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ABSTRACT

The human brain is lateralized, different functions being housed in each hemisphere. Several assumptions which are mistakenly considered fact by researchers include: (1) the left hemisphere is for rational functions, while the right is for intuitive functions; (2) the hemispheres do not interact as well with each other as they should; (3) the use of one hemisphere tends to depress the use of the other until one can become dominant; and (4) hemispheric dominance is probably a cultural phenomenon. Evidence has shown that measures used for assessing dominance and the assumptions they fostered, are suspect. The two-brain theory is of little importance in educational planning. Much concern for educating both sides of the brain is based on the supposition that one hemisphere could languish in ignorance while the other was enlightened. This is a naive supposition; lateralization is part of a complex interweaving of processes. Neurological research may have a profound effect on education in the future. (DWH)

The Two Brains and the Education Process

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The Two Brains and the Education Process

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> . . . teachers should adopt practices that could increase students' facility in the use of each hemisphere singly and in concert . . . We must follow the researchers, translating their findings into classroom practice as soon as possible (Hunter, 1976).

> The notion [of cerebral specialization] has been taken up by people in many different fields besides neuropsychology; for example, in education . . . Marcel Kinsbourne has labeled this phenomenon in its excesses "dichotomania" (Galin, 1974).

> If they be two, they are two so
> As still twin compasses are two;
> Thy soul, the fixt foot, makes no show
> To move, but doth, if th' other do.
> John Donne

I

In certain cases of severe epilepsy, when seizures are of such violence that a person can harm himself, a surgical technique known as commissurotomy can bring relief. The technique is simple: the brain is cut in half.

Of course, there are many ways of slicing the brain in half, and a commissurotomy is a very special way of cutting the brain. However, it is not a complex operation, for the brain is already in two halves, or hemispheres, divided almost totally by a cleavage that extends from front to back, and the operation consists in merely severing a bundle of nerve fibers that con-

nect the two halves. This bundle of fibers, called the corpus callosum, is what sends messages from one half of the brain to the other, and when it is disconnected, the two halves don't communicate any more. Perhaps this can best be illustrated in a diagram.

Insert figure 1 about here

The severence of the corpus callosum leaves the patient, to all outward appearances, the same as before, but a subtle and significant change has in fact taken place in him. The commisurrotomized person now has, instead of one brain consisting of two connected halves, two brains. Two brains, it must be remembered, that have no direct contact with each other.

This lack of communication, which does not show up in everyday behavior, was demonstrated dramatically by Dr. Joseph E. Boger (1969a) who has performed a number of commissurotomies. Before and after each operation, Dr. Bogen asked his patients to perform two easy tasks with each hand: to write their names and to draw simple geometric figures. The post-operative results are astonishing. With the severence of the corpus callosum split brain patients had lost the ability to draw with the right hand, and to write with the left.

Since the left cerebral hemisphere controls the right side of the body, the right hemisphere the left side, Dr. Bogen theorized that the left brain governs writing, the right brain drawing. That is, the human brain is specialized, or lateralized, different functions being housed in different hemispheres.

This discovery of Dr. Bogen's was one of the more recent chapters in an intriguing history that reaches back into the 19th century: the mapping of the brain.

Of course, assigning specific mental functions to different parts of the brain is not new--witness the popularity of phrenology in the 19th century. But whereas in phrenology the outside bumps and contours of the head are arbitrarily assigned significance, the mapping of the brain itself proceeded more systematically.

Though dual functions of the hemispheres was theorized as early as 1844 (Galin, 1974), it was not until the 1860's with the work of Dr. Paul Broca (Penfield and Roberts, 1974) that the basics of both the split brain theory and some of the investigative methods were set. Dr. Broca had as a patient an aphasic who could say only his name and few swearwords. After the patient's death, Dr. Broca investigated the brain and discovered a large infusion of blood in the left side of the cerebral cortex, about where the left ear is (now called Broca's area). He theorized that the speech centers were there, and subsequent research has proven him correct.

Dr. Broca's method of research, examination of brain damaged patients, has also been used extensively in mapping the brain. Modern technology has also used such techniques as dichotic listening tests, tachistiscope studies, EEGs', and in some cases, direct stimulation of the brain with weak electrical current. Out of the many experiments that have been performed has arisen a chart of the brain, with specific perceptual and (it is assumed), cognitive functions assigned to specific areas. (Cf. for instance, Luria, 1970; Penfield and Roberts, 1974; Sperry, 1964; TenHouten and Kaplan, 1973 for overviews).

