# SOCIAL IMPLICATIONS OF SPLIT BRAIN RESEARCH

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## DISCOVERY OF THE SPLIT BRAIN

Forty years ago the physiologist, Pavlov came to the conclusion that people could be divided into two types: artists and thinkers. Neurophysiologists have recently discovered an anatomical basis for this assertion (Deglin, 1976). The fact that the human brain's two hemispheres, the right and the left are cross-linked has been known for generations. Stroke or injury to one side of the brain results in temporary or permanent paralysis of the other side of the body. For more than a century it has been established that the left hemisphere is the situs of two language areas--that of Broca, and posterior to it, that of Wernicke, while a third motor area on the upper surface may also involve language (Jaynes 1976 101). But aside from the specificity of loci, there seemed nothing to distinguish the functions of one hemisphere from those of the other.

The breakthrough to new knowledge comes from an operation on a cat. The object was to discover how the brain manages to translate stimuli received in the visual organ across an intervening jungle of cellular tissue to the visual cortex in the opposite hemisphere. What suggested itself as a possible channel of transmission was the thick "cable", or corpus callosum, a mass of 100 to 200 million nerve fibers that was thought simply to hold the hemispheres together. With the severing of the corpus callosum in the feline brain, the result was a two-brained superior cat. In other words, the two hemispheres functioned independently, and yet identically (Pines,1973).

A similar surgical procedure was carried out by Drs. Vogel and Bogen in Los Angeles. The patients were all advanced epileptics for whom the radical surgery represented an attempt to contain hitherto intractable seizures and convulsions. These were not the first such patients. They were the first to engage in post-operative testing by Dr. Roger Sperry, of the California Institute of Technology (Sperry 1968 724).

What particularly struck Sperry was the obvious restoration of the patients to a condition outwardly normal. One patient happily said that his wife enjoyed him now as she had when they were first married. Invisible to an untrained observer, however, was the unmistakable evidence of the presence of two minds in one body, and two independent streams of conscious awareness where there was one before, as Sperry indicated (1968):

'..each hemisphere seems to have its own perceptions; its own concepts; and its own impulses to act, with related volitional, cognitive, and learning experiences. Following surgery, each hemisphere also has therefore its own separate chain of memories that are inaccessible to the recall processes of the other.'

It was clearly the right hemisphere, for which nothing had prepared the scientists. Lacking a speech center, this hemisphere has been dismissed as the "mute", or "inferior" brain (Penfield, 1963-13). Only recently, had anyone asked, since language is not represented on both sides, what function in the other precludes the development of language (Jaynes 1976 101).

In the California laboratory, answers began to emerge. A number of tests called for a screen to be placed in the patient's right or left half-field of vision, so that when the experimenter projected an image at 1/10th of a second or less, it was prevented from getting into the wrong optic half-field. For example, a spoon shown on a screen in the patient's right optic field registers in the left hemisphere, and can

be described verbally. But if the same image is projected into the left optic field (right hemisphere), the patient will deny having seen anything except perhaps a flash of light on the left side. But if the spoon is placed with other objects, out of sight, the same patient, if requested, will retrieve the very object he denied having seen; and if that object is not there, will select one as closely associated as possible, like a toy watch for a clock.

Two striking episodes revealed the "smart" or "dominant" hemisphere in total eclipse. Earlier tests reportedly showed that the patient's right brain was "nearly imbecile". One day, he was shown the outline of a cross, and told to copy it with a pencil. Swiftly and surely he copied it, drawing the entire figure with his left hand in one continuous line. When asked to copy the same cross with his clever right hand, he could not do it (Pines, 1973).

In a second experiment, the same patient is shown what appear to be square tiles, mixed, red and white, arranged in a design. Given the task of reassembling them the same way (Koh's block test), the right hand begins confidently, only to become hopelessly befuddled, while the able left hand is so irrepressible that it has to be sat on repeatedly. Alone, the left hand performs the task with minimal lost time. Assigned the task together, "mind left", controlling the right hand, refuses to let stand "mind right's" correct design, further demonstrating its spatial incapacity. Sperry accounts for the "unity of conscious awareness" in these patients by the fact that the two separate mental spheres "have only one body, always get dragged to the same places, meet the same people, and see and do the same things, and thus have great overlap of brain organization" (Sperry, 1968,728). After about a year of recovery, these patients continued to watch television and read, probably without perceiving their visual system as bifurcated. But later studies proved that surgical disconnection of the two hemispheres has long-term effects (Zaidel & Sperry 1977; Franco & Sperry 1976).

