Fast eye movements: A possible indicator of more impulsive decision-making

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Despite claims to the contrary, the eyes of the Mona Lisa do not make saccades. Credit: Leonardo da Vinci

Using a simple study of eye movements, Johns Hopkins scientists report evidence that people who are less patient tend to move their eyes with greater speed. The findings, the researchers say, suggest that the weight people give to the passage of time may be a trait consistently used throughout their brains, affecting the speed with which they make movements, as well as the way they make certain decisions.

In a summary of the research to be published Jan. 21 in *The Journal of Neuroscience*, the investigators note that a better understanding of how the human brain evaluates time when making decisions might also shed light on why malfunctions in certain areas of the brain make decision-making harder for those with neurological disorders like schizophrenia,

or for those who have experienced brain injuries.

Principal investigator Reza Shadmehr, Ph.D., professor of biomedical engineering and neuroscience at The Johns Hopkins University, and his team set out to understand why some people are willing to wait and others aren't. "When I go to the pharmacy and see a long line, how do I decide how long I'm willing to stand there?" he asks. "Are those who walk away and never enter the line also the ones who tend to talk fast and walk fast, perhaps because of the way they value time in relation to rewards?"

To address the question, the Shadmehr team used very simple eye movements, known as saccades, to stand in for other bodily movements. Saccades are the motions that our eyes make as we focus on one thing and then another. "They are probably the fastest movements of the body," says Shadmehr. "They occur in just milliseconds." Human saccades are fastest when we are teenagers and slow down as we age, he adds.

In earlier work, using a mathematical theory, Shadmehr and colleagues had shown that, in principle, the speed at which people move could be a reflection of the way the brain calculates the passage of time to reduce the value of a reward. In the current study, the team wanted to test the idea that differences in how subjects moved were a reflection of differences in how they evaluated time and reward.

For the study, the team first asked healthy volunteers to look at a screen upon which dots would appear one at a time ¬— first on one side of the screen, then on the other, then back again. A camera recorded their saccades as they looked from one dot to the other. The researchers found a lot of variability in saccade speed among individuals but very little variation within individuals, even when tested at different times and on different days. Shadmehr and his team concluded that saccade speed

appears to be an attribute that varies from person to person. "Some people simply make fast saccades," he says.

To determine whether saccade speed correlated with decision-making and impulsivity, the volunteers were told to watch the screen again. This time, they were given visual commands to look to the right or to the left. When they responded incorrectly, a buzzer sounded.

After becoming accustomed to that part of the test, they were forewarned that during the following round of testing, if they followed the command right away, they would be wrong 25 percent of the time. In those instances, after an undetermined amount of time, the first command would be replaced by a second command to look in the opposite direction.

To pinpoint exactly how long each volunteer was willing to wait to improve his or her accuracy on that phase of the test, the researchers modified the length of time between the two commands based on a volunteer's previous decision. For example, if a volunteer chose to wait until the second command, the researchers increased the time they had to wait each consecutive time until they determined the maximum time the volunteer was willing to wait—only 1.5 seconds for the most patient volunteer. If a volunteer chose to act immediately, the researchers decreased the wait time to find the minimum time the volunteer was willing to wait to improve his or her accuracy.

When the speed of the volunteers' saccades was compared to their impulsivity during the patience test, there was a strong correlation. "It seems that people who make quick movements, at least eye movements, tend to be less willing to wait," says Shadmehr. "Our hypothesis is that there may be a fundamental link between the way the nervous system evaluates time and reward in controlling movements and in making decisions. After all, the decision to move is motivated by a desire to

improve one's situation, which is a strong motivating factor in more complex decision-making, too."

More information: dx.doi.org/10.1523/jneurosci.2798-13.2013