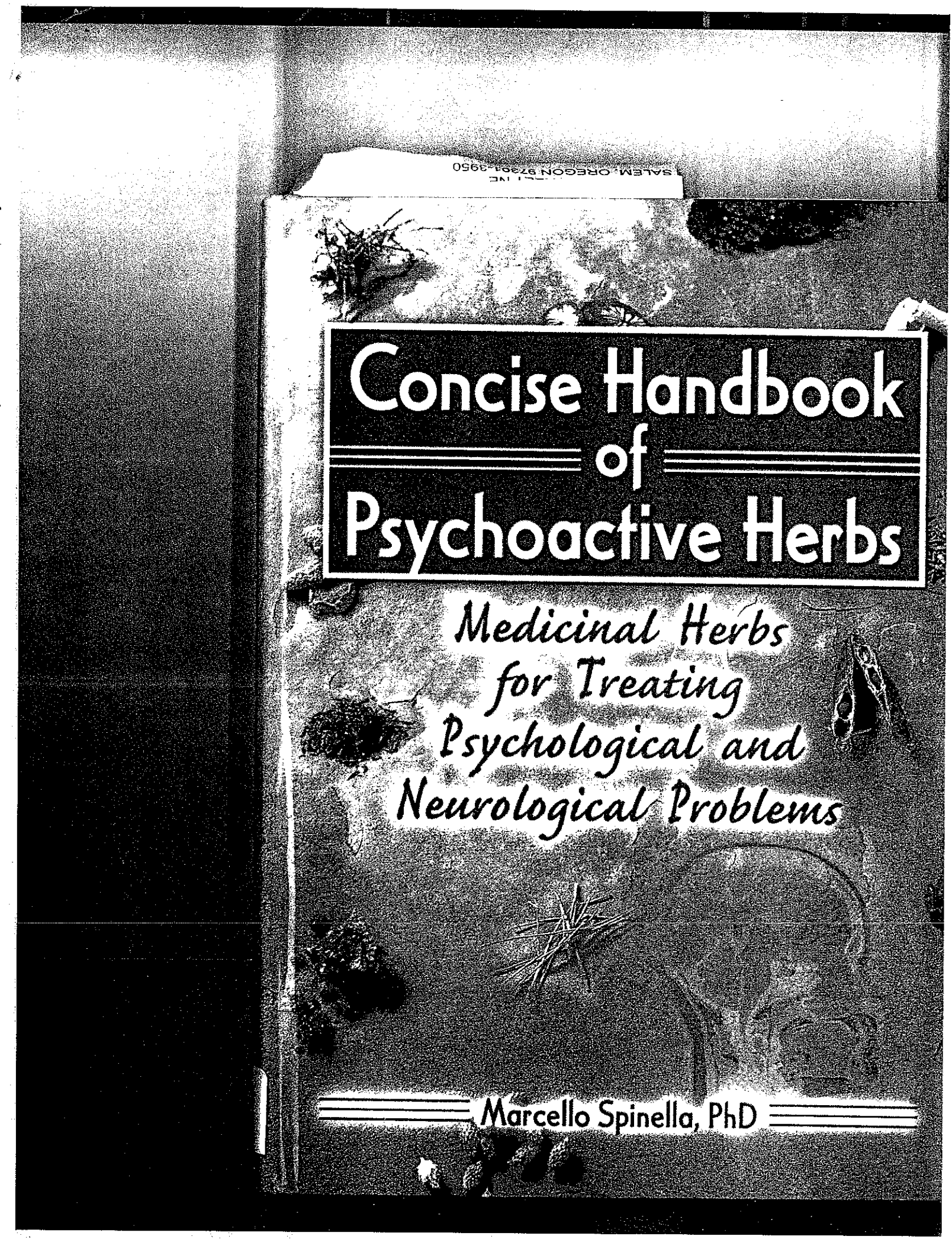

Concise Handbook of Psychoactive Herbs

Medicinal Herbs for Treating Psychological and Neurological Problems

Marcello Spinella, PhD

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Medicinal Herbs for Treating Psychological and Neurological Problems

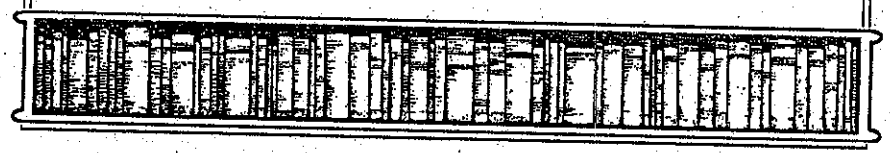
Pre-publication REVIEWS, COMMENTARIES, EVALUATIONS . . .

"This book is a much-needed text that provides the reader with the essential background about psychoactive herbs. It is an outstanding summary that covers commonly used herbal supplements such as ginseng as well as the more exotic plant-based options such as hallucinogenic mushrooms. The book will be a valuable reference text for herbalists, physicians, researchers, policymakers, and all other professionals with an interest in this area."

Edzard Ernst, MD, PhD, FRCP
Professor of Complementary Medicine, Peninsula Medical School, Exeter, Devon, United Kingdom

"This well-written book provides an informative overview of the topic. It offers an unbiased view of the current state of knowledge of various herbs and their potential psychoactive properties. What makes for an enjoyable read is the integration of the historical perspective, cultural perspective, and review of current clinical perspectives. Dr. Spinella clearly differentiates folklore from proven clinical fact, highlighting the importance of well-designed clinical trials to determine effectiveness of any compound thought to affect mood and behavior. This book is a scientifically sound introduction to the role of herbs in mental health."

David A. Baron, DO, MSEd
Professor and Chair, Department of Psychiatry, Temple University School of Medicine



Since the drug is scarce and
long their intoxication. In s
drug first, and others drank
tery why this drug never ca

How Fly Agaric Works

Each drug in fly agaric
Some of these chemicals in
tylcholine, and glutamate. Why this should have hallucinogenic effects is not entirely clear. These neurotransmitters are used throughout the entire nervous system, so disturbing their function could easily alter thoughts and perceptions.

Fly agaric seems to be in a class by itself in this regard among plant hallucinogens. However, pharmaceutical hallucinogens that work by interfering with glutamate include PCP (angel dust) and ketamine (Special K).

Effects of Fly Agaric

Fly agaric causes motor dysfunction in both animals and humans, with a general inhibition of motor function, twitching, trembling, and convulsive movements of the extremities. Paradoxically, it has been suggested that Viking warriors used fly agaric to induce a frenzied, enraged state for battle, which gave them the name berserkers.

Like many hallucinogenic drugs, fly agaric causes altered perceptions, a dreamy state, euphoria, and possibly relief from pain. Confusion and disorientation are also reported. The experience often concludes with fatigue followed by sleep.

Side Effects of Fly Agaric

Little is formally known about the toxicity of fly agaric. Ibotenic acid is a strong neurotoxin. This has been demonstrated experimentally, but it is not certain whether neurotoxicity occurs in humans eating the mushroom.

Chapter 10

Cannabis

HISTORY

Cannabis is one of the oldest cultivated nonfood plants, and does not seem to exist anymore in a wild form. It has been used not only for psychoactive effects, but also for its fibers. Hemp fibers have been found in China dating from 4000 B.C., and hemp ropes dating from 3000 B.C. were found in Turkistan. However, it is uncertain whether cannabis was used for psychoactive purposes at those places and times. This may seem ironic, but consider that there are psychoactive plants all around us and most of us are unaware of them.

Although the psychoactive use of cannabis may be a relatively recent practice, it is also ancient. The earliest recorded psychoactive use of cannabis dates from 2000 B.C. in a Chinese pharmacopoeia attributed to a mythical emperor named Shen Nung. He recommended it for absentmindedness and pain, as well as malaria, beriberi, constipation, and female disorders. Hoa-Glio, an ancient Chinese herbalist recommended a combination of hemp resin and wine as an anesthetic for surgery. But the psychoactive use of cannabis seems to have declined in China by the time of European contact. The Assyrians used cannabis incense as early as 900 B.C. The ancient Hindu Vedas cite cannabis as a divine nectar: the favorite drink of the god Indra was made from it. Indian medical systems cited widespread uses for cannabis, including mania, leprosy, and dandruff. But they also recognized appetite-stimulant and digestive effects. *Bhang, charas,* and *ganja* are all Hindi terms for preparations of the cannabis plant.

The Scythians are credited with spreading the use of cannabis to the Greeks from the steppes. The ancient Greeks knew of the psychoactive effects of cannabis, although it is uncertain how commonly it was used. The Greek physician Galen wrote that cakes made with hemp had intoxicating effects. Women of Thebes were said to use

cannabis to dispel sorrow and bad humor. In medieval Europe, herbalists used cannabis for medicinal but not psychoactive purposes. Cannabis was widely cultivated in Europe and later in the American colonies. Hemp fiber was a valuable commodity, used to make rope and canvas sails for ships. Although it is true that many farmers at the time grew hemp, including George Washington, nothing indicates that they were aware of its psychoactive effects.

