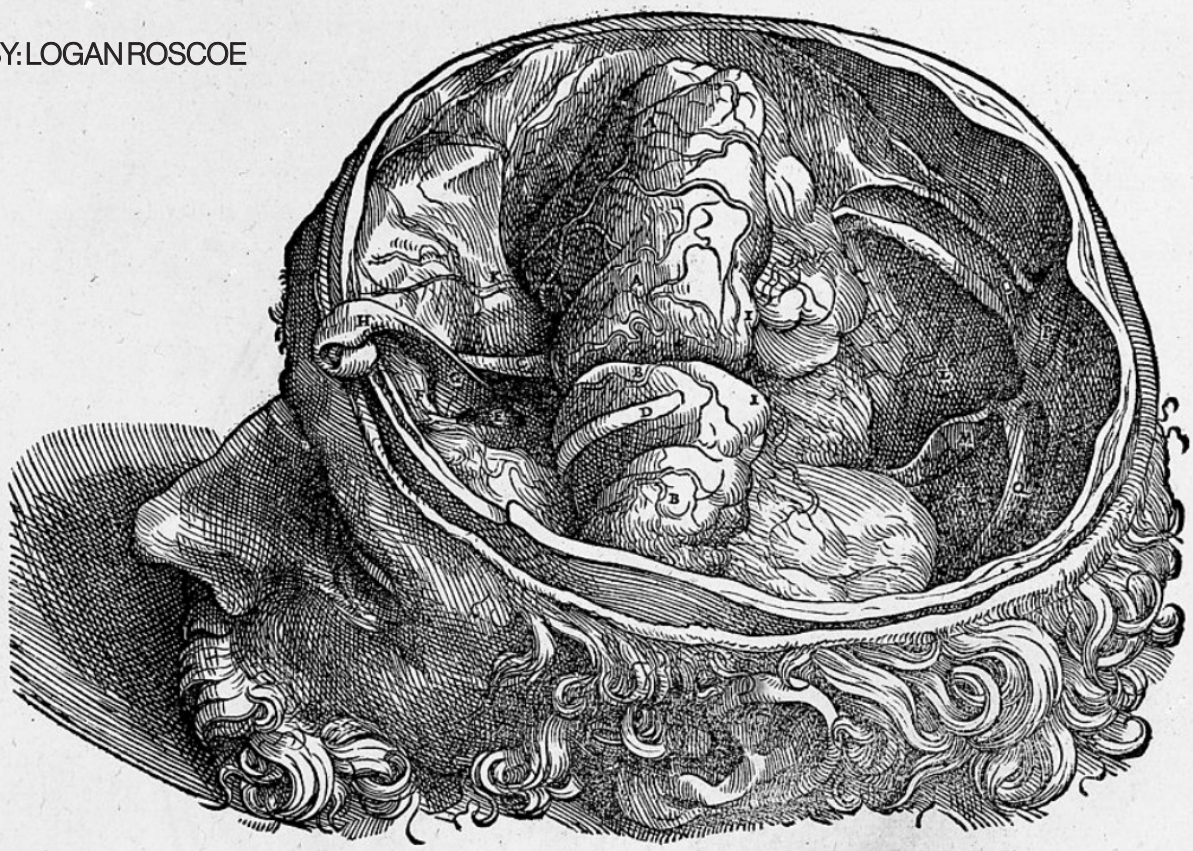
Dual Consciousness in Split-Brain Patients

BY: LOGAN ROSCOE



Adorned with a saturated blue and red sweater, Joe sits in a room full of flickering computer screens as a bright white monitor glows before him on the table. A balding man with circular glasses named Michael Gazzaniga sits next to him. Gazzaniga taps away at some buttons, his monotone voice rolling over the words, "Joe, I'm going to show you some things. I just want you to tell me what you see."[1]

Joe focuses on the monitor. In a thin font, the word CAR flashes on the right side of the white screen. Joe looks at Gazzaniga and gives a short, "car." Gazzaniga nods, moves on.

A new word flashes on screen—this time all the way to the left. PAN. But Joe shakes his head. "I don't see anything," he says.

"Close your eyes and let your left hand do a little work here," Gazzaniga tells him.

Joe puts a marker to paper, shuts his eyes, and begins to draw. A handle, an open cylinder: a pan.

