
Teaching the Right Brain: Historical Perspective on a Contemporary Educational Fad*

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INTRODUCTION

At least since the time of the ancient Greeks, theories about the structure and function of the mind and brain have had a continuing and often profound influence on thinking and practice in education. A familiar example is Aristotle's idea that memory requires the ordering and association of images with one another according to the principles of similarity, contrast, and con-

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tiguity (Aristotle, 1964). This model was influential for over 1000 years and even today is the basis for some systems of memory improvement (Yates, 1966; cited in Wittrock, 1978).

The successful application of scientific knowledge to the solution of educational problems would seem to depend on the extent to which the enterprise meets certain interlocking requirements. Prominent among these are the following: The scientific knowledge itself should be at a sufficiently advanced stage that some application can be reasonably contemplated; the nature and scope of the educational problem must be adequately understood; those persons taking on the onerous job of translating the scientific data into educational practice must adequately understand both ends of the equation; the practical and theoretical limits of any such application must be ascertained and respected; and, related to the last point, excessive zeal and polemicism should be curbed so as to discourage the all-too-human appetite for fads and simple answers.

In this chapter, I discuss these issues and problems as they pertain to educational applications of a topic currently of keen interest to educators, namely, neuropsychological research on the functions of the cerebral hemispheres. Indeed, as we shall see, in each era of major discovery on this topic, from the pioneering work of Paul Broca in the 1860s, which first established the principle that the anterior part of the left hemisphere is the seat of speech, or articulate language (Broca, 1861, 1863), to the discoveries of our own day, educators have tried to put the new knowledge to practical use.

TEACHING THE LEFT BRAIN

Of the various applications of research on lateral specialization, one that is probably familiar to most readers pertains to language problems, or, as some might say, with teaching or enhancing the left, or language-dominant, part of the brain. This application originates, in large part, in the theory of the American neurologist and psychiatrist Samuel T. Orton (1928, 1937; see Gladstone & Best, Chapter 4, and Kershner, Chapter 11, this volume). Orton's theory was developed within the context of several advances in theories of lateral specialization: Broca's was one. Following his initial reports on the role of the anterior part of the left hemisphere for speech (1861, 1863), Broca went on to propose a link with manual specialization, or handedness, so that right-handers speak with the left hemisphere, left-handers with the right hemisphere (Broca, 1865). Subsequently, other researchers proposed that, in right-handers, the left hemisphere was the seat not only of the ability to speak but of a host of other linguistic and intellectual skills as well, including

the comprehension of speech (Wernicke, 1874) and the capacities to read and write (e.g., Dejerine, 1891).

What Orton (1928, 1937) noted was that children having profound difficulties in reading and writing (but who otherwise were intellectually normal) showed frequent and prolonged confusions in recalling the directional orientation of letters and words. Many of these children also were what Orton called "motor intergrades," that is, they showed incomplete or mixed lateral motor dominance expressed as inconsistent hand preference or as a disjunction of hand preference from foot or eye preference. To explain this combination of symptoms, Orton made two assumptions: First, whichever cerebral hemisphere was dominant for visual language skills (following Broca, Orton assumed that this normally would be the left hemisphere for right-handers and the right hemisphere for left-handers; 1937, p. 130), that hemisphere would record letters and words in the correct orientation, while the other, nondominant hemisphere recorded them in reversed orientation; second, the incomplete or mixed *motor* dominance in the motor-intergrade child reflected incomplete, or mixed, *cerebral* dominance (with the implication that lateral specialization was itself a maturational phenomenon and normally increased with age). Orton therefore proposed that the motor-intergrade child's directional confusion in reading and writing arose from the lack of unilateral dominance of the visual language area of the brain.

From his analysis, Orton developed a complex, multisensory program for remediation, which included, but only as a relatively minor feature, measures to correct the child's motoric inconsistencies. For example, if a child who wrote (badly) with the right hand showed clear signs that the left hand was naturally dominant (as indexed by other motor tests), Orton suggested a trial period of change to left-hand use to see whether some of the child's writing problems might be alleviated (see Orton, 1937, Chapter 3).

Orton's remedial programs were experimental and highly individualized. He emphatically rejected any "simplified and universally applicable formula" (1937, p. 143) as is evident in his cautious and undogmatic proposals for changing a child's writing hand. Others, however, have been avid for formula, the result too often being the promotion and faddish embrace of rigid, simplistic programs. One example is the Doman-Delacato group (Delacato, 1959, 1966; Doman, Spitz, Zucman, Delacato, & Doman, 1960). Convinced that the presumably missing unilateral hemisphere dominance in the disabled reader could be directly established by dominance training of hand, foot, eye, and well as ear (a possibility that Orton himself rejected on theoretical grounds; 1937, p. 174), they have made such training the centerpiece of a radical therapeutic program in which they promise to cure a broad spectrum of reading, writing, and other language problems. The program not only restricts use of the subordinate limb and eye; it also bans music

from the child's environment on the assumption that any nonlinguistic activity will disrupt the progress of cerebral dominance training (see Delacato, 1966, p. 27; for evaluation, see Robbins & Glass, 1968).

Current Developments in Research on Lateral Specialization

In Orton's day, indeed before the 1950s, the scientific analysis of lateral specialization was still relatively limited. Beginning in the 1950s, research has grown at an ever-accelerating pace, stimulated by the dramatic studies of commissurotomed (split-brain) individuals by Roger Sperry and his colleagues and students and by the related research on both brain-injured and normal individuals by such leading figures as Arthur Benton, Harold Goodglass, Henri Hécaen, Alexander Luria, Brenda Milner, Wilder Penfield, and Oliver Zangwill. The result has been a substantial growth of our knowledge of lateral specialization, including the amplification as well as the correction of certain earlier views.

For instance, we continue to elaborate and refine our understanding of the nature of cerebral specialization for language, as the reports in such specialty journals as *Brain and Language* amply attest. Among many other things, contemporary research has strongly supported Broca's (1865) postulate about the role of the left hemisphere for speech, although the precise role of what Broca named as the critical area—the left third frontal convolution—remains uncertain (see Mohr, 1976). Research also has aimed at a more careful specification of the nature of left-hemisphere specialization. For example, the left hemisphere seems to be particularly good at analyzing consonant sounds, dealing with grammatical categories, and classifying objects into standard linguistically defined categories.

We also understand better (although still imperfectly) the linkages between handedness and language lateralization. Broca (1865) was fundamentally correct in postulating that right-handers speak with the left hemisphere; but it is not the case that left-handers either speak with the right hemisphere or, as Orton (1937) and many others assumed, have visual language control on the right side. Current estimates vary but indicate that perhaps as many as two-thirds of left-handers are *left*-lateralized for linguistic functions, with the remainder either right-lateralized or bilateral. This may explain why left-handers as a group are more weakly lateralized than right-handers and why they also are more likely to suffer aphasia following unilateral cerebral lesion to either side and are more likely to recover function (Hécaen & Ajuriaguerra, 1964; Hécaen & Sauguet, 1971; Satz, 1980).

Today, we also have a better understanding of the developmental nature of lateral specialization. Through the 1960s, a widely accepted theory (implicit, as I suggest above, in Orton's model) was that lateralization is pro-

gressive, increasing with age from either no or limited lateralization in infancy to full lateralization by adolescence or adulthood (Lenneberg, 1967). More recent evidence has shown that the cerebral hemispheres are structurally and functionally different even in early infancy (see reports in G. Young, Segalowitz, Corter, & Trehub, 1983) and that, notwithstanding the many neurological and neurobehavioral changes that take place over time, the extent of lateral specialization itself does not appear to change (Goodman & Whitaker, Chapter 5, this volume; Harris & Witelson, 1977; Kinsbourne & Hiscock, 1978).

Orton's (1937) theory of reading disability likewise has been found wanting. As Zangwill (1960, p. 14) pointed out, the notion that one-half of the brain records patterns correctly, the other half incorrectly, was "decidedly speculative" (p. 14) and has found little acceptance among neuropsychologists. Likewise, after much research, there is no indication that mixed or incomplete motor dominance is related simply or directly either to cerebral dominance or to reading disability and other language problems (Naylor, 1980; A. W. Young & Ellis, 1981). (This is not to say that developmental disorders of language are unrelated to anomalies of lateralization or that Orton was incorrect in some of his other characterizations of disabled readers; see discussion in Corballis, 1983, Chapter 8; Geschwind, 1982).

There also is no evidence that unilateral cerebral dominance for language functions can be enhanced by direct training of the contralateral limb (a view that, as I said, Orton himself rejected). Therefore, even if there were a simple, direct relationship between mixed cerebral dominance and language disabilities, attempts to remediate such problems through motor training appear to lack any scientific basis (see discussion in Kinsbourne & Hiscock, 1978). Nevertheless, these practices evidently persist, bolstered by the continued acceptance of the now-questionable age-progressive theory of lateral specialization. As Kershner (Chapter 11, this volume) says, "The belief is still widely entertained that it might be a good thing for us as educators to be able to expedite the assumed age-related progressive increase in brain specialization."

Of all the more recent scientific evidence on lateral specialization, perhaps what has most captured the public's (as well, perhaps, as the scientists') imagination pertains to the *right* hemisphere rather than the left. From Broca's time until as late as the 1950s, the right hemisphere was widely believed to be not only mute and alinguistic but generally inferior, lacking any special functions or skills of its own. By this earlier view, the term *cerebral dominance* thus came to be used in an absolute sense, with the left hemisphere regarded as the dominant or major hemisphere for all cognitive domains, the right hemisphere as nondominant or minor. Today, however, we

know that the right hemisphere, rather than being inferior to the left, plays a special and, in many instances, leading or dominant role in various tasks. These tasks perhaps are best described as requiring the perception, recognition, and memory of information that does not lend itself to linguistic description or analysis. (In fact, Broca's contemporary, the great English neurologist John Hughlings Jackson, 1874/1915, and *passim*, anticipated several of these new developments, although his views were not generally heeded at the time; see Benton, 1972). Examples of right-hemisphere specialization include the encoding of certain components of musical structure (Gates & Bradshaw, 1977), face recognition and the interpretation of facial expression (see Levine, Chapter 6, this volume), visualization in the third dimension, and appreciation of spatial relationships, for example, localization of points in space (see Kirk, Chapter 7, this volume). New evidence also suggests a prominent role for the right hemisphere in the perception, experience, and expression of affect and emotional states (Heilman & Satz, 1983). As part of its specialized role in affect and emotion, the right hemisphere also appears to play a leading role in analyzing the prosodic, as distinct from the semantic or syntactic, features of language. We know also that the right hemisphere, although lacking the capacity for speech, is not lacking in certain restricted aspects of linguistic processing, including the comprehension of spoken words (Gainotti, Caltagirone, Miceli, & Masullo, 1981; see also Goodman & Whitaker, Chapter 5, this volume; and Searleman, 1977).