Cannabis was officially listed in the *United States Pharmacopoeia* until 1937, where it was recommended for a number of therapeutic uses, including sedation. The Marihuana Tax Act, passed in 1937, made it effectively illegal to grow, sell, buy, or distribute cannabis. One of the earliest American studies on cannabis was done on American military personnel who discovered it while stationed at the Panama Canal in the 1930s. From the early 1920s, cannabis gained a public reputation as a menacing deviant drug, an attitude characterized in the movie *Reefer Madness.* By the 1950s and 1960s, cannabis use had gained popularity, particularly among American youths. Use peaked in the late 1970s, when 60 percent of high school seniors surveyed reported having used cannabis, and 11 percent reported daily use. By 1996, 35 percent of high school seniors had used cannabis at least once in the past year, but only 4.6 percent used it on a daily basis. In contrast, use of alcohol and cocaine did not change across this period. In 1990, it was estimated that 6 to 10 million Americans smoked cannabis at least once per week.

The legal status of cannabis in the United States has varied. The Controlled Substances Act of 1970 classified cannabis as a Schedule I drug, which implies that the drug has no currently accepted medical use and has a high potential for abuse. However, a degree of tolerance grew toward cannabis during the 1970s. By 1977, most states classified possession as a misdemeanor, and by 1980, eleven states had decriminalized possession. This atmosphere changed in the 1980s, when severe legal penalties were enacted and the toxic pesticide paraquat was sprayed on domestic cannabis crops.

The Dutch effectively legalized cannabis in 1976. Legalization itself did not increase cannabis usage among the Dutch population, but the advent of commercial access to the drug has. However, parallel increases in use occurred in the United States during this period despite prohibition of cannabis use. Dutch cannabis use has remained equal to or below that of the United States, per capita. How the Dutch example relates to the American legalization issue is still a matter of debate.

Cannabis is a general term that corresponds to three closely related species of plants: *Cannabis sativa, C. ruderalis,* and *C. indica* (see Figure 10.1). *Cannabis sativa* is a tall plant, reaching 8 to 12 feet in height. In addition to psychoactive effects, this is the species that has been a source of fiber for rope and canvas. *Cannabis indica* is found in the Middle East, India, and Central Asia, and is a shorter plant, growing 3 to 6 feet tall. This species has been the traditional source of hashish. *Cannabis ruderalis* is a third species found in Eastern Europe and Central Asia. However, it has little fiber or psychoactive effects.

CANNABIS AND THE HUMAN BODY

Active Chemicals

Cannabis contains approximately 400 chemicals. Some of these are unique to the cannabis plant, and are referred to collectively as

FIGURE 10.1. Two species of cannabis *(Cannabis sativa* and *C. indica).* Copyright 2004 by Marcello Spinella.

cannabinoids. The most potent and most abundant psychoactive cannabinoid is delta-9-tetrahydrocannabinol **(THC),** but there are others (e.g., delta-8-THC, 11-hydroxy-delta-8-THC, etc.). However, not all cannabinoids are psychoactive. For example, cannabinol and cannabidiol are found in the cannabis plant but do not seem to have any psychological effects.

The various names people commonly use to refer to cannabis actually refer to preparations made from different parts of the plant (see Table 10.1). Hashish and charas are a dried resin exuded by the female flowers. (Cannabis plants are dioecious, meaning there are male and female sexes.) This resin has the highest concentration (10 to 20 percent) of THC, so it has the most potent effects. Ganja and sinsemilla refer to the flower buds of the female plants, which averages 5 to 8 percent THC. Marijuana and bhang are from the rest of the plant and have the lowest THC concentration (2 to 5 percent).

Cannabis in the Brain

Cannabis provides one of the more recent and eloquent examples of how studying psychoactive drugs teaches us about the brain itself. As the workings of many psychoactive drugs began to be unraveled in the late twentieth century, some researchers turned their attention toward cannabis. Many psychoactive drugs, such as amphetamine or LSD, were found to work through known systems in the brain. They interfered with neurotransmitters with which we were already familiar. However, the mode of action of cannabis remained mysterious.

To further add to the mystery, THC was found to have its own unique receptor in the brain. The receptor was isolated and analyzed, but it did not belong to any of the known neurotransmitters. This presented a bit of a puzzle: It would seem highly unlikely that a receptor in the brain existed solely for the benefit of cannabis. Rather, it would

TABLE 10.1. Cannabis preparations and THC content.

Name	Preparation	THC content
Hashish, charas	Dried resin exuded by female flowers	10 to 20 percent
Ganja, sinsemilla	Dried tops of female plants	5 to 8 percent
Marijuana, bhang	Remainder of the plant	2 to 5 percent

be more logical if there were a yet-undiscovered neurotransmitter for the so-called cannabinoid receptor. But for years, no such neurotransmitter was discovered.

Perseverance paid off. In 1992, William Devane and his colleagues discovered a neurotransmitter for this receptor. It was named **anandamide,** which derives from the Sanskrit word *ananda,* meaning "bliss." When anandamide was injected into experimental animals, it seemed to have effects similar or identical to THC. They had, in effect, discovered that the brain has its own version of THC. So, when a person smokes cannabis, the THC imitates anandamide, stimulating cannabinoid receptors in the brain and body. As remarkable as it may sound, this wasn't entirely unheard of. For example, endorphin and enkephalin are really the brain's own morphine, and acetylcholine is like the brain's own nicotine. Much of what we know about these neurotransmitters comes from research that was intended to figure out how the drugs work.

A few other neurotransmitters similar to anandamide were discovered afterward, and collectively they are called the **endocannabinoids,** meaning internal cannabis-like chemicals. One of these, **2-AG** (short for 2-arachidonylglycerol) is 170 times more concentrated in the brain than anandamide, and therefore probably plays a more prominent role. Even more interesting is that these endocannabinoids have been found to play a normal role in memory, thinking, movement, and pain perception. This too is logical, since using cannabis affects all of these functions.

Two different cannabinoid receptors have been found, abbreviated CB_1 and CB_2. Both types are found in many parts of the body, but only the CB_1 receptor is found in the brain and thus responsible for the psychoactive effects of THC. The location of the CB_1 receptors in the brain reveals something about the effects of THC. For example, many receptors are found in the basal ganglia, cerebellum, and cortex, which is where THC apparently has its effects on movement and thinking, since that's what those parts of the brain do. Receptors are also found in the limbic system, which is where THC has its emotional effects. In contrast, very few receptors are found in the brainstem and spinal cord. Since the brainstem controls vital functions, such as breathing, cannabis has little effect on them. Alcohol or her-

oin, in contrast, will kill a person if too much is taken since they act on receptors in the brainstem.

Drug Issues with Cannabis

Cannabis is most commonly consumed by smoking in a cigarette or pipe. An average cannabis cigarette has about 0.5 to 1 g of cannabis. Considering that cannabis is usually 4 to 5 percent THC, then the average cannabis cigarette contains about 50 mg of THC. However, the amount that actually reaches the blood after smoking one cannabis cigarette varies from 0.4 to 10 mg. Interestingly, people may unknowingly regulate their smoking based on the potency of the cannabis: the weaker it is, the longer and deeper they seem to inhale. Conversely, high-potency cannabis causes people to inhale more briefly and shallowly. The common argument that modern cannabis is more addictive because it has more THC may then be irrelevant, since people seem to adjust their smoking (increase or decrease) according to its potency.

After inhaling the first puff, the psychological effects start within six to twelve minutes. They reach maximum intensity at fifteen to thirty minutes and typically last two to four hours. The lungs and liver break down THC into 11-OH-THC (pronounced "eleven hydroxy THC"), which itself has psychoactive effects. However, this chemical is further broken down and eliminated from the body. The removal process is slow, however, since half of the drug is eliminated every three to five days, and small amounts of the drug or its breakdown products remain in fatty parts of the body for weeks. These remainders are detectable by drug tests, but the amounts are too small to have psychoactive effects. Only in heavy, chronic users could they possibly accumulate enough to have an appreciable effect.

The way cannabis is taken greatly affects its intensity. Cannabis is absorbed into the blood thoroughly when smoked, but poorly when swallowed. For this reason, cannabis leaves are hardly ever eaten by themselves. However, some people have discovered the practice of cooking cannabis in food, such as brownies. This is typically done in foods that are high in fat. Since THC absorbs well into fat, eating it this way allows it to absorb better through the digestive tract.