In an environment brimming with computer cords, cameras, monitors, and inquisitive neuroscientists, such anomalous behavior is expected. Joe is one of dozens of people who have undergone a surgical procedure in which his corpus callosum has been severed, meaning the neuronal bundles that connect the two halves of his brain have been intentionally cut.[2] As such, the behavior seen in neuroscientist Gazzaniga's lab is the result of a split-brain, a brain in which the two hemispheres are disconnected.[2]

The original goal of this surgery was to take advantage of the lack of communication between severed hemispheres. Joe, before becoming a split-brain patient — and like all split-brain patients that preceded and succeeded him — experienced severe epileptic seizures that could not be treated with medication.[3] Though the surgery is rare nowadays and has been replaced with medication, starting in the 1940s onwards, relatively small batches of patients underwent the procedure to contain and limit their epilepsy.[2,4] And it worked—albeit with some side effects.

Joe and many patients like him report feeling no different after the surgery, and their relatives corroborate this claim.[2,3] However, Gazzaniga's findings and the heavily debated theorization that ensued suggested that more is at play.[1,2,3]

"After the surgery, these higher mental activities within each hemisphere seem to be out of contact with and cut off from the corresponding mental experiences of the other hemisphere," writes neurobiologist Roger Sperry, Gazzaniga's mentor.[2,1] "In short, the split-brain animal (or person, as we shall see later) behaves in many ways as if had two separate brains — each with a mind of its own."[2]

Dual Mind, Partially Blind

Experiments conducted on split-brain patients such as the one involving Joe reveal fascinating suggestions for the roles and specializations of each hemisphere. These experiments specifically intend to isolate the

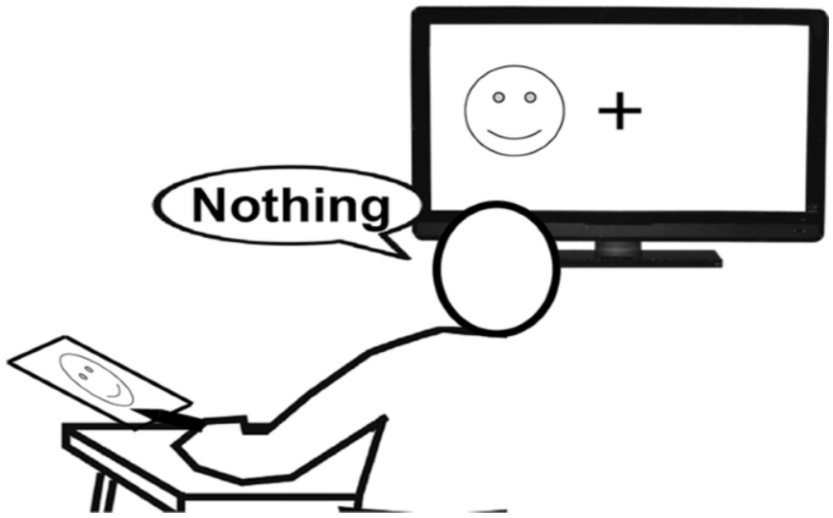


Figure 1: A representation of a common test conducted on split-brain patients, where the patient is shown words and images either on the right or left and prompted to represent the concept by drawing it with their left hand.

hemispheres in order to determine whether an individual is still able to carry out certain tasks without any communication between the two sides of their brain.

The broad characterization of each hemisphere is that the left side is in charge of many acts associated with the right side of the body, and the right hemisphere is responsible for many acts on the left side of the body.[5] While this is a general overview that lacks necessary nuance, it is particularly true for visual processing and handedness. For example, the right hand is controlled by the left hemisphere, and vice versa for the left hand. However, there's one more insight necessary to make sense of Joe's abnormal behavior, and that's the neurological site in charge of speech production. That, crucially, is located on the left.[2,4]

Joe's experiment aptly showcases these mechanisms. If a split-brain patient is presented with a stimulus on the right side of a screen (in this case, a word like CAR), it will be processed by the left hemisphere.[1,4] And therefore, because the left hemisphere also controls speech, the information can essentially be translated into speech without the need to cross hemispheres. However, if instead the word or image is presented on the left side of the screen, it will be processed by the right hemisphere — which is opposite to the side in controlling speech.[4]