TEACHING THE RIGHT BRAIN

New scientific discoveries inspire new educational applications. Thus, whereas Orton's theory (1937) may be said to have focused attention on the left, or what is normally the language-dominant, hemisphere and on disabilities in such basic language skills as reading and writing, the more recent reports documenting the nonlinguistic talents of the right hemisphere have stimulated an equally strong concern among educators in quite a different direction, namely, for nonlinguistic (or not obviously linguistic) skills. The skills comprising this group have ranged from music, art, and mathematics to visualization, imagination, creativity, empathy, and intuition.

Thus, in the reports about right hemisphere specialization, many educators see what they believe is a new educational message: Where children show deficiencies of either interest or skill in these and other presumably nonlinguistic domains, the reason must be over-development of the left hemisphere and underdevelopment of the right. The results of this thinking show all the signs of an educational fad favoring training the right

brain, a fad even stronger than the older movement for training the left. The symptoms are unmistakable: Ambitious educational claims are made about the benefits of stimulating the right brain; special mental exercises are proposed; our usual educational style (the old orthodoxy) is denounced as "left-brained," and its evils in contrast to the virtues of the right-brain psychology are fervently recited; and finally, all this is propagated through the news media, profit-making conferences and workshops, education journals, popular science magazines such as *Brain-Mind Bulletin* and *Science Digest*, and a seemingly endless stream of pop psychology and self-help books such as *The Right Brain* (Blakeslee, 1980), *Drawing on the Right Side of the Brain* (Edwards, 1979), *The Aquarian Conspiracy* (Ferguson, 1980), and *The Psychology of Consciousness* (Ornstein, 1977).

A few cullings from the literature will give a bit of the flavor of this thinking. A professor of music education laments the fact that conventional education has overdeveloped the left hemisphere "to the detriment of the 'whole' person" and tends "to minimize and even atrophy right-hemisphere thinking, which is responsible for music processing of stimulus input" (Regelski, 1977, p. 44). In other words, this critic would put back into the curriculum what the Doman-Delacato group urged be left out.

A principal of an elementary school writes:

The [scientific] findings . . . powerfully suggest that schools have been beaming most of their instruction through a left-brained input (reading and listening) and output (talking and writing) system, thereby handicapping all learners. Students who learn well through left-brain inputs have had minimal or haphazard practice in using their right brains. (Hunter, 1976, pp. 46, 47)

The director of a day school declares, "The present process of education establishes the dominance of the left hemisphere, leaving only a few functions, such as spatial and artistic forms to the right" (Beckman, 1977, p. 155).

Professors of mathematics and science education warn that "the mathematics curriculum in most schools provides little encouragement of right-hemisphere thought" (Wheatley, 1977, p. 38); "the climate militates against it" (Loviglio, 1981, p. 12, paraphrasing the views of P. Davidson). Indeed, things have gone so far that "there are some who have such dominance of one hemisphere that the other hemisphere is rarely activated" (Wheatley, 1977, p. 38).

Significantly, even some members of the left-brain establishment (i.e., language teachers) have added their voices to the call. Thus, an education professor is joined by a member of the National Council of Teachers of English to decry the school's role as "a primary conveyor of the linear/sequential mode of consciousness and its functions" (Grady & Luecke, 1978,

p. 13). A high-school English teacher concludes that there is "little need to be concerned about the left-brain abilities of most individuals. The traditional schooling experience provides more than adequate practice in developing the power of the already dominant left hemisphere" (Myers, 1982, p. 205). And a professor of English and creative arts, sensing the change in climate and apparently not wanting to be left out, offers advice on *Writing the natural way: Using right-brain techniques to release your expressive powers* (Rico, 1983).

Finally, presumably so that ordinary citizens can determine where their cerebral strengths lie, leading magazines and newspapers publish diagnostic questionnaires. For example, the *Chicago Tribune*, in the article "Left-Right Brain Role Is Studied" (April 22, 1984), invited its readers to "Test yourself. Are you right-brained or left-brained?" To find out, the respondent could rate himself on 21 different items, each with three alternatives, one signifying left-brain strength or preference (e.g., "Not good at remembering faces"), another signifying "right-brain" ("Not good at remembering names"), and the third meaning that "both sides of the brain are interactive ("Equally good at remembering names and faces"). The questionnaire was devised by two professors of education at Brigham Young University who were concerned about the "many right-brained children being taught by left-oriented teachers using left-oriented materials and being evaluated by left-oriented measures. Consequently, they do poorly."

It would be unfair of me to leave the impression that it is only the educators themselves who have voiced such concerns about left-brain education. Some scientists have as well and indeed were among the earliest to speak out on this question. One, for example, wrote, in the journal, *Child Education*: "It appears that our schools have been tutoring only the left half of the brain" (Galín, 1976, p. 17). Another asserted, in the *UCLA Educator*, that society has put too much emphasis on left-hemisphere skills (Bogen, 1975).

For all of these critics, it thus would seem not only that the left hemisphere is alive and well in the public schools, but that the once-favored program for establishing left-hemispheric dominance has been all too successful. The answers the critics propose are educational courses and methods that stimulate greater use of the right brain—"hemispheric balance in the curriculum," as two writers put it (Grady & Luecke, 1978, p. 18).

The rewards, we are told, will be manifold: Mathematical work will improve—"problem solving will be enhanced by greater use of the right hemisphere" (Wheatley, 1977, p. 38). Art will blossom: "A new way of seeing will be developed by tapping the special functions of the right hemisphere" (Edwards, 1979, p. vii); and because art is the key to "unlocking the illusive

qualities of the right hemisphere," it might provide the means for society itself to "become a bit more balanced" ("Leonardo Was," 1977, p. 23). A new scientific rationale for "outdoor education" will be won because the "mystique" of the outdoors, which "many outdoor educators insist . . . makes for effective learning and development of the whole child . . . achieves its ultimate impact on an individual in experiences which are probably sensed and interpreted in the right hemisphere" (Staley, 1980, p. 46). Creativity will be enhanced: "Since creativity . . . might be further developed in the right hemisphere, a new major thrust in education, which might educate the whole brain of the child, could evolve out of current efforts to stimulate early right hemisphere functioning" (Beckman, 1977, p. 115; see also Hermann, 1981).

Students by no means will be the only beneficiaries. Businessmen and managers will profit too: "*The important policy processes of managing an organization rely to a considerable extent on the faculties identified with the brain's right hemisphere.* Effective managers seem to revel in ambiguity; in complex, mysterious systems with relatively little order" (Mintzberg, 1976, p. 53; emphasis in original). (This characterization of the effective manager, I might add, inspired hot dispute in the letters column of the *Harvard Business Review*.) Likewise, the financial investor will gain by following *The Tao Jones Averages: A guide to whole-brained investing* (Goodspeed, 1983).

Indeed, the promised rewards transcend any single intellectual, cognitive, or emotional domain. "Only when people attain what may be called a 'mental ecology,' where all aspects are interdependent and synergetic, can the human race discover its ultimate potential and solve the problems that inattention to the right hemisphere of the brain has caused" (Regelski, 1977, p. 47).

From the vantage point of the period from the 1920s and 1930s to the present, there is irony in this shift in concern—then, stimulate the left brain to enhance cerebral dominance; now, stimulate the right brain for the sake of cerebral balance. But the irony runs deeper still because the shift actually brings us full circle back to an even earlier period. From roughly 1903 to 1915, some educators and scientists also were convinced that the right hemisphere was neglected, envisioned abundant rewards if only it was properly stimulated, and on these grounds started an educational crusade with some striking similarities to current-day developments. The story is very interesting in its own right, but it also offers useful lessons for us today as an illustration of what happens when the application of scientific data to educational problems fails to meet the requirements I named earlier. Therefore, before we consider today's proposals for educating the right brain, let us recount the story of this earlier movement.

THE AMBIDEXTRAL CULTURE SOCIETY

The earlier movement was for what was known as *ambidextral culture*, the equal training of the hands. Its birthplace was England and its time as a formal educational program was, as I said, the early years of the twentieth century. But its origins lay in the 1860s and 1870s, a time, like today, of great discovery about lateral specialization of function in the human nervous system. Unlike today, however, at least in most Western societies, this also was a time of wide-spread prejudice and superstition about one aspect of laterality, namely, left-handedness. The growing literature on handedness often mentioned the biblical, etymological, and social evidence for the inauspiciousness of the left side. The result was that at home and school, left-hand use was widely punished or otherwise discouraged (see Harris, 1980a).

Out of this background, there appeared the English writer and social critic Charles Reade (1878), a widely celebrated author of what he called "novels with a purpose" in which he attacked the evils of Victorian society. An admirer called Reade a "champion of the lunatic and the gaol-bird, and of other helpless and inferior members of the human race" (Lindsay, 1904, p. 129). The left hand being one of those supposedly helpless, inferior members, Reade sprang to its defense as well.

Reade's vehicle was a remarkable essay called "The Coming Man," published in 1878 as a series of letters to the editor of the *London Daily Telegraph* (1878) and, in the same year, in the American magazine, *Harper's Weekly*. There also were articles in the *Illustrated London News*. Reade's style was evangelistic, histrionic, and not a little pugnacious, all of which qualities were amply conveyed in his first letter:

In a word, Sir, I believe that "THE COMING MAN" is the "EITHER-HANDED MAN"—that is to say, neither "right-handed" nor "left-handed", but a man rescued in time from parroted mothers, cuckoo nurses, and starling nursing-maids, with their pagan nursery rhymes and their pagan prejudices against the left hand; in short, a man as perfect in his limbs as his Creator intended. (Reade, January 19, 1878, p. 51)

Reade went on to speak exaltingly of equal-handedness, or ambidexterity, and to urge that every child be permitted to enjoy its blessings.