The Effects of Cannabis

Cannabis stands in a class by itself, not only because of its unique effects on brain chemistry, but also for its constellation of effects. It shares common effects with other drugs such as hallucinogens or sedatives, but its total pattern of effects is unique.

Psychological Effects

As with many other drugs, the psychological effects of cannabis can vary. They depend on how much experience the person has with the drug (if any), what expectations the user has, and even some personality characteristics. In general, using cannabis produces relaxation, a mild lifting of mood, and giddiness (see Box 10.1). The senses are heightened so that smells, tastes, and so on may seem more intense. Time also seems to pass more slowly. However, half of cannabis users report experiencing unpleasant side effects such as anxiety or panic reactions at some time. These reactions are more common in inexperienced users and those using high doses. Other unpleasant effects include dissociative symptoms such as derealization (the feel-

BOX 10.1. The Effects of Cannabis

Subjective effects
- Relaxation
- Mild euphoria
- Giddiness
- Heightened sensory perceptions
- Stimulates appetite
- Perceived slower passage of time
- Panic or anxiety
- Dissociative symptoms

Physiological effects
- Increases heart rate
- Reduces body temperature
- Slowed gastrointestinal function

Brain activity
- Mixed excitation and inhibition
- Increases deep, slow-wave sleep; reduces REM sleep

ing that one's experiences are not real, or are a dream), or depersonalization (feeling out of one's body, or detached from oneself). Reassuring and comforting the person who is having negative reactions seems to be an effective way to treat the problem when it occurs, although anti-anxiety medications are sometimes given.

Physiological Effects

Cannabis causes an increase in heart rate and a reduction in body temperature. It also mildly slows digestion. Cannabis use does not appear to induce a hangover in the way that alcohol or other sedatives can. The hangover after alcohol use has documented effects on sleep, mood, motor, and thinking abilities.

Cannabis interacts with several hormones. It tends to decrease sex hormones such as testosterone, but it's not clear that this amounts to anything significant in normal circumstances. It does reduce sexual function in animals, but whether it has an effect in humans at the doses normally used has not been studied. Cannabis also causes a release of stress hormones. Many psychoactive drugs are known to have a similar hormonal effect, including ginseng and caffeine.

Cannabis is widely known to stimulate appetite, what's known as "the munchies." This occurs in both animals and humans alike. Most likely, it happens through THC's effects in the hypothalamus, which regulates appetite. This effect of cannabis has been considered as a therapeutic use for the drug for patients with poor appetite.

Brain Activity

Cannabis has been shown to cause changes in brain activity, whether measured through the brain's electrical activity, blood flow, or metabolism. Monkeys given THC show a slowing of electrical activity in the brain for a few hours (accompanied by sedation), followed by a period of increased activity, suggesting a rebound excitability when the drug has partly worn off. Long-term use of cannabis in humans is associated with slowed electrical patterns across the frontal lobes of the brain.

Studies of the effects of THC on blood flow and metabolism in the brain in humans produce very mixed results, sometimes increasing brain activity and sometimes decreasing it. This may seem confusing, but it makes sense when you consider that the psychological effects

of cannabis are also very variable, depending largely on one's mindset and environmental setting.

One interesting finding is that THC alters activity in the cerebellum. The cerebellum is known to play a role in the experience of time, and an altered sense of the passage of time occurs when people use cannabis.

Sleep

Cannabis has effects on sleep, shown by electrical patterns in the brain (measured with the electroencephalogram). When people are given daily doses of THC, they spend less time in REM sleep and more in Stage 4 sleep. REM sleep is an active, dreaming state and Stage 4 is a deep, restful state, so it seems that THC increases restorative sleep. However, the doses used in this study were large (70 to 210 mg) compared to the dose received in a usual cannabis cigarette (about 10 mg). So we don't know if the effects caused by more typical use would be as extreme.

Movement

Studies of THC in animals and humans show similar effects on the motor system. THC makes it harder to maintain balance and reduces fine motor control and dexterity. Some report an increase in reaction time. Extremely high doses given to animals cause immobility and abnormal posture.

A primary concern is whether cannabis affects the ability to drive, which requires good motor functioning. Surprisingly, cannabis seems to have relatively small effects on driving ability. Nonetheless, any impairment while driving is potentially dangerous, considering the consequences. Thus, driving is best avoided when cannabis is used, just as it is best avoided when taking a sedating allergy medication. Cannabis certainly should not be combined with alcohol by anyone who is going to drive, since the two may magnify each other's effects.

Cognitive Functions

Cannabis certainly affects higher thinking abilities. However, the results of this type of research must be handled appropriately to avoid false conclusions. When looking at a cannabis study, one must first

consider the subjects who are being studied (e.g., occasional cannabis users, frequent users, or first-time users). Do these subjects have any preexisting problems that could affect the results? For example, is it a healthy group of responsible adults, or do the subjects have any psychiatric or criminal history? Also important to consider is the amount of cannabis (or pure THC) that is given to them, the duration of time it is given (e.g., is it in the range of what is normally used), and what is used to measure the effects (e.g., what tests or behaviors are being measured). Many studies of the same drug produce different results because they use very different methods to study it.

It is also very important to distinguish between *correlational* and *experimental* studies that examine cannabis. In an experimental study, researchers compare the people who get the drug to people who get the placebo. That way they know that the difference is due to the drug and not to expectations. In correlational research, a relationship is shown between two variables. For example, it has been shown many times that marijuana use correlates with juvenile delinquency. But a correlational study only shows a relationship, and cannot prove which causes which, even though such statistics are often misused for such purposes. So juvenile delinquents are more likely to smoke marijuana than others, but nothing suggests that smoking marijuana caused the juvenile delinquency. There are dozens of other equally probable possibilities. For example, juvenile delinquents tend to disregard rules and may just be more likely to break laws and use illegal drugs in general. Correlational research is quite often misrepresented in the news, and sometimes even by scientists who should know better.

Several studies show that cannabis decreases attention and concentration. This partly depends on the dose of THC. In one study, impairment of attention occurred with a higher dose of THC, but not with a lower dose. The most basic forms of attention do not seem to be impaired, but impairment can occur for more complex forms of attention, such as shifting attention. Cannabis has a more noted effect on working memory. Working memory is a form of short-term memory, enabling a person to hold information in mind and work with it (e.g., mentally adding up prices while you are shopping). So, for example, cannabis causes a person to remember fewer words on a short-term memory test.

The effects of cannabis on long-term memory have been examined in numerous studies, again with variable results. Cannabis impairs

some forms of long-term memory, such as the ability to recall words from a list. However, it does not affect the ability to learn pairs of words. Cannabis may partly disrupt the brain's process of making memories permanent. In contrast, cannabis does not affect the ability to recall information already permanently stored.

Cannabis use is sometimes cited as the cause of an amotivational syndrome, consisting of a loss of interest in social activities, school, work, or other goal-directed activities. However, no evidence supports any causal relationship. Instead, evidence suggests that the amotivational syndrome symptoms are part of depression. In contrast to alcohol, no evidence supports the idea that cannabis causes an increase in violent behavior. However, cannabis use is not a good idea for people with existing psychiatric disorders such as bipolar disorder or schizophrenia.

Daily cannabis users show more mental impairments than infrequent users. However, these studies are problematic since the subjects are self-selected, so we cannot determine whether cannabis causes the impairments. It may well be that people with mental impairments are more prone to heavier cannabis use. Indeed, people who abuse multiple drugs have been shown to have smaller frontal lobes than nonusers (Liu et al., 1998). Although long-term users tend to experience greater difficulty in complex forms of memory and attention, these deficits are relatively subtle.

The effects of THC on mental abilities such as attention are comparable to the effects of alcohol. Both THC and ethanol increase reaction time. The effects of THC tend to last longer than those of alcohol. Of course, using THC and alcohol together produces additive effects.

In conclusion, there is good evidence that cannabis produces impairments in attention and concentration, the formation of new memories, perceptual-motor function, and executive functions. However, these impairments are relatively modest, comparable to those of alcohol. As with alcohol, the degree of impairment depends on how much is used.

CANNABIS ADDICTION

Chronic use of cannabis causes cannabinoid receptors to adapt and become less sensitive (tolerance). This effect is not permanent, and reverses after discontinuation. As with any mood-altering drug, can-

nabis has the potential to produce dependence. It is likely that dopamine is involved in the reinforcing effects of cannabis. However, cannabis is arguably less addictive and produces milder withdrawal symptoms than drugs such as cocaine, alcohol, and heroin. The intensity of the withdrawal syndrome would be related to the degree of use and tolerance. There is evidence that chronic THC administration can increase ethanol intake.