For this discussion, we will be interested in the functions of the brain that are the result of hemispheric difference, rather than, for instance, front to back differences.

In normal right handed individuals, the left side of the brain (which, it will be remembered, controls the right side of the body) seems best adapted for sequential and segmented behavior. That is, when rapid temporal order judgements need to be made, the left hemisphere of the brain seems to be best suited to them. The right hemisphere, on the other hand (no pun intended) seems to operate in a holistic mode, and in spatial relationships. When part to whole relationships need to be expressed, the right hemisphere is best at that (for a good discussion of the basis for these judgements, read the first part of Bogen, et al., 1972). Beyond those broad statements, though, it is difficult to make any categorical assertions about the functions of the brain, especially when this involves transferring our attention from perception to cognition and attention. For instance, though it is generally supposed that music is a right hemisphere function and language a left hemisphere function, even these truisms must be severely qualified (Cf. Alekoumbides, 1978; Gazzaniga, LeDoux, and Wilson, 1977).

Nonetheless, by the mid 1970's, it was assumed that the left hemisphere was sequential, linguistic, logical, and analytic. The right hemisphere was deemed to be holistic, non-linguistic, intuitive, and synthetic.

II

Once the functions of the two hemispheres seemed to be firmly established, scholars began to speculate on the significance of the dichotomy, and to seek explanations in the divided brain for natural and social problems.

To do this, however, involved some risk taking. One of the risks involved (which science must take if it is to advance) was to move beyond the known facts, and to make inferences. In the case of the split brain, a chain reaction seems to have been initiated. That is, neurologists would make hypotheses about the nature of right brain/left brain phenomena which would be taken by other scholars--who were not neurologists--and used as the basis for further hypotheses, which would in turn be taken as the basis for still further hypotheses, thus building an edifice of dizzying height, a great pyramid, which came finally to the attention of educators, who are in danger of using the speculations about speculations about speculations as a basis for pedagogical programs. And therein lies the danger, for while it is one thing to demonstrate that the right brain handles spatial relationships better than the left brain, it is speculative to announce, as Miner (1976) did, that ". . . the right hemisphere functions in spatial, holistic or gestalt, combinatory--and in other aesthetic activity besides the musical (emphasis mine) [p. 503]." And it is another thing altogether to suggest, as did Nebes (1975) that the mythical and artistic elements of mankind reside in the right brain. Finally, it is a long leap from there to the implication given by Nelson (1977) that boredom in class, crime and vandalism, and even perhaps broken families, can be cured by paying attention to both sides of the brain.

I should like to describe in a little more detail how this edifice grew. But before I do it, need to call attention to a condition which almost assured that the two-brain theory would be unhesitatingly, eagerly, accepted. This pre-condition for acceptance is the long-term existence of paired opposites for human cognition and conduct, acknowledged in almost every society in history: the concept of Yin and Yang. As suggested by Bogen (1975) and TenHouten and

Kaplan (1973), throughout much of recorded history, humankind's faculties have been placed into opposing and opposite camps. One side corresponds to the male, to dryness, heat, light, logic, legitimacy, science, and the right hand. The other side corresponds to the female, to wetness, cold, darkness, intuition, bastardy, magic, and the left hand.

The doctrines of hemispheric laterality fit this pattern too well to be ignored. They were, it would seem, made for each other. For one thing, laterality studies tended to give yin and yang a sound physiological foundation, while the yin/yang tradition gave the budding theory of laterality a whole corpus of information, of folk wisdom, to work on. So, what happened was perhaps inevitable. All the yin and yang dichotomies were simply incorporated into the theory of hemispheric dominance (Cf., for instance, the assumptions about hemisphericity and culture in Ornstein, 1972, and Sagen 1977).