Reade's letters attracted a great deal of attention. A biographer said that his "earnestness infected thousands, and he was deluged, privately and in the press, with letters from all classes of correspondents resident in various parts of the world" (Elwin, 1931, p. 328). The same biographer, however, also dismissed the entire issue as "apparently a typical 'silly-season' topic" (p. 328). If so, the season was a long one. Four years before Reade, in 1874, the eminent French-American neurologist Charles E. Brown-Séquard (1874/1877) recommended equal training of the two hands in his Toner Lec-

tures given in Washington, D.C. The next year there were further appeals from the pioneer educator Edouard Seguin in his *Report on Education* (1875/1976), and from a physician named Hollis (1875) in an article in the *Journal of Anatomy & Physiology*. Through the turn of the century, advocates continued to speak out (e.g., Ireland, 1880; Lundie, 1896; Sawyer, 1900; Smith, 1889). However, neither Reade's letters nor any of the other articles succeeded in creating a popular movement for ambidextral training. A later admirer of Reade's wrote (with some exaggeration, given the actual history), "For although there was a vigorous correspondence, the subject dropped as suddenly and completely as if it had been the most trivial and contemptible nonsense that ever dribbled from the fingers of the feeblest penny-a-liner" (Jackson, 1905, pp. 140-141). This admirer was a grammar-school teacher from Belfast by the name of John Jackson (no relation to John Hughlings Jackson, mentioned earlier). Under John Jackson's guiding hand (or rather, hands), several of Reade's ideas became practice. Jackson's own ideas about hand training had been germinating through the 1890s and culminated in the founding in 1903 of an organization he called the Ambidextral Culture Society. In 1905, he explained the goals of the society in a massive and extensively documented tome entitled, *Ambidexterity or Two-Handedness and Two-Brainedness: An Argument for Natural Development and Rational Education*.

Jackson had a success. Just a year after the founding of the Ambidextral Culture Society, a British physician wrote approvingly that systematic training of the left hand "has become an established fact in up-to-date schools, not only in America, but also in England" (Lindsay, 1904, p. 129). And by 1907, only 2 years after the publication of Jackson's book, another British physician, the distinguished Sir James Crichton-Browne, commented, this time not so approvingly:

We have now an Ambidextral Culture Society; big books upon ambidexterity have been published, pamphlets and leaflets dealing with it are being circulated, schools are trying to attract pupils by advertising that they give ambidextral training, of course with unparalleled educational successes; and in the most renowned of all our schools the thin edge of the wedge has been introduced, for it has been ordained, we are told, that at Eton the boys who for their transgressions are called upon to write lines, are henceforth to do so with the left hand. (1907, p. 624)

Who was attracted to ambidextral culture? Crichton-Browne went on to say:

In this present movement . . . I fancy I detect the old taint of faddism. Some of those who promote it are addicted to vegetarianism, hatlessness, or antivaccination, and other abberant forms of belief; but it must be allowed that beyond that it has the support of a large number of highly educated, intelligent and reasonable people, and of some men of light and leading. (1907, p. 624)

Of those supporters "addicted" to vegetarianism, antivaccination, and especially, I should think, hatlessness, further comment would be gratuitous. But what of "men of light and leading"? Crichton-Browne was not speaking of humble schoolteachers or country doctors unconnected to the great teaching hospitals and unschooled in scientific research, but of his own colleagues—eminent university-connected physicians, physiologists, neurologists, and surgeons, some of whom, like Brown-Séquard (1874/1877) and the orthopedic surgeon Eldred Noble Smith (1889), had advocated ambidextral training years before John Jackson arrived on the scene. It was their endorsement that provided the engine for Jackson's movement. Indeed, several served on the 50-member committee of the Ambidextral Culture Society. Once we know their reasons, we can better understand why the movement won their support.

REASONS FOR HANDEDNESS

The most important reasons behind the advocacy of ambidextral culture were anchored in the scientific debates of the day on the origins of handedness and the relationship between handedness and lateral specialization of the brain for language and skilled movement. Most scientists of that time agreed that handedness was a product of certain naturally occurring lateral asymmetries of body organs, although they differed on the organ or organs of choice (see review in Harris, 1980a).

Visceral Position, Blood Supply, and Brain Size

At first, attention was concentrated largely on peripheral organs. For example, in 1862, Andrew Buchanan, a physician and professor of physiology in the University of Glasgow, attributed right-handedness to the greater weight of the viscera on the right than left side of the body. Buchanan's idea was that this caused a shift of balance to the left side, leaving the right limbs freer for action.

Many other scientists argued instead that the reason for handedness lay directly in the blood supply to the hands, the right hand supposedly being better supplied because of the asymmetrical origin of the subclavian arteries (e.g., Hyrtl, 1860).¹ When it became clear from Broca's (1861, 1863) work

¹The right subclavian artery arises off the brachiocephalic trunk (innominate artery) and is closer to the heart by about 1 inch. The left subclavian arises later, though directly off the aorta. The assumption was that the blood in the right subclavian artery, being closer to the heart, would be under greater pressure, thus providing more blood to the right side of the body.

that the critical organ was the brain, not the hand, the search for the structural underpinnings of handedness shifted appropriately. Now many supposed that right-handedness originated from an asymmetry in the origin of the internal carotid arteries favoring the left cerebral hemisphere (e.g., Fleury, 1865).² It was supposed that the left hemisphere, presumably being better vascularized than the right, also was heavier, larger, or denser as a result, and there were numerous comparisons of the two hemispheres on these dimensions (e.g., Boyd, 1861; Bastian, 1866). Broca himself, in 1875, reported differences in weight favoring the left frontal lobe—the location of the anatomical area that he hypothesized was the seat of articulate language.

In all of these various explanations, the further implication was that for left-handers, the position of the critical organ was simply the reverse of that found in the modal right-handed type. Thus, for Buchanan's visceral balance theory (1862), left-handers would be those individuals having *situs inversus totalis* of their visceral organs. Broca (1865), as noted earlier, supposed that the reversal was in the brain itself, so that left-handers would speak with the right hemisphere rather than the left.

First Appearance of Handedness

If there was fundamental agreement among scientists that handedness (like language and speech) was an inborn, or native, human trait, there was not yet a consensus on the timing of its development. For example, Buchanan believed that the shift of balance responsible, in his visceral balance theory, for lateral preference would become operative only after the first year, or at least after the child had begun to walk. Broca, however, wrote that the child shows a preference for the ultimately dominant hand "from the first moments of life" (1865, p. 383). Here, Broca had been influenced by his colleague Louis Pierre Gratiolet's observation that in fetal brains, the frontal convolutions develop more rapidly on the left side than on the right (Leurat & Gratiolet, 1857, pp. 241-242; Harris, 1984). Still other writers, while holding to the brain theory espoused by Broca, agreed with Buchanan that handedness was absent in the very young infant. Parrot (1879), for example, stated that the predominance of the right hand, "in the same way as speech, makes its appearance only a long time after birth" (p. 517).

These were only some of the many references to infant behavior made dur-

²The left carotid arises directly from the aortic arch, whereas the right carotid is a branch off the brachiocephalic trunk. Note, of course, how, with the change from the "subclavian" to the "carotid" explanation, the earlier emphasis on absolute distance from the heart was conveniently abandoned.

ing these times, and it is hard to tell whether or not they were based on actual evidence (see Harris, 1983a). All such accounts, in any case, has gone unnoticed by Charles Reade when he wrote his broadside, "The Coming Man." In 1890, however, a clearly empirical study had appeared, which made a strong case for the brain physiologists. The author was the American psychologist James Mark Baldwin (Baldwin, 1890; Harris, 1983a, 1983b). The subject was Baldwin's daughter, whom Baldwin raised during her first year in such a manner as to preclude the influence of parental or other external influences on hand preference. Then, during that time, Baldwin elicited reaching by presenting various objects before her. By the seventh and eighth months, Baldwin noted a "distinct preference for the right hand" and "confirmed" right-handedness by 13 months (1890, pp. 247-248), leading Baldwin to conclude that the true cause must be sought in the physiology of the brain.

Handedness and Evolution

Still another factor in early disputes about the origins of handedness was the evolutionary theory of Charles Darwin. It was widely invoked in support of the view that handedness was "natural," representing, through the process of natural selection, a more advanced state in the evolution of the species. But if scientists agreed on this point, they sharply disagreed on what they saw as its implications. Some, like the French physician Louis Jobert (1885), supposed that ambidexterity therefore would be common among "inferior" peoples: "the more man is civilized, the greater the difference between his upper limbs. The asymmetry, in effect, is an anthropological character of the elite races . . . among the inferior races, the use of two hands is necessary for all the work that they accomplish, this work having above all the requirement of the use of force" (Jobert, 1885, p. 11). Just as many others, however, denied any such implication. This group included Daniel Wilson (1891), who cited observations and experiments on tool making and tool use to prove the preeminence of right-handedness in palaeolithic man (p. 56).

RESPONSE BY AMBIDEXTRAL CULTURISTS

The proposition that handedness was a natural human characteristic was, of course, odious to John Jackson, for if not disputed and effectively rejected, it would be seen not only to justify the status quo but to portend great, even insuperable, obstacles to change. Jackson and other advocates of ambidextral culture rose to the challenge.

How, in the first place, to explain the fact of near-universal right-handedness? Charles Reade had simply put it down to the prejudiced actions of adults: "Every child is even and either-handed till some grown fool interferes and mutilates it" (1878, p. 175). By John Jackson's time, however, there was Baldwin's (1890) report of his infant daughter to contend with, and Baldwin had taken pains neither to interfere with nor to "mutilate" his daughter. Jackson took a different tack instead: "No reliable or general deduction, such as Professor Baldwin offers, can logically be drawn from the phenomena of a single case" (1905, p. 82). But there was still the "single case" to explain. Here, Jackson conceded that natural ambidexterity was not universal and that there were "17 percent of strongly biased right-handed births" and "3 percent of left-handed births" (1905, p. 97). (How Jackson arrived at these percentages is a mystery, although the 3% figure for left-handed births was within the 2 to 5% range of then-current estimates of left-handedness in the general population, e.g., Brinton, 1896). But these, Jackson decided, were "freaks of nature"—and just as "unexplainable" as are other "abnormalities" (Jackson, 1905, p. 97). So Baldwin's daughter was a "freak of nature." As for the remaining 80%, Jackson declared that they are made one-handed solely through the misguided efforts of "nurses, mothers, teachers, and an uncompromising prejudice" (p. 97).

