A New Map of How We Think: Top Brain/Bottom Brain

Who hasn't heard that people are either left-brained or right-brained—either analytical and logical or artistic and intuitive, based on the relative "strengths" of the brain's two hemispheres? How often do we hear someone remark about thinking with one side or the other?

A flourishing industry of books, videos and self-help programs has been built on this dichotomy. You can purportedly "diagnose" your brain, "motivate" one or both sides, indulge in "essence therapy" to "restore balance" and much more. Everyone from babies to elders supposedly can benefit. The left brain/right brain difference seems to be a natural law.

Except that it isn't. The popular left/right story has no solid basis in science. The brain doesn't work one part at a time, but rather as a single interactive system, with all parts contributing in concert, as neuroscientists have long known. The left brain/right brain story may be the mother of all urban legends: It sounds good and seems to make sense—but just isn't true.

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The origins of this myth lie in experimental surgery on some very sick epileptics a half-century ago, conducted under the direction of Roger Sperry, a renowned neuroscientist at the California Institute of Technology. Seeking relief for their intractable epilepsy, and encouraged by Sperry's experimental work with animals, 16 patients allowed the Caltech team to cut the corpus callosum, the massive bundle of nerve fibers that connects the two sides of the brain. The patients' suffering was alleviated, and Sperry's postoperative studies of these volunteers confirmed that the two halves do, indeed, have distinct cognitive capabilities.

But these capabilities are not the stuff of popular narrative: They reflect very specific differences in function—such as attending to overall shape versus details during perception—not sweeping distinctions such as being "logical" versus "intuitive." This important fine print got buried in the vast mainstream publicity that Sperry's research generated.

There is a better way to understand the functioning of the brain, based on another, ordinarily overlooked anatomical division—between its top and bottom parts. We call this approach "the theory of cognitive modes." Built on decades of unimpeachable research that has largely remained inside scientific circles, it offers a new way of viewing thought and behavior that may help us understand the actions of people as diverse as Oprah Winfrey, the Dalai Lama, Tiger Woods and Elizabeth Taylor.

Our theory has emerged from the field of neuropsychology, the study of higher cognitive functioning—thoughts, wishes, hopes, desires and all other aspects of mental life. Higher cognitive functioning is seated in the cerebral cortex, the rind-like outer layer of the brain that consists of four lobes. Illustrations of this wrinkled outer brain regularly show a top-down view of the two hemispheres, which are connected by thick bundles of neuronal tissue, notably the corpus callosum, an impressive structure consisting of some 250 million nerve fibers.

If you move the view to the side, however, you can see the top and bottom parts of the brain, demarcated largely by the Sylvian fissure, the crease-like structure named for the 17th-century Dutch physician who first described it. The top brain comprises the entire parietal lobe and the top (and larger) portion of the frontal lobe. The bottom comprises the smaller remainder of the frontal lobe and all of the occipital and temporal lobes.

Our theory's roots lie in a landmark report published in 1982 by Mortimer Mishkin and Leslie G. Ungerleider of the National Institute of Mental Health. Their trailblazing research examined rhesus monkeys, which have brains that process visual information in much the same way as the human brain. Hun-

dreds of subsequent studies in several fields have helped to shape our theory, by researchers such as Gregoire Borst of Paris Descartes University, Martha Farah of the University of Pennsylvania, Patricia Goldman-Rakic of Yale University, Melvin Goodale of the University of Western Ontario and Maria Kozhevnikov of the National University of Singapore.

This research reveals that the top-brain system uses information about the surrounding environment (in combination with other sorts of information, such as emotional reactions and the need for food or drink) to figure out which goals to try to achieve. It actively formulates plans, generates expectations about what should happen when a plan is executed and then, as the plan is being carried out, compares what is happening with what was expected, adjusting the plan accordingly.

The bottom-brain system organizes signals from the senses, simultaneously comparing what is being perceived with all the information previously stored in memory. It then uses the results of such comparisons to classify and interpret the object or event, allowing us to confer meaning on the world.

The top- and bottom-brain systems always work together, just as the hemispheres always do. Our brains are not engaged in some sort of constant cerebral tug of war, with one part seeking dominance over another. (What a poor evolutionary strategy that would have been!) Rather, they can be likened roughly to the parts of a bicycle: the frame, seat, wheels, handlebars, pedals, gears, brakes and chain that work together to provide transportation.

But here's the key to our theory: Although the top and bottom parts of the brain are always used during all of our waking lives, people do not rely on them to an equal degree. To extend the bicycle analogy, not everyone rides a bike the same way. Some may meander, others may race.

Beyond what is required by a particular situation (your reaction, say, to a car speeding toward you), all of us can use each system in optional ways. You can use the top-brain system to develop simple and straightforward plans, as re-

quired by a situation—or you have the option to use it to develop detailed and complex plans (which are not imposed by a situation).

For example, instead of just catching dinner in an unfamiliar city by finding the nearest restaurant, you might formulate a more detailed and complex plan that involves coordinating schedules with a friend, finding the best way to reach different parts of town, discovering which restaurants have tables at specific times and so on. And you can use the bottom-brain system to get a quick sense of what you perceive—or you can use it in optional ways to go "deeper," interpreting even the subtleties of a situation. For example, instead of just noticing the type and size of a restaurant, you might check out how many other people are dining there, the types of cars in the parking lot and so on.