With this in mind, let us return to the base of the pyramid, and climb more slowly, beginning with those who actually formulated some of the early theories, based on their experiences with brain damaged patients. One of those pioneers was Dr. Joseph E. Bogen, whom I have alluded to earlier. In a series of papers (Bogen, 1969a; 1969b; Bogen and Bogen, 1969; Bogen, et al. 1972), Dr. Bogen laid what has been much of the groundwork for later researchers. In this series are formulated a number of assumptions that later scholars took, not as assumptions, but as fact. For instance, later scholars took as their basis, their gospel, not the cautious assertion that one hemisphere seemed to control graphic functions in split brain patients, but the broader, more global pronouncements that the right brain controlled the artistic side of humankind.

Four of these assumptions which are still finding their way into the introductions of studies as received fact are:

1. The hemispheres are specialized for different cognitive functions, the left for the rational, the right for the intuitive.

2. The two hemispheres don't interact as well with each other as they perhaps should.

3. The use of one hemisphere tends to depress the use of the other, until one can become dominant.

4. Hemispherical dominance is probably a cultural phenomenon.

Implications of these four assumptions for the education of Pacific peoples can be clearly seen, and I will return to them later. For now, let us make another step up the pyramid and examine how these assumptions began appearing in the work of others outside the narrow fields of psychology and neurology.

When Dr. Bogen was investigating the functions of split brain patients, he formulated names for the specific functions of the brain. Left hemisphere cognition was "propositional," while right hemisphere action was "appositional," and an interaction of the two was "oppositional." Working with Dr. Bogen on one of his studies was Warren TenHouten, of the University of California at Los Angeles linguistics department. Professor TenHouten was a sociolinguist, interested in the interaction of the brain and language in society. With Robert Kaplan, he published in 1973 a work entitled, Science and Its Mirror Image: A Theory of Inquiry. It is an utterly fascinating work. In it, TenHouten and Kaplan, who prefer the terms "analytic" for left brain, and "synthetic" for right brain, attempt to demonstrate that such arcane approaches to the world as Tarot, I Ching, and the vision Quest of Don Juan (the Yaqui mystic), are synthetic, or right brain approaches to information and prediction that are, in their own ways, fully as operational and acceptable as our analytic, left brain

approaches that we call logic. In the section of the treatise called, "Culture, Nature, and Brain Asymmetry" TenHouten and Kaplan expand on the information given them, applying it to problems of culture, perception, and language. They note:

> More generally, the left hemisphere deals with culture, and with language, and with propositional logic, which do not exist in nature, but are essential to the development and transmission of culture (p. 22, emphasis mine).

Thus we see one inference, that the left hemisphere deals with culture, taken over intact, and then extended into a purposeful framework which assigns this hemisphere the further task of developing culture, which is seen, along with the operations of the left hemisphere so noted, as being not natural. It is, of course, but a short step to a consideration of other methods of interpreting nature which are possibly more nearly natural: Tarot, I Ching, and Don Juan.

One scholar who took a further step up the pyramid was the rhetorician Ross Winterowd, of the University of Southern California. Drawing on material he had synthesized during the years 1975-79, he published a major article in the Fall-Winter 1980 issue of Language and Style. Winterowd began his paper by noting that while he had called on the (then currently) most reliable theories of brain function, he did not hesitate to use them metaphorically or heuristically. That is, though Professor Winterowd was sure that what he was about to say was real, he thought the things he said would be important even if they were only a good way of analyzing and picturing the data. Professor Winterowd invites the reader to determine for him or herself where conclusiveness ends and speculation begins. However, as Win-

terowd himself has cheerfully and readily admitted, most of what he says in the paper is speculative, and highly so. Further, though Winterowd had no way of knowing this when he wrote his piece, his solid foundation in brain theory partakes of the assumptions and presuppositions I have noted earlier, and is thus somewhat less solid than he, because he is a meticulous scholar, would have liked.

As one of Professor Winterowd's prime scholarly interests is the teaching of writing, he turns his attention to it, and discovers that there are two types of student writing which correlate very well with right and left brain functions. Using Bogen (1969) as his basis, Winterowd identifies one kind of writing as Propositional, or left brain, having as its characteristics a stated topic, organizational rigidity, generality or abstraction, backgrounded style, and little presence, [p. 158]. The right brain writer, or Appositional writer, on the other hand, has an implied topic, organizational flexibility, specific examples, foregrounded style, and great presence. To sum it up, the pure left brain writer is organized but highly abstract and bloodless, while the pure right brain writer is concrete and specific, but disjointed.