Jackson was no more impressed by the evolutionary argument and tried to turn Darwin's own words against the idea that handedness is natural. If, as Darwin claimed, natural selection acts to preserve favorable variations and to destroy variations in the least degree injurious, then how, Jackson asked, could dextral superiority, with a corresponding deterioration of the other limb, possibly be beneficial to those animals so affected? "It seems obvious and irresistible that, whether apes or human beings, they must equally suffer in their powers of locomotion, . . . and would be still more disadvantaged in their offensive and defensive endowments and capabilities by the possession of an inferior and partially crippled limb" (Jackson, 1905, p. 91).

The anatomical evidence (1905) fared no better in Jackson's hands. Indeed, much of it was easy to question, and the criticisms by ambidextral culturists frequently echoed certain objections raised by the scientists themselves, although Charles Reade, as always, did so with an élan lacking in the scientists' own writings. "I must," he said in one of his letters, "now waste a few lines on sham science" (March 23, 1878, p. 234), thereon making quick work of (dare we say eviscerating?) Buchanan's (1862) visceral asymmetry theory by correctly noting that there were many *more* left-handers than there were people with situs inversus.

It was one thing to dismiss Buchanan's theory, it already being in general disrepute for precisely the reasons Reade named. But Reade was no less respectful to Broca, whom he called a "brainless dissector of the brain."

He pretends that the left hemisphere is larger than the right, and thinks it has the sole control of the right-hand movements. Here we have a statement and a juvenile divination: the statement is not supported by English measurements of the brain in young people; we find that sometimes one lobe is heavier and sometimes the other. (March 23, 1878, p. 234)

Indeed, the brain weight reports *were* inconclusive, with as many showing no differences or differences favoring the right hemisphere as there were those showing differences favoring the left. Furthermore, some of the measurers themselves put no great store in their findings. For instance, Thurnam, in 1866, reported differences in brain weight favoring the *right* side but disclaimed "any pretensions to minute accuracy" (p. 4) and noted the great difficulty in making the measurements. Nearly four decades later, the anatomical evidence for lateral specialization seemed no clearer, as Cunningham concluded in his 1902 Huxley lecture: "Accurate determination of the relative weights of the two cerebral hemispheres is no easy matter, as many factors may contribute to vitiate the result" (1902, p. 289). Cunningham likewise was skeptical of Gratiolet's (Leurat & Gratiolet, 1857) hypothesis that the convolutions of the left hemisphere develop earlier than those of the right. Cunningham cited another scientist's failure to find any differences (Ecker, 1868) and added (correctly) that Gratiolet had not expressed himself with any confidence on the question in the first place.

Jackson must have written to Cunningham immediately after publication of the Huxley lecture because he quoted a letter from Cunningham dated October 29, 1902 in which Cunningham repeated his conclusions. So with some scientists declaring that there was an inherent structural superiority of the left hemisphere and others declaring that there was not, Jackson could say, "Surely, the most biased jury in such a case of conflicting testimony could only return a verdict of 'Not Proven'" (1905, p. 78).³

Ambidextral culturists could reasonably question the anatomical and physiological evidence for the natural superiority of the left hemisphere. The functional evidence, that is, the fact of left-hemisphere specialization for language, was a different matter. Jackson's position was to challenge the *primacy* of the evidence and to propose that any functional superiority of the left hemisphere was wholly secondary to training imposed by culture on the right hand: "Whatever, therefore, may be the connection between the hand and the brain, it must not be forgotten that the left-headedness, on

³Cunningham was confident, nonetheless, that a structural explanation would be found, commenting that his inquiry "has been conducted up to the present along wrong lines, and I do not doubt that the problem will ultimately be satisfactorily explained" (1902, p. 293). Jackson was unmoved by this promissory note: "until some fresh light is thrown upon this inexplicable phenomenon, the theory may be relegated to the region of unproved speculations . . ." (Jackson, 1905, pp. 94-95).

which we are told this right-handedness depends, may be just as easily an EFFECT of the right-hand predominance as its CAUSE!" (1905, p. 83).

In other words, to Broca's maxim, "We speak with the left hemisphere" (1865, p. 383), we could imagine Jackson adding, "because we are taught to use the right hand." On this point, most of the scientist members of the Ambidextral Cultural Society were more moderate. They accepted the proposition that handedness is a result, not a cause, of cerebral specialization—"depends something on nature," as Brown-Séguard wrote (1877, p. 16)—but added that the special training imposed by custom on one hand was important as well. There were several neurologists who subscribed to this latter view whether or not they personally endorsed the broader goals of ambidextral culture.

BENEFITS OF AMBIDEXTRAL CULTURE

Advocates of ambidextral culture thus had sometimes disparate views on the behavioral and physiological evidence for handedness. They also were attracted to the movement for different reasons.

From Peace to War

Today's believers in two-brain education see it as bringing about a "mental ecology" of harmony and peace (Regelski, 1977, p. 47). So did Edouard Seguin, who wrote that "by this even education of the two side-organs, and by the more equal hematose of the two side-circulations, which would follow, the human temper and passions would be harmonized and subdued to a point, which the mind cannot reach today, but whose social consequences cannot be overestimated" (1873/1976, p. 34). The American education writer Hans Ballin warmly endorsed this view in an article, "Symmetry in Education," published in 1896 in *The Child-Study Monthly*.

By John Jackson's (1905) time, however, with the Boer and Russo-Japanese wars in recent memory, opportunities were envisioned for the practice of somewhat more robust activities. A vice-president of the Ambidextral Cultural Society was Major General Baden-Powell, later Lord Baden-Powell, remembered today as the founder of the Boy Scouts. Baden-Powell wrote the introduction to Jackson's book:

I do not consider a man is a thoroughly trained soldier unless he can mount equally well on either side of his horse, use the sword, pistol, and lance, equally well with both hands, and shoot off the left shoulder as rapidly and accurately as from the right. (In Jackson, 1905, p. XII)

To this Jackson added, "If these things are indeed so, what is our War Department doing to neglect such a vital element of strength and efficiency? Can we afford thus to trifle with our country's interests and safety?" (p. 137).⁴

Art Education

Jackson also had more pacific ambitions. He saw advantages in ambidextral culture for the teaching of art, and his book contains impressive examples of children's left-hand drawings. He never supposed, however, that the left hand would show any special talent for art—only that, with training, it at least might become the right hand's equal.⁵

Writing Cramp

In addition to securing a harmony of tempers and passions as well as a citizenry ready both for either-handed fighting and drawing, various other rewards were promised as a result of ambidextral training. The physicians in Jackson's society naturally enough looked for relief from health problems.

⁴Jackson, incidentally, claimed Japan as an outstanding example among contemporary cultures of the military advantages of ambidexterity, the Japanese having defeated Russia in the Russo-Japanese war, though he did not offer any evidence for his characterization of the Japanese as ambidextral. A later advocate, Macnaughton-Jones, offered his own military example:

The Germans, who are second to no nation in the world in their powers of organization, and insistence upon system, are not insensible to the advantages of ambidexterity in war, and are, I believe, making inquiries in regard to it in their military schools" (Macnaughton-Jones, 1914, pp. 96-97).

Given the publication date of his book, Macnaughton-Jones, at the very least, proved himself a master of timing.

⁵Jackson was inspired particularly by the work of J. Liberty Tadd, an American teacher at the Philadelphia Public School of Industrial Art. According to one account, Tadd, in about 1884, had originated a method of bimanual art training that was soon adopted in the elementary schools of Philadelphia, the exercises consisting largely of blackboard drawing with both hands, clay modeling, and carving in wood (Bare, 1898). Tadd not only claimed remarkable successes ("perfect results produced, the simplicity of the work, the almost instant balance and symmetry") but linked his exercises to the physiological principles inherent in the ambidextral culture movement ("the better and firmer the union of each hand with its proper hemisphere of the brain, and the more facility we have of working the two together, and also independently, the better the brain and mind, and the better the thought, the reason, and the imagination will be" (Tadd, 1899, quoted in Jackson, 1905, p. 128). In the United States, the practice was not confined to Philadelphia. By 1899, similar developments had taken place on the West Coast: "Ambidexter drawing is taught now in all grades [of the Los Angeles public schools], and with gratifying success" (Bradfield, 1899, p. 9).

Among these was cramp in the writing hand, a malady suffered by clerks and other workers who wrote for long hours each day. Jackson quoted an eminent physician G. V. Moore, who believed that the only remedy was

to teach the child to write with both hands, which I believe might easily be done. Girls in this respect are better off than boys, for such exercises as piano-playing and knitting encourage a great amount of Ambidexterity in girls. Why should not the clerk use either hand alternately, and so give to each its much-needed rest. (quoted in Jackson, 1905, p. 125)

Major General Baden-Powell, incidentally, was a staunch exponent of either-handed *writing* as well as either-handed *fighting*. He signed his introduction to Jackson's book twice, once with each hand.

Spinal Curvature

Writing cramps were bad enough. Because the custom was to slant the writing to one side, Jackson (1905) warned that the writer, particularly if a young child, also risked developing curvature of the spine. Writing therefore would have to be *upright* as well as *ambidextral*, and Jackson, who also was the author of a text on a "system of upright penmanship,"⁶ again looked to medical authority for support. He did not have to look far—the president of the Ambidextral Culture Society was E. N. Smith, Senior Surgeon to the City (of London) Orthopedic Hospital, who long before had warned of the dangers of one-handed slanted writings in his authoritative text, *Curvatures of the Spine* (1889). Smith provided Jackson with a worthy testimonial: "I consider the teaching of Ambidexterity in elementary and secondary education to be one of the most valuable innovations in tuition of the age" (quoted in Jackson, 1905, pp. 126–127).

