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Reading about . . .

The Split-Brain Syndrome

A recurrent theme in psychiatry is the belated and often confused appreciation of advances in other relevant disciplines. An example of this is the "split-brain syndrome", which provoked a Zeitgeist in the kindred field of neuropsychology and which has shaped notions of mental functioning impinging on the domain of psychiatry as well as philosophy, aesthetics, and education (Benson & Zaidel, 1985). The 'left brain – right brain story', while giving rise to much creative scientific enquiry, has also spawned some rather dubious psychophantasy. The purpose of this article is therefore to summarise this vast and growing body of work, to highlight areas of particular relevance, and to steer the reader away from the more wayward regions of speculation.

History and Background

The function of the corpus callosum, the band of over 200 million nerve fibres which connect the cerebral hemispheres, has been the subject of considerable argument for more than 100 years. Whether it had any function at all save as a form of brain scaffolding was a serious question until less than 30 years ago (a view supported by the apparent lack of consequences following callosal transection reported by the neurologist Akelaitis in the 1940s (Bogen, 1985)). By the 1950s, however, Roger Sperry and Ronald Myers had shown in animal experiments that by severing this tract, information presented exclusively to one hemisphere via the opposite visual field remained unavailable to the other hemisphere. When neurosurgeons Philip Vogel and Joseph Bogen decided to resurrect commissurotomy, or the "split-brain operation" (dividing the callosum, and the anterior and hippocampal commissures) to control intractable epilepsy, Sperry and his new assistant, Michael Gazzaniga, at the California Institute of Technology were keen to find out whether they could demonstrate the effects of disconnection in man (Gazzaniga *et al*, 1962; Gazzaniga *et al*, 1965). At the same time, Norman Geschwind and his colleagues in Boston, from a tradition in neurology stretching back to Dejerine and Liepmann at the turn of the century, described the syndromes of naturally-occurring lesions of the corpus callosum (Geschwind, 1965). Armed with the knowledge and apparatus developed from primate commissurotomy work, the effects of the surgery were found this time to be dramatic and compelling. An object placed in a subject's left hand could not be named (by the right cerebral hemisphere), although it could be retrieved from an array. The same object could be named easily when placed in the right hand. The right hand could write but not draw, while the opposite pertained with the left hand (Bogen, 1969). A picture presented for a fraction of a second (tachistoscopically) in the right visual field (left hemisphere) could be named and matched, but when presented to the opposite hemifield, the subject claimed not to have seen anything, yet could again select the corresponding object from a range of choices. Studies in other sensory modalities confirmed these findings and established the dual notions of lateral specialisation and relative hemisphere independence (Sperry, 1968, 1984), i.e. that both left and right hemispheres are endowed with complementary skills. Sperry (1984) summarised this as follows: "Each hemisphere can be shown to experience its own private sensations, percepts, thoughts and memories that are inaccessible to awareness in the other hemisphere . . . each . . . appears to have a mind of its own."

This endeavour was extended by a whole generation of talented psychologists using ever more ingenious techniques. Visual chimeras, pictures consisting of the right half of one drawing and the left half of another, were used, with each half of the composite stimulus having two possible matches, either by function or appearance (Levy & Trevarthen, 1976). The results elegantly revealed the reciprocal preference and predisposition, often called cognitive style, of each side of the brain. Another breakthrough followed the development of a contact lens system whereby visual input could be maintained in one half field long enough to elicit the full range of linguistic capabilities of the right hemisphere (Zaidel, 1978). In the meantime, Gazzaniga moved to the East Coast of America and continued his research on

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two new series of patients operated on by Donald Wilson and Mark Rayport, using a more limited procedure confined to part or all of the corpus callosum, callosotomy, which seemed to reduce the morbidity of the surgery without reducing efficacy. Another series has recently been reported from Yale (Spencer *et al*, 1988). The impressive body of knowledge gained by Sperry and associates led to the award of the Nobel Prize for Physiology and Medicine in 1981. Current research centres around such issues as how representative are the findings on such a small and decidedly unusual group of individuals? In what ways are the hemispheres truly independent (Zaidel, 1987)? How are resources allocated within and between the hemispheres (Gazzaniga, 1987)? Can information be transferred subcallosally (Sergent, 1987)? Is the callosum excitatory, inhibitory, or both (Cook, 1986)?

