

ON HUMAN NATURE

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Anonymous, Valentine, c. 1850

Hands and Minds

On a clear spring afternoon in 1915, in the no-man's-land between the trenches at Marchéville, France, thousands were destroyed by machine gun fire, among them Robert Hertz. Hertz, age thirty-three, was a second lieutenant in the French infantry, a husband, and the father of an infant son. He was also foremost among the pupils of Emile Durkheim—considered, in fact, most likely to succeed Durkheim as the reigning figure in French sociology. Nearly seventy years after Hertz's death, in November of 1984, Norman Geschwind, the reigning figure in the discipline of behavioral neurology—the analysis of behavior through the study of the brain—died of a heart attack. There is a kind of tragic symmetry in these untimely deaths, not just because each man was felled by a common killer of his day but because the two scholars had approached the same subject from opposite ends: through the study of culture, on the one hand, and of anatomy, on the other. Indeed, there is a kind of symmetry (or, really, a kind of asymmetry) about the subject itself, because

theirs was the study of right and left.

Of the several influential papers that Hertz had published by his early thirties, one was to prove of lasting influence: "La Prééminence de la main droite: étude sur la polarité religieuse"—"The Preeminence of the Right Hand: A Study in Religious Polarity." This essay was a reasoned yet impassioned look into the cross-cultural symbolism of right and left, symbolism that had imparted a near-universal and, in Hertz's view, illegitimate aura of superiority to the right hand and everything connected with it, however arbitrarily. He began by observing that in primitive thought dualities are not only commonplace but central—sacred and profane, noble and base, decent and sinister, cultivated and wild, high and low, light and dark, hot and cold, male and female. This observation has stood the test of time (although as Claude Lévi-Strauss and other modern anthropologists have pointed out, dualisms—in particular, good and evil, "we" and "they"—are as characteristic of the "primitives" in the White House and the Kremlin as of the

ones who rule greener jungles).

Hertz showed not only that "right versus left" was one of the main dualities in many cultures, but also that it was consistently associated with these more abstract polarities. During ceremonies among the Wulwanga of Australia, the right hand held a stick that signified strength and masculinity, while the left held a stick representing weakness and femininity. In the sign language of the Indians of North America, the right hand could be used to symbolize bravery, power, virility, high, and "me," while the left signified death, destruction, burial, low, and "not-me." Among the natives of the Guinea coast, the very touch of the left thumb to food was thought to introduce a lethal poison.

In the decades following Hertz's death, as his essay began to inspire field and historical studies, the examples multiplied. But these cross-cultural studies, while underscoring the universality of the right-left duality, did not invariably give right the superior aesthetic and moral color. Apparently Hertz had been unaware that the case of China introduced distinctive

subtleties and a kind of balance—a balance that surely would have pleased him. In the yin-yang duality, yin signifies right and female, while yang signifies left and male. In various settings, traditional Chinese etiquette gave preference alternately to the right or left side, often according to quite complex rules. Sometimes blood from the right arm was used to consecrate an oath, but on other occasions it was blood from the left ear. When expecting to be punished, one uncovered the right shoulder, but when attending a joyful gathering, the left. The Chinese had evidently developed a system of crossed and interlocking dichotomies that rose above the usual simple dualities, suggesting that humanity is not condemned to follow rigid symbolic polarities.

Hertz's belief in the ubiquity of the right-sided bias led him to advance a striking hypothesis about the origins of right-handedness. He began by citing the work of the great French neurologist Paul Broca, who had shown a half century earlier that the speech faculties of the overwhelming majority of people are situated in the left hemisphere of the brain, which controls the right side of the body, while the right hemisphere controls the muscles on the left. Broca, to explain the preeminence of the right hand, asserted that the left hemisphere was by nature the dominant hemisphere.

Hertz did not deny the dominance of the left brain, but he challenged Broca's contention that the dominance was in-born. He speculated that the imposition of right-handedness on infants and young children was the *cause* of left-brain dominance in most people. As evidence he cited the large number of people—a great majority, he believed—who are naturally ambidextrous but become right-handed through training. Hertz seemed to feel that his viewpoint was needed to redress the imbalance of centuries: "If the constraint of a mystical ideal has for centuries been able to make man into a unilateral being, physiologically mutilated, a liberated and foresighted society will strive to develop the energies dormant in our left side and in our right cerebral hemisphere, and to assure by an appropriate training a more harmonious development of the organism." This statement, from the closing passage of "La Prééminence de la main droite," is remarkable for having come decades before research would convincingly demonstrate the unique aesthetic, musical, and emotional sensitivity of the right, nondominant hemisphere of the brain—as contrasted with the more analytical bent of the left hemisphere—and before some psychotherapists would on those grounds argue for hemispheric "balance" in much the same terms.

The "two brains" were never far from Norman Geschwind's mind. He viewed

hemispheric specialization as the evolutionary novelty responsible for some of the most impressive features of the human mind, such as complex language and abstract thought. In 1968, he and the neurologist Walter Levitsky published a key paper in *Science* showing a consistent anatomical difference between hemispheres in the structure of the planum temporale, a part of the temporal lobe involved in speech perception. Later, he and a number of younger colleagues became interested in a kind of epilepsy that seemed to result from damage to that lobe, a disorder characterized not only by seizures, often preceded by an "aura," or a sense of *déjà vu*, but also by an odd behavioral syndrome that affects the patient between seizures. It consists—with much variation—of unusually fervent religious conviction, reduced sexual interest, recurring anger, the production of voluminous amounts of writing, and a certain behavioral "stickiness"—a tendency to keep returning to the physician with minor questions.

