

# Gene variations can be barometer of behavior, choices

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Michael Frank is the director of the Laboratory for Neural Computation and Cognition at the Brown Institute for Brain Science. Credit: photo provided

Researchers at Brown University and the University of Arizona have determined that variations of three different genes in the brain (called single-nucleotide polymorphisms) may help predict a person's tendency to make certain choices.

By testing [DNA samples](#) from saliva in conjunction with computerized cognitive tests, researchers found that the certain gene variations could be connected to certain choices — focusing on decisions that previously produced good outcomes, avoiding negative outcomes, or trying

unfamiliar things even though an outcome is uncertain.

"In some cases, single genes can have surprisingly strong influences on particular aspects of behavior," said Michael J. Frank, assistant professor of cognitive and linguistic science, psychology, and psychiatry and [human behavior](#). Frank, lead author of the research, directs the Laboratory for Neural Computation and Cognition in the Brown Institute for Brain Science.

Frank worked with Brown graduate student Bradley Doll and collaborated with geneticists Francisco Moreno and Jen Oas-Terpstra of the University of Arizona. Research findings will be published in the August 2009 [Nature Neuroscience](#) and will be available online July 20. The paper builds on research Frank conducted while he was at the University of Arizona.

The study examined the effects of three genes that control aspects of dopamine function in the brain while participants performed a computerized decision-making task. Dopamine is a [neurotransmitter](#) that helps keep the central nervous system functioning. Its levels fluctuate as the brain feels motivated or rewarded.

Variations in two of the genes — DARPP-32 and DRD2 — independently predicted the degree to which people responded to outcomes that were better or worse than expected, by reinforcing approach and avoidance type behaviors. These genes affect dopamine processes in the basal ganglia portion of the brain. Frank said this is important for "simple reinforcement of learning processes that you might not even be aware of."

Frank and the other researchers also studied exploratory decision-making — the choices people make when they are in "uncharted territory." They found that variations in a third gene — COMT —

predicted the extent to which people explored decisions when they were uncertain whether the decisions might produce better outcomes.

COMT affects dopamine levels in the prefrontal cortex, known as an executive center of the brain. Frank said this level might be needed to "prevent the more basic motivational learning system from always taking control over behavior, so as to gather more information and prevent getting stuck in a rut."

Frank said the findings could have some interesting implications. "We cannot say on the basis of one or two studies," he said, "but if a student isn't doing well in a particular learning environment, [a gene study could show that the student] may be well-suited to a particular teaching style."

The data could help shape future treatments for conditions such as Parkinson's disease, which involves dopamine loss. Treatment options now lead to unwanted side effects.

"Medications that increase dopamine stimulation can help treat debilitating aspects of the disease but in some patients the meds can induce pathological gambling and impulsivity," he said.

Frank suggested that genetic factors involved in influencing motivational processes in the brain could someday help predict which patients would be negatively impacted by particular medications.

Seventy-three college students, with a median age of 19, took part in the study.

Scientists took saliva samples, from which they extracted DNA and analyzed the genes with subsequent computerized cognitive tests. Subjects watched a clock face, on which the arrow revolved around for five seconds, during which the subjects were to press a button once to try

to win points. The subjects did not know that the statistics of their reward depended on their response time, and they had to learn to adjust their responses to increase the number of points they could win.

That data was then fed into a biologically based computer model that quantified the learning and exploration processes on a trial-by-trial basis. These variables were then compared against different genes.

Source: Brown University ([news](#) : [web](#))

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