At the I. M. Sechenev Institute of Evolutionary Physiology and Biochemistry in Leningrad, cerebral asymmetries were studied under unusual conditions. For Dr. Vadim Deglin, of the Institute, Sperry's major breakthrough made it clear that: "the right hemisphere must not be regarded merely as an adjunct to the left, but makes its own substantial contribution to nervous activity (Deglin, 1976,6). The Soviet contribution to split-brain theory is due to the method of administering electro-shock therapy. Electrodes are placed on alternate sides of the head at each treatment, and the results have been evaluated by Institute psychiatric staff since 1967. "Although it is an oversimplification", Deglin states, "after a unilateral shock, the patient feels, behaves, and thinks only with the active hemisphere." As revealed by electro-encephalograph records, one hemisphere is "asleep" while the other is "awake".

Here, we are dealing with <u>intact</u> brains of persons with <u>only</u> one hemisphere functioning. However, our "one-hemisphere person", Deglin cautions, "is an invention, a collective synthesis" of research on a large number of persons in treatment. Further, what follows applies to right-handed people; for left-handed people, the facts are reversed (Deglin 1977 8).

THE LEFT-HEMISPHERE PERSON

The 'left hemisphere' person not only retains speech, but becomes excessively talkative; the vocabulary becomes richer, more varied. Speech perception and acuity, measured on earphones, show a lower than usual threshold of awareness. He hears quieter speech sounds than when both hemispheres are working; he repeats words faster, more accurately. Is his speech improved? No. The voice has lost all inflection, the tone is monotonous, dull, rasping. Prosodic elements have been replaced by dysprosody. Ability to analyze speech directed to him is defective also: when short phrases are presented on tape, whether angry, plaintive, inquiring, or enthusiastic, he has lost the ability to distinguish the intonations or to identify tones or say whether voices are feminine or masculine. Sound images on tape--laughter, snoring, vehicular and industrial noise--baffle him; he has developed auditory agnosis, or inability to recognize what he hears; and this applies also to musical images. Of paired phrases on tape, he cannot tell whether they are identical or not. He hums wrong notes, gives up, and ends by tapping it out. He classifies what he cannot recognize, saying of a barking dog, "It's an animal."

Has his hearing failed? Not at all. Visual capacity is also deficient. If asked to select pairs of geometrical figures, triangles and squares, striped and colored, he is unable to. He cannot pair them either by color or shape. He sorts through them, and gives up.

In incomplete pictures, the 'left-hemisphere' person does not observe that a pig's tail is missing, or the earpiece of spectacles. Presented with 4 cards bearing an Arabic 5, 10, and a Roman V, X, and asked to pair them, he does not, as the normal person typically does, hesitate and indicate some indecision.

THE RIGHT-HEMISPHERE PERSON

The 'right-hemisphere' person displays sharply diminished capacity for speech, vocabulary is impoverished, and includes no abstract concepts. He has difficulty recalling the names of objects, though recognizing them and capable of explaining their use.

Speech comprehension is poor. We need to speak to him in short, simply constructed sentences. His own speech is likewise composed of simple sentences, often of isolated words. Speech activity is reduced. Instead of replying in words, he will mime or gesture. It is difficult to converse with him, and he is inattentive.

Speech awareness threshold is high: he is aware of only loud sounds, and even these he cannot always take in and repeat--although hearing is unaffected. The 'right-hemisphere' person's voice remains unchanged, the intonations unaltered, though he is uncommunicative. He is able to distinguish male from female voices with no effort, and is more subtle and accurate in interpreting voice intonations. He is less attentive to words and more active listening to non-verbal sounds such as laughter, snoring, etc. Has no trouble identifying surf breaking on the shore which few are able to recognize. He identifies songs faster and hums them without being requested to. He can reproduce sounds but not classify them. His perception has been restructured; deterioration is now verbal, and selective improvement appears in all imaginal perceptions. He has no difficulty in selecting pairs of triangles or squares, and sorting them by stripes or colors, and does it faster than before. The 'right-hemisphere' person has no difficulty completing unfinished drawings, and quickly points out the missing items: pig's tail or spectacles earpiece. In classifying the four cards, he unhesitatingly chooses

(Left-Hemisphere, Continued)

Instead, the 'left-hemisphere' person will unhesitatingly choose the abstract numeral and pair: 5, V; 10, X, and so on.

Thus, while handling of objects in space is defective, handling of concepts improves. His mental activity is 'stratified'. He retains theoretical knowledge learned in school through the verbal medium; retains memory of words and can repeat and remember them, and when brain function is normal, can pick them out. But if asked to commit to memory a succession of shapes, he is unable.

As for time and space orientation, he names hospital, ward number, date and day of the week, but does not recognize rooms, even the consulting room where he has been so often. Asked to look out the window and name the season, he will say, "January is a winter month," though it may not be January. .

Most surprising, unexpected, and unexplained is a marked mood change: to more easygoing, sociable, and cheerful than normally. His characteristic depression disappears, and he takes an optimistic view of his condition and his future prospects.

(Right Hemisphere, Continued)

them by visual appearance, pairing the Roman V, X; and the Arabic 5, 10.

