

Your attention please: 'Rewarding' objects can't be ignored

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Steven Yantis is a professor and chair of psychological and brain sciences at The Johns Hopkins University. Credit: Will Kirk/JHU

The world is a dazzling array of people, objects, sounds, smells and events: far too much for us to fully experience at any moment. So our attention may automatically be snagged by something startling, such as a slamming door, or we may deliberately focus on something that is important to us right then, such as locating our child among the happily screaming hordes on the school playground. We also know that people are hard-wired to seek out and pay attention to things that are rewarding, such as food when we are hungry, or water when we are thirsty.

So what happens when the things that signify a "reward" are actually not important at all? Are they still powerful enough to capture our attention, when so many other things are competing for it?

According a team of [neuroscientists](#) at Johns Hopkins, the answer is "yes," especially when those things previously have been associated with something rewarding, such as money. In a paper published this week in the [Proceedings of the National Academy of Sciences](#), a team led by Steven Yantis found that test subjects who were completing a [visual search](#) task were distracted when items that had previously been associated with small amounts of money occasionally appeared.

The results have implications for understanding how the brain responds to rewarding [stimuli](#), which may contribute to the development of more effective treatments for drug addiction, obesity and [ADHD](#), said Yantis, professor and chair of psychological and [brain sciences](#) in the Krieger School of Arts and Sciences.

"We know that not everyone who takes drugs becomes addicted to them, but we also recognize that there is some connection between the [euphoria](#) that the drugs cause and how that [sensation](#) 'rewires' the brain in ways that make it difficult to suppress the craving to experience that again," he explains. "One aspect of this scenario is how reward-related objects capture attention automatically in the way that a sign advertising happy hour at a bar might snag the attention of a recovering alcoholic driving by. Understanding the psychological and brain mechanisms of that reward-object pairing and why some people are more susceptible to it than others could lead to more effective treatments."

In the study, people first searched for red or green circles in an array of many differently colored circles displayed on a computer screen. One color (for instance, red) was always followed by a monetary reward (10 cents) and the other (perhaps green) by a smaller reward (1 cent). After doing this for more than an hour, the study subjects then were asked to search for particular shapes (for instance, a circle among diamonds) and color was no longer relevant or rewarded. Still, occasionally, one of the items in the display was red or green. When that happened, the study

subjects' responses slowed down.

According to Yantis, this proved that an overwhelming number of people in the study became distracted by the red or green objects, even though the study subjects had been instructed to ignore those items and the items were inconspicuous and had no relevance to the task at hand.

"It was clear to us that those red or green items had become valuable to the study subjects, because they were linked in their minds with a reward," Yantis said.

In addition, the study subjects also completed a questionnaire measuring impulsivity. The team found that people who were more impulsive to begin with were even more prone to distraction by the "high value" red or green objects.

"One measure of good cognitive control is how long a person can hold information in his or her short-term memory, and we found that those people who were less impulsive tended to be more resistant to distraction by those things that had no value in and of themselves but had become associated with a reward," Yantis explained. "We also found that the distraction caused by value-related features persists for weeks after the original learning."

The team is now investigating how value is learned, and how learned value can seize the brain's attention circuits, Yantis said.

"We think that this form of attentional capture may play a role in various clinical syndromes like [drug addiction](#)," he said.

More information: Value-driven attentional capture, *PNAS*, Published online before print June 6, 2011, [doi: 10.1073/pnas.1104047108](https://doi.org/10.1073/pnas.1104047108)

Abstract

Attention selects which aspects of sensory input are brought to awareness. To promote survival and well-being, attention prioritizes stimuli both voluntarily, according to context-specific goals (e.g., searching for car keys), and involuntarily, through attentional capture driven by physical salience (e.g., looking toward a sudden noise). Valuable stimuli strongly modulate voluntary attention allocation, but there is little evidence that high-value but contextually irrelevant stimuli capture attention as a consequence of reward learning. Here we show that visual search for a salient target is slowed by the presence of an inconspicuous, task-irrelevant item that was previously associated with monetary reward during a brief training session. Thus, arbitrary and otherwise neutral stimuli imbued with value via associative learning capture attention powerfully and persistently during extinction, independently of goals and salience. Vulnerability to such value-driven attentional capture covaries across individuals with working memory capacity and trait impulsivity. This unique form of attentional capture may provide a useful model for investigating failures of cognitive control in clinical syndromes in which value assigned to stimuli conflicts with behavioral goals (e.g., addiction, obesity).

Provided by Johns Hopkins University

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