Suddenly stopping chronic cannabis use can produce a withdrawal syndrome consisting of restlessness, irritability, insomnia, nausea, and muscle cramping. However, this syndrome occurs only in people who use high daily amounts and suddenly stop. These full-blown symptoms are not usually seen in clinical populations, and frequent users of cannabis are not driven by a fear of withdrawal as opiate addicts may be. **Dronabinol** (Marinol) is a synthetic oral form of THC developed for medical use. A thorough study concluded that dronabinol has very low abuse potential since people tended to use it in the recommended doses for the recommended period of time, and there was no evidence of "script chasing" or "doctor shopping."

THERAPEUTIC USES OF CANNABIS

Cannabis shows promise for clinical treatment of several conditions, including nausea, pain, spasticity, multiple sclerosis, glaucoma, and AIDS wasting syndrome. The legal status of cannabis is currently a gray area and a matter of constant legal debate.

THC was first tested for the reduction of nausea and vomiting during chemotherapy in the 1970s (Vincent et al., 1983). THC is superior to placebo and as effective as or superior to the pharmaceutical antinausea drug prochlorperazine (Compazine). People taking THC reported more side effects, but these effects did not reduce patients' preference for the drug. The intensity of the antiemetic effectiveness of THC correlates with the subjective high reported.

Appetite Stimulant

Some evidence suggests that THC is effective in reducing nausea associated with cancer chemotherapy and stimulates appetite. In patients with appetite loss due to advanced cancer, THC (2.5 mg taken orally, three times per day) stimulated appetite and was well tolerated.

Cannabis and cannabis-derived drugs also are effective for AIDS-related appetite loss and wasting. Open trials were conducted with positive results, and were followed by controlled trials. The synthetic THC drug, dronabinol (2.5 mg taken orally, twice daily), improved appetite in patients with AIDS. Mood also improved, and stable body weight was maintained for at least seven months. Increases were also seen in body fat (1 percent). The psychological effects of dronabinol can reportedly be curbed by using another drug called prochlorperazine.

Glaucoma

Glaucoma is a condition involving excessive fluid pressure in the eye, eventually impairing vision. A controlled study in the early 1970s showed cannabis to reduce eye fluid pressure in people suffering from glaucoma. THC decreased pressure by an average of 37 percent, with maximum decreases of 51 percent. How THC achieved this effect is uncertain.

Movement Problems

In studies, THC reduces muscle spasticity in both animals and humans. A 10 mg dose of THC significantly reduces spasticity resulting from many different illnesses. A survey of multiple sclerosis patients indicated that cannabis relieves spasticity, pain, and tremors caused by the disease. A study in mice similarly supports a role for THC in reducing the tremor and spasticity caused by multiple sclerosis. A recent study in people with Parkinson's disease showed that THC may reduce the excessive movements caused by the medications used to treat the disease.

Side Effects

Pregnancy

Cannabinoids are teratogenic and should be avoided during pregnancy. When women use cannabis during pregnancy, it's associated with a risk of premature delivery and low birth weight. Babies of mothers

who smoke cannabis during pregnancy can experience mild withdrawal symptoms after birth. Problems with language, attention, memory, and behavior are related to prenatal exposure to cannabis.

Pulmonary Toxicity

One of the major health problems associated with cannabis use relates to the fact that it is most often smoked. Cannabis and tobacco smoke, apart from containing different psychoactive drugs, are actually very similar in their composition. Cannabis smoke is carcinogenic. It is at least as harmful as tobacco smoke, and contains three times as much tar and five times as much carbon monoxide. Cannabis smoke irritates airways, and reduces the capacity for breathing.

Cardiovascular System

THC commonly increases heart rate and blood pressure. These effects are not generally severe. Cannabis has a high safety margin, and no fatal dosages have ever been reported in humans. However, these effects could be a danger to someone who already has high blood pressure or heart disease. THC dilates blood vessels in the eye, creating the red eye commonly associated with cannabis use.

Immune System

The immune system has cannabinoid receptors, which means that THC could theoretically suppress the immune response. However, the relevance of these effects appears to be subtle or insignificant.

Brain Toxicity

There is a common conception that cannabis use kills brain cells, but this is actually a controversial topic. Large doses over a long period of time kill neurons in animals, but most drugs given in unrealistically high amounts will do the same. What is more relevant is what happens at the doses of THC normally used by humans.

Until recently, little clear evidence showed cannabis use is toxic to neurons. However, a recent study showed that THC damages neurons in the hippocampus of primates in doses that are proportionate to normal human doses. This is likely due to certain chemical changes and free radical damage. The toxicity of THC was prevented by giving nonsteroidal anti-inflammatory drugs (such as aspirin) and the antioxidant vitamin E. However, THC is not the only chemical in cannabis. Cannabidiol, for example, actually has protective effects on neurons. So the total combined effect of using cannabis is still uncertain. Limiting use of cannabis and using antioxidants may be the best strategy to avoid potential harm.

Seizures and Epilepsy

Cannabis may have harmful effects in people with epilepsy. Drugs in cannabis have complex and mixed effects on seizures, and can sometimes trigger them. Cannabis tends to slow activity in the brain, which is generally good for seizures, but when the drug wears off, the brain can rebound and become overexcitable. This effect of cannabis can last twenty-four hours or longer after cannabis is taken. It would depend also on how much was used and over what period of time. The effects of cannabis on seizures are, at best, unpredictable, so people with seizure disorders would probably do best to avoid it.

SUMMARY

Cannabis has been used by humans for thousands of years for both psychoactive and nonpsychoactive purposes. It remains in popular use for recreational purposes, and potentially for medical purposes. Through studying cannabis, we have discovered new chemical systems in the brain and body, and we are just beginning to appreciate how they work.

To be certain, cannabis is not a harmless drug. Like any psychoactive drug, it should be treated with respect and caution. It has prominent effects on thinking, emotion, the senses, and coordination. Reckless use of any psychoactive drug is a recipe for disaster.

However, the case for cannabis impairing mental functions has been overstated in many studies. Cannabis certainly impairs mental abilities, as do other drugs such as alcohol, codeine, and antihistamines. The degree of impairment is determined by how long and how

often a person uses the drug. As with alcohol, cannabis should certainly not be used by adolescents or pregnant women due to potentially harmful effects on development. Also similarly to alcohol, cannabis use is not appropriate when peak mental abilities are needed, such as when driving.

Cannabis carries some potential for dependence and addiction. Compared to cocaine, heroin, alcohol, and nicotine, cannabis may have less addictive potential and withdrawal effects. Nonetheless, some people develop compulsive and maladaptive patterns of use that are harmful and require treatment. Individuals with existing mental disorders (such as schizophrenia or bipolar disorder) should be leery of using cannabis in the interests of avoiding compulsive use patterns.

Cannabis has many potential medical uses, ranging from treatment of cancer to AIDS, multiple sclerosis, muscle spasticity, pain, and glaucoma. More controlled research is warranted in order for cannabis to become a legitimate treatment for these conditions. Cannabis is currently classified as a Schedule I drug by the DEA, suggesting that it has no legitimate medical uses. With the proper research, it is reasonable to suggest that it could be switched to Schedule II, where it could be prescribed and its use monitored by a physician. Cannabis may produce some mental impairments and have abuse potential, but so do opioid drugs such as codeine and Darvocet, yet we tolerate these drawbacks when they are used properly. Thus, cannabis could be used in a controlled manner similar to opioids.

Whether cannabis should be legalized for recreational use is a separate matter. One could argue that alcohol is a legal drug that also produces mental impairment. Both alcohol and tobacco have known addiction potential, yet they remain legal. Whether another such drug should be added to the list of legal drugs is a matter of philosophical standpoint. Ultimately, whether the use of cannabis is to be permitted and for which purposes (medical or recreational) remains to be collectively decided by society and the legislators we appoint. Hopefully, these decisions will be made on the basis of opinions formed by sound scientific research.

Chapter 11

Use, Abuse, and Addiction

Drug addiction is an affliction that has affected countless millions of lives. It is both stubborn and persistent, and despite progress in the fields of psychology and neuroscience, we are no closer to eradicating it today than we were a hundred years ago. It is by no means a new problem, but probably has existed to some degree as long as humans have had access to psychoactive drugs.

It seems that everybody has either struggled with addiction or is close to someone who struggled, or continues to struggle, with it. The National Institute on Drug Abuse confirms this picture. In 1999, 14.8 million Americans had used an illegal drug at least once in the month before being interviewed. About 3.5 million were dependent on illegal drugs and another 8.2 million were dependent on alcohol. Given a population of about 270 million in the United States in that year, it means that roughly 4 percent of the population was addicted to a drug. The trends for different drugs and geographic areas tend to fluctuate: several cities in the northeastern United States saw a decrease in the use of cocaine and crack in 1999, but heroin use had increased among eighteen- to twenty-five-year-olds by 51.4 percent from 199 to 1999. However, the use of both cocaine and heroin have increased since 1999, as has the number of emergency room reports of treating patients who had used these drugs. Marijuana use seemed to have stabilized for the time being, while use of Ecstasy (MDMA) had been growing in recent years. Overall, estimates from 2002 indicate that 8.3 percent of Americans used an illicit drug in the month prior to the survey. This percentage was highest (20.2 percent) among the eighteen- to twenty-five-year-old group.