Naturally, says Professor Winterowd, most writers are not extreme styles, but the perceptive eye can discern trends. From this, he suggests that, having identified propositional or appositional writers we should take steps to move them back toward the center (which, though Winterowd doesn't mention it, is called oppositional).

Notice the progression. From the characteristics of right and left hemisphere acting alone, and armed with the assumptions that the two do not interact appreciably, and that too much use of one impairs use of the other, and that

left is logical and right is intuitive, we have moved from description of functions, to cognitive patterns assigned to those functions, to production of written prose under the control of those functions, to assessing and diagnosing those influences, to prescribing exercises to correct and imbalance in those influences. In other words, we have constructed a pedagogical system based on progressive enlargements and logical extensions of the fact that we have two brains. I need not say, however, that with each step the connections, however logical, get more and more tenuous, and the conclusions which we may draw more and more etherial.

Before turning to more practical matters, let me pause for a moment to note what may be the apex of the pyramid, Julian Jaynes's theory of the bicameral mind. Jaynes (1977) suggests that until about the second millenium B.C, man did not have consciousness as we know it, but had two minds, the bicameral mind, governing his actions. Instead of the essential "I" or ego, the real force in mankind's destiny, the impulse toward order and civilization, was provided by the right hemisphere, which spoke to various humans in "voices" heard with the left mind and often obeyed. Certain of the people in olden times heard and obeyed voices and built temples, kingdoms, arks, roads, legal systems — in short, civilization. All gods, mythical forces, religions, all are the result of bicameral man listening to the ghostly right mind voices. When this connection from right to left mind was lost, the gods disappeared, and modern consious man came into being.

From theories which translate hemispheric functions into societal or educational trends, it is but a short step to applying right brain/left brain theories to the educational process. This may take the form of general admonitions to teach both brains, without specifying how (Hunter, 1976), or it may

take a more specific direction, as when it is suggested that right hemisphere dominants might benefit from traditional courses in logic and reasoning (Winterowd, 1980).

The situation is especially acute with regard to educating Pacific and Asian peoples. An extension of the assumption that hemispheric dominance may be culturally determined is that non-industrial cultures, or non-dominant cultures within a larger culture, such as the Black, Chicano, or Indian, are almost certainly right hemisphere dominant (Cf. TenHouten and Kaplan, 1973; Bogen, 1975). If this were the case, it would explain at once and easily why minority groups often do less well in school than white middle class students. White middle class America is technological, that is, left hemisphere dominant, and minorities are traditional, that is right hemisphere dominant (at least, according to neuro-socio-linguists). What is equally evident, say some who have read split brain theories, is that the American school system is almost incurably left brained, both in curriculum and testing (Cf. Wolfe and Reising, 1977).

With a background in theories of hemispheric dominance, and with the traits of right and left hemispheric dominant groups in mind, it should be evident to everyone with half a brain that the inhabitants of the Pacific Islands are the quintessential right-hemisphere dominants. In an address before a graduate seminar in 1975 (before he had ever heard of Tonga or the Cook Islands) one scholar took a step into the company of TenHouten and Kaplan, and Jaynes. He suggested that the following would be characteristics of a society which was right hemisphere dominant in the extreme: First, they would be an oral, instead of a written culture. Second, they would depend on dance and music for transmission of tradition from generation to generation. Third, they would be very nature oriented, considering themselves part of the ecology. Fourth, they would

have a different notion of the significance of time. Fifth, they would structure discourse in different ways from technological society. Sixth, they would have a very good kinesthetic sense.

Two things should be noted about these extensions of right brain/left brain theory. First, characteristics described above were not drawn out of a hat, but were extrapolated, quite logically, from information on hemispheric studies (and the assumptions which flowed from them), and from studies which investigated dichotomies between traditional and technological studies, such as Phillips (1972) or Goody (1968). Second, the characteristics described above can be applied easily and directly to societies such as Tonga or Samoa, and the fit is excellent.

The danger of such a course is obvious. As an example; one acquantence related being present at a meeting in which a paper on the Piagetian development of one South Pacific people was being discussed. The presenter of the paper noted his puzzlement that, while the subjects were very good at conservation of volume, they were very poor at conservation of number, although by Piaget's developmental scheme the two are very close together. It was obvious to my acquaintence, he notes, that the South Pacific people, being right brained, would conserve volume well, since it is a spatial technique, and not conserve number well, since it is a mathematical and thus a left brain technique. Thus we simplify.

