Excerpt chapter from *Making the Words Stand Still* by Dr. Donald E. Lyman
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15

The Divided Mind-Brain

FIFTY YEARS AGO one half of a brain was removed from a human skull. The art and science of *hemispherectomy* was born.

Long before this, anatomy showed that nature had divided the human brain into two compartments, equal in size, weight, and configuration. This division does not occur throughout the whole brain, only in the cerebrum. I recall studying that the cerebellum is sort of divided by a roll of cells called the vermis (worm, of all names). But the division of the cerebrum is clear cut, no "sort of" about it.

Hemispherectomies began to be performed around the third decade of this century and proliferated to the benefit of brain-tumor patients who preferred to be living bodies with a half brain to corpses with all of it. Neurosurgeons have learned much about brain function from this surgical procedure. They have learned nothing about the mind, however, because they are not sure if the mind lives in half brain, is half brain, or whole brain, or is something universal that uses the brain (whole or half) as long as it lives.

The brain is spherical and its compartments are laterally adjacent to each other, so the compartments were called right and left hemispheres. In actuality, they are not completely separate but joined by cross cables of nerve-filled fibers.

These fibers are called commissures or, collectively, the corpus callosum. The hemispheres communicate with each other through these commissures.

It is surprising that psychologists and educators did not communicate with neurosurgeons during all these years, for surely a divided brain must add something to or subtract something from learning theory. But none of this happened. Until the sixth decade of the twentieth century.

At the California Institute of Technology, Roger W. Sperry, Michael Gazzaniga, Jerre Levy, Colwyn Trevarthen, Robert Nebes, and others (now called the Cal Tech Group) studied a small number of neurosurgical patients whose cerebral hemispheres had been surgically separated (the corpus callosum was cut) to alleviate epileptic seizures involving both hemispheres. Their studies, and others that followed, have pointed new directions for learning theories that were up against mind-brain dead ends. Psychologists and educators continue to find new inspiration in these studies. Even I, a stubborn, pragmatic teacher, ask two questions of each hemisphere. "What can you teach me about learning-disabled children? How will this information help me to help them better?"

I wish I could arrange my answers into neat categories, presenting them in charts, graphs, grids, and computer printouts. But my answers raise questions, and my questions do not always raise answers. The mind-brain as computer would make this job easier, but the mind-brain is computer plus, plus, plus…

The best I can do is to offer a random list of what I have learned, apply this information to learning disability, and attempt a synthesis at the end of the chapter. Bear with me. For the moment, don't try to relate these observations; they are intended to stand alone.

1. The right cerebral hemisphere directs the left side of the body — left leg, left hand, left ear, left eye.

2. The left cerebral hemisphere directs the right side of the body — right leg, right hand, right ear, right eye.
3. The left cerebral hemisphere is usually the language hemisphere, which deals with naming objects, qualities of objects, actions, qualities of actions, and states of being. Since language (and the abstractions and communication of abstractions that language makes possible) is considered the "human element" of our planet, the left hemisphere is called the dominant hemisphere. Patients who have undergone hemispherectomy of the dominant hemisphere usually become what we call "vegetables." The mind is removed, other nonthinking, nonaware functions remain. (I have read that in a very few of these cases the mind has returned from nowhere or somewhere and somehow found the speech to express itself.)
4. Right-handed, right-eyed, right-eared, right-legged people have a left cerebral hemisphere that controls language. In the case of some left-oriented people, and a few with the orientation mixed, the right hemisphere controls language. Some ambidextrous persons use either hemisphere for the language function. All of these are exceptions. They amount to only five percent of the population. (Learning-disabled children comprise perhaps fifteen percent of the school population, so their disability must relate to something other than or something *in addition* to lack of left-hemisphere dominance.)
5. In all but a very, very few cases, the language function resides in the left hemisphere only. Most other functions are located in both hemispheres. (This is an unusual arrangement. In case of hemispheric brain injury, almost all functions can be compensated for by the sister hemisphere — except the language function that places us "just a little below the angels." What is the meaning of nature's reckless disregard for a function of such magnitude? Maybe language is such a highly specialized, very

recent addition to our humanness that human neurology hasn't completely assimilated it yet. Maybe language is not all that makes us human, or even the most important thing.)

