

Multitasking Splits the Brain

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When the brain tries to do two things at once, it divides and conquers, dedicating one-half of our gray matter to each task, new research shows. But forget about adding another mentally taxing task: The work also reveals that the brain can't effectively handle more than two complex, related activities at once.

When it comes to task management, the prefrontal cortex is key. The anterior part of this brain region forms the goal or intention—for example, "I want that cookie"—and the posterior prefrontal cortex talks to the rest of the brain so that your hand reaches toward the cookie jar and your mind knows whether you have the cookie. So what happens when another goal enters the mix?

To find out, neuroscientists Etienne Koechlin and Sylvain Charron of the French biomedical research agency INSERM in Paris turned to functional magnetic resonance imaging, which measures changes in brain activity. They monitored 16 women and 16 men, aged 19 to 32, as they performed a complicated letter-matching task. Shown letters pulled at random from the word "tablet" on a computer screen, volunteers had to determine whether two successive letters (either all lowercase or all uppercase) appeared in the same order as they do in the word. To multitask, they also had to deal with uppercase and lowercase letters at the same time, matching them to either all uppercase or all lowercase words. The volunteers received a small amount of money if they performed well.

As the team expected, working on a single letter-matching task at a time activated both sides of the volunteers' brains, setting off the anterior-to-posterior chain of command to get the job done. But as soon as the volunteers took on the second task, their brains split the labor: activity in the left side of the prefrontal cortex corresponded to one task while the right side took over the other task. Each side of the brain worked independently, pursuing its own goal and monetary reward, the team reports in tomorrow's issue of *Science*.

Koechlin says the results suggest that the brain can't efficiently juggle more than two tasks because it has only two hemispheres available for task management. Indeed, when the team asked another 16 volunteers to match letters of the same color while completing the same two letter-matching tasks the first group tackled, the triple-task jugglers consistently forgot one of their tasks. They also made three times as many errors as they did while dual-tasking.

"In terms of everyday behavior, you can cook and talk on the phone at the same time," Koechlin explains. "The problem arises when you pursue three goals at the same time. Your prefrontal cortex will always discard one."

Neuroscientist Scott Huettel of Duke University in Durham, North Carolina, isn't convinced of the two-task limit on human multitasking ability. "This shows there are conditions in which you can't add a third task, but it depends on the type of task and whether it draws on other parts of the brain," he says.

For example, people are remarkably good at eating while doing other things, he says, because the practiced motor skills involved in eating don't overlap too heavily with those that interpret visual cues, control language, or run other complex processes. Nevertheless, he finds the dual-task division of labor "novel and exciting." The study illustrates our striking lack of knowledge about how the brain's hemispheres organize themselves, he says. "I wouldn't have bet multitasking worked this way."