Enhancement of Mental Capacity

All the aforementioned benefits may have been enough to attract pacifists, soldiers, art teachers, and orthopedists to ambidextral culture. More influential, however, (and far more interesting from a neuropsychological perspective) were the promised cognitive and neurological rewards. First, and most generally, it was asserted that training the two hands equally would equally train the two hemispheres of the brain, and thereby enhance—even

⁶ According to one report, Jackson's method had found so much favor, because of the superior legibility of the writing, that it became required "in all branches of the [English] civil service," and was adopted in many English as well as Austrian and German schools (Witherbee, 1893, p. 86).

double—mental power. And now, for Jackson, the earlier writings of two men became critical, a relatively obscure mid-nineteenth century physician named Arthur Ladbroke Wigan and the neurologist Brown-Séquard, mentioned earlier. In 1844, Wigan had recounted medical reports of individuals who had suffered grievous injuries, even destruction, of one of the cerebral hemispheres but who had shown no obvious impairment of intellectual powers (which in every case Wigan or the authors of the reports cited evidently defined as the capacity to use and understand language). On the other hand, mental impairment always was found to accompany injury to both hemispheres. From such accounts, Wigan developed an elaborate theory of mind, which he outlined in 20 propositions. Three of these—Propositions 1, 2, and 14—were of special value to ambidextral culturists. Proposition 1 was “that each cerebrum is a distinct and perfect whole as an organ of thought;” it therefore followed (Proposition 2) “that a separate and distinct process of thinking or ratiocination may be carried out in each cerebrum simultaneously” (Wigan, 184, p. 26). Here, Jackson recognized one means by which mental work could be enhanced—by training the hands not merely to be equal for any kind of work but to be totally independent of each other as well: “if required, one hand shall be writing an original letter, and the other hand shall be playing the piano; one hand shall be engaged in writing, the other in making a pen-and-ink sketch” (Jackson, 1905, p. 225).⁷

Finally, Proposition 14 was “that one cerebrum may be entirely destroyed by disease . . . ; may be *annihilated*, and in its place a yawning chasm; yet the mind remains complete and capable of exercising its function” (Wigan, p. 28). This proposition may be quite defensible considering that Wigan wrote in the pre-Broca era and given, furthermore, the particular clinical cases on which he based his views.⁸ If, as Wigan declared, two brains mean two

⁷ Jackson was most pragmatic in his use of expert testimony, for in invoking Wigan's second proposition in support of this practice, Jackson, however, conveniently failed to mention Wigan's eighteenth proposition, which emphatically denied the wisdom of such a course of action: “that the object and effect of a well-managed education are to establish and confirm the power of concentrating the energies of both brains on the same subject at the same time” (Wigan, 1844, p. 29).

⁸ Of 12 cases (Wigan, Chpt. VI, pp. 38–54), there were 2 adults with left-hemisphere injuries dating from early childhood; 5 adults with right-sided injury, evidently of late onset; 3 adults and one 12- or 13-year-old boy with unspecified side of injury; and 1 adult with left-sided injury, presumably of late onset. Assuming that all these individuals were right-handed, the reported absence of mental (meaning linguistic) impairment in the first two cases is consistent with other, later reports pertaining to the relationship between early injury and language development; in the next 5 cases, language impairment would not have been expected with a right-hemisphere injury. The remaining cases, except the last, are uninterpretable because the side of injury was not mentioned. (See Harris, 1983c, for further details on Wigan and also Henry Holland, a later figure also relevant to Jackson's argument.)

organs of thought and if one brain alone is sufficient for the full performance of the mental functions, it was an easy step to suppose that our "double brains" are under used. Wigan himself did not take this next step, but several later writers did. One was Seguin (1875/1916), who asserted that exercising the left side of the body would increase the circulation and functions of the right hemisphere, thereby inducing "equal or substitutive mental operations from both hemispheres, by which more continuous learning and thinking could be accomplished" (p. 34). (Seguin also mentioned that he had begun to carry out these practices with the first training of idiots in 1837-1838 [Seguin, 1866]). Another advocate was Brown-Séquard, who, as mentioned earlier, accepted the physiological evidence for the natural superiority of the left hemisphere, and, by implication, of right-handedness. Crediting his inspiration to Wigan, Brown-Séquard outlined his ideas in 1874 in the Toner Lectures cited earlier.

Wigan had written in the era before Broca, Brown-Séquard afterward. So for Brown-Séquard, the new evidence linking language preponderantly to the left hemisphere carried a startling message: "If we make use of only one brain for most of our actions, we leave inactive one-half of the total mass of brain matter, and, therefore, we leave quite useless one-half of the most important of our organs as regards manifestations of intelligence, will, and perception or sensation." Therefore, "We ought to give education to the two sides of the brain, or, rather, to the two brains" (1874/1877, p. 2).

Because Brown-Séquard assumed that brain and mental development were connected to the "leading movements of the body" (1874/1877, p. 20), the exercises he proposed as a means of educating the presumably under-used, empty right hemisphere were predominantly motor: Every child should be made to "exercise the two sides of the body equally—to make use of them alternately. One day or one week it would be one arm which would be employed for certain things, such as writing, cutting meat, or putting a fork or spoon in the mouth In this way it would be very easy indeed to obtain a great deal, if not all the undeveloped power possible to the individual" (1877, p. 20).

Wigan and Brown-Séquard provided Jackson with plenty of ammunition. Wigan's Propositions 1 and 14 gave him points against the localizationist school of Broca, and Brown-Séquard's writings provided support both for his general policies and for his program of motor training, which closely followed Brown-Séquard's.⁹

⁹Jackson's citation of Brown-Séquard was to an 1890 paper, which I have not seen ("Have We Two Brains or One?"). Judging from the passages quoted (in Jackson, 1905, pp. 248-250), the arguments are identical to those expressed in the 1877 work.

Prevention of Aphasia

In enhancing mental capacity by means of motor training, Jackson (1905) promised another and very specific benefit—the prevention or amelioration of the aphasias and hemiplegias resulting from unilateral brain injury. This claim, in fact, had been made as early as 1875 by the physician Hollis, mentioned earlier in this essay. In his article in the *Journal of Anatomy & Physiology* (1875), Hollis noted that Samuel Johnson and Jonathan Swift had suffered from aphasia in their last years, and concluded that such cases “show how active energetic brains break down by overwork, or rather by ill-balanced work . . . I believe it is probable that the disease would have been indefinitely postponed had their education been other than ‘lopsided’” (p. 271).¹⁰ By Jackson’s time, this view had come to be expressed repeatedly. For instance, Sir James Sawyer, Consulting Physician to the Queen’s Hospital, Birmingham, and a vice-president of the Ambidextral Culture Society, proposed that ambidexterity, by tending to the more equal use of the two sides of the brain “might prevent, or help in the cure of, some cases of hemicrania. Perhaps it might prevent some cases of hemiplegia” (1900, p. 1303).

One advocate even proposed a way for individuals to learn second and third languages so as to guard against total loss after left-brain injury. While learning one language, hold the book, turn the pages, and write out the words with left hand, and keep the right hand as inactive as possible. This method could lead

to the acquisition of the language by the unused right brain-centres; and if this were so, the capacity of the brain for languages would be doubled. We may imagine some future generation keeping their left brains for the Teutonic languages, and storing the Romance languages on the right side. If one of them has his left speech-centres damaged, he will still retain some languages in which he can communicate his ideas to others.” (Lundie, 1896, p. 12)

EVIDENCE

What evidence could ambidextral culturists muster for any of these various and remarkable claims? Jackson himself showed that two different tasks could be carried out at the same time. His book contains several illustrations of simultaneous hand work, for example, two different letters

¹⁰ Johnson suffered a stroke in 1873 when he was 74. He continued to be able to write (“Though God stopped my speech he left me my hand”), but not without difficulty (“My hand, I knew not how or why, made wrong letters”) (Wain, 1974, p. 360). Swift had a stroke at age 75 years, although it has been suggested that it was instead a violent attack of Menière’s disease (Rowse, 1975, pp. 18, 231).

written concurrently by a 17-year-old girl—after 8 months of practice (1905, p. 193). Another girl, Jackson's own daughter, appears to have been particularly accomplished, judging from this account by N. E. Smith:

In the presence of myself and a few medical friends the young lady wrote several words and two letters quite different in character simultaneously, one written with the right and the other with the left hand.

Then I tested her by getting her to read a paragraph in a newspaper while I kept her closely in conversation answering my questions given rapidly, questions which required her careful attention. She was then able to repeat almost word for word what she had been reading.

This seems to me to be the most conclusive proof that the brain (at least in this instance) is capable of entertaining two distinct currents of thought or to perform two cerebral actions simultaneously. (Smith, 1903, p. 92)

Ambidextral culturists also enthusiastically recalled an extraordinary feat performed, some years earlier, by Sir Edwin Landseer, the British painter of animals and portraits. The feat was described by Sir William Richland at a lecture, "ambidexterity in art," one of a series of lectures delivered in London under the auspices of the Ambidextral Culture Society.

[Landseer] drew the profile of a stag's head with its antlers complete with one hand while with the other he outlined the profile of a horse. This, Sir William Richland thought, clearly showed that Sir Edwin Landseer must have been able to use both sides of his brain separately. (*The Lancet*, 1905, p. 830)

Richland was reported to have added, however, that he—Richland—had tried to repeat the experiment but had failed.

For evidence that ambidextral training aided victims of aphasia, Jackson (1905) turned to medical testimony. Hollis (1875) had said that "aphasic lesions can be recovered from by exercising the opposite side of the brain for articulatory purposes" (1875, p. 268), and he—and Jackson after him—referred to supporting statements by Brown-Séquard (1874/1877). On this same point, Jackson also took much satisfaction from the views of the great Scottish neurologist Sir David Ferrier. In his major work, *The Functions of the Brain* (1886), Ferrier acknowledged the evidence that the speech center was in the majority of instances in the left hemisphere but went on to say that there was no reason, "beyond education and heredity, why this should necessarily be so" (1886, pp. 450-451).

It is quite conceivable that the articulating centres of the right hemisphere should be educated in a similar manner. A person who has lost the use of his right hand may by education and practice acquire with his left all the cunning of his right. In such a case the manual motor centres of the right hemisphere become the centres of motor acquisitions similar to those of the left. As regards the articulating centres, the rule seems to be that they are educated, and become the organic seat of volitional acquisitions on the same side as the manual centres. Hence, as most people are right-

handed, the education of the centres of volitional movements takes place in the left hemisphere. (p. 451)

Ferrier also said that although the left articulatory center was the one commonly and specially educated in speech, "it is quite conceivable that a person who has become aphasic by reason of total and permanent destruction of the left speech centre may re-acquire the faculty of speech by education of the right articulatory centres" (p. 451).¹¹

Ferrier had not, in fact, said specifically that this education could be brought about by hand training, although this idea seems to be suggested in the passages just quoted. A later writer, Varia Kipiani, was explicit on this point. Kipiani, a strong partisan of ambidexterity, mentioned cases cited by a Dr. Manfred Fraenkel in which speech that was lost after a left-sided stroke with right-sided paralysis, reportedly had been regained by systematic writing with the left hand. Even after a second left-sided stroke, speech remained, proving clearly, according to Fraenkel, that left-hand writing had caused the power of speech to transfer to the right brain (Kipiani, 1913). Another advocate of ambidextral training mentioned the still more extraordinary case of the effects of hand training in a polyglot aphasic. This was a boy who had lost his left hand and wore a prosthesis, and who, at the age of 30 years, showed right-sided paralysis with loss of speech. "By means of a wooden ring furnished with a pen drawn over the forefinger of his artificial, i.e., left, hand he gradually learnt to write, and finally not only recovered the use of his native tongue, (German) but also his former knowledge of Russian and French" (Macnaughton-Jones, 1914, p. 53). The reason for citing this case, presumably, was to suggest that working the left hand had caused the transfer of all three languages from the man's left to his right hemisphere.