6. When we are born, the neurological structure necessary for language exists in the right hemisphere as well as in the left. In a child, a major lesion of the left hemisphere produces a transfer of the language function to the right hemisphere. The older the child the less the chance of this happening. After age eight it rarely happens. After age ten it almost never happens. In fact, the area in the temporal lobe of the right hemisphere corresponding to the language area of the left hemisphere appears to have no function at all in adolescents and adults. (The learning-disabled child has great difficulty with either visual language or oral-aural language or both. This indicates a dysfunctioning of the dominant left hemisphere. Early detection and training would appear to be very wise. This is a time during which the right hemisphere might be capable of "picking up the slack.")*

*Early detection of learning disability and early training of learning-disabled children have always been difficult areas to research and implement because school failure has been the primary symptom of this disability, and remediation of school failure the principal treatment. The preschool child does not possess the cognitive, perceptual, motor, or language maturity necessary to assess his academic future accurately. Delayed language development is probably the most accurate predictor. When high risk of failure is predicted, no sure way exists, to my knowledge, to turn this risk factor into a success factor before the child's schooling begins. If you are interested in information on current efforts with the three- to five-year-old group, you might contact:

Learning Disability Program
Bureau of Education for the Handicapped
U.S. Office of Education
Washington, DC 20202

The Association for Children with Learning Disabilities
4156 Library Road
Pittsburgh, PA 15234

7. The corpus callosum is not developed until age two. (The foundations of language are laid during the first two years of life. During this period the child develops "object constancy." He learns to perceive differences among objects, then perceives that objects with their particular differences remain the same. He learns to symbolize or create impressions in his mind-brain of objects no longer present to his senses. This symbolization is concrete [actually visualization], but it forms the functional pattern for abstract symbolizing. It is during this period that the child begins to imitate the sound symbols used by adults. Then he goes beyond sound imitation. Using these sounds, he begins to name objects. During the first two years of life, the child also develops an internalized form of sensory motor action, which, combined with body knowing and awareness, enables him to plan movement. This lays the foundation for future concept formation, which is nothing more than planning relationships among semantic elements. All of this foundation building happens without the intervention of the corpus callosum. No learning is passing from hemisphere to hemisphere. Each hemisphere is building the foundation of language a foundation that will be abandoned in the right hemisphere like a bankrupt building project.)
8. Medical research has indicated for some years now that brain functions can be shaped and reshaped by environ-

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ment. Surrounding cortical areas can take up functions once assigned to a dysfunctioning area. Sometimes, a functioning area in one hemisphere will substitute for a corresponding area that is dysfunctioning in the opposite hemisphere. At times this transfer of function just happens. Nature has "built in" the back-up mechanism. At other times, transfer is triggered and stimulated by external therapy or training. (Visual and aural-oral language dysfunctions do not seem to transfer naturally, but require triggering or training. For this reason, it would seem to be a mistake to wait for a child to "outgrow" his learning disability, letting nature take its course. There is another good reason why we should avoid this wait-and-see game. The older the brain gets the more set in its ways it becomes. Mind follows brain here. Just as the brain gets used to dysfunction, so the mind gets used to failure. I am hard put to recall an adolescent who just "grew out of" a childhood or preadolescent learning disability. Most that I recall who reached adolescence without help grew into the disability more deeply, both academically and emotionally. Since none of us is sure how, where, or why the brain develops learning disability, we should concentrate great energy on creating, refining, and implementing techniques that stimulate symbol-semantic activity in the brain. Proof that we are using a correct technique is simple. It is not necessary to examine brain patterns. The true test is simply to observe the child. Is he reading, writing, spelling, and speaking better?)

