Seeing our errors keeps us on our toes

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If people are unable to perceive their own errors as they complete a routine, simple task, their skill will decline over time, Johns Hopkins researchers have found—but not for the reasons scientists assumed. The researchers report that the human brain does not passively forget our good techniques, but chooses to put aside what it has learned.

The term "motor memories" may conjure images of childhood road trips, but in fact it refers to the reason why we're able to smoothly perform everyday physical tasks. The amount of force needed to lift an empty glass versus a full one, to shut a car door or pick up a box, even to move a limb accurately from one place to another—all of these are motor memories.

In a report published May 1 in the *The Journal of Neuroscience*, the Johns Hopkins researchers describe their latest efforts to study how motor memories are formed and lost by focusing on one well-known experimental phenomenon: When people learn to do a task well, but are asked to keep doing it while receiving deliberately misleading feedback indicating that their performance is perfect every time, their actual performance will gradually get worse.

It had been assumed that the decline was due to the decay of memories in the absence of reinforcement, says Reza Shadmehr, Ph.D., a professor in the Department of Biomedical Engineering at the Johns Hopkins University School of Medicine.

But when Shadmehr and graduate student Pavan Vaswani asked

volunteers to learn a simple task with a few twists designed to deliberately manipulate the brain's motor control system, they learned otherwise.

The volunteers were told to push a joystick quickly toward a red dot on a computer screen. But the volunteers' hands were placed under the screen, where they couldn't see them, and their starting point was shown on the screen as a blue dot. In addition, as the volunteers moved the joystick toward the red dot, a force within the contraption would suddenly push the joystick to the left. So the volunteers practiced until they could move the blue dot straight to and past the red dot by compensating for the leftward push with pressure toward the right.

Once the volunteers had mastered the task, Shadmehr and Vaswani changed it up without their knowing. For one group of 24 volunteers, they added a stiff spring to the joystick device that would guide the user straight to the target, but would also measure the amount of rightward force the volunteers were applying. To the volunteers, it looked as though they were now doing the task perfectly every time, and, as in previous experiments, they gradually stopped pushing to the right, apparently "forgetting" what they had learned.

For a different group of 19 volunteers, though, the researchers not only added the spring, but also changed the feedback on the screen not to reflect what was actually happening during each task, but to show feedback similar to reruns of earlier efforts. The volunteers weren't seeing the errors they were actually making, but feedback that looked convincingly like errors they might have made. This group continued to do the task as they'd learned, applying the right amount of force to the joystick hundreds of times.

This shows that decline in technique "isn't just a process of forgetting," says Vaswani. "Your brain notices that you are doing this task perfectly,

and you see what you can do differently."

Adds Shadmehr, "Our results correct a component of knowledge we thought we understood. Neuroscientists thought decay was intrinsic to motor memories, but in fact it's not decay—it's selection."

More information: www.jneurosci.org/content/33/18/7700.abstract

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