Another kind of evidence for the merits of equal-hand training was provided by left-handers because it was routinely noted that left-handers, presumably by force of custom, came to use their right hand far more often than right-handers used their left. Left-handers thus subject both hemispheres "to the frequent stimulus of efferent nerve-force" (Wilson, 1891, p. 210) and attain "a degree of ambidexterity which renders them, instead of 'gauche,' peculiarly clever and skillful in their manipulations" (Lundie, 1896, p. 11). Their example was deemed to be worthy of emulation: "There seems to be no good reason why right-handed people should not attain some of the ambidexterity which is usually the privilege only of the left-handed" (Lundie, 1896, pp. 11-12).

¹¹ Ferrier surmised that to some extent the right centers had already been educated along with those of the left through associated action, "registering automatically . . . the volitional acts of the left" (1886, p. 452). It was this "automatic" power that Ferrier proposed may be educated into volitional power. (In his use of the terms automatic and volitional, Ferrier was adopting the conceptual scheme of his contemporary, John Hughlings Jackson.)

Finally, advocates of ambidextral training took special note of reports that left-hemisphere injury was less likely to result in permanent speech loss in children than in adults. Broca (1865) may have been the first to note this relationship and to suggest an explanation: "Someone whose third frontal convolution, ordinarily the seat of articulate language, would be atrophied from birth, would learn to speak and would speak with the *right* hemisphere" (pp. 386-387; emphasis in original). Similar views were expressed by later writers, including Brown-Séguard (1874/1877) and the neurologists Howell T. Pershing (in Stedman, 1897, p. 787) and Sir William Gowers (1896-1902; quoted in Jackson, 1905, p. 123).¹²

Broca (1865) interpreted the age difference cautiously, noting, for example, that the adult aphasic rarely received the intense language training ordinarily provided children (p. 390). Others, however, were more confident that the explanation was neurological. Thus, Sachs proposed that in young children, hemispheric differentiation for speech "is not nearly so complete as in the adult" (in Stedman, 1897, p. 333); and Gowers concluded that there must be "a capacity for the acquisition of voluntary speech processes on the right side of the young which there is not in the adult" (quoted in Jackson, 1905, p. 123). Consequently, "The exclusive relation of voluntary speech to the left brain is due to the disuse for speech of the right brain: it seems to occur in the transition from childhood to youth, and it is related to the use of the right hand" (Gowers, quoted in Jackson, 1905, p. 123). The reports thus gave "clear proof," as Brown-Séguard put it, "that the right side of the brain can be educated to become a leader in mental faculties as well as the left side of the brain" (1874/1877, p. 18). The moral for Jackson and the ambidextral culturists was clear: Begin the education of *both* hands—and thus both brains—early in each child's life, and enhance mental power and reduce the likelihood of debilitating unilateral cerebral injury.

EVALUATION OF EVIDENCE

Given the state of knowledge at the time, the ambidextral culturists' use of the available clinical and other evidence cannot be said to have been purely idiosyncratic or fanciful. Consider their reference to left-handers. Left-handers generally do use their right hand more frequently than right-handers use their left, as modern studies have consistently shown (e.g., Benton, 1962; Herron, 1980). The ambidextral culturists supposed that this was a result of the left-hander's forced adjustment to a right-handed world. However, as I

¹²Jackson was citing a paper by Gowers entitled "The use of words, &c," and dated 1896-1902. I have not seen this paper, but the statements quoted are similar to those published in Gowers (1885).

mentioned earlier, the evidence now indicates that left-handers, as a group, have a greater degree of bilaterality of cortical function for language (Hécaen & Ajuriaguerra, 1964; Hécaen & Sauguet, 1971; Satz, 1980). Thus, just as left-handers generally are both more likely to suffer language impairment following unilateral cerebral disease, and are more likely to recover, so might their greater measure of bidexterity have its basis in inherent cortical organization. One can imagine how ambidextral culturists would have welcomed the more recent findings about left-handers, because they surely would have construed them as powerful evidence for their views about the direct effects of hand training on the development of cortical centers.¹³

The ambidextral culturists' remarks about the sparing or recovery of languages in brain-injured polyglots are interesting to consider also. One wonders whether those remarks had been partly inspired by then-recent accounts of polyglot aphasic patients who, reportedly, recovered one language before another (e.g., Bastian, 1875; Bernard, 1885; Bianchi, 1886; Charcot, 1884; Scoresby-Jackson, 1867; Pitres, 1895). Some theorists suggested that the reason was different premorbid patterns of anatomical organization of the languages. (None, however, proposed Lundie's [1896] "hand-to-write-and-turn-the-page" scheme as the means whereby such organization could have been effected.) This possibility continues to stir interest; for example, Albert and Obler (1978) have proposed, on the basis of both old and new studies, that the right hemisphere may have as much capacity to acquire language in adulthood as in childhood and "may even be dominant for one of the languages of the bilingual" (p. 254). I think this radical proposal is unwarranted (Harris, 1980b; see also Genesee, 1980); however, certain differences in the conditions of first- and second-language acquisition could well affect patterns of hemispheric processing (see Vaid & Genesee, 1980).

What of the principle that in the immature brain, the right hemisphere has a capacity for the acquisition of language that is lacking in the adult brain? In Jackson's time, this also was hardly an unreasonable view of the clinical evidence such as it was. After all, contemporary neuropsychologists have drawn a similar conclusion about the greater "plasticity" of the immature brain on the basis of new studies (e.g., Chase, 1974; Dimond, 1972; Krashen,

¹³In Jackson's own time, an Italian physician, Guisepe, writing in 1890, perhaps came closest to anticipating this clinical outcome among ambidexters and left-handers (cited in Wilson, 1891, pp. 186, 192-193, 210). There also was this statement in a 1917 paper: "Such cases of pathology [aphasia and agraphia] are found but seldom in left-handed or ambidextrous people, who, by education or custom, are strongly influenced to use the right hand largely, hence working the left as well as the right hemisphere" (Smith, 1917, pp. 29-30). Although attributed to Macnaughton-Jones (1914), an advocate of ambidextral training, no such statement appears in this work.

1973; Lenneberg, 1967; McFie, 1961). Indeed, as St. James-Roberts has observed in an important review, the principle has become a "part of neuropsychological dogma" (1981, p. 32). If today, on closer inspection of the evidence, the dogma is starting to look questionable (Bishop, 1981; St. James-Roberts, 1979, 1981), we surely could not hold the ambidextral culturists to account.

Finally, for his statement that exercising the right hemisphere by training the left hand would build new language centers in the right hemisphere and thus facilitate recovery from aphasia, Jackson—as already noted—drew support from such prominent figures as Ferrier (1886) and Brown-Séguard (1874/1877). Jackson's confidence therefore is understandable, even if this particular idea seems to have been only implicit in Brown-Séguard's and Ferrier's writings, and then given only a certain construction of their views. Neither man, in any case, cited any direct clinical evidence of such an effect of hand training on reacquisition of language. Evidently unknown to the ambidextral culturists was C. T. Buzzard, physician to the (British) National Hospital for the Paralyzed and Epileptic, who seems to have come closest to arguing that training the hand contralateral to the uninjured hemisphere could create new language centers.¹⁴

On several grounds, then, proponents of ambidextral culture could marshal what at the time would seem to have been powerful arguments in their support. Nevertheless, almost from the beginning, the movement met with equally powerful opposition. The aforementioned arguments not being the obvious weak spots, the critics directed their attacks elsewhere.

First and most fundamentally, the ambidextral culturists' argument that the two hemispheres and, by implication, the two hands were inherently and originally the same was increasingly challenged as Broca's work became increasingly incorporated into the body of established scientific thinking. Few critics, however, went so far as Crichton-Browne, who refused to concede even a particle of influence to social training: "It cannot now be doubted that right and left handedness are dependent on cerebral organization and on nothing else" (1907, p. 648).

¹⁴ Buzzard's system (lacking any documentation) is briefly described in his *Clinical Lectures and Diseases of the Nervous System* (1882).

The idea is, as I have said, in the failure from disease of Broca's convolution, to develop by afferent impulses the corresponding convolution in the *right* cerebral hemisphere. With the same view, I make the patient go through gymnastic exercises with the left arm, and delicate movements with the fingers of the left hand, with the aim of producing that *dexterity* (using the term in its etymological sense) with which the faculty of expression by speech and signs is so intimately associated. (Buzzard, 1882, P. 441)

Baldwin's (1890) report of early hand preference in his infant daughter also continued to be influential, Jackson's objections notwithstanding. Furthermore, in the years to follow, several new studies appeared (e.g., Major, 1906; Dearborn, 1910; Woolley, 1910; Voelckel, 1913), all of which found evidence for hand preference before the end of the first year, and in the absence of any obvious social influence. And most of these investigators concluded, with Baldwin, that the basis of handedness was physiological—although the critical brain area may not be *initially* functional (see review in Harris, 1983a).

The argument by ambidextral culturists that the left hand needed training presupposed that it was merely an untrained, inferior copy of the right, just as the right hemisphere was presumed to be an untrained, inferior copy of the left. At least with respect to the hands, this characterization was disputed. An early critic wrote:

Each hand learns to do its own work and to do it well; if you made it do the other hand's into the bargain, it would have a great deal more to learn, and we should find it difficult even then to prevent specialization . . . the division of labour . . . is certainly a gain to those who possess it. ("Right and Left," 1889, p. 558)

Crichton-Browne (1907) elaborated the point. The left hand, he said, contributes "its fair share to human achievement. If the right hand holds the pen, the left steadies the paper; if the right hand twangs the string, the left grasps the bow and props the arrow" (p. 635).