These statistics are disturbing. They emphasize the point that drug use is widespread, with no sign of slowing down. Some successfully

quit, while others relapse, and new users continue to appear. In many respects it is a frustrating problem: it seems as if there is no cultural memory from which mistakes of the past can be learned and avoided. Instead, it seems as if newer generations continue to suffer the same problems as those before them.

Why is addiction such a stubborn problem? Why have our best efforts failed to make a serious dent in it? This chapter takes a look at what addiction is, why it's so persistent, and what can be done about it.

DEFINITIONS

Before trying to explain addiction, it's important to have a firm idea of what it is. We must understand the distinction between drug use, abuse, and addiction. In reality, the lines between them are fuzzy, but definitions help us understand and agree on what it is.

Good versus Evil

Who gets to decide whether taking a drug is use, abuse, or addiction? Certainly not all drug use is abuse. So who has that authority? The standard manual for defining and diagnosing mental illnesses is the *Diagnostic and Statistical Manual of Mental Disorders,* Fourth Edition, Text Revision (DSM-IV-TR), published by the American Psychiatric Association (2000). They list criteria for drug abuse and addiction, which are discussed in this chapter. The symptoms chosen to define addiction are very common themes in drug abuse and addiction, and most will agree that they paint a fairly accurate picture of the condition. But rather than just appealing to authority, it's important to know why they chose the symptoms they did. Beneath all of these criteria is an underlying principle that we use to decide if use of a drug is "good" or "bad."

The underlying idea is to weigh costs and risks against benefits. We must first consider the total costs and risks of taking a drug in terms of how it affects one's financial, physical, mental, and social well-being. This is then weighed against the potential benefits of the drug, or how it might improve a person's well-being. What tips the scale from use to abuse is the relative relationship of costs and risks

versus benefits. In a larger sense, everything that we do involves some risks and costs. Most of what we do involves some form of benefit. Whether any given activity is worthwhile, then, is a matter of how much good it creates relative to how much harm (or potential for harm). Whether or not we realize it, we make these types of judgments all of the time.

It's easy to see, in this framework, why taking a painkiller after surgery is acceptable. Pain after surgery can be severe, which affects a patient's mental and physical health. The limited use of a prescribed painkiller presents minimal risks, reduces suffering, and greatly enhances the person's ability to function. Medical examples such as this are fairly clear-cut, or so it would seem. Now consider the example of a heroin user injecting heroin intravenously. Chronic heroin use causes physical and mental health problems, and stopping it causes a serious withdrawal syndrome, making the user dependent on it. It's exceedingly expensive; frequent use is a financial drain as well. Clearly, recreational use of heroin is a case where the costs and risks far outweigh any benefit.

The tricky part involves the cases somewhere in between. What about a person who comes home from work and drinks one or two glasses of wine? Assuming that the person isn't driving and is able to carry out normal duties at home, is it any harm? Research says that if a person has one or two alcoholic drinks per day (on average, and depending on one's body size), the odds for being healthy are actually improved. Moderate alcohol use is associated with a reduced rate of heart disease, stroke, stress, depression, dementia, ulcer, gallstones, rheumatoid arthritis, osteoporosis, and type II diabetes mellitus. But it's a fine line. Any more than one or two drinks and the risks overshadow the potential benefits.

Use versus Abuse

Use of a drug simply means taking it to intentionally produce a desired effect, whether for therapeutic or recreational purposes. This includes taking aspirin to relieve a headache, taking insulin to treat diabetes, or drinking alcohol at a cocktail party. The term *use* doesn't make any judgments, either positive or negative.

The phrase **substance abuse** immediately carries a negative connotation. There are four criteria for what constitutes drug abuse, and the presence of any one of them signifies abuse (see Box 11.1). The first deals with repeated drug use that makes a person unable to fulfill important roles, such as performance at work, school, or in the home. This criterion is not enough by itself, since many people who abuse drugs remain generally functional—although it could be argued that if you look hard enough, you'll find the problems. The second criterion states that abuse occurs when a person uses a drug in situations in which it's dangerous. Immediately, driving a car while drunk comes to mind, but this applies to other situations as well. Riding a bicycle while drunk can be equally dangerous to the person who's drunk. Third, having legal problems as a result of drug use also signifies abuse, although this becomes a matter of which drugs a society considers legal and illegal. Cannabis use is illegal in the United States, but legal in Holland. Obviously, getting on an airplane and flying to Amsterdam doesn't change much except the legal status of the drug. Fourth, abuse is indicated when drug use continues despite persistent social problems. When drug use starts to affect a person's relationships, leading to disagreements, friction, arguments, or even fighting, it's a problem.

Addiction

At some point, drug abuse crosses the line into drug addiction. Seven criteria describe when drug use is considered to be **substance dependence** (see Box 11.2). A person must show three or more of these criteria for a twelve-month period. Of course, the twelve-month

BOX 11.1.
American Psychiatric Association Criteria for Drug Abuse

1. Recurrent drug use and failure to fill important roles in the person's life
2. Use of a drug in situations where it's dangerous
3. Legal problems resulting from drug use
4. Continued drug use despite persistent problems

BOX 11.2.
American Psychiatric Association Criteria for Substance Dependence

1. Tolerance
2. Withdrawal syndrome
3. Taking larger amounts over time, longer than intended
4. Desire or unsuccessful attempts to cut down or quit
5. Excessive time spent getting, using, or recovering from a drug
6. Normal activities hindered by the drug use
7. Persistent use despite knowledge of harm

rule is just for purposes of classification. Obviously someone who is dependent on a drug for eight months still has concerns.

The first criterion is tolerance for the drug, which is discussed in more detail in Chapter 3. Essentially it means that taking the same dose over time has a progressively smaller effect, so to maintain the same intensity of effect, the dose must be increased. A withdrawal syndrome is the second criterion, meaning that a person cannot function normally without the drug. This may be different for every drug, and typically it consists of the opposite effects of the drug. For example, cocaine causes euphoric happiness and cocaine withdrawal causes depression. Sometimes people take similar drugs to ease withdrawal symptoms. For example, people may take other sedatives when quitting alcohol. The third criterion is that a user ends up taking a drug in larger amounts or longer than intended. Often, people realize they are using a drug too much or too often, but their attempts to quit are unsuccessful, which is criterion 4. Criterion 5 reflects the fact that a person who is addicted often spends considerable time getting the drug, using it, or recovering from its effects. Time spent on the drug is time that is not spent on other activities, which is criterion 6. A person addicted to a drug will sometimes avoid contact with people, including activies such as family events, work, or socializing with friends. The last criterion explicitly addresses the risk-benefit aspect, when the person continues to use the drug despite knowing that it causes mental or physical harm.

EVOLUTIONARY BASIS FOR DRUG ABUSE

At first glance, it would not seem that evolution has much to do with addiction. However, considering human psychology in terms of our origins sheds light on drug use and abuse. Humans essentially have not changed for tens of thousands of years in terms of our physical or psychological makeup. We have more knowledge nowadays, since it accumulates through language and culture. But if you could go back in time and kidnap a human baby from 10,000 years ago and raise it in today's world, the baby would most likely be just like any other.

For most of human history, we've lived as hunter-gatherers, and evolution has selected traits in us that make us successful candidates for living that lifestyle. The food our ancestors ate was whatever animals they could kill or whatever plants they could find, so they needed the physical and mental abilities to get that food. They lived in small nomadic groups or tribes, making social skills a necessity. Aggression was needed at times to fight for a mate or food, or to protect the tribe from others. The only psychoactive drugs our ancestors consumed came from plants. Perhaps occasionally they stumbled upon a plant that had noticeable psychological effects, and sometimes perhaps they remembered the plant and went back to use it.

Even though our bodies and minds are still designed for hunter-gatherers, the situation has changed. Agriculture and language gave rise to civilization, and most humans live a life that is very different now. This is called **evolutionary mismatch:** evolution prepared us for one set of circumstances, but rapid changes in the past few thousand years have led us to live otherwise.

Now consider modern, industrial life in contrast to our ancestors' lives. The food we eat comes from agriculture and food is no longer scarce but in abundance. Food is created for its taste more than its nutritional necessity (think McDonald's), and as a result we have increased illnesses such as obesity, diabetes, and heart disease. Humans were sparse thousands of years ago, but now we live in cities with over 50,000 people per square mile. The consequences of crowding and stress are evident and our tolerance for social contact is taxed to the limit. The same instincts that drove our ancestors to fight off an invading tribe are now at work when we create nuclear weapons. This is not to argue that civilization is inherently evil (although many people

have), only different from what evolution prepared us for. For all its shortcomings, it also has its benefits. After all, our ancestors likely lived harsh lives and were lucky to see age thirty.