9. Both hemispheres receive language, but only the left hemisphere uses it. I have read accounts of stroke patients with left-hemisphere damage who could not speak, read, or write. Yet these patients could understand language; they were able to follow both oral and picture language. Presurgical procedures that sedate one hemi-

sphere and then the other have also generated empirical evidence that the left hemisphere is the locus of receptive and expressive language. The right hemisphere is receptive only. And reluctantly. The Cal Tech experiments indicate that, except in cases of trauma, the left hemisphere does all the receiving and all the expressing. Yet. in cases of extreme trauma (like left hemispherectomy) the adult mind has, on rare occasions, found its way over to the right hemisphere and forced it to "speak." (It seems that every time man postulates a rule concerning the functioning of his mind-brain-body [a rule based on frequent, solid evidence], nature finds a few exceptions t it. The language foundation built in the right hemisphere during the first two years of life is truly abandoned in maturity. Except...)

10. Under conditions stated in number nine, above, it has been discovered that while the left hemisphere prefers to deal in semantics, the right hemisphere is comfortable with melody. When the right hemisphere only is active (as in the sedation procedure) the person cannot talk but can sing. When only the left hemisphere is active, the person can talk but cannot sing. Mind you, the right hemisphere's singing is not usually semantic. Mostly, it is merely a rhythmic repetition of words or sentences, but it can be a mindful duplication of a song once learned and now remembered. (I'm not sure, but I wouldn't be surprised if the right hemisphere were accompanied by some foot tapping and finger accompaniment when singing. Melody generally involves as much of the body as it can. The melody I described earlier seems to engage the left hemisphere as well. It generates a better appreciation of word meanings.)
11. EEG machines can measure which cerebral hemisphere is more active at any given time. While both hemispheres are continually active, a greater level of activity is gen-

erally registered in one hemisphere. This greater level of activity switches from one hemisphere to the other approximately once every minute. Underlying this major transfer of activity, there must be continuous lower level communication between hemispheres so that the right hand knows what the left hand is doing — and the right eye, ear, and leg, also. The corpus callosum is a busy bridge. (This minute-by-minute transfer of activity apparently occurs whether the person is involved in right or left or bihemispheric activity. It is difficult to determine which hemisphere is more engaged when the head is hooked to an EEG machine. Nerve impulses go trucking across the corpus callosum, full or empty, according to a set time schedule. This indicates a perpetual melody of neural movement. The brain-body is full of such melodies. Even two heart cells, separated from each other but still living, can be observed under the microscope pulsing to the same rhythm without any function to perform beyond the pulsing. I am convinced that the natural, functional melody of brain-body is the learning-disabled person's greatest ally in the struggle to master disability.)

12. When you ask a person a question, he must grapple with language inside his head in order to come up with an answer. Therapists use a test to determine which hemisphere a person uses for language. They ask a question and observe the person's eyes. If they move to the right while the person thinks of an answer, he is using his left hemisphere; to the left and he is using his right hemisphere. (In the act of reading the eyes move to the right, for writing too. The left hemisphere apparently controls both processes.)
13. Cal Tech research results indicate that the left hemisphere is analytical (good at breaking down) and the right hemisphere is synthetic (good at pulling together).

The left hemisphere is linear and sequential while the right hemisphere is holistic. (The act of reading is linear. It breaks meaning and logic into segments that occur sequentially. This act must be accomplished by the left hemisphere. It cannot be handled by the right hemisphere, whose function is holistic.)