Our theory predicts that people fit into one of four groups, based on their typical use of the two brain systems. Depending on the degree to which a person uses the top and bottom systems in optional ways, he or she will operate in one of four cognitive modes: Mover, Perceiver, Stimulator and Adaptor.

Mover mode results when the top- and bottom-brain systems are both highly utilized in optional ways. Oprah Winfrey, who overcame a difficult childhood to create a formidable TV and publishing empire, illustrates such behavior. According to the theory, people who habitually rely on Mover mode are most comfortable in positions that allow them to plan, act and see the consequences of their actions. They are well suited to being leaders.

Others who seem to typify the Mover mode include: the Wright Brothers, who incorporated lessons from their many failures into designing the successive models that finally led to the first airplane; Franklin Delano Roosevelt, who brought the U.S. out of the Great Depression and led the country during World War II; and the late Nascar chairman Bill France Jr., who began by parking cars and working the concession stands at his father's speedway and eventually grew the sport into a multibillion-dollar business.

Perceiver mode results when the bottom-brain system is highly utilized in op-

tional ways but the top is not. Think of the Dalai Lama or Emily Dickinson. People who habitually rely on Perceiver mode try to make sense in depth of what they perceive; they interpret their experiences, place them in context and try to understand the implications.

But they don't make and execute grand plans. By definition, such people—including naturalists, pastors, novelists—typically lead lives away from the limelight. Those who rely on this mode often play a crucial role in a group; they can make sense of events and provide a bigger picture. In business, they are key members of teams, providing perspective and wisdom but not always getting credit.

Then there is **Stimulator mode**, which results when the top-brain system is highly utilized but the bottom is not. According to our theory, people who interact with the world in Stimulator mode often create and execute complex and detailed plans (using the top-brain system) but fail to register consistently and accurately the consequences of acting on those plans (using the bottom-brain system). They don't update or correct their plans when events unfold in unexpected ways.

Such people may be creative and original, able to think outside the box even when everybody around them has a fixed way of approaching an issue. At the same time, they may not always note when enough is enough. Their actions can be disruptive, and they may not adjust their behavior appropriately.

Examples of people who illustrate Stimulator mode would include Tiger Woods, who clearly makes ample use of his top-brain system but does not always respond well to the consequences of carrying out his plans, and the late social activist Abbie Hoffman, who effectively organized major protests in the 1960s but reacted poorly when some of his plans went off track.

Finally, there is **Adaptor mode**, which results when neither the top- nor the bottom-brain system is highly utilized in optional ways. People who think in this mode are not caught up in initiating plans, nor are they fully focused on

classifying and interpreting what they experience. Instead, they become absorbed by local events and the immediate requirements of the situation. They are responsive and action-oriented and tend to "go with the flow." Others see them as free-spirited and fun to be with.

Because they can easily embrace the plans of others, those who typically operate in Adaptor mode can be valuable team members. In business, they often form the backbone of an organization, carrying out essential operations.

The New York Yankee slugger Alex Rodriguez and the late Elizabeth Taylor show evidence of often functioning in this mode. Coming to the Yankees in 2004 from the Texas Rangers, where he played Gold Glove-winning shortstop, Mr. Rodriguez agreed to switch to third base to accommodate his new teammate Derek Jeter—"the ultimate team move," as Mr. Rodriguez himself called it. But his ongoing troubles over his alleged use of steroids suggest that Mr. Rodriguez has not learned from his experiences. As for Taylor, she was a great actress—and fun to be around, by all accounts—but her eight marriages suggest that she had difficulty understanding her experiences and making detailed plans.

In applying this new way of looking at the brain at work, it is important to avoid the pitfalls of the left-brain/right-brain story. The top-brain and bottom-brain systems should not be seen in isolation. The key is how they interact—both within individuals and in groups where individuals tend to favor one mode over another.

Individuals who operate in different modes can complement each other to form a successful team. Consider, say, a mayor who has an efficient staff. Her policy experts may be people who habitually operate in Perceiver mode; the person answering phone calls from constituents perhaps habitually uses Adaptor mode; the chief of staff might be someone who often operates in Mover or Stimulator mode (but, if the latter, someone will need to exert quality control on the ideas). All the while, the mayor could be operating in Mover mode. She

is at the center, drawing on help as needed.

No one mode is "better" than the others. Each is more or less useful in different circumstances, and each contributes something useful to a team. Our theory leads us to expect that you can work with others most productively when you are aware not just of the strengths and weakness of their preferred modes but also of the strengths and weakness of your own preferred mode.

The injunction to "know thyself" is not exactly news, but science is regularly advancing toward this ancient goal—and we hope that our new theory proves to be a step forward.

Messrs. Kosslyn and Miller are the authors of "Top Brain, Bottom Brain: Surprising Insights Into How You Think," which will be published by Simon & Schuster on Nov. 5. Dr. Kosslyn was a cognitive neuroscientist and professor of psychology at Harvard University for over 30 years and now serves as the founding dean of the Minerva Schools at the Keck Graduate Institute. Mr. Miller is an author and filmmaker.

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