THE PROBLEM OF CEREBRAL DOMINANCE 1*

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Le problème de dominance cérébrale

The concept of hemispheric cerebral dominance arose from Broca’s observations of the association between aphasia and disease of the left hemisphere. For a number of decades the concept of left hemisphere dominance was confined to language functions. However, the work of Liepmann and of Gerstmann led to extension of the concept to cover certain praxic and orientational capacities. More recent work has forced consideration of the possibility that the right hemisphere is either absolutely or relatively dominant for the abilities involved in certain aspects of non-verbal behavior. The question as to whether the right hemisphere does in fact have distinctive functions in the mediation of behavior that are not shared by the left hemisphere must still be regarded as open. It is a question which deserves intensive exploration.

Le problème de dominance cérébrale

La notion de dominance hémisphérique cérébrale provient des observations de Broca concernant l’association de l’aphasie aux maladies de l’hémisphère gauche. Pendant plusieurs décennies, cette notion de dominance de l’hémisphère gauche se bornait aux fonctions du langage. La notion s’est toutefois élargie, grâce aux travaux de Liepmann et de Gerstmann, pour atteindre ensuite certaines capacités de praxie et d’orientation. Des travaux plus récents obligent désormais à considérer la possibilité d’une dominance hémisphérique droite (absolue ou relative) quant à certains aspects du comportement non-verbal. La question reste encore ouverte, cependant, de savoir si certaines fonctions spécifiques, dans le comportement, relèvent exclusivement de l’hémisphère droit sans qu’elles participent en rien à l’hémisphère gauche. Cette question mérite des études approfondies.

My topic is concerned with the idea that the cerebral hemispheres are not equipotential. It is the concept that one cerebral hemisphere serves distinctive functions in the mediation of behavior which are not shared by the other. It postulates a particular type of cerebral localization, namely hemispheric localization, and indeed a special form of hemispheric localization.

The idea of localization of cerebral function along the anterior-posterior dimension of the brain, without regard to hemisphere, is a very old one. It was introduced into medical thought almost 2000 years ago in the form of a “localization” of perception, reasoning and memory in the anterior, middle and posterior parts of the brain respectively. This tripartite localization became quite popular and persisted for many centuries (cf. Pagel, 1958). And in at least one of its forms, the concept of hemispheric cerebral localization is even older. One finds in the Hippocratic writings (ca. 400 B.C.) the observation that “an incised wound in one temple produces a spasm in the opposite side of the body” (Chadwick and Mann, 1950) and this concept of crossed innervation was accepted on a clinical level by a number of medical writers who, however, were not in a position to provide evidence in support of its validity. It remained for Pourfour du Petit to demonstrate it experimentally in animals in 1710 and for Morgagni to establish it beyond doubt for man somewhat later in the 18th century.

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In contrast, the concept of hemispheric dominance is only 100 years old. As we know, it arose out of Broca’s observation in 1861 of the association between aphasia and lesions of the left frontal lobe and, within a few years, it became accepted doctrine. Broca’s observation in itself was not a new one. The concomitant occurrence of aphasia and right hemiplegia (and thus, by implication, of aphasia and left hemisphere disease) had been described scores of times (cf. Benton and Joynt, 1960; Benton, 1964). But the inference that aphasia was specifically related to disease of the left hemisphere had not been drawn, not even by so astute an observer as Morgagni who had assembled a mass of convincing clinicopathological evidence in support of the association between paralysis of one side of the body and the presence of disease in the opposite cerebral hemisphere.

If we ask why this seemingly obvious inference was not made by the earlier observers, a number of possible reasons come to mind. First, the two hemispheres are very much alike structurally and this would suggest the same rather than different functions. Then the discovery of the facts of crossed innervation must have reinforced the idea that, while the two hemispheres serve opposite sides of the body, their functions are qualitatively identical. Finally, theological and philosophical considerations played a role in retarding exploration of the idea that the higher mental processes could have their seat in one hemisphere but not the other. Since these processes belonged to the non-corporeal soul, centrally located or symmetrical structures such as the pineal body and the cerebral ventricles seemed to be more suitable places for the soul to interact with the body.

In this respect, it is worth noting that Broca himself was extremely cautious — one might even say, inhibited — in drawing inferences from his observations of 1861 (cf. Joynt, 1964). By 1863, he had assembled 8 cases of aphasia with verified left frontal lobe disease as well as one negative case with disease of the right frontal lobe. But in reporting his findings that year, he simply stated: “Here are 8 cases where the lesion is situated in the posterior portion of the third frontal convolution... and, a most remarkable thing, in all of these patients the lesion is on the left side. I do not dare to make a conclusion and I await new findings.” It was only two years later, in 1865, that Broca finally advanced the idea that aphasia was specifically related to disease of the left hemisphere and enunciated his famous dictum, “nous parlons avec l’hémisphère gauche.” What role the memoir of Gustav Dax, submitted to the Paris Academy of Medicine two years before, may have had in pushing Broca toward this conclusion is an entirely open question (cf. Joynt and Benton, 1964).

Once enunciated by Broca and Dax, the specific association between aphasia and disease of the left hemisphere was immediately accepted and, at virtually the same time, certain qualifications were advanced. Some people “speak with the right hemisphere.” For the