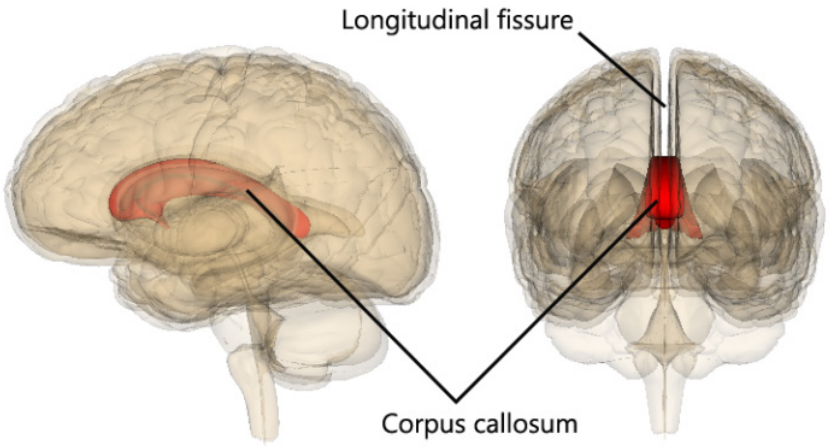


Figure 2: The location of the corpus callosum in the human brain. The corpus callosum is a bundle of neurons connecting the left and right hemispheres, which is severed during split-brain procedures.

With the corpus callosum severed and no effective bridge between the hemispheres, the information processed by the right side doesn't get transferred to the hemisphere in charge of speech. Critically, though, the information has still been processed by the right, even if it isn't translated into speech. If one were to perhaps prompt the patient to use their left hand (also controlled by the right hemisphere), the information would manifest as an accurate drawing.[1,4] This is precisely why Joe was able to draw the pan but not see the pan: the processed information wasn't communicated to the left hemisphere in charge of speech, but he processed it in his right hemisphere nonetheless — as shown by the ability to draw the pan with his left hand. Some recent studies have even hypothesized that split-brain patients in Joe's position do indeed "see" stimuli in the left visual field, but they just might not be able to verbally identify it or retrieve the word.[4]

It is an overgeneralization to claim that the brain is strictly divided into hemisphere-specific roles and abilities, but cutting off the communication between those hemispheres does indeed limit their ability to carry out certain tasks. As put by Professor Richard Ivry, former director of the Institute of Cognitive and Brain Sciences at UC Berkeley: "The split work really showed that the two hemispheres are both very competent at most things, but provide us with two different snapshots of the world."[2]

A Double Agent

Early split-brain experiments generated a passionate discussion on what they implied for the conscious experience of each hemisphere. Sperry was one of the trailblazers in split-brain studies, publishing a text in 1969 crucial for the understanding of this phenomenon. He is known particularly well for his beliefs regarding identity in split-brain patients.[3] Sperry famously claimed, "in the split-brain syndrome we deal with two separate spheres of conscious awareness, i.e., two separate conscious entities or minds running in parallel in the same cranium, each with its own sensations, perceptions, cognitive processes, learning experiences, memories and so on."[3]

Any proof of these claims is loosely based on highly-specific experiments designed to draw out abnormalities. In everyday life for patients that undergo this procedure, signs of having a split-brain are relatively rare, pardon the occasional case of one's hands vying with what their brain preferred to do.[2,3] One particular patient claims she'd reach for

