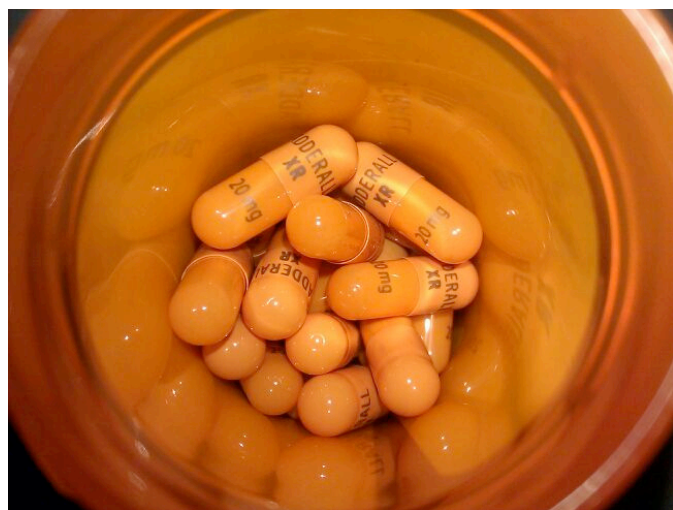




Chapter 14: Essay

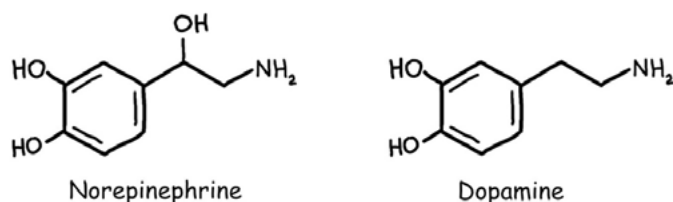
Mind-Enhancing Drugs

It's the night before the exam. If only you had something a bit stronger than coffee to keep you going. Your study-buddy offers you a little strange pill. What is this? What's it do? Is it safe? Should you take it?



A Look Into the Chemistry

Your nervous system operates using chemical messengers known as neurotransmitters. Two important neurotransmitters include norepinephrine and dopamine.



Neurotransmitters

There are receptor sites to which these neurotransmitters bind within the nervous system. Upon binding, they produce a myriad of effects such as improved alertness, memory formation and retention, euphoria, focused attention, as well as

increased heart rate, blood pressure, blood sugar, oxygen to muscles, and movement of your GI tract. All of these are part of your body's fight-or-flight response, whose purpose is to help you survive in the face of a threat.

Stimulants are chemical compounds that mimic the action of these and related fight-or-flight neurotransmitters. They do so because they share such similar structures.



Look carefully and you'll see what they have in common is a nitrogen found two carbons away from a benzene ring (highlighted in methylphenidate). Such a structural feature related to specific pharmacologic activity is called a *pharmacophore*. What all the structures shown above have in common is that they share the same pharmacophore, which allows them to bind to the same receptor site, more or less depending upon their unique other structural features. As such, they all share similar, though not identical, biological activities.

Methamphetamine is notorious as a drug of abuse, also known as crystal meth. The great danger of crystal meth arises from how it is inhaled as fumes into the lungs. This mode of administration results in a concentrated plug of the agent into the brain within seconds. It would be no quicker to inject a dose directly into the brain with a syringe because the lungs are that efficient. This quick and concentrated dose results in a most intense high.



It also leads to severe problems, notably subsequent intense lows, which then push the user to use more. This leads to serious and life-threatening addiction. So, the danger of crystal meth lies much in its dangerous route of administration.

Amphetamine can also be abused. However, because of its greater polarity (stickier molecules) it doesn't form vapors very well when heated. Instead, amphetamine is taken orally as a water-soluble salt. By this mode, the agent is released much more slowly into the body, which is less dangerous than inhalation. Recreational doses of amphetamine can start at 5 mg and build up to more than 60 mg. With regular use, the body adjusts counteracting the effect. The user will soon find they require greater and greater doses for the same effect. Except they also discover the quality of the effect also changes with less of the "lovely" feelings and more feelings of irritation and paranoia. In this way, amphetamine is addictive and destructive. A body adjusted to high levels of amphetamine is a body that feels pretty lousy with amphetamine and very much worse without the amphetamine.

