The EEG records collected during meditation showed several differences between the two groups. One finding was that the brains of well-practiced meditators showed a pattern of neural activity in which brain areas that were anatomically distant from each other were nonetheless firing at the same rhythm and in synchrony. The specific rhythm observed, and the synchrony itself, are both thought to be crucial for the processes that coordinate and integrate brain activity in distinct areas (Figure 6.24). (For more on this issue of how separate brain regions can be "bound" together, see Chapter 5.) The implication, therefore, is that the meditation had created a strongly unified, cohesive experience—an experience, roughly put, of "one-ness." More broadly, this shift in brain activity associated with this type of meditation is certainly consistent with the idea that the meditation does produce a change in the quality of the meditator’s moment-to-moment conscious experience.

Drug-Induced Changes in Consciousness

Meditation is one way to change the quality of conscious experience; medication is another. Many psychoactive drugs change aspects of one's experience—so that antidepressants can decrease someone's sense of apathy or sadness; analgesics can decrease how much pain someone is feeling. Other drugs have broader effects and seem to change the very nature of our experience. This is certainly true for many of the illegal drugs taken for recreational purposes; indeed, the change in consciousness is often the reason why people use (and abuse) these drugs. In Chapter 3, we discussed some of the biological mechanisms underlying the drugs' effects and noted that these mechanisms all influence information flow at the synapse. Let's now turn to the psychological effects of these drugs by looking first at depressants (drugs intended to decrease neural activity) and then at the stimulants (drugs that promote neural activity). After that, we'll discuss marijuana as well as the broader set of hallucinogens. And finally, we'll consider the thorny problem of defining "drug dependence" and addiction.

DEPRESSANTS

Depressants are broadly defined as drugs that decrease activity in the nervous system. Many depressants are available to us; one is alcohol, a widely used recreational drug in many countries, but also widely used by people as a way of managing their own stress and anxiety. Other depressants are commonly prescribed by physicians; these drugs include medications (e.g., zolpidem) given to people who have trouble sleeping, and drugs (usually benzodiazepines, such as Valium or Xanax) used to treat anxiety. (For more on these drugs, see Chapter 17.)
Depressants are helpful in many circumstances—but if they’re misused or overused, they can lead to serious medical and psychological difficulties. For example, both the benefits and the problems associated with alcohol are well documented. At low doses, alcohol produces feelings of pleasure and well-being. But alcohol also depresses activity in neural circuits that ordinarily control our impulses, and when these (inhibitory) circuits are less active, people are likely to engage in a wide range of behaviors they would ordinarily avoid. If provoked, they’re more likely to be aggressive. If tempted toward sexual behavior, they’re more likely to give in to the temptation. But the same mechanisms can also promote positive behaviors. For example, people asked for charitable donations are more likely to say yes if they’ve had a drink or two; restaurant customers are more likely to leave generous tips after they’ve enjoyed a bottle of wine.

This relaxation of inhibition can, of course, create enormous dangers. Thus, people who understand perfectly well the dangers of driving an automobile while drunk may still get behind the wheel of a car—thanks, in large part, to impairment in brain circuits that would ordinarily forbid such behavior. Then, once the person is behind the wheel, alcohol’s other effects come into play—slower reaction times, poor coordination, and impaired decision making. All of this makes it easy to understand why, according to annual surveys by the National Highway Traffic Safety Administration, almost half of the deaths from traffic accidents in the United States involve alcohol consumption. Similar data have been reported in many other countries.

Researchers have further suggested that alcohol produces a narrowing of attention, so that people who have been drinking pay attention to a diminished set of cues in the environment and a smaller set of considerations from memory (Steele & Josephs, 1990). As a result, the drinker’s thinking is very much tied to the here and now, and he pays little attention to the possible consequences of his actions. This helps us understand why, for example, college students are less likely to use condoms if they’ve been drinking—apparently, in this setting, students pay less attention to the obvious dangers associated with unprotected sex (MacDonald, Zanna, & Fong, 1996; MacDonald, Cohen, Stenger, & Carter, 2000). This shortsighted thinking may also help explain why, according to one estimate, alcohol is involved in 90% of the rapes and a similar proportion of the violent crimes occurring on college campuses (Wechsler, Davenport, Dowdall, Moelykens, & Castillon, 1994).

