Inner Workings: Discovering the split mind

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Seeing is believing but the results seemed hard to fathom. In 1962, scientists observed an epilepsy patient named W.J. as he attempted to complete a seemingly simple task: manipulate a set of painted blocks to match a specific pattern. Strangely, he could only execute the task with his left hand, not his right. This striking phenomenon, later captured on film (Movie S1), was one in a series of findings that would influence the course of cognitive neuroscience for years after.

W.J. had recently undergone surgery to sever his corpus callosum—a swath of nerve fibers running between the left and right hemispheres—to limit the spread of epileptic seizures in his brain. As a result, the 48-year-old man's brain appeared to contain two seemingly separate minds, each arising in one cerebral hemisphere.

Earlier studies of brain-injured patients had suggested that the two hemispheres differed in their functions. However, researchers lacked the means to cleanly separate and compare the abilities of the two parts. At the time, some neuroscientists thought that the corpus callosum played a purely mechanical role of holding the hemispheres together (1).

"The notion that you could split the mind into two coherent entities all within the same brain was a pretty shocking thing," says Michael Gazzaniga, then a graduate student in the laboratory of Roger Sperry at the California Institute of Technology. Together with Sperry and neurologist Joseph Bogen, Gazzaniga published the first study of W.J. (2), and later filmed some of his experiments.

W.J.'s behavior after surgery suggested that the corpus callosum mediated communication between the two hemispheres. With that information conduit broken, the Sperry laboratory had an unprecedented opportunity to dissect the different roles that the two sides of the brain play in consciousness and cognition.

In the block test, W.J.'s right hand, controlled by his left hemisphere, appeared incapable of matching a set of blocks to a pattern on a flash card. W.J.'s left hand, controlled by the right hemisphere, could execute the task with ease, however, even trying to jump in to help the fumbling right hand.

"That was a powerful moment—to see that there were two different mental control systems competing to solve this problem," says Gazzaniga, now a psychologist at the University of California, Santa Barbara.

In other tests, the researchers attempted to communicate with each of W.J.'s hemispheres separately. They flashed images of geometric shapes and everyday objects in either the patient's right or left field of vision. W.J. could readily name images presented in the right half of space, which are processed by the left hemisphere. However, he reported seeing nothing in response to images in the left visual field, processed by the right hemisphere.

W.J. could, however, use his left hand (controlled by his right hemisphere) to point to a picture of the image he had seen on the left, supporting the idea that the right hemisphere was cognizant but largely lacking in speaking ability.

W.J. was the first of a series of split-brain patients that the Sperry laboratory would study. Their data provided some of the clearest evidence then of the functional differences between the hemispheres. The test with blocks suggested, for example, that the right hemisphere excelled at visuospatial tasks, compared with the left hemisphere. Other tests bolstered the theory that in many people, the left hemisphere dominated language skills, compared with the right hemisphere.

Modern advances in brain imaging have since allowed neuroscientists to elaborate on these ideas and develop a more complete view of how neural circuits work together across both hemispheres. (Sperry went on to win the 1981 Nobel Prize in Physiology or Medicine for his split-brain research and work on hemisphere specialization.)

In the popular imagination, the split-brain studies would eventually give rise to depictions of the right brain as the creative side and the left brain as the logical side. "It became exaggerated and simplified to the point of being incorrect," says Charles Gross, a cognitive neuroscientist and historian of neuroscience at Princeton University. "It's true that certain cognitive activities tend to use one hemisphere over the other. For almost all cognitive activities, you need both."

From a scientific perspective, however, the work's enduring influence was to show that aspects of cognition could be linked to specific neural tissues performing specialized computations, indicating a localization of function, says Michael Posner, a cognitive psychologist and emeritus professor at the University of Oregon. "The idea was not new at the time," he says, "but this was a particularly strong demonstration."

A front view of the human brain. Image courtesy of Shutterstock/albund.

1 Gazzaniga MS (2014) The split-brain: Rooting consciousness in biology. *Proc Natl Acad Sci USA* 111:18093–18094.
2 Gazzaniga MS, Bogen JE, Sperry RW (1962) Some functional effects of sectioning the cerebral commissures in man. *Proc Natl Acad Sci USA* 48(10):1765–1769.