

Stimulants and Society

Accelerating our lives, one compound at a time

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At any point in time, our bodies can be pushed to speed up or slow down. Central Nervous System (CNS) stimulants "accelerate" our body while CNS depressants "decelerate" it. By examining some of the most famous members of the CNS stimulant family, such as caffeine, cocaine, methamphetamines, and pharmaceuticals, one can better grasp how pervasive stimulants are in our society. The use and study of stimulants have also fueled many debates, such as the dangers of caffeine during pregnancy or the administration of drugs for alertness in children. The world is moving faster today than it ever has before due to advances in technology, greater communication, and globalization. People are expected to do more in the same amount of time than they were just decades ago, and many are relying heavily on stimulants just to keep up. While small amounts of legal and appropriate stimulants are perfectly fine for most people, one must be careful not to overdo it because side effects, including dependency, can occur. These stimulating drugs that alter our state of being are extremely powerful, and they can do a lot of good as well as a lot of damage, depending on how they are used.

Caffeine

Since childhood, caffeine has been a pervasive part of most of our diets. It is found in many natural and processed foods such as chocolate and beverages (coffee, tea, and soda), as well as in pills such as No-Doze and Excedrin. Caffeine can influence almost all organ systems, but the drug predominantly targets the CNS and the cardiovascular system. At these sites, the chemical blocks receptors for adenosine, an inhibitory neurotransmitter that aids in sleep and suppresses arousal. Caffeine also increases the effects of dopamine by blocking reuptake, which can make a person feel good. At mild doses, caffeine can be beneficial by causing alertness without major side effects. This chemical may also have less understood benefits; for instance, it has been suggested that caffeine may help to prevent Alzheimer's disease.

Fortunately for all of the "caffeine addicts" out there, caffeine is a relatively safe stimulant because it takes quite a large dose to produce negative effects. At these higher doses, this drug may cause vomiting, abdominal pain, agitation, and seizures. Consuming large amounts of caffeine on a regular basis can cause dependency and desensitization, meaning one's body may require increasing amounts of caffeine to

produce the same effect. Toxicologists estimate caffeine's LD50 to be approximately 50 cups (or 50 caffeine pills) for a 60 kg person, meaning that this dose is lethal for fifty percent of the population (Erowid 2007). In the rare case that someone would consume this much caffeine, ventricular fibrillation would occur, leading to death. While caffeine generally does not lead to life-threatening addictions, many people cannot discontinue their use because of the potentially severe withdrawal symptoms. These may include: headache, fatigue, drowsiness, difficulty concentrating, irritability, depression, anxiety, flu-like symptoms, and motor and cognitive impairment.

Moderate amounts of caffeine do not pose a threat to the average person, but pregnant women need to take caution. In a Kaiser study released in January 2008, 1,063 pregnant women were tested and those who consumed over 200 mg/day (two or more cups of regular coffee or five 12-ounce cans of caffeinated soda) were found to be twice as likely to miscarry as those who consumed no caffeine (Kaiser Permanente 2008). This study found that caffeine, and not other chemicals in coffee, was directly related to the heightened miscarriage rate. Caffeine can be harmful because it crosses the placenta and reaches the fetus, which can have difficulty metabolizing the caffeine since its metabolic system is not fully developed. Adverse effects on fetal development may also be attributed to hindered cell development and decreased placental blood flow. Although a 100% correlation is not shown, Kaiser Permanente has great faith in the findings of this study and recommends avoiding or highly limiting caffeine intake during pregnancy. Many physicians have already been making this recommendation despite the lack of clear-cut evidence, simply to err on the side of caution.

The main criticism of this particular study, as well as of many other similar studies, was that morning sickness may lead to confusing results in caffeine studies. This is because women with healthy pregnancies tend to have more morning sickness symptoms as a result of a proper hormonal balance, and the morning sickness often gives them an aversion to caffeine, leading them to consume less. Critics claim that women who appear to have lower rates of miscarriage consume less caffeine, when really they had healthier pregnancies to begin with (Grady 2008). Other confounders need to be taken into account, since miscarriages most commonly result from chromosomal abnormalities and infections, neither of which can be attributed to caffeine. Still, many doc-

tors are taking this study very seriously and are recommending that their patients avoid caffeine completely, whereas others are awaiting more conclusive studies and telling their patients that minimal amounts of caffeine are not harmful.

Cocaine

One of the world's most infamous stimulants is cocaine, and it has been used by humans for over five millennia. It was first used by native South Americans who chewed the plant for its stimulating effects. In modern times, the drug has made its way to the United States, first becoming available to the public in the late nineteenth century at a high price. At this time, cocaine was not yet considered taboo, and the chemical was even an ingredient in Coca-Cola until 1903, when it was replaced by caffeine (Narconon 2008). It was not until the early twentieth century when the negative effects of cocaine became apparent. At this point, many cocaine users had developed a regular habit and the drug's association with violence and paranoid behavior was established. In 1910, President Taft warned against the many ills of cocaine, and the drug's reputation quickly changed from a luxury into a dangerous fixation (Narconon 2008).