Memory characteristics are the opposite of the 'left' hemisphere. Theoretical knowledge gained in school is largely lost and ability to memorize words is impaired. He is unable to repeat words after hearing them, and of a series of words, is able to repeat, at best, 2 or 3. When both hemispheres are restored to operation, he cannot pick out the words. But when shown a series of oddly shaped figures, he remembers them, and can select them from a larger group later.

His time and space orientation are affected, but in an opposite way. He appears completely disoriented, not knowing where he is, nor the date nor year. He is "probably" in the hospital. He remembers the rooms, but cannot specify their purpose. Asked to look out the window, he can say what season of the year it is, and approximate the month. His visual and practical orientation are retained, but not the verbal orientation. The mood change here is equally surprising, and in the opposite direction, toward negative emotions; his spirits decline, he becomes morose, pessimistic about himself, his condition, his future, and complains about feeling unwell.

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This research has unsparingly exposed the short-comings of "mind left" bereft of its hemisphere partner, "mind right". Though the latter's specialization in non-lingual expression appears the very proof of its inferiority, it nevertheless has a monopoly of musical and artistic expression, is more discriminating than its partner, more sensitive to nuances of sound and sight, and more responsive to faces, shapes, colors, and intonations. The presence of both artist and thinker in one mind was brilliantly demonstrated by Albert Einstein, who described his own method of thinking. He explained that he rarely thought in words at all: 'A thought comes, and I may try to express it in words afterwards,' he remarked. His concepts first appeared through 'physical entities', -- certain signs and more or less clear images that he could reproduce and recombine. These elements were of 'visual, and some of muscular type,' he explained. "Purely conventional

words or other signs have to be sought for laboriously... when the mentioned associative play is sufficiently established and can be reproduced at will.'(Pines 1973)

In the division of labor between hemispheres, each to the appropriate extent inhibits the activity of the other. Their faculties thus are necessarily situated in different parts of the brain. Deglin concludes: "...it seems certain that it is incorrect to speak of the main hemisphere and the subsidiary hemisphere...the right hemisphere is the basis of imaginal thinking and grasps the world of phenomena in all its richness and variety" (Deglin, 1976).

How dichotomized is the mind of an ordinary, "normal" human being? Where do laterality-dominance -asymmetries show up? Studies directed to these questions are legion. They go from hand and eye movements to verbal, nonverbal, musical, and object recognition tests. There are attempts to correlate eye, hand, and ear "superiority" with variables such as age, sex, ethnic identity, social class and occupation. Hemisphere dominance has been tested for bearing on creativity, dreaming, humor, haptic perception of Braille, alcohol, marijuana use, and schizoprenia (Buck 1976).

Hand movements are indicative of hemisphere asymmetry to a surprising extent. Kimura (1976) found that right and left handers engage in different types of movement. Hand movements were tied to speech laterality Left-handers did not differ from right-handers when speech was in the left hemisphere, but they differed markedly when speech was in the right hemisphere, in the scope and manner of hand movements. Another test indicated that two occupational groups used their brains differently, when given a block design test and a tracing problem. When the encephalogram data of lawyers and artists were compared, lawyers showed more change in alpha brain wave activity than the artists (Ornstein 1978).

Hemisphere research indicates the extent to which left hemisphere skills and ways of thinking "have seemed to dominate the school curriculum", while most educators and taxpayers regard what seem to be right-hemisphere skills as "frills". All knowledge cannot be expressed in words. Yet our education is based almost entirely on written and printed forms. According to Ornstein: "we happen to live in a society in which a child who has trouble in learning to read is in difficulty, while the artist, the dancer, and the mystic have learned to develop the nonverbal portion of intelligence" (Ornstein, 1978).

For their bearing on Ornstein's thesis, two contemporary areas, one in art, and the other in dance, deserve recognition. The Inuit Eskimo of Baffin Island by their talents in carvings, art, and visuospatial talents, show a right-brain orientation (Trotter, 1976). Cross-cultural studies of African societies suggest that Tanzania's famed Makonde and their idiosyncratic carvings indicate rightbrain orientation. The same holds for any African people still "illiterate" in Western eyes, because they use no writing technique, and cannot read. For them, drums, dance, and sculpture talk (Balogun, 1977).

Basic reading, writing and math skills are being practiced nonlingually by American children in schools where trained choreographers and dancers have been invited to teach them. According to one school supervisor: the child who dances is involved in organizing schematically, visualizing, planning, sequencing, conceptualizing, constructing reality. These are all intellectual skills needed for reading with comprehension (Wenner, 1975).

According to Dr. Sperry, our educational system, and modern society generally, discriminate

against one half of the brain. The attention given the right half is minimal "compared to the training lavished on the left hemisphere." Now, a new view of human consciousnesss is regarded as one of the most important findings to come from brain research (Sperry, 1975).

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