14. A growing mountain of research into hemispheric functions has uncovered sufficient data and patterns of data to make researchers feel secure in attributing specialized functions to the opposite hemispheres. It is not surprising that these functions often pattern into opposites—the Yin and Yang of Western research. Here follows a listing of those functions that I am aware of:

a. There is overlapping.
b. The left hemisphere is analytic; the right is synthetic.
c. The left gives meaning to a context only in terms of its parts. The right gives meaning to parts only within a context.
d. The left is verbal as well as analytical; the right is spatial and constructive.
e. The left deals with verbal abstractions; the right with concrete visual images.
f. The left attends to and gives meaning to words; the right attends to and gives meaning to facial expression and verbal overtone.
g. The left produces speech; the right produces song.
h. The left enjoys logic no matter how grating; the right enjoys melody no matter how illogical.
i. The left thinks neatly and vertically, moving toward logical conclusions; the right thinks sloppily and laterally. Depending on intuition, it is surprisingly, sometimes crazily, creative.
j. The left works in a space-time continuum; the right is unaware of time unless forced to deal with it, as in cases of left-brain dysfunction.

k. The left sees cause and effect; the right sees effect and doesn't concern itself with cause.
1. The left is digital; it lines up concepts in logical order, like numbers. The right is analogical. It sees likenesses and relationships. It is the seat of the metaphor.
m. The left takes percepts from the body senses and elevates them to concepts abstracted from "body knowing." The right starts its concepts in the body and finishes them there. Its concepts are the product of physical experience.
n. The left is symbolic, using symbols to represent meaning even when these symbols have no concrete relationship to the meaning. The right is concrete, relating to things as they really are.
o. The left is semantic, assigning meaning to symbols and symbols to meaning. The right is sensuous, attracted to things it can use the body to touch, see, smell, hear, taste, or feel.
p. The left is individual; it creates individual mind. The right is universal; it shares in universal mind, relating directly to creation without self-awareness.
q. The left relates to literate, abstract culture; it is the seat of communication among beings. The right is communal. It relates to universal being; it is the seat of "just being."

In terms of this list, I would be inclined to conclude that learning-disabled children are right-hemisphere children. These children are concrete thinkers. They prefer to manipulate and put together concrete objects rather than to use and relate words. They enjoy constructive drawing as long as their efforts aren't named. They will, however, tolerate naming, sometimes encourage it, if the name identifies objects they have encountered and experienced. They can form vivid

visual images of objects, actions, and states that they have experienced deeply enough to link to "body knowing"—objects they have seen, heard, felt, manipulated, taken apart, assembled, rubbed, stretched, caressed, internalized.

These children cannot visualize symbols. Flow do you "body know" something like that? They also form vivid auditory images of things that they have internalized. They realize that the sound goes with the sight and feel. They cannot, however, auditorialize "ăh" or "ĕh" or "ĭh." What real thing makes sounds like that except adult people like teachers and teaching parents? And these aren't their real sounds.

Learning-disabled children are very adept at perceiving the overtones and hidden meanings of facial expressions and body gestures.(God help the unsure, anxiety-ridden, confused parent and teacher. Better for them to have the expression of a mummy or a sphinx.)

These children love humming and foot tapping and pencil tapping and any kind of rhythm. Many sing very well and dance well as long as the dance doesn't have prescribed steps. Break dancing is the dance of the learning disabled. I have seen them do it marvelously.

Learning-disabled children are very creative when they can deal with concrete objects and situations. (Not usually with words.) They are especially creative in the surprising, crazy meaning of creativity. When I see a stalking praying mantis or a feeding frog or a hiding, goggling crab, I imagine that these children understand the bizarre nature of our Creator better than anybody. I remember a twelve-year-old learning-disabled youngster who rigged his boat with foot pedals, oars, a sail, and a rump-controlled rudder. The boat, in or out of operation, looked as bizarre as any praying mantis, frog, or crab. It didn't work as well.

Children who are learning disabled usually live in a space-time vacuum, roving from immediate experience to immedi-

ate experience until or unless they become bored. Then they become acutely aware of space and time. "Get away from me. Give me room. What time is it? When's lunch?"

Learning-disabled children do not like to be individual. They prefer to share a natural commonality that most others do not care to share with them. Insects eat each other's eggs, larvae, and each other. Mammals eat each other. Humans eat other mammals. Nobody cares. Learning-disabled children eat each other's lunch (sometimes borrowing a few bites before lunch) and nobody cares, until somebody points it out to a supervising adult. Then all hell breaks loose.