Let us now take the left brain/right brain theories to their ultimate application in the classroom, the curriculum, and in the school as a whole. Armed with the newest of neurological data, a teacher might push to have the traditional admittance procedures done away with as detrimental to the chances of right brained individuals. He or she might suggest that testing must

be done differently, so that the right brain will be tested as well as the left. Indeed, he or she might well suggest extensive and sweeping changes in the curriculum, so that right brained people may exercise their flaccid left brains, and left brain people their weakend right brains, thus bringing whole, two brained people into the world, making it a delightful place to live.

III

It is not my purpose in this discussion to argue these theories, or attempt to refute them. Indeed, it is possible that they are correct: that the Tarot is as good a way of working out problems as listing pros and cons; that there are essay types governed by right and left brain; that Moses was listening to his right brain when he parted the Red Sea. I deny the authenticity and veracity of none of them.

However, neither do I accept them. And I would certainly never build an educational edifice of any kind on them. This for three reasons. First, there is growing evidence that the measures we have used for assessing dominance, and the assumptions that grew out of these measures, are suspect. Second, it may well be that we have underestimated drastically the extent to which the two brains cooperate. Thirdly, most of the discussion of the two brain theory is, quite frankly, beside the point when it comes to talking about education.

Let me briefly expand on each of the points. Since the first is the most important, it will receive the lion's share of the discussion. That point, it will be remembered, is that the basis for assigning right and left

hemisphere functions may themselves be suspect. Those bases were of two general kinds: examination of brain-damaged people, and inferential tests, such as dichotic listening tests. Of the evidence for separate functions to date, Hardyck, Tzeng and Wang (1978) say bluntly, "While belief in the separate but equal cognitive processing capacities of the cerebral hemispheres may be widespread, it is scarcely overpowering [p. 56]." Citing what they feel to be shortcomings in experimental design with many right brain/left brain studies, and the presence of alternate theories such as those of Kinsbourne and Broadbent, Hardyck et al. conclude that a hemispheric lateralization model just does not provide all the answers.

Doubt on the validity of inferential tests is cast by Satz (1977), who notes at the beginning of his discussion that his purpose is not to argue with current, somewhat oversimplified theories of brain dominance, but ". . . to address some increasing abuses in the interpretation of . . . lateral sensory assemytries [p. 208]." The problem is, as Satz notes, ". . . the assumption that because a relationship exists between two variables (e.g., ear symmetry and speech-brain lateralization) then inductive inferences can then be made on individual Ss to classify them into respective hemispheric dominant groups [p. 208]." Satz demonstrates that for right ear advantace dichotic listeners, the probability is 97% that they are left hemispheric language users. But, for left ear advantage listeners, the probability is 90% that they are left brain language users. In other words, whether a listener in a dichotic test has a right or a left ear advantage there is a 90% or better change that he or she is a left brain language user. Or, to put it more simply, dichotic tests are useless in assigning hemispheric dominance for language. Let me take the analysis one step farther. If dicho-

tic listening tests are untrustworthy in assigning dominance, then the concept of dominance itself shows signs of becoming like the little man who wasn't there.

The second of the three points I made earlier blends in with the first; indeed, they may be facets of the same problem. That point, it may be remembered, was that we may have underestimated the extent to which the two hemispheres interact. Such an underestimation is a natural one, when one considers that the vast majority of studies have been done either been done on split brain patients, or have been so constructed to isolate the hemispheric differences. They question has always been, "How are the two hemispheres different?" and not, "How do they interact?" so the natural result has been the assumption that not only are they different, but separate.

An examination of this assumption, however, leads to problems, as was demonstrated in an elegent experiment by Basso, Sisiach, and Capitani (1977). They presented subjects with dichotic stimuli consisting of grey rectangles embedded in black and white backgrounds, so that the two hemispheres of the brain experienced "opposed brightness contrasts [p. 96]." The grey rectangle extended through both visual fields, with opposed backgrounds. With the situation thus, if one hemisphere dominated, the shade of grey suggested by the background of the dominant hemisphere visual field would be chosen. On the other hand, if the hemispheres cooperated, then a shade of grey between that indicated by the two backgrounds would be chosen.

