Cerebral Commissurotomy in Man
Minor Hemisphere Dominance for Certain Visuospatial Functions

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Huglings Jackson[22] wrote in 1864, "If, then, it should be proved by wider evidence that the faculty of expression resides in one hemisphere, there is no absurdity in raising the question as to whether perception—its corresponding opposite—may not be seated in the other." Nielsen[27] showed in 1937 the dominance of one occipital lobe over the other; and more recently Critchley[8] discussed asymmetry in parietal lobe functions. Recent experiments by Sperry[23,24] have drawn new attention to the functions of the corpus callosum, among them the possible integration of dissimilar or complementary capacities of the two hemispheres. Dide[27] in 1938 considered the complementary functions of the two hemispheres to be symbolic versus gnosis-kinesthetic. However, an increasing accumulation of clinical data suggests that complementary functions in man may be verbal v. visuospatial.

Brain[7] reported a series of patients with right cerebral tumors whose visual disorientation disabilities were greater than their other defects. Heimburger and Reitan[21] suggested that tumors might be lateralized to the left or to the right depending on whether the patient had more difficulty with writing or drawing. Although localization studies on tumor patients are notorious for pressure and other secondary symptoms, support has come from studies of patients with circumscribed injuries or infarction. For example, Olsen's[29] patient with a right parietal thrombosis had visual agnosia but had excellent visual acuity, played the piano and conversed well. Especially notable are studies by modern neuropsychologists: Paterson and Zangwill[25] emphasized the importance of the right hemisphere in constructional apraxia, a conclusion supported by Piercy and Smyth[22] in their recent review of this subject. Hécaen and Angelergues[20] found that of 18 unilateral lesions with agnosia for faces, 16 were on the right side; of the remaining 2 patients, one was known to be left-handed. Teuber[36] found visual seizures in 15 patients, the injury being predominantly right-sided in 13 cases. Delimitation of the lesions is perhaps more exact with surgical removals such as temporal lobectomy: Milner[24] found verbal deficits following left-sided ablations and visuospatial deficits on the right.†

It was suggested by Bard and Brooks[8] that acceptance of the localization of a particular function to a particular area requires affirmative as well as negative evidence. That is, not only must there be loss of the function with injury to the specific area, but there should also be preservation of the function when the specific area remains intact in the event of widespread surrounding loss. Such a criterion is particularly relevant here since Denny-Brown[10,11] has pointed out that certain visuospatial (which he terms morphosynthetic) processes in the left hemisphere may suffer losses difficult to demonstrate because of the more important losses in certain language (propositional) processes.

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† It should be pointed out that the difference is one of degree, just as the left hemisphere is dominant rather than exclusive in language function. See Nielsen,[28] Subirana,[26] Zangwill,[28] Critchley,[9] on the role of the minor hemisphere in language and the more general question of relative dominance.
Hemisphere Dominance in Cerebral Commissurotomy

Affirmative evidence for lateralization of visuospatial function was found by Mullan and Penfield, in 217 patients with temporal lobe epilepsy, had visual illusions, arising in 11 cases from the hemisphere minor for handedness.

Affirmative evidence of visuospatial dominance in the minor hemisphere has recently become available from of our patients who had complete section of the corpus callosum and anterior commissure for the treatment of seizures. The first patient's clinical history and surgery have been discussed before in detail. Our second patient was operated upon in September 1963, and has had a smooth postoperative course with complete relief of convulsions to date; a more detailed report is in preparation. Both of these patients, W. J., a 48-year-old man, and N. G., a 30-year-old woman, were always right-handed and right-footed and without lefthanded near-relatives except N. G.'s maternal uncle.

§ Part of the relevant data has been presented as part of an extended discussion of visual perception following commissurotomy (Gazzaniga et al.)

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FIG. 1. (Upper left) Two months before operation, W. J. uses the left hand fairly well for writing although he is right handed. (Upper right) The right hand writes better than the left. (Lower left) Two months before operation both hands copy a Greek cross correctly; the right shows better motor coordination. (Lower right) Two months after operation the left hand is apraxic and cannot effectively copy the Greek cross. The right hand is well coordinated but the design is misshapen.

FIG. 2. (Upper left) Before operation, N. G. writes legibly with the left hand. (Upper right) The right hand writes better than the left. (Lower left) The left hand draws well from a model (the wisp of smoke was not in the model). (Lower right) The right hand draws, from a model, with slightly more assurance than the left.

FIG. 3. (Upper left) Two years after operation, a pencil was placed in W. S.'s left hand and he was asked to write a simple arithmetic problem (14X5). He managed a few scrawls, scowled, and said "argh." The word "TODAY" was printed on the same sheet of paper and he was asked to copy it. He succeeded at first, slowed down, growled again, and threw down the pencil. (Upper right) The pencil was placed in his right hand and he was asked to multiply 815 by 34. He completed the writing as shown and then shook his head saying, "I have trouble seeing the numbers." (Lower left) The pencil was then used to draw a model cube. It was placed in his left hand and he was asked to copy the model on the same sheet of paper. When he finished the eighth line, the hand moved to one side and rested. (Lower right) With a new sheet of paper, the pencil was used to draw a second model and then placed in his right hand. He drew seven lines and stopped. He was asked, "Should there be some more lines?"; he then drew the last two lines and stopped, again shaking his head.