The promise that ambidextral training would greatly enhance mental power likewise was not universally believed, even by those generally sympathetic to the ambidextral culture movement. The editors of *Nature* (1903) called "probably well founded" (p. 445) the belief that the child taught to write equally well with both hands will easily acquire left-handed skill in all other manipulations. They were less certain that this also would aid mental development: "The balance of probability seems to be against it" (p. 445).

Jackson's goal to have the two hands write simultaneously on different subjects likewise did not find universal approval, though, again, few were quite so harsh as Crichton-Browne, who warned that any such program "must involve the enormous enlargement of our already over-grown lunatic asylums" (1907, p. 652).

Ambidextral culturists' views on the handedness of primitive man fared no better. Charles Reade had declared that primeval, "natural man" was "as perfect in his limbs as his Creator intended" (January 19, 1878, p. 51). The critics said no. Primitive man was *not* "perfect in his limbs." He was right-handed in approximately the same proportion as are contemporary civilized peoples. Here, Crichton-Browne and others recounted the evidence on this point already mentioned by Wilson (1891) and other earlier writers.

Nor did the absence of handedness signify a "state of grace," as Reade (1878) had contended. To critics, it was a likelier sign of just the opposite—intellectual and moral inferiority. Here some already old research figured in the dispute. In 1880, the physician William Ireland had reported finding a much higher proportion of ambidextrous, but not specifically left-handed, children among imbecile (microcephalic) children than in the general population. Other reports followed. The anatomist Cunningham, whose skeptical views on the physiological evidence for handedness Jackson happily quoted, saw a dark meaning in these reports. This time Jackson did *not* quote him.

Of course, I fully appreciate the fact that the statistics at our disposal on this subject are not sufficient to justify us in arriving at any far-reaching conclusions, but all the same I am inclined to consider that there is exhibited in the microcephalic idiot a distinct atavistic tendency to revert to the ambidextrous conditions of the early progenitors of man. (Cunningham, 1902, pp. 286-287)

Cunningham was not, of course, proposing that ambidextral training of dextral (or sinistral) individuals would lead to idiocy any more than he believed it would lead to genius.

Left-handers again played a role in the dispute, this time on the critics' side. The critics did not challenge the proposition that many left-handed adults, because they used their hands more nearly equally than right-handers did, demonstrated the possibility of ambidextral training. They noted instead that the effects of deliberate training of the nondominant hand were not entirely salutary. Here, there began to appear references to anecdotal reports of emotional disturbance along with serious disturbances in writing skill when parents and teachers interfered with children's hand preference. Left-handed children were the usual target, of course, for such interference. Such a case was mentioned by a Philadelphia physician, George M. Gould, a prominent writer and the editor of *American Medicine*, and a personal nemesis of Jackson.

Gould described a naturally left-handed friend who, "by arduous and continuous training was compelled to write with his right hand" and who, since then, "can not do any original thinking while writing" (1904, p. 366). Gould declared all attempts to institute ambidexterity to be injurious, unwise, and resulting in "life-long cruelty to the left-handed" (p. 366).

To be fair, Gould's charge against Jackson was a red herring. The Ambidextral Culture Society did not urge the *substitution* of one hand for the other, and Jackson (1905) protested vigorously at Gould's misrepresentations.

Here is a boy with a strongly developed sinistral bias, or naturally left-handed, and because his parents were so blind and foolish as to repress that bias, to try and

destroy it, and to make him write with his right hand INSTEAD OF WITH HIS LEFT—that is, to keep him still ONE-handed—the Doctor throws all the blame on the faculty of TWO-HANDEDNESS and on the Society that has been founded for the purpose of promulgating the principles of Ambidexterity or EQUAL-HANDEDNESS! (Jackson, 1905, pp. 166-167)

But such protests seem to have been of little avail. In 1907, Gould returned to the attack, saying, "Let the left-handed child alone! Nature is quite as wise as the ignorant meddlers!" (Gould, 1907, reprinted 1908, p. 39). Gould's point, presumably, was that the right-handed child should be let alone for the same reason.

It is not clear that many minds were moved by these exchanges. But a few years later, a powerful new ally emerged on the critics' side. All along, many critics had been urging that any interference with the natural unidexterity of children could give rise not only to disturbances in writing, as Gould had reported, but also to disturbances in speech—stammering in particular. However, there was no convincing statistical evidence. Then, in London, the 1911-1912 volume of the influential *Journal of Experimental Pedagogy and Training College Record* published a report of a survey by Ballard of London school children diagnosed as "dextro-sinistral." By this, Ballard meant "a congenitally left-handed person" who had conformed with social custom in writing with the right hand (p. 298). Among these children, stammering was about four times more frequent as among other children, including left-handed children whose left-handedness had never been interfered with. Ballard thought that the explanation lay in the

intimate functional connexion of the writing centre with the system of word centres, and particularly with the speaking centre . . . it is conceivable that the dominant speech area is either robbed of some of its energy, or that some sort of competition takes place which tends to disorganize its function. (1911-1912, p. 308)

Ballard concluded that the goal of the Ambidextral Culture Society—the duplication of the graphic function—"has been shown to be fraught with danger. Writing should always be done by the superior hand, and *by the superior hand exclusively*" (p. 309; emphasis in original).

In addition to what we might call the substantive objections to ambidextral training, there were two others that, in practical terms, might have weighed heavily in the debate. First, many observers may have begun to sense that, however reputable were the scientist advocates as well as other members of the Ambidextral Culture Society, the movement was yet another of a long line of social crazes and educational fads. We recall Crichton-Browne's remark to this effect in 1907. He was not alone in this view. In 1904, just after the founding of the Ambidextral Culture Society, a surgeon warned, "Do we take up with fads we shall be as bores to the youngsters and butts for the gibes of the cast-iron pedagogues who, alas! are not yet dead"

(Harmon, 1904, p. 16). Secondly, whatever the claims and counterclaims by advocates and critics of ambidextral culture, resistance to ambidextral training also was reported to have arisen among the teachers themselves. After all, they were being asked to shoulder the bulk of the training. As one advocate of ambidextral culture admitted, for them "the system naturally offers difficulties" (Mollett, 1910, p. 328).

The ambidextral culturists did not give up, and the movement continued to attract distinguished disciples. One was H. Macnaughton-Jones, a former president of the Obstetric and Gynaecological Section of the Royal Society of Medicine. At Jackson's instigation and through materials provided by him, Macnaughton-Jones published a series of articles extolling ambidextral training in the British journal *The Child*. In 1914, the articles were amplified into a book entitled *Ambidexterity and Mental Culture*. The dedication was to John Jackson: "In recognition of his life-long work in the cause of Ambidexterity."

There also were scattered calls for ambidextral training on the Continent. In France, in 1919, a physician named Armaingaud published an extraordinary appeal in the *Bulletin de L'Académie de Médecine*. Citing recommendations by Major General Baden-Powell, among others, Armaingaud asked the French Academy of Medicine to request the French government to institute steps "in favor of the equal education and use of the two hands" (p. 151, trans., L. J. H.). Specifically, Armaingaud urged the Academy to appeal to the French people, "in the name of the national interest," to train children, from the very earliest years, to use their two hands equally; and also to invite the Minister of Public Instruction to make obligatory in all primary and secondary schools the use of both hands for writing and other exercises (pp. 156-157). Armaingaud also suggested that a prize be granted to institutions that make the best use of ambidextral training, and invited contributions from members of the Academy for this purpose.

It was all to little avail. In France, Armaingaud's appeal did not seem to win any support. At least no prize for institutions making the best use of ambidextral training was ever announced. And in England, whether as a result of Jackson's increasing isolation from scientific opinion about handedness and brain specialization for language, the zeal of certain influential critics, the new and dire warnings about speech disturbances, the growing faddish trappings of the movement, or simply the waning of teachers' interest in yet another educational innovation, ambidextral culture lost ground and, by about 1920, seems to have died out as a topic of concern in education.

And now, as we have seen, with the advent of another productive and exciting era in neuropsychology, the passionate advocacy of two-brain education has returned—and just as confident and very nearly as ambitious in its claims.

AMBIDEXTRAL CULTURE AND EDUCATION: THEN AND NOW

Are the concerns and promises of today's two-brain culturists any more valid than those of the ambidextral culturists of this earlier day? The signs thus far do not seem to me to be very convincing. But what exactly is wrong with the call today for "hemispheric balance" in the curriculum and, indeed, in life itself? After all, the neuropsychological evidence is far more advanced now than in John Jackson's time, so that the translation of this new, more advanced information into educational practices would seem to stand a much better chance of being correct. Perhaps it could be, but there are several reasons why it has not so far.

Understanding of Neuropsychological Evidence

First, although we know vastly more about the nature of specialization of the cerebral hemispheres today than was known in Jackson's time—particularly about the special capacities of the right hemisphere—educators (not surprisingly) have not learned of these new developments through the primary literature. Their sources instead appear to have been their own professional journals, magazines, and popular books like those I quoted from earlier. Furthermore, much of this literature feeds on itself, so that the documentation for one source comes from one of the others. And what all of these accounts do, of course (even those written by experts), is what always happens in popular writing, which is, alas, what makes it popular—all the subtleties, complexities, inconsistencies, and nonreplicable findings are passed over (where they were known in the first place). Sometimes even the findings about the nature of left and right specialization that we are confident are straight, plain, and well-substantiated are seriously misconstrued. What remains is cut-and-dried, idealized, static, and therefore wrong. In other words, what remains exemplifies what we might call *dichotomania*—the placement of highly complex cognitive phenomena in toto into either the left brain or the right, with scarcely a hint of the many-layered complexities involved. This is as mistaken and misleading a view of lateral specialization as was the idea of the "empty," unused right hemisphere held by John Jackson and most of the scientists of his time. At least Jackson had no better scientific evidence to guide him. The same, in theory, cannot be said for today's advocates, although in practice, as I have noted earlier, it perhaps comes down to the same thing.

Let us consider a few examples. Consider, first the question of artistic ability. It may be appealing for art educators to suppose that artistry is a unique property of the right brain so that stimulating the right brain will

enhance the ability to draw (Edwards, 1979). Unfortunately, the neuropsychological evidence refuses to accommodate itself to this simple scheme. Instead, it indicates that both hemispheres contribute, although in different ways: The left hemisphere identifies details and internal elements, the right hemisphere supplies location, orientation, and dimensionality (see Warrington, 1969). Musical ability, likewise, cannot be localized in one hemisphere or the other. It seems to depend, among other things, on which components of music one is concerned with. For example, in tests of music perception, rhythm tends to be left-lateralized, pitch and tonality right-lateralized (e.g., Borchgrevink, 1982). As with drawing, however, these relationships also depend on the individual subject's strategy and skill as well as the familiarity of the type of material employed (see Gates & Bradshaw, 1977).