Learning-disabled children do not acculturate easily. They move with nature and immediate inclinations. They are the embarrassment of parents who wonder if others wonder about their upbringing skills and of teachers who worry about their teaching skills.

It is so very tempting to label these children "right-brained" (and "right-minded"). It excuses personal, parental, and teacher guilt just as the "learning-disabled" label has done. It rings with a nostalgia for primitive innocence. There is also a muffled but perceptible undertone: "It's all right to be stupid, dummy. Because you're so sweet and funny."

I am captivated by the "right-brain" concept of learning disability. I want to adopt it as my own. But it doesn't provide enough answers. It doesn't really fit all the problems of these children — only a part of them. For example: The right-brained person is analogical; the learning-disabled child is not. He does not care to compare. Ordinarily, he does not use or appreciate metaphors, especially verbal metaphors.

There are a few exceptions I have known, but these exceptions only add more complexity to our study of humanness. The right-brained person is spatial-visual. He can perceive, duplicate, and remember lines and designs as long as you don't ask him to explain their meaning. Letters, numbers,

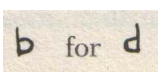
even words are simple designs.Yet he is hard put to perceive, duplicate, or remember them, even when they are presented bereft of meaning. Is this because his mind-brain sorts out a residue of semantics in the task? Or because he is genetically programmed to snoop out and avoid semantics? I don't know, But I feel that a true, strong, right-brained person should be able to handle the simple design of letters and numbers, regardless.

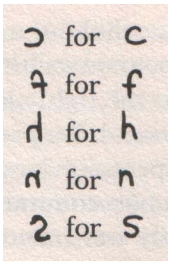
The right-brained person perceives a gestalt. His perception is global, holistic. But most learning-disabled children cannot remember whole words. My major successes with this kind of child have been analytical. Concentrate on the parts Remember the whole.

The right-brained person is rhythmic in both the oral-aural and the movement modes of expression. Why, then, does the learning-disabled child read in shreds and write with the finesse of a shredding machine, if he is right brained?

Many learning-disabled children I have known are superb at solving puzzles and winning nonsemantic logic games. (They are often crackerjacks at chess and checkers.) Recently I have discovered that they pick up basic computer programming with surprising adeptness. Admittedly, these tasks are visual-spatial but they are equally logic oriented — a left-brain task.

Most learning-disabled children are better oriented to clockwise movement than to counterclockwise Primary youngsters most often draw clockwise circles. Draw them a counterclockwise circle, have them draw many such circles and they unconsciously revert to clockwise a short way into the exercise. The most frequent reversals made by learning-disabled children are clockwise reversals for counterclockwise letters. Note the direction of the lateral, curved lines in these letters:





But counterclockwise should be a right-hemisphere direction. When our eyes shift left or we use our left ear or move our hand left, we engage the right hemisphere. The learning-disabled child uses eye, ear (he thinks the letter name), and hand when he writes, but his mind-brain prefers to go clockwise. Puzzling, if he is "right brained." It becomes even more puzzling when left-handed learning-disabled children and those with mixed dominance or no apparent dominance at all prefer clockwise — and most of the time they do.

The right-brained person can image and visualize. Why can't the learning-disabled child visualize a letter or number, much less a series of them? The more vivid I make the symbol using oral expostulations and visual embellishments), the less he remembers it, especially in the long term. But he sometimes remembers the expostulations and embellishments. Why? What happens to letters and numbers in the right or left brain of the learning-disabled child? Back we go again to the semantic connection. Even the "right-brain" theory of learning disability, neat and satisfying as it is, fails when we come to the making of symbols.

It's time to synthesize. It would seem to me that both cerebral hemispheres become involved in different aspects of visual, written, and oral-aural language; that the right hemisphere has some equipment necessary for language as well as the left; that the left is oriented to semantic abstractions and the right to concrete experiential sensations. The right hemisphere apparently is better equipped to handle the spatial,

configural, whole-word, whole-sound aspects of language. But it is not oriented to semantics; this seems to have become an atrophied function on the right side.

