

# The split-brain: Rooting consciousness in biology

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From bugs to humans, the rate at which we have accumulated information about nervous systems in the last 100 y has been astonishing. Nonetheless, if one always adopted the intellectual style of first learning all there is to know about a topic before studying its new dimensions, future progress would be slow. Unlike many other disciplines, neuroscience does not currently enjoy the luxury of an agreed on set of next questions to be answered. It has been the Wild West, untamed and reinless, and, in many ways, continues to be.

Roger W. Sperry, perhaps the premier brain scientist of the last century, always plunged ahead with the sentiment, "Try it. And don't read the literature until after you have made your observations. Otherwise you can be blinded by pre-existing dogma." That is surely a paraphrase of what he said to me a hundred times, and that is how we operated in those delicious carefree and exploring days at Caltech. "Try it."

The Sperry laboratory was going full tilt with experiments of all kinds on the so-called "split-brain" (1). Cats and monkeys were the main animals, and the results were clear and riveting. Train one side of the brain on

a sensory task, and the other side didn't know anything about it. The standard preparation was to divide the optic chiasm down the middle, such that information exposed to one eye was only projected to the ipsilateral half brain. Such animals would easily learn a task and would easily be able to perform the task through the originally untrained eye. If in addition to the midline section of the chiasm, the corpus callosum and anterior commissure were sectioned, however, the split-brain phenomenon presented itself. In this condition, the untrained hemisphere remained ignorant of the task learned by the other half brain. It was as if there were two mental systems cohabitating in one head. Riveting as these findings were, they seemed incoherent when considered in the context of human behavior. Could a left hand not know what the right hand is holding? Preposterous.

In 1960, I had the good luck to show up at Caltech on a summer National Science Foundation (NSF) fellowship to study with Sperry. I was drawn to the laboratory by an interest in the issue of neural specificity. One thing led to another, and before I knew it, I was starting graduate school at Caltech the following summer. My first assignment was to prepare a set

of studies for a human patient, W.J., who was being worked up by a neurosurgical resident, Joseph E. Bogen, to sever the corpus callosum for treatment of severe epilepsy.

Looking back at those early days, it is hard to overstate the adventurous nature of our project. Nobody thought the patient would actually provide evidence the mind could be split. Weeks earlier, a case of callosal agenesis, a birth defect where there is a complete or partial absence of the corpus callosum, had come through the laboratory and nothing seemed out of the ordinary. From a larger view, even though one of the world's greatest neurobiologists was involved, neither Sperry nor certainly I, a green-as-could-be new graduate student, had any significant experience examining patients. To others it might have seemed to be a fool's game and a waste of time. However, it was not, because at Caltech, the attitude was always, "try it."

So the adventure went forward. First, unsurprisingly, preoperative testing confirmed that case W.J.'s two hemispheres were normally connected: each hand knew what was in the other, and each visual cortex seamlessly connected to the other. The very thought it could be otherwise was outlandish. As all of the studies were completed, we put the work aside, and went on to other research projects studying nonhuman primate memory systems, cortical pathways involved in eye-hand coordination, and much more. A few months later, our interests changed back to case W.J. The World War II veteran had recovered nicely from his surgery and was ready to be tested again.

The big test came on a bright sunny Pasadena day. W.J. was rolled up to the entrance of the biology building on San Pasquale Avenue. Still recovering from surgery, W.J. used a wheelchair to get around. He still sported his helmet, which he had been wearing to protect himself from possible seizure-associated falls. Was this World



The author displays one of the tachistoscopes he built for the first tests of split-brain subjects.

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