Now consider the psychoactive drugs available today. The first consideration is variety: a greater variety of drugs is available to us than has ever been available to humans. Our ancestors would have been lucky to stumble across two or three species of psychoactive plants. We, on the other hand, have ready access to hundreds of legal and illegal psychoactive drugs. The second difference is potency. Humans in South America only had coca leaves, but for the past 150 years, we've had pure cocaine. The Inca used coca for thousands of years without apparent detriment, but cocaine has been a liability ever since it was purified from the plant. A third difference in modern drug use is the way we take drugs. Eating a plant or drug has mild effects since it absorbs slowly into the body, and excessive amounts will cause us to self-protectively vomit it up. However, we've invented smoking and injection, so now the same dose of drug hits the brain faster and creates more intense effects.

So we're taking drugs in ways that evolution never prepared us for. Nothing in human history could have prepared us for the effects of smoking crack. Yet these drugs and methods are available now, and we must deal with them. Again, this is not to say that all drug use is bad. It's only different from what evolution has prepared us for, and we must keep this in mind when we make decisions about what to use and how. When you think about legalization of drugs such as heroin in this context, it seems absurd.

PSYCHOLOGICAL PERSPECTIVE

Drugs and Behavior

Many areas of psychology can shed light on addiction. Perhaps the best place to start is a behavioral perspective. Behavioral psychology classifies influences on behavior as **reinforcement** or punishment where reinforcement increases a behavior and punishment decreases a behavior. For example, taking a drug may induce pleasant feelings or it may take away pain or feelings of nervousness. Both of those consequences are reinforcement for taking the drug, making it more

likely that the drug-taking behavior will be repeated in the future. Punishment can also encourage drug use when attempts to stop taking a drug have aversive effects. For example, quitting tobacco is difficult for many because of the mental and physical withdrawal symptoms that occur.

On the other hand, the unpleasant consequences of a drug, such as feeling nauseous after drinking too much alcohol, also serve as punishment. This type of punishment makes it less likely that the drug will be taken again in the future. All drugs have both pleasing and aversive effects, so the drugs that are taken repeatedly are those whose pleasing effects are strongest relative to their aversive effects. For example, aspirin takes away pain and causes mild side effects in most people. As a result, aspirin has been very commonly used. The most addictive drugs, such as cocaine and heroin, are so intensely reinforcing that users often overlook their negative effects.

The reinforcing or punishing conditioning that occurs with drugs does not just come from the drug itself. Much of it comes from social influences, where some drugs are encouraged and others are discouraged. Drinking a glass of beer in a social gathering on a weekend may be encouraged, while drinking hard liquor first thing in the morning is usually discouraged. The use or possession of many illegal drugs carries a penalty of jail time, which serves as a strong potential punishment.

However, learning drug use and related behaviors occurs in many instances before reinforcement or punishment ever occur. Many people make choices about using illegal drugs without having ever been sent to jail. In psychology, this is called social learning or observational learning, since it can occur simply by observing and interacting with others. So people who observe a family member abusing drugs while growing up may internalize many of those behaviors long before they ever repeat them (or avoid repeating them).

Addiction and Emotion

In addition to considering behavior, we must consider the effects of drugs on emotion, since emotions are what motivate us to act, or not act, as the situation would have it. Most psychoactive drugs are used to change one's emotional state, either directly or indirectly.

Alcohol can create feelings of relaxation, reduce tension, and lift u one's mood. Caffeine mildly lifts mood as well, although larger amount will induce anxiety. Cocaine and heroin both induce intense euphc ria, despite the fact that cocaine stimulates the mind and heroin se dates it. Although aspirin has little direct effect on mood, it relieve pain, which indirectly reduces emotional suffering and distress.

Thus, many psychoactive drugs are shortcuts for changing ou emotional state. Changing our emotional state by changing behavic takes much more work and time to accomplish. Although the result of changing behavior are better in the long run, drugs are alluring be cause they offer much more immediate results. Consider the exampl of a person who is feeling sad or depressed. There are many ways h could make himself feel better. Exercising has proven mood-liftin results, equivalent to antidepressant drugs in some studies. Makin plans with friends and increasing social contact is beneficial to mooc Getting adequate rest and nutrition are also important. In more sever cases, he could talk to a counselor and learn to handle stressors diffe ently, or reevaluate social ties with friends and family.

These methods are reliable for improving mood, but they requir persistent effort over a period of time. Depression, unfortunately, of ten doesn't depart quickly. On the other hand, an array of psychoac tive drugs can also alleviate depression, even if only temporarily. Fc example, alcohol, cocaine, opiates, and cannabis can lift mood, or a least reduce the feeling of suffering. Unfortunately, the effects c these drugs are not long-lasting. Typically, the depression returns c may worsen when the effects wear off. Depression is only one exam ple. People can similarly use a drug to quell tensions, tranquilize ar ger, or alleviate stress.

So drug addiction can be viewed as a maladaptive form of moo management, although people are often unaware that they have falle into this pattern. Reliance on a drug to manage mood makes peopl less able to manage their moods on their own, by altering behavic and forming healthy habits. Mood management through drugs ma be socially tolerated in some situations, such as moderate alcohc consumption at a social gathering or coffee to brighten up a morning However, addiction is the same pattern to a more harmful degree.

Stress appears to play a significant role in drug abuse. It's a signif cant factor in the development, continuation, and relapsing of addic

tions. For example, stress is a major contributor to smoking relapse, even long after a person has quit. Children exposed to severe stress (such as abuse or the loss of a parent) are at increased risk of drug abuse during adulthood. Stress as an adult can contribute to addiction as well. Between 30 and 60 percent of people with an addiction also have post-traumatic stress disorder (PTSD). A startling 75 percent of combat veterans with PTSD suffer from alcoholism.

Addiction and Thinking

There's a strong two-way relationship between thoughts and emotions. Thoughts can trigger emotions, and emotions can shape (or sometimes warp) our thinking. People with mood disorders such as depression and mania not only have emotional symptoms, but changes in their thinking as well that accompany the extreme moods. In mania, a person's judgment is affected so that they tend to be unrealistically optimistic, while in depression people tend to be overly self-critical and pessimistic.

Not surprisingly, psychoactive drugs have effects on people's thinking, often by altering emotional states. One of the core features of addiction is the persistent use of a drug despite negative consequences for one's physical, mental, or social well-being. The musician Elton John stated that he had continued to use cocaine even after experiencing seizures that were caused or worsened by the drug.

The great irony is that people who are addicted often have poor awareness of the problem, although it may be blatantly obvious to those around them. It's not a matter of intelligence: people with addictions don't have a lower IQ than those who have never developed an addiction. But something about the addictive state limits a person's awareness of the problem. In a sense, unawareness of the problem is itself the problem, creating a catch-22. The powerful emotional effects of certain drugs naturally influence users to think in positive terms about the drug use, or to avoid negative thoughts about the drug, despite evidence to the contrary.

Addiction and Personality

Personality traits, which are characteristics that tend to be fairly stable over a person's lifetime, can contribute to addiction. For example, nervousness, moodiness, low self-esteem, anger, resentfulness,

and personal instability (e.g., employment, relationships) have bee associated with addiction. Keep in mind that although someone wh is nervous may be more likely to use a drug to calm down, being ner vous does not necessarily mean that a person will use the drug or be come addicted. Personality traits are tendencies, not destiny. Thus, n clear "addictive personality" exists.

One trait that seems to have particular importance is impulsivity, c the tendency to act on immediate needs rather than long-term goal For example, heroin users have been shown to undervalue a rewar (money) when they had to wait for it. Heroin users also show impuls ivity on pen-and-paper tests, such as completing a maze.

Essentially, addiction is an impulsive form of mood managemen Someone chooses to get immediate results by taking a drug rathe than going through long-term behavioral changes, even though the eventually are more effective.

Coping strategies can also protect against addiction or relapse. study of heroin users found that those who used cognitive, avoidanc and distraction coping strategies were better able to avoid relapse.

ADDICTION IN THE BRAIN

A great deal of research is being done nowadays to delineate th neurobiology of addiction. All aspects of a person's mind and behav ior are reflected in the activity of brain cells. The trick is to discov exactly which brain cells and what type of activity relate to addictio Research in this field hopes to understand what changes in a person brain when addiction occurs, as well as what may make some peopl more susceptible than others. For example, millions of people hav tried cocaine at some point, but only some of them go on to use it reg ularly and become addicted. There must be some neurobiologic difference between those two groups.