The right hemisphere sends its package full of the spatial, constructive, gestalt aspects of language to the left hemisphere (there is continuous communion between the two). This package is ordinarily welcomed by a semantic-oriented left hemisphere and language is generated. In the case of the learning-disabled child, however, the left hemisphere is not much more comfortable with semantics than the right; so the package of right-brain elements stays, for the most part, unopened, not processed into symbols, neither semantic for the left nor concrete for the right. Having no meaning for mind to consider or contemplate, these symbols are "washed out" by the mind-brain, and forgotten.

I am postulating that the learning-disabled child is semantically disabled. For some of these children only visual symbols wash out; for some aural symbols wash out; for others all symbols wash out. Symbols have no reason for existing without meaning attached to them. The learning-disabled person can spend a lifetime shuffling symbols in search of meaning.

Perhaps the learning-disabled child is right-brain oriented by necessity, rather than by choice. Because of his semantic difficulty he is insulated at an early age from much of the acculturation of a literate society. He cannot readily make his ideas converge with what the culture values, nor can he readily communicate a growing acculturation to others, for he deals with images and concrete experiences more than with ideas. His inner world is a duplication of his outer world; he is, so to speak, a tissue of sense impressions. Because words do not stuff his hemispheres, he does not constantly juggle them and relate them inside his head. For this reason, he is not very good at using them externally.

I feel that external training (environmental pressure, in-

tensely but judiciously applied) can breathe life and activity into the learning-disabled child's semantic apparatus. (Whatever it is and wherever it is.) This training must stimulate both cerebral hemispheres for a number of reasons. Both hemispheres are in continuous two-way communication; both possess the foundation and potential for symbolic-semantic language; each relegates to the other side the tasks that it would prefer to avoid (and we don't want any tasks left out); both understand language and therefore understand the scope of the task. If the paradoxes of language learning reside in both hemispheres and in their relationships to each other, then these paradoxes can be resolved only by engaging both hemispheres.

Different training approaches have been suggested by concerned researchers and educators. One approach recommends blocking right-hemispheric activity so that it doesn't interfere with left-hemispheric learning. Another recommends engaging the right hemisphere in music so that it is too occupied to interfere. Another suggests retraining the child to left-hemisphere orientation through various cognitive and/or perceptual motor exercises. Another recommends that both hemispheres be engaged in training. I agree with this last approach. Let me add some stipulations:

The training should be done early, before the right hemisphere forgets that it has a language function.

The training should be done intensely, so that neither hemisphere has time to go back to its old, separate ways.

The training should not attempt to restructure the right hemisphere into a left hemisphere on the right side. The use of right-brain functions, in my experience, seems to catalyze the dormant semantic elements of right brain to work in harmony with the active semantic elements of the left.

One final stipulation. In fact, let's make this stipulation a plea: Don't try to extinguish the right-brain personality of learning-disabled children. They are not deviant. They

are the way they are supposed to be, and the way they enjoy being.

Albert Einstein struggled through his early years in school, then dropped out because he hated it so much. Later, he went back.

Thomas Edison was a school dropout.

Woodrow Wilson admitted that he had many problems in school.

Leonardo da Vinci wrote backward.

Socrates preferred listening and speaking to reading and writing.

What a shame for us, had society changed the personalities of these people, while still young, in "their own best interest."

Much of the information concerning hemispheric functions that I use in observations 1 to 14 was gained from the following sources:

Tony Buzan, *Use Both Sides of Your Brain* (New York: E.P. Dutton, 1976).
Marilyn Ferguson, *The Brain Revolution* (New York: Taplinger, 1973).
Michael S. Gazzaniga, *The Bisected Brain* (New York: Appleton-Century-Crofts, 1970).
Julian Jaynes, *The Origin of Consciousness in the Breakdown of the Bicameral Mind* (Boston: Houghton Muffin, 1976).