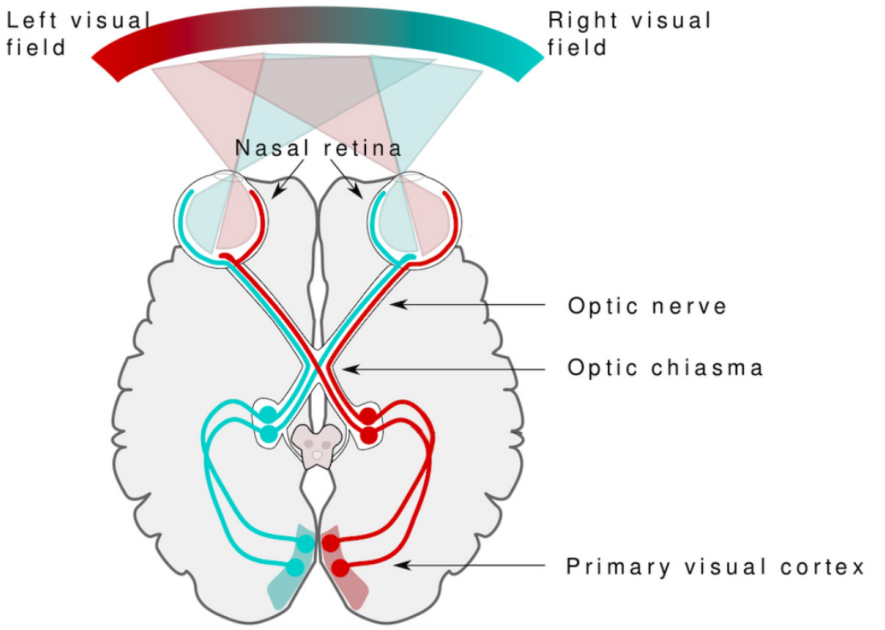


Figure 3: The brain is essentially flip-flopped in terms of visual processing. The left visual field is processed by the brain's right hemisphere, and the right visual field is processed by the brain's left hemisphere. The same mechanisms apply to handedness, meaning the right hand is controlled by the left hemisphere, and vice versa.

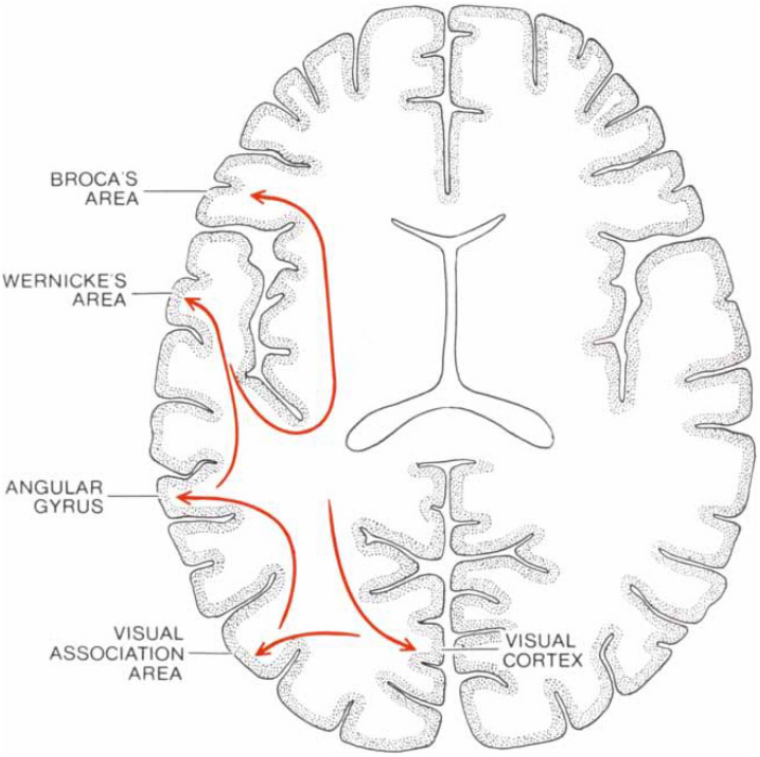


Figure 4: A representation of how information in the right visual field is processed by the left hemisphere and can travel to areas associated with language processing (the Angular Gyrus, Broca's Area, and Wernicke's Area) without crossing hemispheres. This means that for split-brain patients, images seen in the right visual field can be translated into speech, but images seen in the left visual hemisphere cannot.

items on a grocery store shelf with her right hand, only for her left to come in and try to fend the other off.[2] Some neuroscientists have postulated that in a patient's regular life, they have many ongoing neural mechanisms that compensate for the disconnection that is otherwise purposefully drawn out in lab experiments.[3,4]

And as for the more metaphysical claims that the split-brain patient has two separate conscious agents, there are numerous reasons to assign it to the world of philosophy. For one, Sperry himself admitted that the two "conscious agents" would hardly result in any behavioral differences compared to someone with a single consciousness, given "that these two separate mental spheres have only one body and therefore they always get dragged to the same places, meet the same people, see and do the same things all the time and hence are bound to have a great overlap of common, almost identical experience."[3]

Furthermore, there are more grounded scientific hypotheses that may speak to the ways information gets transferred between hemispheres even in split-brain patients. One hypothesis for their normal behavior outside the lab could be that the body gives subtle cues by minimal eye or facial movements that go unnoticed by the patient themselves. These small cues are initiated by a stimulus and could potentially "encode" the response, signaling to the other hemisphere a recognition of said stimulus.[4] This is but one example of a hypothesis rationalizing the apparent connection between hemispheres in split-brain patients, making sense of what seems to counteract the behavior exposed in the labs.[4]

In the continuous collective curiosities surrounding split-brain procedures, it appears as though two lines of thought have surfaced. Many scientists concern themselves with that which they can empirically test, locating the sites of certain neural processes and the relationship between hemispheres. Meanwhile, other researchers instead focus more on the surgeries' implications for identity, questioning the subjective experience of a split-brain patient. With a perspective so closely related to yet almost distressingly different from an average person's, split-brain patients stir monumental interest in what it's like to have the very foundations of our conscious experience altered. Decades after the surgeries have concluded, whether as scientists or philosophers, we're left to ponder: what is it like to live with two distinct spheres of perception, of consciousness, altogether?