We should add, though, that alcohol’s effects derive from a mix of the drug’s actual impact on brain chemistry and people’s expectations about its effects. In one study, half of the participants consumed an alcoholic drink and half consumed an alcohol-free drink (Abrams & Wilson, 1983; also see Goldman, Brown, & Christiansen, 1987). In each group, half of the participants thought they had consumed alcohol and half believed there was no alcohol in the drink. (The taste of the drink, for all participants, made it impossible for them to detect the alcohol, and so their beliefs about the drink depended entirely on what the experimenter told them.) All participants were then shown an erotic movie, and those who thought they had consumed alcohol (whether they actually had or not) reported stronger sexual fantasies in response to the film and reported feeling less guilt about these fantasies. Alcohol, it seems, can release someone’s impulses through psychological means as well as pharmaceutical ones.

What about the other depressants—sleeping pills or the various antianxiety drugs? These are highly effective if used appropriately, but they can also produce physical and psychological dependence, making withdrawal symptoms after prolonged use quite likely; the symptoms can include enhanced anxiety (a “rebound” effect), insomnia, or even seizures. In addition, people who’ve been taking these drugs for a long time often become less sensitive to the medication—a pattern known as drug tolerance—and so need a higher and higher dose to achieve the same effects. Unfortunately, at higher doses these drugs have further effects: High doses of benzodiazepines, for example, can cause cognitive impairment and, especially if combined with alcohol, can push the person into a coma.

[Varieties of Consciousness]
6.25 The availability of caffeine

Caffeine, a commonly used stimulant, is available from many sources.

**STIMULANTS**

For medical or recreational reasons, people sometimes turn to stimulants—drugs that stimulate the nervous system and broadly increase the level of bodily arousal. These drugs raise the person's blood pressure, increase heart and breathing rate, and certainly increase overall alertness. Like the depressants, some of the stimulants are freely available; the most obvious example is caffeine, which is found in coffee, tea, various colas, and some of the new energy drinks (Figure 6.25). Other stimulants are more powerful, less available, and in many cases illegal; the list includes cocaine and various forms of amphetamine, such as d-amphetamine, methamphetamine, and MDMA (also known as ecstasy). This list is surely partial, however, because new stimulants are often synthesized to supply an eager market.

Some stimulants have, or once had, legitimate uses. Amphetamines, for example, are sometimes prescribed by physicians to reduce appetite or fatigue, and they're also prescribed as treatment for attention-deficit/hyperactivity disorder (ADHD). Ritalin is another stimulant often prescribed in treating ADHD. (For more on ADHD, see Chapters 16 and 17.) Cocaine was used for many years as a local anesthetic for ear, nose, and throat surgery; it's still used for some surgical procedures. (Novocaine, a more widely used anesthetic, is a close chemical cousin of cocaine.) However, all of these stimulants are often abused as recreational drugs. People use these drugs to boost their energy, mood, and sense of confidence; to decrease the need for sleep; and to improve athletic performance. These benefits may come at a high cost, though, because stimulant use can lead to physical and psychological dependence. What's more, a regular user who abruptly stops using one of these drugs is likely to experience powerful withdrawal symptoms including fatigue, irritability, depression, headaches, and more.

Heavy users of methamphetamine often end up smoking large quantities of this stimulant. They gain a rush of energy and pleasure from inhalation and typically feel elated, confident, and able to stay awake several hours past their usual sleeping time. However, this aroused state is associated with markedly higher blood pressure that can increase the user's risk of heart failure or stroke (Figure 6.26). And, inevitably, the person will reach the end of this aroused period and come crashing down. At that point, the person is likely to become depressed and irritable, and sleep for days.

