Left and Right Hands Rely on Different Senses

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Sometimes, the right hand really may not know what the left hand is doing. It turns out that each of them relies on a different set of sensory inputs to control its movement.

In a small study of right-handed people, the dominant hand was found to be more dependent on vision for its guidance, while the left, non-dominant, hand was more attuned to body-based sensations from muscles, joints and skin.

"We think you can see this in the way a right-hander typically opens a jar," said Susan Brown, associate professor of movement science at the University of Michigan School of Kinesiology. "The preferred hand is usually monitored by vision as it twists off the lid while the non-preferred hand holds and stabilizes the jar's position using information from sensory receptors within the arm itself."

Graduate student Daniel Goble designed a study in which right-handed adults performed two tasks while attached to a lever system that measured the horizontal displacement of their elbow joints.

In the first task, which assessed visual control over movement, subjects were shown a lighted target to their left or right for less than a second. Then they were asked to mark the location the target had been in by moving a laser pointer attached to the lever system. The measurement was made with both hands, and with targets on the same side, or across from, each arm. Smaller errors were found for the preferred right arm in

this visual task.

In the second task, the left or right forearm of blindfolded subjects was moved to a target position and held for three seconds before being returned to the start position. Then the subjects were told to return to that spot with either the same arm or the opposite arm. In this test, errors were smaller on the left, or non-preferred, side.

"We really saw marked differences in matching accuracy between arms, depending on what type of sensory input was used to present the target," Goble said.

Handedness and arm dominance have traditionally been attributed to differences in motor output, with the preferred arm demonstrating more speed, strength and efficiency than the non-preferred arm, perhaps because it gets more use. But in a previous study, Goble had shown that differences also exist in each arm's use of sensory feedback. The non-preferred left arm showed an enhanced ability to perform tasks based only on non-visual sensory inputs.

The fact that different parts of the brain primarily control each arm may shed some light on how handedness in humans evolved. It also may have implications for improving rehabilitation therapy for patients who have suffered damage to one side of the brain and have difficulty moving one side of the body. If the arms use different senses, perhaps vision-based tasks should be used to rehabilitate the preferred arm and body-based tasks for the non-preferred arm.

Brown and Goble plan to explore this sensory dominance further by looking at a wide range of movement tasks, such as differences in the ability to match different movement speeds, arm trajectories and muscle forces with and without visual information. They would also like to use brain imaging to see how neural activity compares with the observed

behavior of the arms.

Computer animations of the experimental setup: www-personal.umich.edu/~dgoble/Vision%20Task.mov

Source: University of Michigan