Dichotomania

In an effort to characterise the fundamental differences between the two hemispheres, a vast range of dichotomies have been advocated (Bradshaw & Nettleton, 1981). The verbal/nonverbal and dominant/minor distinctions have been ushered out by the split-brain work, only to be replaced by other contrasting attributes of marginally greater explanatory power. Favourites include analytic/gestalt, serial/parallel, rational/intuitive, etc. (Springer & Deutsch, 1985). Some of these models may be of heuristic value and serve to draw attention to the possibility that we may have talents and abilities which – like the capacities of the disconnected right hemisphere – may be overlooked (Bogen, 1975). This is quite distinct from the appealing proposition that each one of us has a poet, inventor, or composer of genius, hidden in the recesses of our unused brains, locked away by the narrow materialism of Western 'left brain' society (Prince, 1978; Edwards, 1979). These latter notions have little in common with academic split-brain research, other than perhaps their shared origins in California. Geschwind & Galaburda (1985) have argued with typical verve that cerebral laterality is a culmination of the asymmetries which pervade the whole of nature, a (left-handed) twist of fate encoded in the DNA helix, or perhaps reducible to the orientation of sub-atomic particles!

Split brains and split minds

One other dichotomy which has crept into this discussion is that of unconscious/conscious, representing right and left hemispheres respectively. It has grown out of a few oft-repeated anecdotes from observations of split-brain patients. For example: "One flashes a series of pairs of pictures to right and left visual fields . . . Into a series [of] neutral stimuli one then flashes a vivid pin-up shot of a nude that projects into the minor hemisphere only. At the same time a horse . . . appears on the right side. The subject says, of course, that she saw a horse . . . But then you notice that a kind of sneaky grin has begun to spread over the subject's features . . . If you ask her what she is grinning at, she does not know and says, 'Oh, that light.' " (Sperry & Gazzaniga, 1967).

Does the subject really not know, or is the instinctual right hemisphere knowledge 'repressed' by the censorious left hemisphere 'superego'? Psychiatrist David Galin (1974) has marshalled an impressive literature supporting the view that the phenomenon of dissociation may arise from the actual separation of mental events across the corpus callosum. Freud's attempt to locate his psychic topography in neuroanatomy, the "Project" of 1895 (Freud, 1895), has been found to fit comfortably into phylogenetic models of brain development. In this scheme, the 'primitive' regions that make up the limbic system have been superceded in man by higher cortical structures, so that aggressive and sexual drives are controlled and steered in socially acceptable directions (see McLean, 1985). This hierarchical, horizontal splitting has given way to the more democratic view that some of these drives may not only be adaptive but may also be creative and equally 'civilised'. A metaphorical vertical split could therefore be invoked to conceptualise a separation of these attributes from rational and verbal faculties. This is another reflection of the elevation of right hemisphere functions in neuropsychology, and has parallels in psychoanalysis, particularly in the writings of the post-Freudian, Melanie Klein.

Some aspects of dissociation are amenable to empirical testing. For example, in one split-brain patient the inability to name objects in the left hand was attenuated by hypnosis implying *increased* interhemispheric communication (McKeever *et al*, 1981). The suggestion that the 'primary process' dream world is the province of the right hemisphere (Hoppe, 1977) has been challenged by the finding that split-brain patients experience dreams during REM sleep which, like normals, they can recall on being woken. This implies that at least some dreams are available to the speaking left hemisphere (Greenwood *et al*, 1977). The controversial syndrome of multiple personality, where not feigned, is probably an extreme form of dissociation (Fahy, 1988). Some authors have taken Sperry's notion of the two hemispheres having "separate streams of consciousness" (Sperry, 1968) to an extreme by postulating that each person-