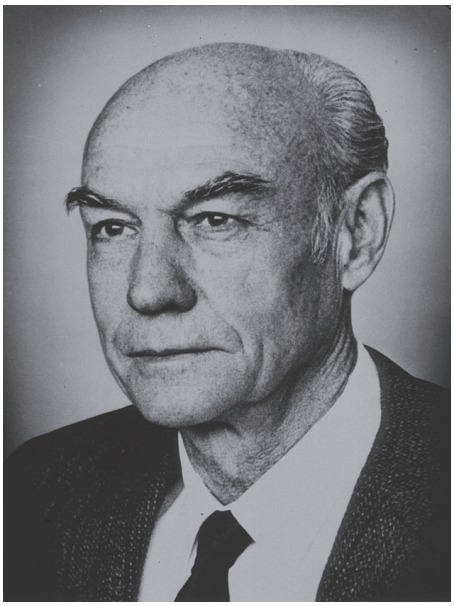


Figure 5: Roger Wolcott Sperry, a foundational thinker and scientist in the field of split-brain studies. He published the pivotal text "Mental Unity Following Surgical Disconnection of the Cerebral Hemispheres" and mentored scientist Michael Gazzaniga, who furthered Sperry's research.

Acknowledgements

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References

1. markmcdermott. "Split-Brain Patient "Joe" Being Tested with Stimuli Presented in Different Visual Fields." Www.youtube.com, 2010, youtu.be/aCv4K5aStdU?si=MmpGbb6XcP-DLyBJ. Accessed 6 Mar. 2024.
2. Wolman, David. "The Split Brain: A Tale of Two Halves." Nature, vol. 483, no. 7389, 14 Mar. 2012, pp. 260–263, https://doi.org/10.1038/483260a.
3. Sperry, Roger. Mental Unity Following Surgical Disconnection of the Cerebral Hemispheres. New York, Academic Press Inc., 1968.
4. de Haan, Edward H. F., et al. "Split-Brain: What We Know Now and Why This Is Important for Understanding Consciousness." Neuropsychology Review, vol. 30, no. 2, 12 May 2020, pp. 224–233, www.ncbi.nlm.nih.gov/pmc/articles/PMC7305066/, https://doi.org/10.1007/s11065-020-09439-3.
5. Schechter, Elizabeth, and Tim Bayne. "Consciousness after Split-Brain Surgery: The Recent Challenge to the Classical Picture." Neuropsychologia, vol. 160, Sept. 2021, p. 107987, https://doi.org/10.1016/j.neuropsychologia.2021.107987.

Image References

1. Banner Image: Category:historical illustrations of the human brain. Wikimedia Commons. (n.d.). https://commons.wikimedia.org/wiki/Category:Historical_illustrations_of_the_human_brain
2. Figure 1: de Haan, Edward H. F., et al. "Split-Brain: What We Know Now and Why This Is Important for Understanding Consciousness." Neuropsychology Review, vol. 30, no. 2, 12 May 2020, pp. 224–233, www.ncbi.nlm.nih.gov/pmc/articles/PMC7305066/, https://doi.org/10.1007/s11065-020-09439-3.
3. Figure 2: Ascensionglossary.com, 2024, ascensionglossary.com/images/6/67/Callosumhemispheres600.png. Accessed 6 Mar. 2024.
4. Figure 3: Amazonaws.com, 2024, s3-us-west-2.amazonaws.com/courses-images/wp-content/uploads/sites/855/2017/07/18200627/Screen-Shot-2017-07-18-at-3.05.52-PM.png. Accessed 6 Mar. 2024.
5. Figure 4: Geschwind, N. (1972). LANGUAGE AND THE BRAIN. Scientific American, 226(4), 76–83. http://www.jstor.org/stable/24927318
6. Figure 5: "Roger Wolcott Sperry." Wikimedia Commons, commons.wikimedia.org/wiki/File:Roger_Wolcott_Sperry.jpg. Accessed 6 Mar. 2024.