The active chemical in cocaine is methylbenzoyl ecgonine, a fast-acting and highly addictive CNS stimulant,

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appetite suppressant, and anesthetic. The drug binds to and inactivates dopamine transporters, thereby blocking dopamine reuptake in the synapses, the site of chemical and electrical communication between neurons. This leaves more dopamine available in the synapse that can bind to and activate dopamine receptors. Dopamine-rich areas of the brain such as the nucleus accumbens are therefore stimulated, rewarding "pleasure centers" of the brain along the mesolimbic pathway. This region is thought to be responsible for producing feelings of pleasure, which can play significant roles in addiction. Cocaine often causes the user to feel euphoric, energized, powerful, alert, restless, and anxious.

The "high" from cocaine can last from just a few minutes to hours, depending on the dose and the pathway through which the drug entered the body. Injection causes blood plasma levels of cocaine to peak in 2-3 minutes, smoking (in the form of crack cocaine) in 5-10 minutes, and snorting in 15-30 minutes (Narconon 2008). After the high wears off, detectable traces of the drug remain in the body for two days. As the drug is metabolized, neurotransmitter sources are

depleted, and feelings of depression and a "crash" may ensue. The state of mind changes from normal to depressed, and this shift often leads to addiction because the user needs the drug just to attain a sense of normalcy. The more they use, the more they need, and this cycle often turns occasional, recreational experimentation into a regular habit. Unlike other popular street drugs such as heroin, which creates a physical addiction, or marijuana, which creates a psychological addiction, cocaine creates both a bodily and a mental addiction, making it one of the most difficult drugs for users to quit. In fact, the relapse rate of recovering cocaine addicts is over 80% (Boston University). It is generally thought that a combination of pharmaceutical and psychological therapies gives addicts the best chance at recovery, although any approach will require a great deal of time, effort, and support.

Methamphetamine

Methamphetamine is another common stimulant that has become more and more popular in recent years. It is not nearly as ancient as cocaine, and was first synthesized in Japan in 1893 from ephedrine, a compound used widely in medications such as stimulants and decongestants. During World War II, pilots took methamphetamine as a stimulant to help them focus and remain alert, and after the war, it was prescribed for medicinal uses (Greater Dallas Council on Alcohol and Drug Abuse 2005). It also became a well-known street drug nicknamed crystal meth, which is relatively easy to make at home and has become quite commonplace. In 1983, a law was passed making it illegal to produce crystal meth in the United States.

Like cocaine, methamphetamine stimulates the brain's mesolimbic reward pathway. It does so by triggering a cascading release of the neurotransmitters norepinephrine, dopamine, and serotonin, which play a role in alertness and mood. The effects associated with methamphetamine mimic many of the symptoms of schizophrenia. These include: increased pulse, weight loss, extra alertness, irritability, panic, increased sex drive, dilated pupils, acne, scratching sores, dry mouth, paranoia, delusions, and hallucinations. Methamphetamine is not considered a "luxury drug" like cocaine, and abusing it can impact and destroy nearly every aspect of a person's life.

Treatment for ADHD and ADD

Stimulants are not only found in a cup of coffee or in recreational drugs, but they are also used for medicinal purposes. Counter-intuitively, stimulants can actually heighten alertness while diminishing hyperactivity and impulsive behavior. This effect makes these drugs useful for alleviating depression and narcolepsy, a neurological disorder involving excessive daytime sleepiness, and they can also

help to facilitate weight loss. However, the most common medicinal usage of these types of stimulants is for the treatment of Attention Deficit Hyperactivity Disorder (ADHD) and Attention Deficit Disorder (ADD). These conditions are most prevalent in children, causing a lack of focus, hyperactivity, and impulsivity. The four most commonly prescribed treatments for these disorders are: Adderall and Dexedrine, which are derived from amphetamine, and Ritalin and Concerta, which are derived from methylphenidate. These drugs affect the balance of certain neurotransmitters in the brain, (such as dopamine, serotonin, norepinephrine, and epinephrine), that are associated with feelings of pleasure, happiness, energy, focus, etc. It is also important to point out that because these stimulants have a high potential for abuse, they are classified as Schedule II, meaning that they need to be closely monitored by physicians and pharmacists.

Dexedrine and Adderall are both derived from amphetamine. It is believed that their mode of action involves binding monoamine transporters, thus increasing cellular levels of these biogenic amines: dopamine, norepinephrine, and serotonin. They can also block monoamine oxidase (MAO), which breaks down serotonin, dopamine, norepinephrine, and epinephrine. Due to these drugs' effectiveness in helping patients to focus and remain alert, Adderall is commonly abused by high school and college students who are under a great deal of academic stress and need the extra boost in brain power. As with illegal methamphetamines, this abuse may lead to extreme dependency, depression, and schizophrenia-like symptoms.

