Also by the author:
Drawing on the Artist Within

The New Drawing on the Right Side of the Brain

Betty Edwards

Jeremy P. Tarcher/Putnam
a member of
Penguin Putnam Inc.
New York

HOW DOES THE HUMAN BRAIN WORK? That remains the most baffling and elusive of all questions having to do with human understanding. Despite centuries of study and thought and the accelerating rate of knowledge in recent years, the brain still engenders awe and wonder at its marvelous capabilities—many of which we simply take for granted.

Scientists have targeted visual perception in particular with highly precise studies, and yet vast mysteries still exist. The most ordinary activities are awe-inspiring. For example, in a recent contest, people were shown a photograph of six mothers and their six children, arranged randomly in a group. Contestants, strangers to the photographed group, were asked to link the six mother-and-child pairs. Forty people responded, and each had paired all of the mothers and children correctly.

To think of the complexity of that task is to make one's head spin. Our faces are more alike than unlike: two eyes, a nose, a mouth, hair, and two ears, all more or less the same size and in the same places on our heads. Telling two people apart requires fine discriminations beyond the capability of nearly all computers, as I mentioned in the Introduction. In this contest, participants had to distinguish each adult from all the others and estimate, using even finer discriminations, which child's features/head-shape/expression best fitted with which adult. The fact that people can accomplish this astounding feat and not realize how astounding it is forms, I think, a measure of our underestimation of our visual abilities.

Another extraordinary activity is drawing. As far as we know, of all the creatures on this planet, human beings are the only ones who draw images of things and persons in their environment. Monkeys and elephants have been persuaded to paint and draw and their artworks have been exhibited and sold. And, indeed, these works do seem to have expressive content, but they are never realistic images of the animals' perceptions. Animals do not do still-life, landscape, or portrait drawing. So unless there is some monkey that we don't know about out there in the forest drawing pictures of other monkeys, we can assume that drawing perceived images is an activity confined to human beings and made possible by our human brain.

"Few people realize what an astonishing achievement it is to be able to see at all. The main contribution of the new field of artificial intelligence has been not so much to solve these problems of information handling as to show what tremendously difficult problems they are. When one reflects on the number of computations that must have to be carried out before one can recognize even such an everyday scene as another person crossing the street, one is left with a feeling of amazement that such an extraordinary series of detailed operations can be accomplished so effortlessly in such a short space of time."

F. H. C. Crick, "Thinking about the Brain," in *The Brain*, San Francisco: A Scientific American Book, W. H. Freeman, 1979, p. 130.

Both sides of your brain

Seen from above, the human brain resembles the halves of a walnut—two similar appearing, convoluted, rounded halves connected at the center (Figure 3-1). The two halves are called the "left hemisphere" and the "right hemisphere."

Fig. 3-1.

The left hemisphere controls the right side of the body; the right hemisphere controls the left side. If you suffer a stroke or accidental brain damage to the left half of your brain, for example, the right half of your body will be most seriously affected and vice versa. As part of this crossing over of the nerve pathways, the left hand is controlled by the right hemisphere; the right hand, by the left hemisphere, as shown in Figure 3-2.

The double brain

With the exception of human beings and possibly songbirds, the greater apes, and certain other mammals, the cerebral hemispheres (the two halves of the brain) of Earth's creatures are

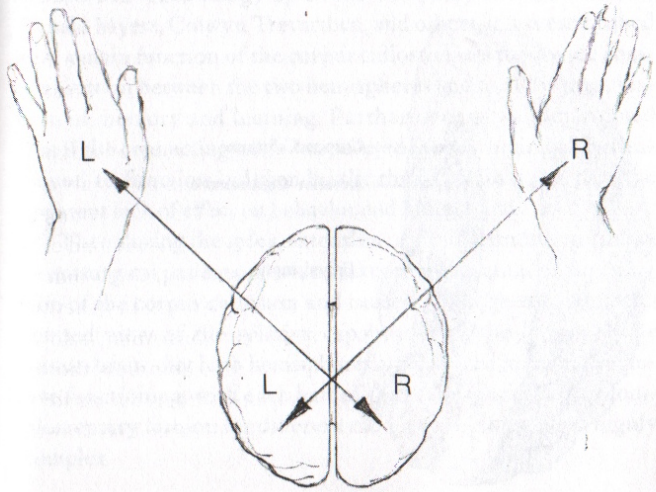

Fig. 3-2. The crossover connections of left hand to right hemisphere, right hand to left hemisphere.