The brain has a **reward system,** which encourages us to pursu pleasurable activities and avoid aversive activities. This system in place naturally for many purposes. It ensures that we satisfy ou physiological needs, such as food, water, and sex. Not surprisingl people take great pleasure in receiving these physical necessitie (Although sex is not necessary for survival the way food or water ar

it is necessary for life to continue by procreation.) The reward system also adapts to accommodate abstract rewards such as money. Literally speaking, money is just printed paper, metal discs, or numbers on a bank statement, but through conditioning we learn that money can get us other things. The reward system of the brain has been shown to respond to both physiological and abstract rewards.

In the anatomy of the brain, the frontal lobes and limbic system are important parts of the reward system, and thus highly relevant to addiction. The frontal lobes are involved in executive functions, such as planning, decision making, motivation, regulating behavior, and impulse control. Any drug that has pleasurable effects is, in effect, shaping the activity of the frontal lobes to seek it out again in the future. The patterns of activity in the frontal lobes become focused on things that are rewarding, whether they are praise from a family member, a raise from an employer, or a line of cocaine. All behavior is a matter of making choices, and the frontal lobes are especially implicated in choice. For example, whenever someone decides to spend hard-earned cash on a drug (a pack of cigarettes, a beer, or a can of cola), it is done in place of buying food, a movie ticket, or saving it in a bank account. These choices are weighed in the frontal lobes.

The limbic system, as mentioned in previous chapters, represents emotional experiences in the brain. Accordingly, drugs that create pleasurable feelings and euphoria do so by altering activity in the limbic system. The limbic system and the frontal lobes communicate extensively with each other. In a sense, a mood-altering drug is tricking your brain. Emotional reactions typically occur in response to real-life events, such as getting a promotion, eating a delicious meal, or falling in love. We're designed to have those emotional reactions whenever something beneficial is happening to us. Taking a mood-altering drug is activating that same system, creating the emotional reaction, but without any real benefit. Thus, the brain is tricked into thinking that the drug-taking itself is a beneficial event even though the drug itself offers little or no practical benefit (and may instead be a financial, emotional, or physical drain). On some level, the addicted person is attributing significance or importance to the drug, which doesn't deserve importance since it doesn't offer any lasting benefit to the individual.

Studies have shown activation of the reward system in response t tasty foods such as chocolate, pleasant smells, a soft caress on th skin, enjoyable music, or even winning money. Brain imaging studie also show that taking a mood-lifting drug, such as nicotine, cocain and heroin, similarly activates the frontal lobes and limbic systen corresponding to the lift in mood they create. The reward system als responds to anything that is new or interesting, which helps explai why people like changes once in a while, to break from their usu routines (such as going on vacation). The reward system also act vates in response to sexual arousal and orgasm. It's no surprise th love has been called a drug, since it has such powerful effects on th reward system.

In addition to the anatomy of the brain, we must also consider i chemistry. Several neurotransmitters are involved in reward and ac diction. The one that has received the greatest attention is dopamin Neurons that produce dopamine originate in the brainstem and pr ject to higher areas of the brain, such as the frontal lobes and limb system. Results from numerous experiments suggest that these dop mine neurons are active whenever one experiences something ple surable or novel and interesting. These neurons release their dop mine in the frontal lobes and limbic system, focusing their activity c whatever caused the release of dopamine (e.g., food, sex, money, or drug). Dopamine neurons even start to fire signals when a reward anticipated (e.g., when waiting for your meal at a restaurant), but the become silent if a reward is not delivered (e.g., the food is really bad The neurotransmitter serotonin has also been implicated in rewar particularly in the ability to tolerate a delay before getting a rewar Thus, low serotonin activity makes a person less able to delay gratif cation, or more impulsive.

So an addiction is essentially dysfunction of the reward system c the brain. It is learned, to some degree, as the mood-altering drug taken repeatedly. The neuroscientist George Koob has defined addi tion as **homeostatic hedonic dysregulation.** In essence, this sug gests that humans maintain a regular range of pleasure in our lives. A of the enjoyable things we do keep us in a certain range of happines neither too high nor too low. Drugs that cause intense pleasure, such a cocaine or heroin, send our pleasure levels off the charts. After exper encing highs like that, normal reinforcers, such as a scoop of ice crea

or a hug, don't seem so great anymore. The intense highs distort our reward economy, so that ordinary pleasures don't do the trick.

To a limited degree, susceptibility to addiction may be inherited. David E. Comings has defined a **reward deficiency syndrome.** He and his colleagues have done extensive research showing genetic differences in people with addictions. For example, genetic variations in a certain dopamine receptor make them under-sensitive to dopamine. It is presumed that this makes some people deficient in a sense of reward when they do something pleasurable. As a result, they must resort to more extreme measures to bring their pleasure levels up to par. Thus, they are more likely to develop addictive patterns, such as using drugs.

ARE ADDICTIONS LIMITED TO DRUGS?

Addictions are not limited to drugs by any means. Really, anything that creates pleasure could be used in an addictive pattern. One brain imaging study actually showed that playing a computer game releases dopamine in the brain. When the comedian Robin Williams said that Nintendo was "cocaine for kids," he wasn't far off the mark. Many activities similarly activate the reward system of the brain, and can be used maladaptively to manage mood.

The idea of behavioral addiction, or an addiction to an activity instead of a chemical, is fairly well accepted. Nothing about the concept of addiction requires that a drug be involved. Addictions to gambling, food, sex, spending money, exercise, and the Internet have been recognized. Potentially, anything that alters emotions in a pleasurable way (i.e., increasing pleasing emotions or decreasing unpleasant emotions) can be used in an addictive pattern.

Remember that the feature that tips the balance from use to abuse is cost versus benefit. To take gambling as an example, someone who gambles a small, set amount of money infrequently is doing so in an adaptive pattern. Someone who gambles large amounts of money compulsively is doing more harm than good. Many with a gambling addiction (also called "compulsive gamblers" or "pathological gamblers") admit that they gamble to alleviate stress, sadness, or anxiety, suggesting dependence on gambling to manage their mood. They even show tolerance: the excitement of smaller bets wears off over time, so that larger and larger stakes must be made to get the same boost.

The same parallels can be made with other behaviors such as eating. Bulimia and binge eating disorder are both conditions in which people eat massive amounts of food, far exceeding what they need for nutrition. Eating is pleasurable, and these conditions represent an immediate, impulsive means of getting pleasure. The long-term consequences of this type of eating are either obesity, eating restriction, or purging to avoid weight gain. Sexual addiction is particularly difficult to deal with since the means of getting pleasure (i.e., one's own genitals) are so readily available. Drug or gambling addicts can at least make efforts to avoid places that would tempt them.

Not surprisingly, people with one type of addiction have a higher chance of having another type of addiction as well. For example, the rate of drug addiction is higher than normal among people with gambling addiction, and vice versa. So it's somewhat short-sighted to think of a drug as the main problem in an addiction. It's more of an overall approach to managing pleasure, pain, anxiety, and stress.

Since all of the addictions have so many similarities, it's ironic that they can be regarded so differently. An overeater is seldom viewed in the same light as a heroin abuser, yet in many ways both suffer the same underlying problem. That probably has to do with the greater risks of a drug such as heroin, which has more serious, immediate risks including legal entanglements, financial loss, or contracting a disease (when the user injects it). Someone who overeats will likely suffer illnesses such as cardiovascular disease or diabetes eventually, so the potential for harm, if not fatality, is equally great. Addiction will only worsen the odds of untimely demise, regardless of the object of the addiction.

TREATMENT

Understanding addiction on multiple levels (biological, psychological, social, etc.) is essential to its treatment. It is hoped that improving our understanding will guide us to better treatment and prevention, since those are ultimately what matter.

Readiness for Treatment

The "stages of readiness" for treatment of addiction were developed by DiClemente and Prochaska (see Box 11.3) to help under

BOX 11.3
DiClemente and Prochaska's Stages of Readiness

1. Precontemplation
2. Contemplation
3. Determination
4. Action
5. Maintenance
6. Termination

stand where people are in terms of changing their drug use. People in the precontemplation stage are not yet thinking that their drug use (or other addiction) is harmful, so they don't see it as a problem. They may lack knowledge that the drug is actually doing them any harm, or they may think that people complaining about their drug use are overreacting. Other addicts may see an attempt at quitting as hopeless.

The next stage is contemplation, when people begin to acknowledge a problem and are considering the possibility of changing, but are still on the fence about it. At this stage, they may just be seeking information and exploring the possibilities. At this point, an addiction counselor would help them consider the risks versus rewards of using the drug.