Cocaine is another commonly used—and abused—stimulant. This drug, derived from the leaves of the coca plant, is usually snorted or inhaled and quickly enters the
bloodstream, causing a rush of excitation and euphoria (Figure 6.27). Once again, though, this rush is only temporary. The subsequent crash—as with amphetamines—can involve feelings of fatigue and depression. And here too, long-term abuse can bring with it a set of problems that include risk of dependence, feelings of paranoia, and an array of medical difficulties including cardiac arrest and respiratory problems (Franklin et al., 2002; Gourevitch & Arnsten, 2005).

Another often-abused stimulant is methylenedioxymethamphetamine (MDMA; also known as ecstasy). MDMA is a molecule synthesized in the lab; chemically, it resembles another stimulant—methamphetamine—as well as the hallucinogen mescaline. MDMA is a drug often taken in social settings (at clubs or a rave) and produces an emotional elevation that involves feelings of pleasure, elation, and warmth. MDMA is also a mild hallucinogen and produces a strong sense of empathy and closeness to everyone who is around.

Once again, though, there's a price to pay for these benefits. When people are using MDMA, they are likely to become dehydrated and to clench their jaws so tightly that they can damage their teeth and jaw muscles. In addition, and like other amphetamines, MDMA users are susceptible to substantial increases in blood pressure, pulse, and body temperature. This situation can put the user at greater risk for cardiac complications (e.g., heart attack) and/or stroke. When the MDMA wears off (typically, after 3 or 4 hours), the person may also experience a kind of rebound that makes him feel sluggish and depressed. And at least some research suggests that continued use of MDMA can create a risk for several other problems (Biello & Dafters, 2001; Morgan, 2000; Pacifiì et al., 2001)—including impaired memory, problems in one's body clock that may include sleep difficulties, and weakened immune system function (and so greater vulnerability to illness).

Overall, it seems clear that these stimulants do change a person's conscious experience. Excitement, euphoria, and increased self-confidence all powerfully color his experiences, and the stimulants may produce a sense of enhanced awareness that changes how the world looks, sounds, and feels. The strong sense of empathy produced by MDMA also adds a pleasurable dimension to one's experience. But as we've seen, these drugs expose users to serious health risks including life-threatening medical conditions, a danger of addiction, and a catalog of medical, mental, and emotional difficulties associated with long-term use.

MARIJUANA

Marijuana consists of the leaves, flowers, and buds of the hemp plant (Cannabis sativa and also Cannabis indica). The active ingredient in marijuana is the chemical delta-9-tetrahydrocannabinol (THC), which can be introduced into the body in a variety of ways—dried and then smoked, for example, or eaten. The THC can also be concentrated into a form known as hashish. In all cases, marijuana has a range of effects: It relaxes the user, lifts her mood, and (like alcohol) reduces the ability to resist impulses. It also heightens sensations, so it can be considered a mild hallucinogenic.

Like most drugs, marijuana's effects depend on the context, including the user's expectations. If you're surrounded by giggly friends, marijuana is likely to make you giggly as well. If you're alone and anxious, marijuana can magnify these feelings as well.

Marijuana has various therapeutic uses. For many years, it was the best way to control the pain from glaucoma or the nausea from chemotherapy. (Other, more reliable, medications have now been developed for these purposes.) Marijuana also seems to be effective in treating the pain and general discomfort associated with several other medical conditions, including AIDS. This is why marijuana is prescribed
for medical use in roughly a dozen U.S. states, although each state places its own restrictions on how and by whom the marijuana can be acquired and used.

The risk of addiction or dependence is low for marijuana. Infrequent users seem to suffer few withdrawal problems if they stop using the drug altogether. For more frequent users (e.g., multiple marijuana joints per day), quitting has been shown to produce withdrawal symptoms similar to those of tobacco users when they stop smoking. These symptoms may include sleep difficulties, increased anxiety, and irritability.

