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Why do people choke when the stakes are high?

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A new study by researchers at the California Institute of Technology suggests that when there are high financial incentives to succeed, people can become so afraid of losing their potentially lucrative reward that their performance suffers. The researchers also found that the more someone is afraid of loss, the worse they perform. Credit: Lance Hayashida/Caltech

In sports, on a game show, or just on the job, what causes people to choke when the stakes are high? A new study by researchers at the California Institute of Technology (Caltech) suggests that when there are high financial incentives to succeed, people can become so afraid of losing their potentially lucrative reward that their performance suffers.

It is a somewhat unexpected conclusion. After all, you would think that the more people are paid, the harder they will work, and the better they will do their jobs—until they reach the limits of their skills. That notion tends to hold true when the stakes are low, says Vikram Chib, a

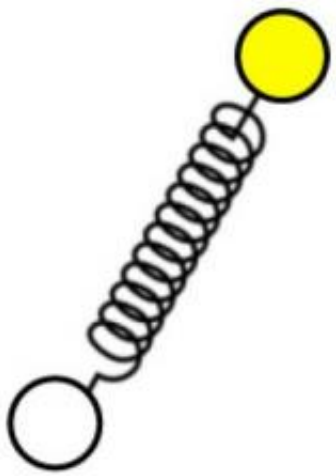
postdoctoral scholar at Caltech and lead author on a paper published in the May 10 issue of the journal *Neuron*. Previous research, however, has shown that if you pay people too much, their performance actually declines.

Some experts have attributed this decline to too much motivation: they think that, faced with the prospect of earning an extra chunk of cash, you might get so excited that you will fail to do the task properly. But now, after looking at brain-scan data of volunteers performing a specific motor task, the Caltech team says that what actually happens is that you become worried about losing your potential prize. The researchers also found that the more someone is afraid of loss, the worse they perform.

In the study, each participant was asked to control a virtual object on a screen by moving an index finger that had a tracking device attached to it. The virtual object consisted of two weighted balls connected by a spring. The task was to place the object, which stretched and contracted as a weighted spring would in real life, into a square target within two seconds.

The researchers controlled for individual skill levels by customizing the size of the target so that everyone would have the same success rate. That way, people who happened to be really good or bad at this task would not skew the data.

After a training period, the subjects were asked to perform the task while inside an fMRI machine, which measures blood flow in the brain—a proxy for brain activity, since wherever a brain is active, it needs extra oxygen, and thus a larger volume of blood. By monitoring blood flow, the researchers can pinpoint areas of the brain that turn on when a particular task is performed.



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The task began with the researchers offering the participants a randomized range of rewards—from $0 to $100—if they could successfully place the object into the square within the time limit. At the end of hundreds of trials—each with varying reward amounts—the participant was given their reward, based on the result of just one of the trials, picked at random.

As expected, the team found that performance improved as the incentives increased—but only when the cash reward amounts were at the low end of the spectrum. Once the rewards passed a certain threshold, which depended on the individual, performance began to fall off.

Incentives are known to activate a part of your brain called the ventral

striatum, Chib says; the researchers thus expected to see the ventral striatum become increasingly active as they bumped up the prizes. And if the conventional thought were correct—that the reason for the observed performance decline was over-motivation—they would expect the striatum to continue showing a lot of activation when the incentives became high enough for performance to suffer.

What they found, instead, was that when the participants were shown their potential rewards, activity in the striatum did indeed increase with rising incentives. But once the volunteers started doing the task, striatal activity decreased with rising incentives. They also noticed that the less activity they saw in a participant's striatum, the worse that person performed on the task.

Other studies have shown that decreasing striatal activity is related to fear or aversion to loss, Chib says. "When people see the incentive that they're being offered, they initially encode it as a gain," he explains. "But when they're actually doing the task, the thing that causes them to perform poorly is that they worry about losing a potential incentive they haven't even received yet." He adds, "We're showing loss aversion even though there are no explicit losses anywhere in the task—that's very strange and something you really wouldn't expect."

To further test their hypothesis, Chib and his colleagues decided to measure how loss-averse each participant was. They had the participants play a coin-flip game in which there was an equal chance they could win or lose varying amounts of money.

Each participant was offered varying potential win-loss amounts ($20-$20, $20-$10, $20-$5, for example), and then given the opportunity to either accept each possible gamble or decline it. The win-loss ratio at which the subjects chose to take the gamble provided a measure of how loss-averse each person was; someone willing to gamble

even when they might win or lose $20 is less loss-averse than someone who is only willing to gamble if they can win $20 but only lose $5.

Once the numbers had been crunched and compared to the original experiment, it turned out that the more averse a participant was, the worse they did on the task when the stakes were high. And for a particularly loss-aversive person, the threshold at which their performance started to decline did not have to be very high. "If you're more loss-averse, it really hurts you," Chib says. "You're going to reach peak performance at a lower incentive level, and your performance is also going to be worse for higher incentives."

"Previously, it's been shown that the ventral striatum is involved in mediating performance increases in response to rising incentives," says John O'Doherty, professor of psychology and coauthor of the paper. "But our study shows that changes in activity in this same region can, under certain situations, also lead to worsening performance."

While this study only involved a specific motor task and financial incentives, these results may well be universal, says Shinsuke Shimojo, the Gertrude Baltimore Professor of Experimental Psychology and another coauthor of the study. "The implications and applications can include any sort of decision making that contains high stakes and uncertainties, such as business and politics."

These findings, the researchers say, might be used to develop new ways to motivate people to perform better or to train them to be less loss-averse. "This loss aversion can be an important way of deciding how to set up incentive mechanisms and how to figure out who's going to perform well and who isn't," Chib says. "If you can train somebody to be less loss-averse, maybe you can help them avoid performing poorly in stressful situations."

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