

New insight into why haste makes waste

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Why do our brains make more mistakes when we act quickly? A new study demonstrates how the brain follows Ben Franklin's famous dictum, "Take time for all things: great haste makes great waste."

The research – conducted by Research Assistant Professor Richard Heitz and Jeffrey Schall, Ingram Professor of Neuroscience, at Vanderbilt University – has found that the [brain](#) actually switches into a special mode when pushed to make rapid decisions.

The study was published Nov. 7 in the journal *Neuron*.

"This is a question that is very basic to our experience as human beings, and something that we encounter on a daily basis," Heitz, who designed and carried out the study, said. "If we can understand how our [brain changes](#) when we are pushed to respond faster, we have gone a long way toward understanding the decision-making process in general."

The tradeoff between speed and accuracy is a universal aspect of decision making that has been studied extensively in humans. Numerous behavioral and [brain-mapping](#) studies have supported a simple model: The brain uses the same basic method to make both deliberate and rapid decisions. In order to shorten the decision-making time, the brain simply reduces the cumulative amount of [neuronal activity](#) it requires before making a decision. Because the brain must make snap decisions based on less information than it uses for slower decisions, the likelihood that it will make mistakes increases.

However, none of the previous experiments were capable of studying the decision-making process at the level of individual [brain cells](#) called [neurons](#). Although it is easy to set up tests with human subjects that prompt them to switch between speedy and accurate decision making, the methods for measuring human brain activity do not have the required speed or resolution. On the other hand, it is possible to measure the activity of individual neurons in monkeys, but no one knew how to train them to vary the speed of their decision making.

The scientists developed a method for teaching monkeys to switch back and forth between fast and accurate decision making in a task that involved picking out a target from an array of objects presented on a computer screen. In one experimental condition, monkeys learned that only accurate responses would be rewarded. In another condition, they learned that making some mistakes was okay, as long as the decisions were fast. Meanwhile, the researchers monitored signals from single neurons in their prefrontal cortex – the area in the brain dedicated to higher cognition.

"Our tests are like two different game shows. One – call it Fast Fury – is like Jeopardy. In order to answer a question you must be the first to hit the buzzer. Buzzing in and answering incorrectly is bad, but being slower than the other contestant means you will never earn a reward," Heitz said. "That is much different than the second game show – call it High Stakes Showdown – where buzzing in at any time gives you the opportunity to answer a question, but being wrong results in a serious penalty.

"The first thing you see is that neural activity of the player of Fast Fury jumps up even before the question is read," Heitz said. "The subjective experience of getting ready that we all experience appears to be reflected in the background activity of neurons in prefrontal cortex." In comparison, the neural activity drops to extremely low levels during

High Stakes Showdown while the player waits to hit the buzzer.

This picture differs substantially with the standing theory that the brain uses the same process for all types of decisions. "Our second observation, in particular, was really startling," Schall said. "It really flies in the face of what we thought we knew about decision-making."

Returning to the game show example, consider what happens when contestants in Fast Fury and High Stakes Showdown are given identical questions. The activity of the prefrontal cortex neurons increases while observers decide how to respond. But the new data suggests that this activity is amplified during Fast Fury and suppressed during High Stakes Showdown.

"What this means is that identical information presented to the brain is analyzed differently under speed stress than under accuracy stress," Schall said.

These unexpected results are controversial and important because they are at odds with currently accepted mathematical models of [decision making](#), which are being used to understand psychiatric and neurological disorders. For example, people with certain types of brain damage seem to get stuck in a hasty, impulsive mode of deciding, and the models provide some indication for how this might happen mechanically in the brain. Heitz and Schall have shown how these mathematical models can be modified to make them consistent with the new results.

So, does haste inevitably make waste? According to Schall, it all depends. "Haste makes waste when a mistake entails dire consequences. But there are many situations in life when the cost of not acting is higher than making an error in judgment. For example, if the decision is whether or not to shut down a nuclear reactor in the presence of a potential meltdown, I'd prefer haste."

Provided by Vanderbilt University

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