

Brain imaging, behavior research reveals physicians learn more by paying attention to failure

November 23 2011

When seeking a physician, you should look for one with experience. Right? Maybe not. Research on physicians' decision-making processes has revealed that those who pay attention to failures as well as successes become more adept at selecting the correct treatment.

"We found that all the physicians in the study included irrelevant criteria in their decisions," said Read Montague, Ph.D., director of the Human Neuroimaging Laboratory at the Virginia Tech Carilion Research Institute, who led the study. "Notably, however, the most experienced doctors were the poorest learners."

The research is published in the Nov. 23 issue of [PLoS One](#), the Public Library of Science open-access journal, in the article, "[Neural correlates of effective learning in experienced medical decision-makers](#)," by Jonathan Downar, M.D., Ph.D., assistant professor of psychiatry at the University of Toronto and Toronto Western Hospital; Meghana Bhatt, Ph.D., assistant research professor at Beckman Research Institute, the City of Hope Hospital, Duarte, Calif.; and Montague, who is also a professor of physics in the College of Science at Virginia Tech.

The researchers used functional [magnetic resonance imaging](#) (fMRI) to look at the [brain activity](#) of 35 experienced physicians in a range of non-surgical specialties as they made decisions.

The doctors were instructed to select between two treatments for a series of simulated patients in an emergency room setting. "First they had a chance to learn by experience which of two medications worked better in a series of 64 simulated heart-attack patients, based on a simplified history with just six factors," said Bhatt.

Unknown to the test subjects, of the six factors, only one was actually relevant to the decision: diabetes status. One medication had a 75 percent success rate in patients with diabetes, but only a 25 percent success rate in patients without diabetes. The other had the opposite profile. The physicians had 10 seconds to select a treatment. Then they were briefly presented with an outcome of "SUCCESS: (heart attack) aborted" or "FAILURE: No response."

"After the training, we tested the physicians to see how often they were able to pick the better drug in a second series of 64 simulated patients," said Bhatt. "When we looked at their performance, the doctors separated into two distinct groups. One group learned very effectively from experience, and chose the better drug more than 75 percent of the time. The other group was terrible; they chose the better drug only at coin-flipping levels of accuracy, or half the time, and they also came up with inaccurate systems for deciding how to prescribe the medications, based on factors that didn't matter at all."

In fact, all the doctors reported including at least one of the five irrelevant factors, such as age or previous heart attack, in their decision process.

"The brain imaging showed us a clear difference in the mental processes of the two groups," said Montague. "The high performers activated their frontal lobes when things didn't go as expected and the treatments failed." Such activity showed that the doctors learned from their failures, he said. These physicians gradually improved their performance.

In contrast, the low performers activated their frontal lobes when things did go as expected, said Bhatt. "In other words, they succumbed to 'confirmation bias,' ignoring failures and learning only from the successful cases. Each success confirmed what the low performers falsely thought they already knew about which treatment was better." The researchers termed this counterproductive learning pattern "success-chasing."

"The problem with remembering successes and ignoring failures is that it doesn't leave us any way to abandon our faulty ideas. Instead, the ideas gain strength from each chance success, until they evolve into something like a superstition," said Downar.

The fMRI showed that a portion of the brain called the nucleus accumbens "showed significant anticipatory activation well before the outcome of the trial was revealed, and this anticipatory activation was significantly greater prior to successful outcomes," Montague said. "Based on the outcome of the training phase, we were actually able to predict results in the testing phase for each low-performing subject's final set of spurious treatment rules."

The authors state in the article that the formation of spurious beliefs is universal, such as an athlete's belief in a lucky hat. "But the good news is that physicians can probably be trained to think more like the high performers," said Downar. "I tell my students to remember three things: First, when you're trying to work out a diagnosis, remember to also ask the questions that would prove your hunches wrong. Second, when you think you have the answer, think again and go through the possible alternatives. Third, if the treatment isn't going as expected, don't just brush it off – ask yourself what you could have missed."

"These findings underscore the dangers of disregarding past failures when making high-stakes decisions," said Montague. "'Success-chasing'

not only can lead doctors to make flawed decisions in diagnosing and treating patients, but it can also distort the thinking of other high-stakes decision-makers, such as military and political strategists, stock market investors, and venture capitalists."

More information: Downar J, Bhatt M, Montague PR (2011) Neural Correlates of Effective Learning in Experienced Medical Decision-Makers. PLoS ONE 6(11): e27768.doi:10.1371/journal.pone.0027768 . [dx.plos.org/10.1371/journal.pone.0027768](https://doi.org/10.1371/journal.pone.0027768)

Provided by Virginia Tech

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