As journalist Maya Pines stated in her 1982 book, *The Brain Changers*, "All roads lead to Dr. Roger Sperry, a California Institute of Technology psychobiology professor who has the gift of making—or provoking—important discoveries."

"The main theme to emerge . . . is that there appear to be two modes of thinking, verbal and nonverbal, represented rather separately in left and right hemispheres, respectively, and that our educational system, as well as science in general, tends to neglect the nonverbal form of intellect. What it comes down to is that modern society discriminates against the right hemisphere."

— Roger W. Sperry
"Lateral Specialization of Cerebral Function in the Surgically Separated Hemispheres," 1973

Because this changed perception of the brain has important implications for education in general and for learning to draw in particular, I'll briefly describe some of the research often referred to as the "split-brain" studies. The research was mainly carried out at Cal Tech by Sperry and his students Michael Gazzaniga, Jerre Levy, Colwyn Trevarthen, Robert Nebes, and others.

The investigation centered on a small group of individuals who came to be known as the commissurotomy, or "split-brain," patients. They are persons who had been greatly disabled by epileptic seizures that involved both hemispheres. As a last-resort measure, after all other remedies had failed, the incapacitating spread of seizures between the two hemispheres was controlled by means of an operation, performed by Phillip Vogel and Joseph Bogen, that severed the corpus callosum and the related commissures, or cross-connections, thus isolating one hemisphere from the other. The operation yielded the hoped-for result: The patients' seizures were controlled and they regained health. In spite of the radical nature of the surgery, the patients' outward appearance, manner, and coordination were little affected; and to casual observation their ordinary daily behavior seemed little changed.

The Cal Tech group subsequently worked with these patients in a series of ingenious and subtle tests that revealed the separated functions of the two hemispheres. The tests provided surprising new evidence that each hemisphere, in a sense, perceives its own reality—or perhaps better stated, perceives reality in its own way. The verbal half of the brain—the left half—dominates most of the time in individuals with intact brains as well as in the split-brain patients. Using ingenious procedures, however, the Cal Tech group tested the patients' separated right hemispheres and found evidence that the right, nonspeaking half of the brain also experiences, responds with feelings, and processes information on its own. In our own brains, with intact corpus callosa, communication between the hemispheres melds or reconciles the two perceptions, thus preserving our sense of being one person, a unified being.

In addition to studying the right/left separation of inner mental experience created by the surgical procedure, the scientists examined the different ways in which the two hemispheres process information. Evidence accumulated showing that the mode of the left hemisphere is verbal and analytic, while that of the right is nonverbal and global. New evidence found by Jerre Levy in her doctoral studies showed that the mode of processing used by the right brain is rapid, complex, whole-pattern, spatial, and perceptual—processing that is not only different from but comparable in complexity to the left brain's verbal, analytic mode. Additionally, Levy found indications that the two modes of processing tend to interfere with each other, preventing maximal performance; and she suggested that this may be a rationale for the evolutionary development of asymmetry in the human brain—as a means of keeping the two different modes of processing in two different hemispheres.

Based on the evidence of the split-brain studies, the view came gradually that both hemispheres use high human-level cognitive modes which, though different, involve thinking, reasoning, and complex mental functioning. Over the past decade, since the first statement in 1968 by Levy and Sperry, scientists have found extensive supporting evidence for this view, not only in brain-injured patients but also in individuals with normal, intact brains.

