Medical Xpress

Promise of a bonus counter-productive in brains with high dopamine levels

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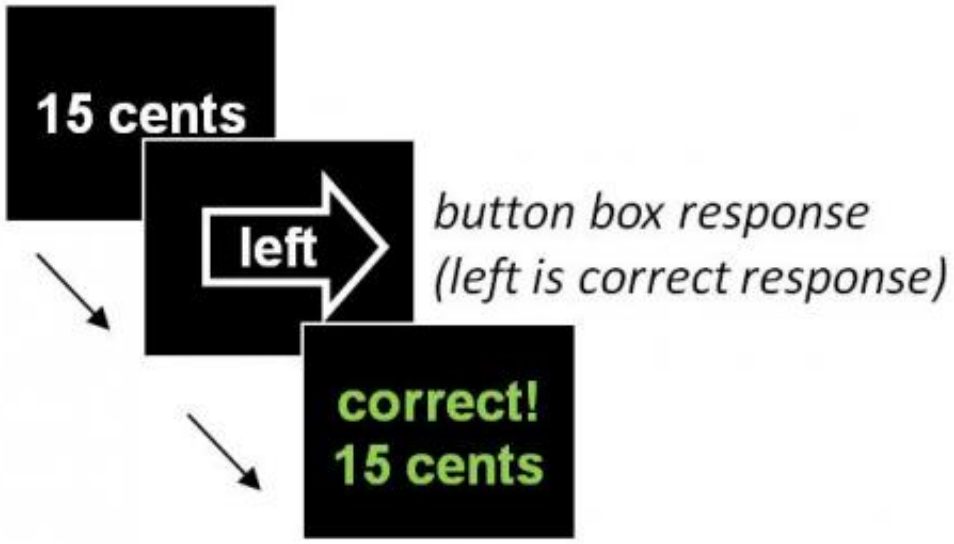

Figure 1: Example of the computer task. The first screen shows the promised bonus (in this case, 15 cents). The second screen shows the task, and the third screen displays the feedback on the test subject's response of the subject. In this case, the subject provided the correct answer (left) and received a bonus of 15 cents.

Some people perform better and others worse when promised a high

bonus. Brain researcher Esther Aarts of the Donders Institute in Nijmegen has demonstrated for the first time that the amount of dopamine in the brain plays a role in this regard. The journal *Psychological Science* will publish the results on February 13.

It has been known for some time that not everyone performs better after being promised a bonus. Scientists have published contradictory results regarding the cause. The study by Esther Aarts now shows that the differences can be explained by differences in the level of dopamine in the brain. People with a high level of dopamine in a specific brain region – the striatum – perform worse after a being promised a bonus, and people with a low level of dopamine in the same area perform better. Aarts used a PET (Positron Emission Tomography) scanner to examine the amount of dopamine in the brains of subjects. She conducted this research in Berkeley, California (USA), where she worked as a post-doctoral researcher for two years.

Overdose of dopamine

The promise of a bonus provides an additional spurt of the 'motivation substance' dopamine in the brain. 'For people who usually have high levels of dopamine, the promise of a bonus causes a type of dopamine overdose in the striatum', explains Aarts. 'Our test subjects were asked to perform a task that required considerable concentration. An overdose of dopamine makes this difficult. People who usually have less dopamine are less likely to have an overdose of dopamine, and they therefore perform better after being promised a bonus.'

Concentration desired

Test subjects performed a computer task that elicited conflicting reactions, therefore requiring considerable concentration: an arrow

appears on the screen, pointing either left or right. The word 'left' or 'right' is written in the middle of the arrow. Subjects were asked to ignore the direction indicated by the arrow and mention only the direction described by the word. For half of the attempts, a bonus of 15 cents was promised for a correct answer. In the other half, the subjects received only 1 cent for each correct answer. People who usually have a high level of dopamine performed better in the low-pay condition than they did in the high-pay condition. The reverse was observed for people with low levels of dopamine: they performed better with high rewards than they did with low rewards.

Flexibility or focus

'This knowledge could make it possible to apply bonuses more effectively, but it would require observing the standard dopamine levels of people, as well as the nature of the task that they must perform', reports Aarts. 'It makes quite a difference whether the task is flexible and creative or whether it requires a great deal of focus. Our research shows how people perform on tasks that require considerable focus'. Given the high cost of PET scans, Aarts is now looking for easier ways of measuring dopamine levels. 'I hope to be able to relate dopamine levels to scores on questionnaires. In the future, this might eliminate the need for PET scans for determining the quantity of dopamine in the brain'.

More information: Esther Aarts, Deanna L. Wallace, Linh C. Dang, William J. Jagust, Roshan Cools, and Mark D'Esposito. "Dopamine and the Cognitive Downside of a Promised Bonus." *Psychological Science* 0956797613517240, first published on February 13, 2014 DOI: 10.1177/0956797613517240