In addition—and despite claims to the contrary—marijuana doesn’t seem to be a “gateway drug” that leads people to try (and eventually abuse) more potent drugs (Hart, Ksir, & Ray, 2009). There’s also little reason to believe the media reports suggesting that marijuana has a long-lasting impact on sexual functioning or fertility (Grinspoon, Bakalar, & Russo, 2005).

Even so, many problems are associated with marijuana use. Marijuana smoke contains cancer-causing substances; in fact, it contains more of these substances than tobacco smoke does. Marijuana intoxication can also undermine a user’s judgment, diminish motor coordination, and increase reaction time (Lane et al., 2005)—and so people under the influence of marijuana should certainly not drive or make big decisions of any sort. Marijuana also seems to interfere with memory—both the creation of new memories as well as the recall of older ones—and these effects seem to persist even when the immediate drug effects have worn off (Pope, Gruber, & Yurgelun-Todd, 2001).

How exactly does THC affect the brain? Evidence suggests that this molecule latches onto receptors located especially in the midbrain and in various limbic structures (Devane, Dysarz, Johnson, Melvin, & Howlett, 1988); it seems that all vertebrates may have these cannabinoid receptors (Elphick & Egertova, 2001; van Sickle et al., 2005).

These results raise a question, though: Why should the body have receptors that are responsive to THC at all? The answer seems to be that these cells are normally activated by a neurotransmitter called anandamide (from the Sanskrit word ananda, meaning “bliss”). This transmitter is chemically similar to THC, but it’s produced naturally in the body (Devane et al., 1992; Wiley, 1999). Ordinarily, it seems to be involved in a range of functions including mood regulation, appetite control, and pain perception. Marijuana may have its effect, therefore, by triggering some of the same mechanisms.

It turns out that other chemicals also bear some resemblance to anandamide and so may mimic some of its effects. One such chemical is found in chocolate—which may be part of the reason so many people enjoy eating chocolate.

**HALUCINOGENS**

So far, we’ve considered drugs that may change the tone of someone’s conscious experience as well as make the person more sensitive to his sensory experiences. A final category of drugs is different: The hallucinogens are drugs that powerfully change perception and can also trigger sensory experiences in the absence of any inputs. These hallucinogenic effects are produced by many substances, including LSD (lysergic acid diethylamide, or “acid”), mescaline (from the peyote cactus), psilocybin (from certain mushrooms), and PCP (phencyclidine, often called “angel dust”).

All of these chemicals produce enormous changes in how the user perceives the world. They may trigger a sense of seeing fantastic and intricate patterns, an intense kaleidoscope of colors, or a series of meaningful images—some fantasy, some apparently based on the user’s emotional experiences. These experiences may trigger or be accompanied by intense emotions, ranging from euphoria in a “good trip” to deep panic or profound paranoia in a “bad trip,” with the consequence that one person might be exhilarated by the experience while another is horribly disturbed.
Hallucinogens seem not to produce dependence. However, due to the unpredictable nature of the experience, users always risk having a hallucination that's deeply distressing. What's more, in the hallucinatory state people often have dreamlike experiences that seem compelling and real; if the person takes these experiences at face value, she can put herself into enormous danger—for example, trying to jump out a window because she's convinced she can fly. In response to these risks, users of hallucinogenic substances often choose to have a support network close at hand—friends who can serve as so-called trip sitters. These are people who aren't using the drug and who stay with the hallucinating person in case the emotions of the trip turn dark or she decides to explore some hazardous activity.

**ADDICTION**

Our main focus in this chapter has been on the nature of conscious experience, and so our emphasis, in describing various drug states, has been on the experience produced by the drug. However, we've also commented on the dangers associated with these substances. Some of the dangers are medical (e.g., the cardiovascular problems sometimes triggered by stimulants). Some of the problems are psychological (e.g., the panic that can be triggered by a bad trip). Still other dangers concern the bad choices someone makes while under the influence of one of these substances. (Think about the linkage between alcohol use and rape, or the fatalities attributable to drunk driving or the life disruption caused by drugs. Think also about the crimes associated with drug use—for example, when a user can't hold a job because of his drug state, and turns to crime to get the money he needs for the next dose.)