A few examples of the specially designed tests devised for use with the split-brain patients might illustrate the separate reality perceived by each hemisphere and the special modes of processing employed. In one test, two different pictures were flashed for an instant on a screen, with a split-brain patient's eyes fixed on a midpoint so that scanning both images was prevented. Each hemisphere, then, received different pictures. A picture of a spoon on the left side of the screen went to the right brain; a picture of a knife on the right side of the screen went to the verbal left brain, as in Figure 3-4. When questioned, the patient gave different responses. If asked to name what had been flashed on the screen, the confidently articulate left hemisphere caused the patient to say, "knife." Then the patient was asked to reach behind a curtain with his left hand (right hemisphere) and pick out what had been flashed on the screen. The patient then picked out a

"The data indicate that the mute, minor hemisphere is specialized for Gestalt perception, being primarily a synthesist in dealing with information input. The speaking, major hemisphere, in contrast, seems to operate in a more logical, analytic, computer-like fashion. Its language is inadequate for the rapid complex syntheses achieved by the minor hemisphere."

— Jerre Levy and
R. W. Sperry
1968

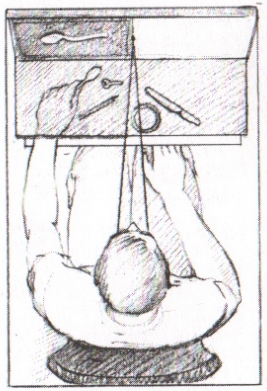

Fig. 3-4. A diagram of the apparatus used to test visual-tactile associations by split-brain patients. Adapted from Michael S. Gazzaniga, "The Split Brain in Man."

essentially alike, or symmetrical, both in appearance and in function. Human cerebral hemispheres, and those of the exceptions noted above, develop asymmetrically in terms of function. The most noticeable outward effect of the asymmetry of the human brain is handedness, which seems to be unique to human beings and possibly chimpanzees.

For the past two hundred years or so, scientists have known that language and language-related capabilities are mainly located in the left hemispheres of the majority of individuals—approximately 98 percent of right-handers and about two-thirds of left-handers. Knowledge that the left half of the brain is specialized for language functions was largely derived from observations of the effects of brain injuries. It was apparent, for example, that an injury to the left side of the brain was more likely to cause a loss of speech capability than an injury of equal severity to the right side.

Because speech and language are such vitally important human capabilities, nineteenth-century scientists named the left hemisphere the "dominant," "leading," or "major" hemisphere. Scientists named the right brain the "subordinate" or "minor" hemisphere. The general view, which prevailed until fairly

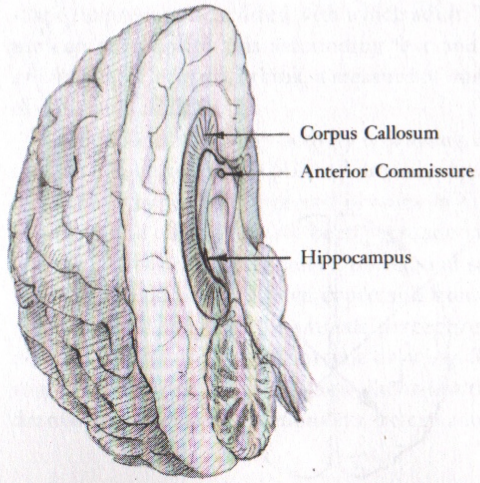

Fig. 3-3. A diagram of one half of a human brain, showing the corpus callosum and related commissures.

recently, was that the right half of the brain was less advanced, less evolved than the left half—a mute twin with lower-level capabilities, directed and carried along by the verbal left hemisphere. Even as late as 1961, neuroscientist J. Z. Young could still wonder whether the right hemisphere might be merely a "vestige," though he allowed that he would rather keep than lose his. [Quoted from *The Psychology of Left and Right,* M. Corbalis and Ivan Beale, Hillsdale, NJ: Lawrence Erlbaum Associates, 1976, p. 101.]

A long-time focus of neuroscientific study has been the functions, unknown until fairly recently, of a thick nerve cable composed of millions of fibers that cross-connect the two cerebral hemispheres. This connecting cable, the corpus callosum, is shown in the diagrammatic drawing of half of a human brain, Figure 3-3. Because of its large size, tremendous number of nerve fibers, and strategic location as a connector of the two hemispheres, the corpus callosum gave all the appearances of being an important structure. Yet enigmatically, available evidence indicated that the corpus callosum could be completely severed without observable significant effect. Through a series of animal studies during the 1950s, conducted mainly at the California Institute of Technology by Roger W. Sperry and his students, Ronald Myers, Colwyn Trevarthen, and others, it was established that a main function of the corpus callosum was to provide communication between the two hemispheres and to allow transmission of memory and learning. Furthermore, it was determined that if the connecting cable was severed the two brain halves continued to function independently, thus explaining in part the apparent lack of effect on behavior and functioning.

