Box 16.4 PATH OF DISCOVERY

Just Rewards

by Kent C. Berridge

The idea that there are separate brain systems for "liking" and "wanting" the same pleasant reward came from a set of failed experiments. Sometimes when an experiment fails to give you an expected answer, it can mean you were asking the wrong question. In my case with Terry Robinson and other colleagues at the University of Michigan, we were asking whether reward was mediated by the neurotransmitter dopamine. That turned out to be too simple a question, as it can be answered either yes or no depending on what reward means.

Pleasure or hedonic impact is what most people mean by reward, and for many neuroscientists who had asked the dopamine reward question before us, the answer generally seemed to be yes. But most previous behavioral neuroscience studies had inferred that DA manipulations changed how much a reward was "liked" (hedonic impact) by changes in how much the reward was "wanted" (preferred, pursued, worked for, or consumed). Our approach was a bit different in that we tried to assess dopamine-caused changes in hedonic impact more specifically by measuring facial "liking" reactions to sweet taste reward. This ethological window into taste pleasure can detect "liking" shifts in rats produced by hunger/satiety, learned preference/aversion, and many brain manipulations. Using our "liking" reaction technique, we were surprised to find in our first experiments that blocking DA systems caused no change in the hedonic impact of a tasty reward (Figure A).

At first, we thought we had done something wrong, as most neuroscientists, after all, were pretty sure that mesolimbic dopamine was the brain's chief pleasure neurotransmitter. So we followed up with stronger manipulations—dopamine brain lesions, electrical stimulation, direct brain microinjections, and others. But always we found that "liking" for sweetness remained unchanged. Because we could successfully change "liking" by manipulating other brain limbic systems, the failure of DA to alter hedonic impact of sensory pleasure stood in stark contrast.

Our surprising "failure" meant one of two things. Either the universe was cruelly telling us we didn't have a clue, or it might be telling us something important—that is, if we could solve the paradox of why the DA reward question had both yes and no answers. We came up with the *incentive salience hypothesis* for dopamine's role in "wanting" reward as a way to reconcile why brain DA sometimes appears to mediate sensory pleasure when it actually does not. Incentive salience "wanting" is purely the incentive motivational value of a stimulus, not its hedonic impact or actual sensory pleasure.

In human life beyond the lab, Terry Robinson and I think the dissociation between "wanting" and "liking" brain systems may help explain what happens in some drug addicts to make their addiction compulsive. Fortunately for most people, both "liking" and "wanting" usually happen together for rewards in life. But some addicts may have sensitized brains, which involves persistent neural changes caused by addictive drugs in dopamine-related mesocorticolimbic systems. Brain sensitization is nearly the opposite of brain tolerance to drugs—both can happen simultaneously in the same brain, but sensitization lasts longer. The result of sensitization may be a bit like too much dopamine: excessive "wanting," even if the drug isn't particularly "liked," and even if withdrawal symptoms are long gone.

Looking back to my own neuroscience beginnings as an undergraduate student, I was fascinated by the idea that mind and behavior could be emergent products of a brain. Links between mind and brain are intricate, subtle, and often surprising. For many people who do neuroscience research, the excitement stays even over decades. If you have a taste for scientific research in neuroscience and psychology, being a part of it can be deeply fun and satisfying. And for everyone else, too, neuroscience can offer a few fascinating insights into the machinery of mind and brain that may help us understand ourselves and others a bit better.

FIGURE A
Reactions to taste "liking." (Courtesy of Kent C. Berridge.)