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## Ask a Scientist: Does nicotine affect dreaming?

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Courtesy of The University of Tennessee, Knoxville.

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Throughout human history, dreams have been one of our most captivating mysteries. We've been fascinated by our experiences in dreams: we can run unbelievably fast or fly; we can find monsters, or idols, or objects with functions that seem impossible in the real world. The events of our dreams seem absurd upon awakening, but our dream selves almost never seem to sense the insanity. Dreams have been a source of inspiration, wisdom and reflection for centuries.

The question of nicotine's effects on dreaming taps into this mystery. In order to know how nicotine can affect dreams, we first need to understand what a dream actually *is*. The most basic understanding of dreams is simple, but may contradict your current understanding of sleep. Many people consider sleep to be a time of complete inactivity, but this is not true! While you're sleeping, your brain is actually very active. It's doing a lot of important things, like sorting through the events of the day, deciding what's important to remember and clearing away everything else. Ultimately, this activity is why you dream during sleep and why sleep is so important. Imagine your brain is a computer: Sleep serves as its anti-virus, malware detection, and disk cleanup services. Have you ever had a computer that you didn't use any of those services? Eventually, it gets really, really slow - and basically useless. The same thing happens to your brain if you don't sleep!

So, activity in the brain during sleep is producing your dreams – but how? Most dreams occur during Rapid Eye Movement (REM) sleep, when the more primitive part of your brain, called the brainstem, is in trying to strengthen all the important connections in your brain. This process produces a lot of intense brain activity. But why does the brain take all of this activity and put on such a crazy show in our minds? One theory is that the parts of your brain responsible for processing and interpreting information are just trying to make sense of all the random activity being produced by the brainstem. This is why dreams seem so nonsensical – there isn't any real order or logic in that brainstem activity. It's actually amazing that your brain is capable of turning such random activity into such eloquent stories!

However, dreams don't only occur during REM sleep. They occur during non-REM sleep too, and your brainstem *isn't* very active during non-REM sleep, so it can't just be brainstem activity that causes dreams. Studies on people that report a complete absence of dreams have shown that they have damage to some parts of the brain known to be involved in motivation. This implies that dreams are actually caused by activity in the motivational centers of the brain during sleep. Think about it – have you ever had a goalless dream? The things we do in our dreams always seem *very* important. So, your crazy REM sleep dreams are produced by the intense, random activity from the brainstem going to motivational areas of the brain. The amount of activity during non-REM sleep is relatively miniscule, which is why we tend to think dreams only occur in REM, but we *do* have some dreams during non-REM as well.

So how are your motivational centers producing dreams? The motivational centers of your brain send information to a lot of other areas, allowing us to work towards our goals and even altering our perception to better fit our needs. Think about mirages of water in the desert. Everyone knows they're illusions, but when you're that thirsty, your motivation for water is so high that you perceive

the water to be real. It's the impact of our motivational centers on our perceptual systems that produce dreams. While you're awake, this impact is relatively small compared to the host of sensory information you're receiving. During sleep, however, your sensory information is severely limited, so the input from your motivational centers has nothing to compete with. You wind up "perceiving" the random activity of your motivational centers.

Now, back to your question, how can nicotine change these processes? One way is that nicotine mimics acetylcholine, which is the brain chemical that helps drive REM sleep. However, this chemical is also important for arousal and wakefulness, so nicotine has dual effects on dreaming. Conceptually, you can think of nicotine as "condensing" REM sleep. It increases the activity produced during REM sleep, which is ultimately going to intensify your dreams. This increased activity, however, also wakens you faster than normal – so your REM sleep episodes are shorter and you spend a lot more time awake. This means that not only will your dreams be more intense, you'll probably remember your dreams better too! Additionally, since we know dreams are caused by brain activity, anything that affects that activity of your brain (including nicotine) is going to affect your dreams, too. In this sense, dreams really do reveal a lot about your current state of mind!

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