Two other popular drugs for ADHD and ADD are Ritalin and Concerta, both of which are derived from methylphenidate. Ritalin was popular during the 1990s, but there were some complaints. People worried about its high potential for abuse since it gets metabolized and takes effect so rapidly (Boyles 2006). They also disliked the fact that although the effects of the pill were very strong after initial intake, the effectiveness of Ritalin slowly diminished throughout the day and patients would then have to take a second pill later in the day (Iannelli 2008). The latter could be troublesome for school children who need to be focused all morning and afternoon. In April of 2000, a time-released

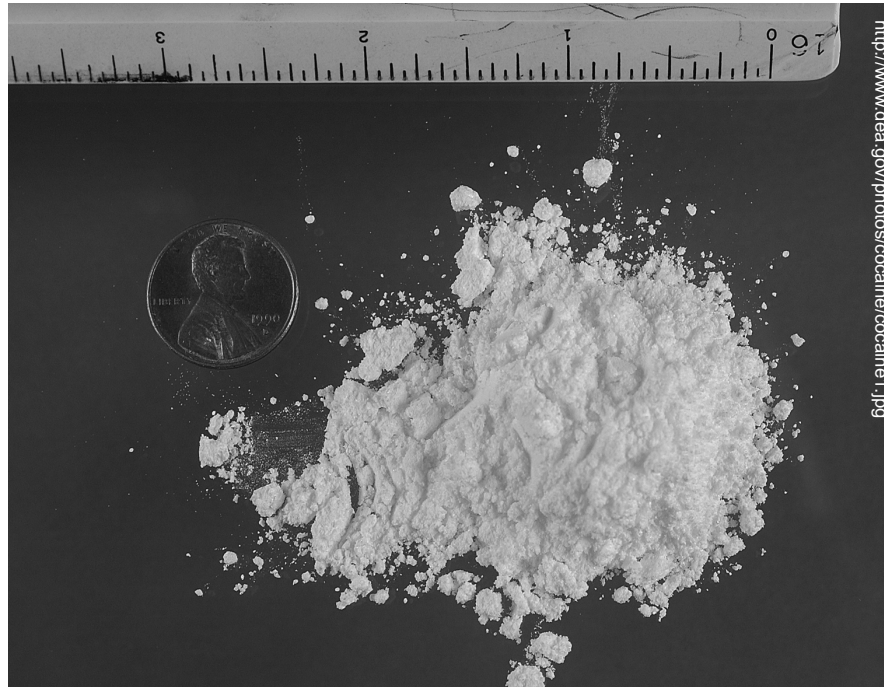
form of methylphenidate known as Concerta was approved, and this new version of the drug allowed for a consistent effect throughout the day without the noticeable highs and lows. Concerta is also more difficult to abuse than Ritalin, since only small amounts of the chemical are released throughout the day. The mode of action of methylphenidate is not completely understood since the cause of ADHD is not fully understood either. Still, it is a known dopamine reuptake inhibitor, meaning that it increases the amount of dopamine circulating in the synapses. Researchers therefore believe that methylphenidate may alleviate the dopamine imbalance in the brain that contributes to ADHD. Methylphenidate may also affect serotonin levels in the brain, but more research is needed.

Are stimulant drugs appropriate for children?

The debate over the use of medicinal stimulants in children has been increasing as more and more of these drugs are being prescribed to them. Side effects of these drugs include: loss of appetite, difficulty falling asleep, dry mouth,

gastrointestinal pain, mood swings, and in more severe cases, addiction and psychosis. Many parents and children are willing to make the trade-off, but in some cases the side effects outweigh the benefits. Namely, some parents are afraid that their child may develop an addiction to stimulants, but research has shown that these medications are not addictive when taken as prescribed. It is also important to note that while more and more young people are being diagnosed with ADHD and ADD and put on medication, in reality, some of these children are probably just having trouble in school or behaving badly, as children will do from time to time. More thorough tests need to be performed before a diagnosis is made to prevent over-prescribing of these medications. As with any medication, the lowest possible dose should be administered initially, and the dosage can then be raised if the effects are not sufficient.

Of course, it is not just the patients who need to worry about adverse effects. Parents, siblings, or friends who have access to the medication may begin taking it to help them concentrate, but addiction may soon ensue for these users who are not being properly monitored or receiving a proper dose. There have even been cases of high school and college



Cocaine in its powder form which is usually snorted

students who sell their medication for profit. This can create a great deal of trouble for the patient as well as for the buyers, who may be unaware of the addictive nature of the medications. Therefore, physicians need to be conservative about prescribing these drugs.

Stimulants have been around for thousands of years. Unfortunately, people encounter stimulants so often in their everyday lives that it becomes easy to downplay their importance and their potency. The more society has learned about stimulants, the more their benefits have been realized, but of course the more available they become for beneficial reasons, the more prone they become to abuse. The potential for abuse is just as great as the potential for benefit, and our society must not forget the great power of stimulants just because they are so common.

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