

Dopamine: Duality of Desire

Being an ex-drug-addict turned neuroscientist brings a unique insight into the physiological and phenomenological realities of addiction.

May 1, 2012

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PUBLICAFFAIRS, MARCH 2012 (US EDITION)

For 10 years I spun in and out of an addiction to opiates (and other drugs) that led to despair, crime, and the loss of everything I valued most—including my place in graduate school. After many failed attempts, I finally quit taking addictive drugs 30 years ago. I reentered grad school, got my PhD in developmental psychology, and became a professor at the University of Toronto, focusing on emotional and personality development. I studied these topics for 13 years, but I never quite understood my own personality development. I came to believe that my theories needed help from neuroscience, and that's why I switched to research on the emotional brain—my focus for the past decade.

I also explored the neurological mysteries of addiction through the prism of my own experience in my book, *Memoirs of an Addicted Brain*, recently released in the U.S. In the book I weave together a personal account of my years of addiction with descriptions of brain states induced by drugs ranging from alcohol and LSD to heroin, as well as brain states underlying addiction itself.

Why are addicts so desperate? Why is it so hard to stop? Neuroscientists seek the answer in a single molecule: dopamine—a neuromodulator long associated with reward. Dopamine focuses attention on goals, powers motor sequences designed to achieve them, and injects them with emotional urgency. A lot of this occurs in the ventral striatum, a subcortical structure densely connected to the prefrontal cortex, the cingulate cortex, and the amygdala. Yet there remains a fundamental controversy about the role of dopamine in the striatum. Is dopamine the basis of reward? Or is dopamine responsible for a desperate longing that doesn't feel good at all?

Many neuroscientists think of the striatal dopamine circuit as a pleasure center. That could explain why addicts have a dopamine spike around the time they get high on drugs. It could also explain the action of drugs like methamphetamine and cocaine, which release and maintain high levels of dopamine and are perceived as profoundly pleasurable.

But a new approach to dopamine has surfaced, partly through the neuroscience of addiction. University of Michigan neuroscientist Kent Berridge and his colleagues view striatal circuitry as the locus of two separate functions: liking and wanting. Their research demonstrates that liking—pleasure—is mediated by opioids. But wanting is mediated by dopamine. The feeling of desire, or wanting, evolved to get us to pursue the things that make us feel good. But the pursuit itself isn't fun.

According to Berridge, dopamine levels peak when goals are just out of reach and drop once they've been attained. For addicts, dopamine increases sensitivity to drug-related cues and generates a state of pursuit. This reconceptualization could explain the findings of neuroscientist Robert Risinger and colleagues who showed that dopamine peaked in the striatum just before, not after, addicts pressed a button that delivered cocaine (*NeuroImage*, 26: 1097-1108, 2005). And those same addicts reported "craving"—not "high"—as the experiential correlate of dopamine.

So why do meth and coke feel so good and not just like souped-up craving? Attraction to something you don't have access to isn't fun. When I was in the throes of intense psychological addiction, my thoughts were continuously (and unpleasantly) drawn to drug imagery. *It would be so great to have*

some now! How can I get some tonight?! But attraction to something you are just about to get feels marvelous. Dopamine-induced engagement turns into a headlong rush of triumph when the goal is finally accessible.

This perspective on the dual nature of attraction helps make sense of addiction. Unsated attraction can be a kind of torture, and addicts may seek drugs to put an end to that torture, more than for the modicum of pleasure drugs actually bestow.

Advances in neuroscience encourage fresh insights, not only into addiction, but into the wider domains of emotion and personality development. Yet a synthesis between neuroscience and subjectivity can perhaps teach us more than either one alone.

Marc Lewis spends half his time as a professor at Radboud University Nijmegen, in the Netherlands, and the other half writing books and blog posts linking addiction and neuroscience for the lay reader. [Read an excerpt](#) of *Memoirs of an Addicted Brain*.

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