In light of all these dangers, why do people keep using drugs? Common sense provides the answer: In many cases, people put a higher value on the benefits (the drug-created changes in experience) than on the costs. And in many cases, people seem to have no choice: They're dependent on the drug, and so feel a powerful need to use it again and again, regardless of the risks.

This perspective raises another key question: What is dependence? And what do people mean when they say that someone is "addicted" to a substance? Answering these questions is—perhaps surprisingly—extremely difficult.

Researchers and clinicians tend to use the words dependence and addiction interchangeably and, overall, to define these words based on several attributes. Someone is dependent if, first, he's lost control over his own drug use; this attribute is usually reflected in the fact that the user has a very hard time giving up the drug, even though he would clearly benefit from doing so. Second, people who are dependent tend to show strong withdrawal symptoms if they go without the drug—they have strong cravings and exhibit a clear pattern of psychological and medical distress. Third, people who are dependent tend to display a pattern of drug tolerance—they have a weaker response to the drug than they did when they first began using it. One frequent result of this tolerance is that as time goes by, the dependent person needs larger and larger doses of the drug to get the desired effect. (For more on mechanisms that lead to withdrawal and tolerance, see Chapter 7.)

This cluster of attributes is clearly in place for some drugs, and some drug users. The most obvious case is probably heroin. People addicted to this drug seem unable to give it up, even though their drug use is hugely disrupting their lives (and often the lives of others). Heroin users typically suffer horrible withdrawal symptoms if they don't get their usual dose. And as they continue using the drug, heroin users seem to require larger doses just to maintain the same effect they've gotten in the past. Cases like heroin leave no doubt that addiction is a real and deeply destructive problem.
But it's easy to find cases in which it's hard to tell if someone has an "addiction" or not. For example, how should we think about cocaine? People do seem to have great difficulty giving up cocaine, once they become frequent users. However, ceasing use of cocaine seems to cause only mild withdrawal symptoms (Kampman et al., 2002). So is cocaine addictive? It shows one of the attributes of addiction, but not another. Or, as a different case, what should we say about habits that show all the characteristics of addiction—but in a relatively mild version? For example, some people spend hours and hours shopping and seem unable to interrupt this habit, even though it's disrupting their lives and their finances. They also seem quite unhappy when they can't go shopping, and so they show a type of withdrawal. They also seem to require more and more hours in the mall, as the years go by, to satisfy their desire for shopping. Should we count this habit therefore as a "shopping addiction"?

Some people do seem willing to stretch the term addiction to cover these borderline cases—so they talk about someone being addicted to shopping, or sex, or television. Likewise, they use words like workaholic or even soccerholic to describe people who (allegedly) need a large daily dose of work or soccer, just like an alcoholic needs a large daily dose of alcohol. Most researchers, however, resist this stretching of the terms. To see why, think about the huge amount of life disruption a heroin addict will endure to support her habit, or the horrific suffering of heroin withdrawal. It seems entirely misleading to compare this disruption, or this suffering, to the (much milder) plight of a shopping addict or workaholic; and so it just seems unwise to use the term addiction to apply to both cases.

But how should we draw the line that will distinguish a "genuine" addict from these other questionable cases? Some writers make a distinction between psychological dependence on a substance (or an activity) and physical (or physiological) dependence. The general idea is that psychological dependence refers to the intense mental or emotional craving for the addictive substance, whereas physical dependence refers to the medical symptoms we observe during withdrawal. Moreover, genuine addicts show both psychological and physical dependence; the borderline cases are unlikely to show physical dependence.

But this distinction, too, is problematic. Among other concerns, bear in mind that so-called psychological dependence often creates feelings of stress—and stress, in turn, shows up in many bodily systems. (When people feel stress, their blood pressure goes up, their blood chemistry changes, and so on.) On this basis, the cravings associated with psychological dependence cause physical symptoms. This issue obviously undermines our effort to distinguish these two allegedly different forms of dependence.

