Sticking with the wrong choice

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The behavior of people who remain committed to a choice, even when it is clear that an alternate choice would be a better option, has been a perplexing phenomenon to psychologists and economists. For example, people will continue to wait in the slow line at a grocery store, stick out an unhealthy relationship, or refuse to abandon an expensive, wasteful project—all because such individuals have already invested time, effort, or money. This well-known cognitive phenomenon termed the "sunk cost fallacy" has long been considered a problem unique to humans. New research has discovered that humans are not the only species that share these economically irrational flaws.

New research from the University of Minnesota published in the journal *Science* discovered that mice, rats, and humans all commit the sunk cost fallacy.

"The key to this research was that all three species learned to play the same economic game," says Brian Sweis, the paper's lead author, an MD/Ph.D. student at the University of Minnesota. Mice and rats spent time from a limited budget foraging for flavored food pieces while humans similarly spent a limited time budget foraging for what humans these days seek—entertaining videos on the web.

Rats and mice ran around a maze that contained four food-delivery-locations ("restaurants"). On entry into each restaurant, the animal was informed of how long it would be before food would be delivered by an auditory tone. They had one hour to gather food and thus each entry meant they had to answer a question like, "Am I willing to spend 20

seconds from my time budget waiting for my cherry-flavored food pellet?" with a delay lasting anywhere from 1 to 30 seconds.

Similarly, humans saw a series of web galleries and were informed of the delay by a download bar. This meant humans had to answer an equivalent question: "Am I willing to spend 20 seconds from my time budget waiting for my kitten video?" In this way, each subject from each species revealed their own subjective preferences for individual food flavors or video galleries.

In this task, every entry required two decisions, a first decision when the delay was revealed, but did not count down, and then a second decision if the offer was accepted when subjects could quit and change their minds during the countdown. Remarkably, the authors found that all three species become more reluctant to quit the longer they waited—demonstrating the sunk cost fallacy.

Strikingly, subjects hesitated before accepting or rejecting offers during the initial decision before the countdown. "It's as if they knew they didn't want to get in line until they were sure," says Sweis. Even more surprising, neither mice, rats, nor humans took into account the sunk costs spent while deliberating. This suggests that the process of deliberation and the process of changing one's mind after an initial commitment depend on different economic factors, and that these factors are conserved across species.

"This project depended on the collaborative nature of science today," says senior author David Redish, a professor in the University of Minnesota Medical School's Neuroscience Department. "This was a collaboration between three laboratories and required working back and forth to ensure that we could ask similar questions across different species on these parallel tasks."

As such, this project builds on a number of breakthrough discoveries recently published by these laboratories, which find that mice, rats, and humans use similar neural systems to make these different types of decisions, that mice and rats also show regret after making mistakes, and that even mice can learn to avoid those mistakes by deliberating first, as revealed in a recent paper by these authors in *PLOS Biology*.

"These tasks reveal complex decision processes underlying the conflict between really wanting something on the one hand versus knowing better on the other," says Sweis.

"This is a conflict between different neural decision systems, and that means we can separately manipulate those systems," says Redish.

In other publications recently appearing in *Nature Communications* and the *Proceedings of the National Academy of Sciences*, these authors have found that both the effect of different drugs (cocaine, morphine) and different changes to neural circuits affect these two systems differently, which suggests that different forms of addiction would likely benefit from individualized treatments tailored to dysfunctions in distinct brain circuits.

"Decisions depend on neural circuits, which means that manipulating those circuits changes the decision process," says Mark Thomas, another of the study's senior authors and a professor in the Medical School's Neuroscience Department.

"There was a day when we asked ourselves, 'Rats forage for food, what do undergrads forage for?'" remembers author Samantha Abram, now a postdoctoral psychology fellow at the San Francisco VA Medical Center, who led the human component as a graduate student in the University of Minnesota Clinical Science and Psychopathology Research Program with her advisor Angus MacDonald, a professor in the Psychology

Department of the University of Minnesota College of Liberal Arts.

By having all three species play the same economic game, these authors have revealed a new insight into how different parts of the brain make different types of decisions and that there is an evolutionary history to the flaws that make us human.

More information: Sensitivity to "sunk costs" in mice, rats, and humans, DOI: 10.1126/science.aar8644 , science.sciencemag.org/content/361/6398/178

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