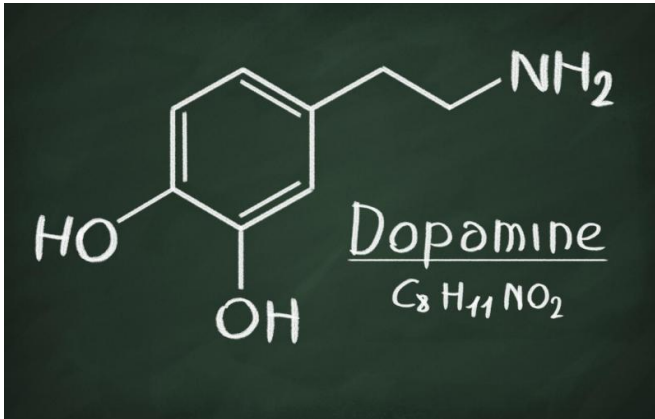


New theory integrates dopamine's role in learning, motivation

24 November 2015, by Jared Wadley



If you've ever felt lackadaisical to start a new project, focus on imagining the joy of completing it, say University of Michigan researchers.

Both are a function of dopamine, which explains the motivation to start and the satisfaction of finishing work, they say.

In a new study, U-M researchers Arif Hamid and Joshua Berke, professor of psychology and biomedical engineering, argue that [dopamine levels](#) continuously signal how good or valuable the current situation is regarding obtaining a reward. This message helps people decide how vigorously to work toward a goal, while also allowing themselves to learn from mistakes.

"We provide a new theoretical account for how dopamine affects learning (what to do later) and motivation (getting fired up to go now) simultaneously," said study lead author Hamid, U-M neuroscience doctoral student.

For many years, researchers have known that dopamine is important for arousal, movement,

mood and executing activities with haste and vigor. Aspects of these normal dopamine functions are highlighted in disorders, such as Parkinson's disease and depression. Drugs that elevate brain dopamine levels, like cocaine or amphetamines, produce euphoric feelings of well-being, in addition to heightened arousal and attention.

Aside from affecting immediate mood and behavior, dopamine also produces changes in the brain that are persistent, sometimes lasting a lifetime.

"This is basically how we stamp in memories of what the smell of cookies or the McDonald's sign mean: predictors of delicious, calorie rich rewards," Hamid said.

Abrupt dopamine increases when a person perceives stimuli that predict rewards is a dominant mechanism of reward learning within the brain—a concept similar to Russian physiologist Ivan Pavlov's dog hearing the bell and salivating at a response to stimuli, he said.

Hamid said the precise mechanism of how a neurotransmitter can achieve both invigorating and learning functions is counterintuitive, and many decades of neuropsychological research has attempted to resolve exactly how.

One theory, spearheaded by U-M psychologists Kent Berridge and Terry Robinson, suggests that dopamine invigorates actions toward desired goals. For example, rats with almost no brain dopamine will not retrieve food a few inches away while they're starving.

Another theory suggests dopamine is a "teaching signal," like a coach who tells his player "good job" or "bad job" to encourage a future reward. In the current study, U-M researchers describe those dopamine fluctuations as a continuous cheer to motivate, with brief moments of criticism.

They measured dopamine levels in rats while they performed a decision-making task, and compared it with how motivated the rats were and how much they learned. They also increased [dopamine](#) levels to artificially motivate the rats and repeatedly made them learn to perform actions that did not produce rewards.

The findings appear in the current issue of *Nature Neuroscience*.

More information: Arif A Hamid et al. Mesolimbic dopamine signals the value of work, *Nature Neuroscience* (2015). [DOI: 10.1038/nn.4173](https://doi.org/10.1038/nn.4173)

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