The determination phase marks a decision to stop the drug use. Some mixed feelings may be lingering, but they're not holding the person back from making the attempt. It would be best to make a realistic plan at this point for how to stop using the drug, with concrete solutions to the problems that may arise. Simply deciding not to use the drug anymore is not a thorough plan. Withdrawal symptoms must be managed, and the user needs a strategy for dealing with the cravings that may occur, and for dealing with stress in other ways than getting drunk or high. If it were as simple as making a decision, few people would ever be addicted.

The action phase involves implementing the plan, which often begins with a public commitment such as attending Alcoholics Anonymous meetings and/or telling family and friends. This serves a few worthwhile purposes. It encourages a social support system to assist

the person in quitting. It also allows people other than the one quitting to monitor the situation and watch for slips. The self-deceiving nature of an addiction makes it useful to rely on others (who one trusts) as a kind of reality-check system. Of course, using the right people (e.g., a sponsor or friend) can make a big difference. Nonetheless, a good plan will work over time, even if adjustments must be made. This kind of success is encouraging and reinforcing, helping the person maintain abstinence. Everyone is different, but the action phase often lasts three to six months.

Once success is met, the person is in a maintenance phase, since sustained abstinence is ultimately what matters. Maintenance can last for years, or maybe for the remainder of the person's life. As newer, more adaptive patterns are established, the risk of relapse becomes less severe. Unfortunately, the nature of the illness makes relapse always a possibility. Some lower their guard against the problem, or feel like testing themselves by engaging in a small degree of use. Others may meet with a great deal of difficulty or stress and not have the skills to cope with it. Fortunately, people at this stage are better equipped to quit again than a beginner, since they are already familiar with the problems and have the social supports, such as a sponsor. In the long run, people can benefit from their relapses, learning where the dangers are. As in most endeavors, persistence pays off.

The goal of addiction treatment is termination, when the person no longer sees the drug as a threat. At this point, the person has identified the situations that can trigger use. He or she has been able to deal with significant adversity by using coping and problem-solving skills, and not needing the drug. It has been debated whether anyone truly reaches this stage. Some believe that life after an addiction is indefinite maintenance of abstinence. Although the risk of relapse diminishes, abstinence is more of a process than a destination.

TREATMENT METHODS

Although substance abuse may be a stubborn problem, it is a treatable disorder.

Drug Treatment

It may seem ironic to treat a drug addiction by giving another drug, but in some cases it's beneficial or even necessary. Simply replacing

one drug with another is obviously not a good strategy. Medications are used to alleviate the withdrawal syndrome caused by abstinence, particularly when it is too severe or even life-threatening. For example, heroin and other opioids cause a hellish withdrawal syndrome that can last up to seventy-two hours. It would be cruel and unnecessary to make people go through it. Instead, drugs such as methadone or LAAM (L-alpha-acetylmethadol) are used to gradually wean the person. This method is no picnic either, but at least it is more manageable. The drug clonidine also helps further reduce the withdrawal symptoms. In the case of alcohol or other sedatives, rapid withdrawal in a person who uses large amounts can be dangerous, causing delirium or even seizures. In those cases, they are switched to a safer drug, such as a benzodiazepine, and slowly weaned.

Another type of medication used in addiction treatment is anticraving drugs. These drugs dampen the urge to use the drug again, making it somewhat easier for the abstinent person to resist temptation. A drug in this category is not sufficient treatment by itself, but may help people in the early stages who have not yet learned to change their behavior and coping skills. Few effective anticraving drugs exist, but obviously they are of great interest. For example, naltrexone has shown some usefulness in reducing cravings for alcohol.

Medication is also used to help remove temptation. These drugs render the abused drug ineffective, or otherwise make taking it undesirable. For example, naltrexone nullifies the effects of opioids such as heroin. So people taking naltrexone daily (or receiving a skin implant of the drug) have less motivation to take heroin because they know it wouldn't have an effect if they took it anyway. Naltrexone by itself, however, doesn't seem to have any apparent psychological effects. In a similar vein, the drug Antabuse (disulfiram) makes people violently ill if they consume alcohol. Thus, it could be taken in the morning to discourage slips later in the day. Of course, these strategies assume that people are willing and cooperative.

Last, drugs that reduce depression or anxiety are sometimes used by people quitting an addiction. Although changes in behavior are a better long-term solution, depression or anxiety that is too severe can hinder progress. Antidepressant drugs (such as Zoloft, Paxil, Wellbutrin) are used temporarily for this purpose, since they don't have any abuse potential themselves. Again, it would be cruel and unnecessary to let a person languish in misery when an appropriate medication is available. In some cases, it may even help the recovery process. For example, people with depression experience even more severe withdrawal symptoms when quitting tobacco, and they have a greater risk of relapsing.

Psychotherapeutic Treatment

Although helpful in the right situation, a medication is never a sufficient treatment for an addiction. Psychotherapeutic treatment is necessary and comes in many forms. In the broadest sense, these treatments include individual counseling or psychotherapy and support groups (such as Alcoholics Anonymous). In some cases, such as heroin, a combination of medication and psychotherapeutic treatment gives the best odds.

Addiction treatment programs may operate on an outpatient or residential basis, and treatment may be short term (less than six months) or long term (six to twelve months). Outpatient treatment is best for people who have fairly stable, socially integrated lives and a shorter history of addiction. Short-term residential programs usually last three to six weeks (or the common twenty-eight days), and typically involve long-term follow-up with a group such as Alcoholics Anonymous or Narcotics Anonymous. Long-term residential treatment (six to twelve months) is used for people with a long history of drug dependence, criminal activity, and social dysfunction. These programs are very structured and attempt to resocialize the person into a better lifestyle.

Treatment is a long and expensive process, but worth every cent. Adding up the costs of medical care, crime, drug abuse treatment, social welfare programs, and time lost from work, drug addiction costs an estimated $67 billion per year. However, studies have shown that we save four to seven dollars for every dollar spent on treatment. Programs in special circumstances, such as prisons, are also worthwhile. In some programs, prisoners who get addiction treatment have a rearrest rate that is lower by one-quarter to one-half. Consider that it costs about $3,300 per month to incarcerate someone, but only $290 per month for methadone maintenance therapy.

PREVENTION

Although addiction treatment is necessary and beneficial, prevention is even better. The adage about an ounce of prevention being worth a pound of cure is almost literally true. In financial terms, it is estimated that every dollar spent on prevention saves a community four to five dollars in costs for treatment and counseling.

Years of research have identified factors that place a person at greater risk for addiction, as well as others that reduce the risk. Research funded by the National Institute on Drug Abuse (part of the National Institutes of Health) shows that prevention programs are effective. Factors that protect against drug abuse include strong family bonds, parental monitoring and involvement, clear and consistent discipline, and involvement with prosocial organizations (such as schools or clubs). Not surprisingly, risk factors include a chaotic home environment (including members with mental illness or addiction), ineffective parenting (e.g., inconsistent or nonexistent discipline), poor school performance, poor coping skills, and affiliation with deviant peers (i.e., hanging with the wrong crowd).

Naturally, prevention programs aim to foster factors that protect against drug abuse. Considering that addiction is a maladaptive form of mood management, it would make sense to teach adaptive forms particularly to children. Although many people learn adaptive skills from parents and family during their early years, many do not, or they learn maladaptive behaviors and the cycle is repeated. For this reason, we cannot rely entirely on families to fix their own problems. Community-based programs help in this regard, educating children as well as parents.

It is unfortunate that these types of programs are not integral parts of our educational system. Although subjects such as mathematics and reading are part of every grammar school curriculum, no widespread program teaches children coping strategies and problem-solving skills for their personal lives. However, when someone develops an addiction, we expect the person to attend treatment and quickly absorb all of these principles. That's equivalent to giving out driver's licenses and then requiring driver education for people who get into accidents. During the Reagan administration in the 1980s, the Just Say No campaign was launched by First Lady Nancy Reagan.

Although well intentioned, it demonstrates a tragic lack of understanding about the causes of addiction. Certainly, shaping attitudes may reduce drug use overall, but Just Say No doesn't teach children anything about what to do when they are angry, sad, or nervous. It doesn't prepare them to handle losing a job, paying bills, having a relationship, or losing a family member. Teaching skills in coping, communication, and problem solving is designed to do just that.

CONCLUSIONS

Addiction is a common and stubborn problem. A clear-cut definition may never be found, but most will agree that it is a self-destructive pattern of behavior that applies to drugs as well as many other behaviors. It can be fully understood only by examining it at biological, psychological, and social levels. Although relapse is a common problem and a simple cure does not seem to exist, treatment is available in the form of counseling and an increasing array of medications. Moreover, solid evidence exists to demonstrate the effectiveness of certain prevention programs. Treatment and prevention are not only humane approaches to addiction but also benefit society and are cost-effective. It is questionable whether addiction will ever be eradicated, but our continued efforts to improve the situation are worthwhile.