Consistent and carefully monitored low doses of amphetamine, however, have been found to help people with conditions such as attention deficit hyperactivity disorder (ADHD). A typical dose starts at 5 mg as is formulated in the drug known as Adderall. The key is to maintain this minimum dose, which can be difficult. But under this maintenance, the drug helps the person with ADHD to settle down and focus on mental tasks that are otherwise beyond their reach. In short, it helps them to overcome an invisible disability to be on an even footing with their peers.

But Adderall has the same effect on everyone, regardless of whether you have ADHD. This raises some ethical questions. If an ADHD patient can be helped by using Adderall, what about allowing a non-disabled person to be brought up above their own average? Indeed, the mind-enhancing benefits of amphetamine are quite well known, especially in high mental energy industries such as on Wall Street or in Silicon Valley and within competitive colleges and universities. The abuse of amphetamine is a rapidly growing problem.

Because of its addictive properties, Adderall is a schedule 2 drug, which means it is technically only be available by prescription. To control the substance, the U.S. Drug Enforcement Agency (DEA) has the authority to regulate the amount of Adderall produced by the pharmaceutical industry. Much of this rationed Adderall ends up in the black market, which leads to shortages of Adderall for ADHD patients. There is a similar story with methylphenidate (Ritalin), which is also widely used for its mind-enhancing effects.

Consider this: The mind-enhancing powers of Adderall and Ritalin are significant but still modest. They don't make the user "smarter". Rather, they just allow the user to focus better, which can then help the person to learn. This needs to be weighed against their addictive and destructive properties. But what will we do when the pharmaceutical industry comes up with compounds that can in fact make us smarter, and potentially with minimal side effects? Would we start viewing such a compound not as a drug but as a food, as we do coffee? Should this smart drug be regulated at the municipal, state or federal level? These sorts of questions are right



around the corner. Stay tuned. But please remember: One of best mind enhancers doesn't come in the form of a pill. Stronger thinking abilities arise naturally with a healthy diet, exercise, supportive relationships, and a good night's sleep.

CONCEPT CHECK

What structural features do norepinephrine, dopamine, amphetamine, methamphetamine, and methylphenidate have in common?

CHECK YOUR ANSWER All these compounds share a structural feature of a nitrogen atom two carbons distant from a benzene ring. This structural feature appears to be essential for pharmacologic activity and is thus called a "pharmacophore".

Think and Discuss

1. If relatively safe smart pills are ever developed, then should they be sold over-the-counter, like aspirin, or regulated by prescription?
2. If relatively safe smart pills are ever developed, then, like alcoholic beverages, should they be made available only to adults over the age of 21?
3. If relatively safe smart pills are ever developed, then should they be given to the homeless as a subsidy?
4. If relatively safe smart pills are ever developed, then might courts be permitted to sentence smart pills in place of a prison so the guilty can realize what they have done wrong?
5. Why might wisdom pills be much more of a challenge to develop than smart pills?





Author Responses to Think and Discuss

- 1. For safety reasons, new and powerful drugs tend to start off as regulated by prescription-only. If the drug is then found to be "Generally Recognized as Safe" (GRAS) it can then be considered for becoming available as "over-the-counter" (OTC). Even then, the dosages available may be regulated. An example is diphenhydramine, which was once available only by prescription and is now available OTC as a powerful antihistamine.*
- 2. The abuse potential of smart pills might follow a profile similar to alcohol. In such a case, these smart pills might be regulated much like alcohol.*
- 3. There are many causes of homelessness, including mental illness as well as growing income inequality. This social problem is most complex and nothing to be solved with simply a pill. While a qualified medical or social worker might find a smart pill would help for a particular situation, a deeper solution is to boost the number of qualified medical or social workers available to help make these sorts of life-altering decisions.*
- 4. People can be led to commit criminal acts for many reasons, including mental illness as well as growing income inequality. This social problem is most complex and nothing to be solved with simply a pill. While a qualified medical or social worker might find a smart pill would help for a particular situation, a deeper solution is to boost the number of qualified medical or social workers available to help make these sorts of life-altering decisions.*
- 5. A level of smartness tends to arise from the ability of the brain to focus on information and to process that information. That focus and processing power is a function of biochemical activities that can be enhanced by chemical agents. A level of wisdom, by contrast, tends to arise from life experiences that help us to understand basic goodness and our interconnectedness. Learning information and knowing how to act wisely with that information are not the same thing. As of this writing, life experiences are earned, not swallowed.*