The two halves of the brain cooperated. Basso, et al. conclude:

> The present data suggest that an attempt to uncover hypothetical lateralized systems of decisions in the intact human brain by presenting simultaneous, competive visual stimuli to the two hemispheres is likely to be circumvented from the activity of the multiple connections which exist between the two hemispheres [p. 98].

Note the emphasis by Basso et al. on the "intact human brain." This seems to indicate that in a normal brain, interaction between the hemispheres is the rule rather than the exception, and even in a situation in which one would expect the specialized hemisphere to act alone there is intercourse between them. This suggests, of course, that split brain patient studies are not indicative of the action of normal people, and that the results of these studies should be applied cautiously, if at all.

In addition to direct and critical examination of left brain/right brain studies, there is another class of study which we can examine: an extensional class. We might explain it thus: if theory X is correct, then we might expect hypothesis Y, derived from theory X, to be correct. A number of studies in fields other than neurology have done just that in the recent past. The results of the studies should be informative.

As an example, consider a dissertation study done by Lewis (1977). The Lewis study was based on Bogen's formulation of reliance on the dominant hemisphere. Lewis had hypothesized that children who are right brain oriented would tend to act more impulsively, whereas children who are left brain oriented tend to be more reflective. The results did not support the hypothesis.

Or consider the study by Askins (1977). Starting from the basic right hemisphere - spatial/left hemisphere - verbal stance, Askins made three predictions, all based on the concept that a student who was less lateralized would have better interaction among hemispheres than those who were strongly lateralized, and would have more vivid imagery in describing items on an image focussing test. The results weakly confirmed one hypothesis, denied the other two.

As a final example, consider the study by Sterne (1976), which investigated the possible correlation of hemispheric laterality with defense mechanisms. It was hypothesized that right hemisphere dominants would have mechanisms requiring detailed perceptions, while right hemisphere dominants would use mechnisms that required more of a gestalt approach. It was further theorized that males would be more heavily lateralized than females. Neither hypothesis was demonstrated.

A little reflection will show possible reasons why these studies, logically worked out and tightly reasoned, had such disappointing results (in the sense that any welll done study can have disappointing results). First, the method of deciding to which extent a person is "lateralized" is suspect. Neither CLEMS (Conjugate lateral eye movements), or visual/auditory dichotic tests seem to predict lateralization well (indeed, if one study is to be believed (Alekoumbides, 1978), people can be lateralized, for language at least, all across the spectrum from extreme right to extreme left, thus making gross lateralization judgements farcial).

Secondly, many of the <u>givens</u> that the studies are build on, the inferences that I have alluded to earlier, may perhaps have to be taken back. Sterne, for example, bases her study on two concepts: left hemisphere cognition is discrete and analytical, and lateralization means left hemisphere dominance, and Lewis tacitly assumes that hemispheric dominance (if there is such a thing), tends to inhibit behavior of the other hemisphere and attendent behavior patterns.

The final point to be made is, of course, that all the theorizing about the two brains is really beside the point. There have been, and continue to be, excellent pedagogical theories and practices which are attuned to exactly those differences in students which the two brain theory purports to describe, but which were developed <u>before</u> the two brain theory became prevelant, and

which operate quite well in its absence. An example of this would be Lowenfeld (1957), who suggests haptic and visual to to describe two types of artistic development in children. Or consider the essays by Jerome Bruner (1976) who speaks of creativity and, interestingly enough, the left hand. Both of these works indicate that perceptive scholars in education are fully able to articulate and deal with any differences in students without appealing to the right brain/left brain dichotomy at all. The sole contribution that a two brain theory might make to pedagogy today is to validate what Bruner and others have been saying, though the tricky relationship between theory and practice makes even that possibility less strong than would seem (Cf. for instance, Popp, 1975).

IV

In this presentation I have attempted to highlight some of the dangers inherent in a too ready acceptance of the two brain theory, and to hint at some of the problems that could arise from a tendency to rush pedagogical programs into existence before the theoretical basis is thoroughly validated. In so doing, I have perhaps given the impression that I do not accept the two brain theory. If so, I need to correct that impression. I am convinced that the two brain theory is not only physiologically real (which is beyond dispute), and a valid way of categorizing perceptual skills (which also seems to be true), but that it can also result in valid assessments of the cognitive operations of the brain. Someday, it is to be hoped, it may serve as the basis for significant classroom programs.