In light of all these points, the word addiction is truly difficult to define. So perhaps we shouldn't be thinking of addiction as a separate category. Instead, we should think about the issues of substance use in terms of a continuum. At one end of the continuum are the social users of various substances; these are people who have an occasional drink or sometimes take a drug for recreation. Farther along the continuum are people who abuse the substances. They use alcohol or drugs more frequently, and they have at least a few problems because of it. Then, at the far end of the continuum, we find people who are truly dependent—using the substance a lot, experiencing serious problems as a result, and being largely unable to control the use. In this view, addiction is not a distinct state of affairs; instead, it's the extreme end of this range—and a point at which the person needs help in conquering the addiction.

DIFFERENCES AMONG PEOPLE

There's one more approach we might take in defining addiction or dependence. We might try to define these words by referring to the drugs themselves. For example, we might claim that addiction is what heroin produces; in contrast, mere habit is what marijuana produces. It turns out, however, that this approach doesn't work because, no matter what drug we consider and no matter what definition of addiction we use, not everyone who
uses that drug will become addicted (Robinson & Berridge, 2003). Among cocaine users, for example, roughly 1 in 5 becomes a habitual user. Even for heroin, often tagged as the clearest case of an addictive drug, it's just 1 user in 4 who becomes addicted.

This variation from one user to the next certainly adds to our difficulties in defining addiction but is, in addition, an important fact for us to explain. Why do some people become addicted, but not others? As always, the answer has several parts. A direct influence of genetics is likely, so that (for example) someone is more likely to become an alcoholic if one of her biological parents was also an alcoholic (Crabbe, 2002).

Personality, which is to some extent shaped by genetics, also plays a role because people differ in their willingness to take risks and their ability to control their own impulses—both factors that can feed into addiction. The environment is also crucial because, in some environments, people have more opportunity to explore various substances and are less discouraged from experimenting with this or that substance (Figure 6.28). A person's life status is also important; substance use is more likely to become substance abuse, and the abuse is more likely to become an addiction, if the person has just lost a job or had a close relationship break up. Cultural factors are also relevant; substance use is forbidden or strictly limited by some groups, so that dependence is extremely unlikely among these groups (Trimble, 1993).

A person's beliefs about their social surroundings can also play a role. Several studies suggest, for example, that students overestimate how much their friends use alcohol or other drugs (Prentice & Miller, 1993) and that those who most overestimate this usage are most likely to become recurrent users themselves (Graham, Marks, & Hansen, 1991).

Unmistakably, therefore, we have many factors to consider when we seek to explain why someone uses a substance, abuses a substance, and may become dependent on the substance. Likewise, we have many options to consider when seeking ways to help people either avoid substance abuse or exit a substance problem they already have.

**SOME FINAL THOUGHTS: THE UNSOLVED MYSTERIES**

Early in the 20th century, American psychologists were convinced that conscious experience could not be studied scientifically, and the topic of consciousness was largely absent from the scientific journals. In the years since, we've realized that this early assessment was far too pessimistic, and we now know an enormous amount about consciousness. In this chapter we've discussed a lot of what we know, and other perspectives on conscious experience will appear in other chapters—for example, when we discuss the subjective sense of familiarity in chapter 8, or what it actually feels like to be depressed in chapter 16.

As we've seen, research has also provided a rich characterization of how much in our minds can proceed without conscious awareness, and this has allowed key insights into what consciousness contributes to our mental functioning. These insights in turn are linked to proposals about the biological substrate of consciousness. Our understanding of the neural basis of consciousness can then be linked to a further set of issues—including the altered states of consciousness associated with sleep, for example, or religious meditation.

By any measure, then, we've made enormous progress in our understanding of these incredibly difficult topics. Even so, many puzzles about consciousness remain untouched. Among them, we still have no solution to the mind-body problem. We can specify the locations in the brain and the types of neural activity associated with consciousness; but it remains a mystery how these neural firings give rise to subjective experience. Likewise, in...