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Study provides insights into the roots of gamblers' fallacies and other superstitions

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Gamblers who think they have a "hot hand," only to end up walking away with a loss, may nonetheless be making "rational" decisions, according to new research from University of Minnesota psychologists. The study finds that because humans are making decisions based on how we think the world works, if erroneous beliefs are held, it can result in behavior that looks distinctly irrational.

This research, forthcoming in the Proceedings of the National Academy of Sciences (*PNAS*) "Early Edition," examines the roots of a seemingly irrational human decision strategy that occurs in so-called binary choice tasks, which has perplexed researchers in economics, psychology and neuroscience for decades. In these tasks, subjects are repeatedly asked to choose between two options, with one option having a higher probability of being correct than the other (imagine a biased coin that will land on heads 70 percent of trials, and tails on 30 percent of trials). While the right strategy is to always pick the higher probability option, subjects instead choose the options in proportion to the probability of it being correct.

"The overarching idea is that there is typically structure in the world, and it makes sense that when we make decisions, we try to understand the structure in order to exploit it," says Shawn Green, a post-doctoral fellow in the College of Liberal Arts' Department of Psychology and Center for Cognitive Sciences. "One of the simplest kinds of 'structure' is when the outcome that just occurred tells you something about what is likely to happen next."

"Where people go astray is when they base their decisions on beliefs that are different than what is actually present in the world," says Green. "In the coin example, if you toss a coin five times and all five times are heads, should you pick heads or tails on the next flip? Assuming the coin is fair, it doesn't matter - the five previous heads don't change the probability of heads on the next flip - it's still 50 percent - but people nevertheless act as though those previous flips influence the next one."

Green says when things are actually independent over time, meaning they don't have any structure, people will interpret results through possible structures, a way of thinking often seen among gamblers. For example, gamblers who win three hands in a row, may believe themselves to be "hot" and thus more likely to win the next hand. Green, with advisors Daniel Kersten and Paul Schrater, showed that similar behaviors are seen even in an optimal, fully rational computer learner given similar incorrect beliefs about the world.

Furthermore, when the context of the task was changed so that subjects understood that the outcomes were actually independent, a drastic shift in their behavior was noted, with subjects all doing the "right" thing for the way the world actually worked.

"This demonstrates that given the right world model, humans are more than capable of easily learning to make optimal decisions," Green says.

More information: The paper "Alterations in choice behavior by manipulations of world model," forthcoming in the *Proceedings of the National Academy of Sciences* (*PNAS*), was co-authored by C. Shawn Green, Charles Benson, Daniel Kersten and Paul Schrater in the Department of Psychology, College of Liberal Arts, University of Minnesota.

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