Then during the 1960s, extension of similar studies to human neurosurgical patients provided further information on the function of the corpus callosum and caused scientists to postulate a revised view of the relative capabilities of the halves of the human brain: that both hemispheres are involved in higher cognitive functioning, with each half of the brain specialized in complementary fashion for different modes of thinking, both highly complex.

spoon from a group of objects that included a spoon and a knife. If the experimenter asked the patient to identify what he held in his hand behind the curtain, the patient might look confused for a moment and then say, "A knife." The right hemisphere, knowing that the answer was wrong but not having sufficient words to correct the articulate left hemisphere, continued the dialogue by causing the patient to mutely shake his head. At that, the verbal left hemisphere wondered aloud, "Why am I shaking my head?"

In another test that demonstrated the right brain to be better at spatial problems, a male patient was given several wooden shapes to arrange to match a certain design. His attempts with his right hand (left hemisphere) failed again and again. His left hand kept trying to help. The right hand would knock the left hand away; and finally, the man had to sit on his left hand to keep it away from the puzzle. When the scientists finally suggested that he use both hands, the spatially "smart" left hand had to shove the spatially "dumb" right hand away to keep it from interfering.

As a result of these extraordinary findings over the past fifteen years, we now know that despite our normal feeling that we are one person—a single being—our brains are double, each half with its own way of knowing, its own way of perceiving external reality. In a manner of speaking, each of us has two minds, two consciousnesses, mediated and integrated by the connecting cable of nerve fibers between the hemispheres.

We have learned that the two hemispheres can work together in a number of ways. Sometimes they cooperate with each half contributing its special abilities and taking on the particular part of the task that is suited to its mode of information processing. At other times, the hemispheres can work singly, with one mode more or less "leading," the other more or less "following." And it seems that the hemispheres may also conflict, one half attempting to do what the other half "knows" it can do better. Furthermore, it may be that each hemisphere has a way of keeping knowledge from the other hemisphere. It may be, as the saying goes, that the right hand truly does not know what the left hand is doing.

The double reality of split-brain patients

But what, you might ask, does all this have to do with learning how to draw? Research on brain-hemisphere aspects of visual perception indicates that ability to draw may depend on whether you can access at conscious level the "minor," or subdominant, R-mode. How does this help a person to draw? It appears that the right brain perceives—processes visual information—in a mode suitable for drawing, and that the left-brain mode of functioning may be inappropriate for complex realistic drawing of perceived forms.

Language clues

In hindsight, we realize that human beings must have had some sense of the differences between the halves of the brain. Languages worldwide contain numerous words and phrases suggesting that the left side of a person has different characteristics from the right side. These terms indicate not just differences in location but differences in fundamental traits or qualities. For example, if we want to compare unlike ideas, we say, "On the one hand . . . on the other hand . . ." "A left-handed compliment," meaning a sly dig, indicates the differing qualities we assign to left and right.

Keep in mind, however, that these phrases generally speak of hands, but because of the crossover connections of hands and hemispheres, the terms can be inferred also to mean the hemispheres that control the hands. Therefore, the examples of familiar terms in the next section refer specifically to the left and right hands but in reality also refer inferentially to the opposite brain halves—the left hand controlled by the right hemisphere, the right hand by the left hemisphere.

The bias of language and customs

Words and phrases concerning concepts of left and right permeate our language and thinking. The right hand (meaning also the left hemisphere) is strongly connected with what is good, just, moral, and proper. The left hand (therefore the right hemisphere)

Nasrudin was sitting with a friend as dusk fell. "Light a candle," the man said, "because it is dark now. There is one just by your left side." "How can I tell my right from my left in the dark, you fool?" asked the Mulla.

— Indries Shah
The Exploits of the Incomparable Mulla Nasrudin