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The Brain is Wired to Mull Over Decisions

The next time you pause to mull over menu selections even after you have decided to order your favorite entrée, it may comfort you to know that you may be behaving that way because your brain is hard-wired to ponder decisions, leaving room for a possible change of mind. New studies have identified a specific neural circuit in the brains of monkeys that is activated when they postpone acting on a decision. The circuit is thought to keep potential choices brewing in memory even after a decision has already been made.

The brain may continue to consider the options even after a decision is made because that extra consideration may sometimes result in a change of mind - and a possible reward, such as a tastier meal. The researchers said that their findings could offer important insight into the function of neural circuits that drive the brain's memory and decision-making machinery.

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> **— Ranulfo Romo**

The researchers, led by Howard Hughes Medical Institute international research scholar Ranulfo Romo, reported their findings in the October 16, 2007, issue of the *Proceedings of the National Academy of Sciences*. Romo and his colleagues are at the National Autonomous University of Mexico.

In their experiments, the researchers trained monkeys to judge whether, when a pair of vibrations were delivered to their fingertip, the second vibration was at a higher or lower frequency than the first. The animals indicated their choice by pressing a button. During this process, the researchers recorded electrical activity in relevant areas of the monkeys' brains.

In previous experiments, Romo and colleagues found that they could identify circuits in the brain's cortex that were involved in encoding in memory the perceptual decision that would trigger the motor action of pressing the correct button.

But the question in this new study was what happens if we ask the monkeys to retain their perceptual decision report for several seconds? said Romo. The current idea is that once the monkeys reach a decision, it becomes very categorical; that is, neurons encode in their activity the aim of the decision and it is very consistent with the motor output of pressing the button.

To answer the question, the researchers conducted experiments in which they required the monkeys to delay their decision. At the same time, the researchers recorded the electrical activity of neurons in a region called the medial premotor cortex—one of the brain regions involved in decision-making and motor choice.

To our surprise, when the monkeys held the decision for several seconds, what we saw in the activity of these brain cells in the medial premotor cortex is that they were still remembering the sensory information on which the decision was based, said Romo. During that time the neurons were recalling the first stimulus, recalling the second, comparing the second against the first, and even reporting in their activity the categorical decision.

The researchers' measurements showed that neurons in the medial premotor cortex were switching back and forth between encoding the sensory information and the decision. It is a dynamic process, as if the monkeys were constantly trying to revise or update their decision. So, whether it is conscious or unconscious, the working memory is still `brewing' the perceptions that led to the categorical decision, he said.

As far as we know, this is the first time anybody has shown such a dynamic process, said Romo. We think it gives a new perspective on how the brain manages decision-making to allow revision based on uncertain sensory input.

This kind of process is quite relevant to everyday life, said Romo. For instance, it happens when you tell the waiter you need a bit more time to look at the menu, even though you already know more or less what's on the menu and what you want for lunch. It gives you time to think about your choice and maybe change your mind.