Where uncertainty enters is in extensions and applications of the two

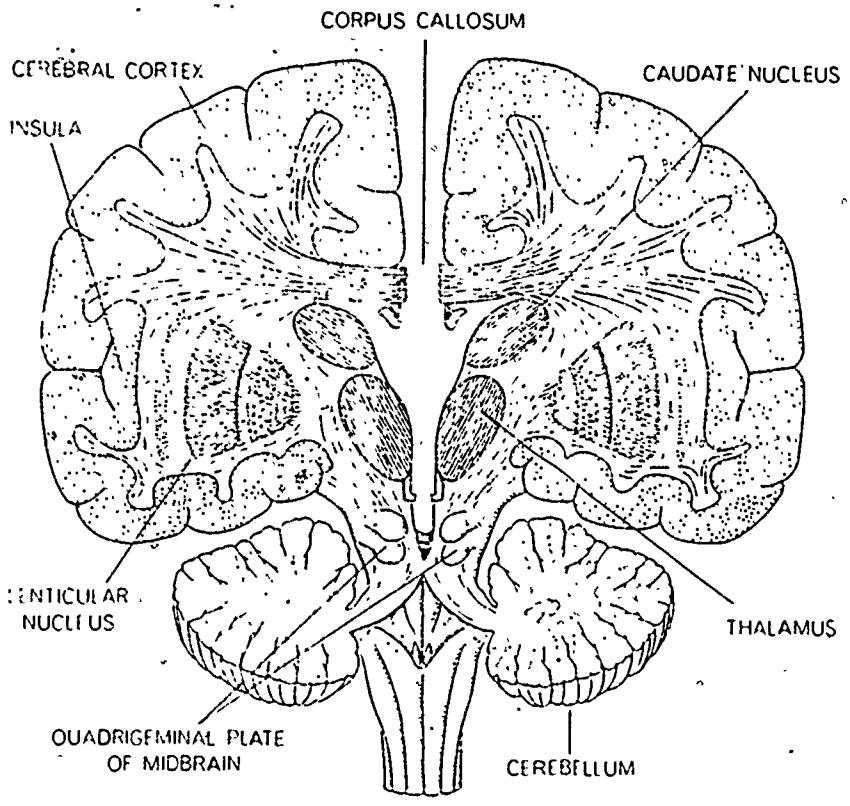
brain theory. As I have noted earlier, much of the concern for educating both sides of the brain was based on the presupposition that one side of the brain could languish in ignorance while the other was bathed in light. Such a stance now seems hopelessly naive, and present extensions of hemispheric lateralization models are far more sophisticated, tending to integrate brain structure into other theories of cognition far better than was done earlier. That is, researchers are more willing to view lateralization as a part of a complex interweaving of processes instead of an isolated and overwhelmingly important concept. Let me give one final example. Goldberg, Vaughn, and Gerstman (1978), hypothesized that the left hemisphere/language, right hemisphere/non-language dichotomy I have alluded to earlier in the presentation (one of the givens on which much research has been built) was too simplistic, and suggested instead that the left hemisphere processes information for which there exists a descriptive system in the brain. Where no system exists, the right hemisphere is the processing center. Using shapes and textures as the basis for their study, they determined that the right hemisphere was better at processing texture, the left for shape, Goldberg, et al., consider that the study has not fully demonstrated the hypothesis, but do suggest that the left hemisphere seems to be dependent on coding systems, whereas the right does not.

The presence of such studies, carefully done and cautiously interpreted, is good news. It is good news because it suggests that the human mind is strong and tough after all; that it is a much better design than simple two brain theories seemed to indicate; that is not as easy to starve one side of the brain as we had thought just a few short years ago.

For educators it seems to say that we are not responsible for patholo-

gical states in our students, that, while there will be no panacea in the near future, no "instant right brain," or "instant left brain," there are also no children out there hopelessly crippled by an exposure to too much math, too much geometry, too much science, too much language. For educators also, the latest research seems to say, "Marvelous things will come out of neurological research. Perhaps one day will appear miraculous new techiniques, techniques which can light up the classroom, which can open doors to the consciousness. But they will come slowly and they will come quietly. Be alert, be aware, be patient."

Fig. 1



THE BISECTED BRAIN
(Sperry, 1964)

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