The work of the neuropsychologists David Bear and Paul Fedio, inspired by Geschwind, has recently added detail to the once-vague picture of the syndrome; temporal lobe epileptics whose seizures originated in the right hemisphere had largely emotional disturbances between seizures, while those with left-hemisphere seizures had more ideational aberrations.

The most original and, potentially, the most broadly significant project of Geschwind's life was his final work on left-handedness. He had been interested in the phenomenon originally for the light it shed on the division of labor between the two hemispheres, but the subject eventually led him to a series of investigations ranging from immunology to anthropology to genetics and culminating in a fundamental challenge to some central dogmas of developmental biology.

Some characteristics, Geschwind noted, are passed on to offspring in ways that do not make sense in terms of Mendelian genetics; these traits are fundamentally different from blue eyes or the ability to roll one's tongue into a U in that the probability of a given child's inheriting them cannot be confidently predicted from the characteristics of parents and other relatives. Left-handedness is a prime example. Although it certainly runs in families, decades of study have failed to reveal the exact pattern of inheritance. Geschwind's eventual explanation of this fact was grounded in one of his characteristic off-hand observations.

Beginning around 1980, he noticed that left-handedness tends to be associated with certain other traits, notably dyslexia and other learning disabilities, migraine headaches, and "autoimmune diseases," a category of illnesses, such as rheuma-

toid arthritis, caused by an immune system so indiscriminately active as to damage the body's organs.

Geschwind's explanation of this pattern was even bolder than his intuition of the associations themselves: all of these traits, he believed, are related to the influence of the male hormone testosterone *in utero* on the development of fetal organs. Citing evidence from experiments with animals, he argued that testosterone slows the growth of the left cerebral hemisphere and that unusually large amounts of it permit dominance by the right hemisphere, and thus by the left hand. Hence the greater frequency of left-handedness in males than in females.

But how could testosterone be linked to migraines and learning disabilities? Really excessive or poorly timed release of the hormone, Geschwind thought, would cause marked abnormalities of the left hemisphere, in the one case giving rise to periodic pain and in the other impairing the brain's ability to master such skills as reading. Such a structural abnormality had been observed during an autopsy on a dyslexic patient. And, since the incidence of dyslexia is four to eight times greater in boys than in girls, the idea that testosterone plays a role in it had an immediate plausibility.

Geschwind's theory about the link between testosterone and autoimmune diseases seemed even more farfetched at first, but he found experimental support. In rats and mice, testosterone slows the growth of the thymus gland, which appears to be responsible for the development of "self-recognition"—the ability of antibodies to distinguish between foreign matter, such as germs, and the body's own cells. Excessive amounts of testosterone in humans, then, might limit the immune system's ability to distinguish invader from ally, thus leaving the body exposed to autoimmune attacks. In a single stroke, Geschwind had provided a fairly plausible explanation for phenomena so diverse that no one had detected any connection among them.

What does Geschwind's writing have in common with Hertz's seminal essay, written more than half a century earlier? First, Geschwind's work, along with other research, confirmed Hertz's suspicion that the left-right dichotomy is to some extent a false one—and not just culturally, but neurologically. Far from being a species of either-or individuals, with a vast majority of right-handers and a minority of equally immutable left-handers, we are in fact on a continuum between the two extremes, with an infinitude of ambidextrous grades. As a species, we certainly lean right, but the absolute left-hander is rare and the absolute right-hander not all that common. Geschwind

would probably agree with Hertz that many individuals in the intermediate range are forced by training to abandon ambidexterity and are crowded onto one side of a very dubious dichotomy.

Of course, Geschwind's explanation of the origin of hemispheric dominance was biological, in contrast to Hertz's cultural determinism. But Geschwind, like Hertz, challenged genetic dogma, invoking a set of influences more complex than simple Mendelian heredity. If the difference between a left-hander and a right-hander lies partly in the level of testosterone during intrauterine life, then it is no wonder that we cannot discern a strict pattern of inheritance. Genes will still play a role, but so will the less predictable forces of the mother's hormone flux and her various other contributions to fetal metabolism. Generalizing from this and other observations about intrauterine development, Geschwind theorized that many mysterious patterns of inheritance would come down to the physiological climate of the womb—itsself determined partly by genes, but also by the environment—and that classic Mendelian laws would explain, in the end, only a small minority of hereditary traits.

At the time of his death, Geschwind was fifty-eight years old, a husband and father of three. At Harvard, he occupied the James Jackson Putnam chair in neurology, and he served as chief of the busy neurology department in Boston's Beth Israel Hospital—a vigorous clinician and teacher who intervened daily to improve the lives of patients and young physicians. He was on the verge of publishing a major series of papers on his theory of left-handedness. These have just begun to appear (in the *Archives of Neurology*, written with Albert Galaburda) and no doubt will have a major influence. Still, it is a great loss that he will not be here to parry the inevitable criticisms with his well-known eloquence and wit.

Geschwind claimed to dislike aphorisms, but he had some very fine ones. "Remember that there are no coincidences"—any seemingly odd association between disparate observations may pay off. "Don't standardize too quickly"—if you decide too soon what variables to measure, you may miss a valuable insight. "Abandon common sense"—unusual explanations are better. "Cultivate naïveté." Perhaps this advice could be summarized (though I suspect that Geschwind would object to the oversimplification) as "Use your right hemisphere, not just your left." ●

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