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ality resides in one or other side of the brain. The theory would be somewhat more plausible if it were not for the fact that unlike Dr Jekyll and Mr Hyde, the number of multiples frequently exceeds two! Despite the obvious flaw, it is possible to conceive of this as a scientific version of themes which run throughout history, namely good versus evil, heaven and hell, the magical and the commonplace (see Jaynes, 1976). To go as far as to suggest that these archetypes are an actual product of man's dual brain rather than a convenient hermeneutic explanation for his multifarious nature is rather doubtful. Nevertheless, the idea that each hemisphere may be conscious does question our intuitions about selfhood and identity in profound ways, and has attracted much earnest philosophical inquiry (Popper & Eccles, 1977). Again, the evidence available from studies looking at each hemispheres' view of itself points to a large degree of unification and consistency (Sperry *et al*, 1979). Probing the values and beliefs of each separated hemisphere in one young man revealed high concordance except for career choice, where the left hemisphere chose "draftsman" while the right preferred "automobile racer" (LeDoux *et al*, 1977). Indeed, even the strategy of having one hemisphere play the other at chess failed to produce dramatic conflict (MacKay & MacKay, 1982). It seems that we may have to draw a distinction between having two potentially independent cognitive systems and having two selves.

Psychiatric consequences of splitting the brain

Careful observation of patients after commissurotomy over many years has failed to reveal any obvious psychopathology. In fact, the most remarkable consequence, apart from mild memory and motor impairment, is their 'social ordinariness'. Where neuropsychiatric abnormalities are present, they are just as likely to be due to prior brain damage and/or epilepsy. One report of six patients before and after callosum section (Ferguson *et al*, 1985) includes brief descriptions of behaviour and personality and concludes that if anything, these parameters were improved. Hoppe (1978), a psychoanalyst, carried out detailed psychodynamic evaluations of patients from the California series and found that they had restricted fantasy lives and were poor in expressing emotions. This apparent "alexithymia", thought to underlie many psychosomatic conditions, has been quantified (Ten-Houten *et al*, 1986), although the validity of the construct has yet to be established and the use of a non brain-damaged comparison group may account for many of the differences noted.

Some striking motor phenomena have been recorded, especially shortly after commissurotomy, which bear a superficial resemblence to the psychotic symptom of passivity, i.e. delusions of influence (see Lishman, 1971). For example, one patient complained that, while attempting to get dressed using one hand, the other hand would busily try to undress him. When another patient was observed assembling a complex puzzle, and "... it was apparent from his facial expression that ... the right hand had performed incorrectly, the left hand ... restrained by the experimenter would sometimes reach out and correct the error." On other occasions, the subject was unable to arrange test items, "... mainly because the right hand would always try to help and would consistently undo the superior accomplishments of the left." (Gazzaniga *et al*, 1965). These incidents, although suggesting a conflict of wills, lacked any of the accompanying delusional elaboration seen in schizophrenia.

Implications for psychiatric research

In 1844 the eccentric English general practitioner Arthur Ladbroke Wigan came up with the idea that insanity ensued when the two brain hemispheres failed to act together in harmony (Clarke, 1987). This thesis remained largely forgotten until it was reported that the corpus callosum was thickened in the post-mortem brains of schizophrenic patients (Rosenthal & Bigelow, 1972). Following this, psychologist Stuart Dimond applied those techniques he had developed in his studies of the split brain to psychiatric patients (Beaumont & Dimond, 1973). The study stimulated an already growing interest in the influence of cerebral laterality on psychopathology (see Flor-Henry, 1983). There is much debate as to whether the abnormalities detected are due to dysfunction in one or other hemisphere (Walker & McGuire, 1982; Robertson & Taylor, 1987; Cutting, 1985) or the transmission between them (Randall, 1983; David, 1987) and whether the morphology of the corpus callosum is in fact different in schizophrenia (Nasrallah *et al*, 1986).

In conclusion, disorders of mood, motivation, perception, thought, etc., can each be examined in the context of the split-brain syndrome, which offers an exciting new explanatory model. However, researchers would do well to remember the pitfalls open to those who try to explain too much on the basis of one line of enquiry and who wish to simplify the baffling complexity of mental illness.

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