As for creativity, as Kershner has mentioned (Chapter 11, this volume), there is little evidence to support the claim that it is related to greater, much less exclusive, use of the right hemisphere compared to the left. I would add that this does not mean that there are *no* differences in thinking style between highly creative and less creative persons (there undoubtedly are) or that such differences might not prove to be relatable in some way to individual differences in complex patterns of hemispheric arousal as well, perhaps, as hemispheric use. (In this respect, we do know, for example, that among right-handed adults, there are individual differences in characteristic patterns of hemispheric arousal; see Levy, Heller, Banich, & Burton, 1983). But this is not to say that differences between highly creative and less creative persons, whatever they may be, are reducible to simple differences in such dimensions of neural activity as either hemispheric arousal or use. And certainly there is no evidence that only one hemisphere is involved in any task, even the simplest (see, for example, studies of regional cerebral blood flow; Lassen, Ingvar, & Skinhøj, 1978).

The first point, then, is that the practice of translating educational concerns into the language of lateral cerebral specialization grows out of mistaken accounts of the basic neuropsychological literature. And when, in these same accounts, nostrums are confidently offered for the cure of every educational malaise that besets us—or that the author thinks besets us—we can hardly expect any sound and psychologically reasonable programs to result.

Does the Right Hemisphere Need Special Exercise?

The aforementioned remarks also begin to show what is mistaken in the notion of the right hemisphere as a sort of endangered species that needs special exercise and encouragement to survive. Recall the critics' reply to

Jackson's call for training of the left hand because forced inactivity had caused it to lack all useful skills. Not at all, said Crichton-Browne: the left hand in fact contributes "its fair share to human achievement" (1907, p. 635), although it has a different role from that of the right. Likewise, today, I would say that the right hemisphere gets plenty of exercise already, even in the so-called left-brained school environments where the emphasis is heavily on reading, writing, and analytic strategies of problem-solving. The best evidence is that the cerebral hemispheres are specialized for their respective functions and are working normally and healthily from the outset (as much new research has shown; see review in Kinsbourne & Hiscock, 1983), and that both hemispheres receive numerous opportunities to do what they are genetically programmed to do merely in the course of normal everyday living in an environment that is open to all of our senses every day of our lives. Furthermore, the schoolroom, contrary to how it has been characterized, is one of those environments. After all, schoolchildren are not subjects in a psychological experiment in which highly controlled procedures (such as tachistoscopic projection of visual targets) are employed in order to give one cerebral hemisphere first access to stimuli. Even adults whose cerebral hemispheres have been separated by commissurotomy have numerous strategies or means by which they can engage both hemispheres in problem solving and mentation. That is why the demonstration of lateralized functioning even in *these* individuals usually requires the application of rigidly controlled experimental procedures. Thus, even if we were to accept the mistaken characterization of reading and writing as exclusively "left-brained" (Hunter, 1976), there is little reason to worry that school lessons in reading and writing are being "beamed" only to the left hemisphere (see also Levy, Chapter 2, this volume).

Effectiveness of Suggested Right-Brain Training

Even if Jackson had been correct in advocating training the left hand to make it equal to the right, we have already seen that there was no evidence that the training could have accomplished the most ambitious goals of the Ambidextral Culture movement. That is, although ambidextrally trained individuals might well have achieved some greater measure of skill with the two hands, there was no evidence that this would have significantly enhanced, much less doubled, their mental capacity, and even less evidence that it would have created duplicate language centers in the right hemisphere. The special exercises urged by today's advocates of two-brain education seem no more likely to be effective, even if we accept the doubtful premise that the right hemisphere needs special exercise in the first place.

Consider some of the suggestions being made. The author of an article entitled "Putting the Other Half of the Brain to Work" writes:

One day a week, make it a rule that no one in the office or plant can use the word no. (The right hemisphere has no equivalent of no.) If something is not acceptable, the person must deal with it by saying, "yes, if . . ."; Give a 30 second explanation of something, and ask people to guess what you're getting at. (Prince, 1978, p. 58)

One could as well ask the author what *he* is getting at.

I offer another and evidently more seriously intended example from Edwards' (1979) book, *Drawing on the Right Side of the Brain*. Edwards promises to improve her readers' drawing ability by teaching them a set of basic exercises. The exercises, in fact, are mostly old hat, having been used by art teachers for many years. What is new is Edwards' characterization of them as having been designed (so the publisher tells us) to "release creative potential and tap into the special drawing abilities of the right half of the brain." One exercise is to copy a rather complex pencil drawing of Stravinsky by Picasso. Ordinarily, of course, the drawing would be copied in the upright orientation. Edwards believes that this encourages what she calls a left-brain, or L-mode, approach because when the picture is upright, we see it as a meaningful and therefore nameable (left-brain) form, with the usual features such as hands, ears, and so on. To put the student into the more appropriate right-hemisphere, or R-mode, state, Edwards recommends making the drawing indecipherable (that is, not nameable) by inverting it. The result, in Edwards' experience, is a great improvement in skill: "Presumably, the left hemisphere, confused and blocked by the unfamiliar image and unable to symbolize as usual, turned off, and the job passed over to the right hemisphere" (Edwards, 1979, p. 55).

This particular exercise may well yield the results claimed (students' copies reproduced in the book are quite impressive, although Edwards has hardly provided a carefully controlled test). But just as the ambidextral culturists drew conclusions of questionable validity from their successful demonstrations of simultaneous drawing or drawing and writing, so might Edwards have misinterpreted her own data. For example, her own characterization of the process of copying an inverted image suggests that the image, no longer easily recognizable as a gestalt or whole, now is copied in a more analytic feature-by-feature (i.e., line-by-line) manner. This strategy, however, is closer to the information-processing style associated with the *left*, not the right, hemisphere. The fact that the hands, ears, and other body parts are less likely to be named may be less consequential. This new characterization of the task is consistent, furthermore, with research on lateral specialization for face recognition. Upright faces generally are likelier to be recognized when tachistoscopically projected to the left visual half-field (right hemi-

sphere), but *inverted* faces are better recognized in the right visual half-field (left hemisphere), possibly because the subject, no longer able to discern expression, now must rely on a more analytic, feature-by-feature strategy (see, for example, Leehy *et al.*, 1978; and Levine, Chapter 6, this volume). (Many other factors also must be considered, since procedural conditions can critically determine which hemifield advantage is obtained in any given experiment with faces or any other stimulus; see Sergent & Bindra, 1981). Ironically, then, in trying to fashion an exercise that taps into the right hemisphere, Edwards may have accomplished just the opposite.

Antiliteracy

Aside from its misinterpretation of the neuropsychological evidence and its tendentious analysis of the school environment, there is one more thing that troubles me about the new "right-brain" movement. It is one thing to attempt to balance the supposed over-emphasis on "left-brain thinking" by trying out this or that sort of putative right-brain exercise, by pressing for support for music and art, or by coming out in favor of intuition and creativity. It is another thing altogether for the critics to attack what they call "left-brain education" in order to promote an educational philosophy and practice that celebrates or at least seeks to excuse anti-intellectualism, irrationality, and illiteracy. John Jackson (1905), for all his zeal, could not be so charged. But there is a disturbing streak of this attitude pervading the current right-brain education literature. For example, consider the argument that a right-brain education, possible only (we are told) in the outdoors, will provide "a world as a classroom that is whole and unfragmented by content disciplines such as math, science, . . . with no artificial boundaries . . . as might be found in textbooks and curriculum guides" (Staley, 1980, p. 47). Or recall the statement, quoted earlier, that "there is little need to be concerned about the left-brain abilities of most individuals" (Myers, 1982, p. 205). Can the author, a high-school English teacher, have been reflecting on his own students' competence in reading and writing? No matter if he has misjudged them, since, as a school principal has pointed out, with the advent of television, "which is primarily a right-brained input system augmented by the temporal (left-brained) input of speech, the whole world is able to receive information without the complex left-brained processing that reading demands" (Hunter, 1976, p. 48).

Therefore, predominantly right-brained individuals can take their proper place in the sun . . . Information about the Arab-Israeli conflict, for example, is no longer privileged communication for left-brained individuals who read about it; right-brained individuals can find out about the conflict through the primarily visual medium of television. (Hunter, 1976, p. 48)

Finally, for what a critic rightly called "blatant hucksterism" (Jones, 1980, p. 847), no example surpasses that of Ferguson (1980), who urges her readers to cease their worship of rationality and to "get in touch" with their right hemispheres.

CLOSING COMMENTS

I trust that no one will take my remarks to mean that music and the visual and the plastic arts have no proper place in education, that intuition, imagination, and visualization should not be encouraged and honored as valuable parts of thinking and problem solving, that hands-on experiences (field trips and the like) are of no educational value, or that teachers should not try to develop instructional techniques that are sensitive to children's different interests and styles, levels of skill, and rates of development. Few would deny that these are worthy goals and practices. But we do not make the case any more convincingly for them through portentous announcements about "right-hemisphere deterioration" or "hemispheric unbalance" of the sort quoted earlier. Rather, the justifications will have to be made on the same grounds as have been made by educators and humanists long before anyone ever heard about the cerebral hemispheres. In other words, if educators are unsatisfied with the educational *curriculum*, they ought to present the case for change on its *own* merits, and not seek to win scientific respectability for their arguments by cloaking them in neuropsychological jargon. Likewise, educators who are unhappy with instructional methods used in certain areas already well-established in the curriculum—such as mathematics or reading—ought to go ahead and work for change. But they should not try to justify their recommendations (and rationalize their failures) through simple-minded and empirically untenable dichotomies about left- and right-brain specialization, learning styles, and the nature of the academic disciplines. Then, of course, they must show that the new ways are truly an improvement over the old. *Innovation* is easy; in education it happens every day. Substantiation of the claims of innovation is very hard. It happens rarely. (See, for example, Guthrie, 1978, and other essays in Benton & Pearl, 1978.) In all these matters, neuropsychologists have their responsibilities too. Above all, we must be extremely careful not to mislead educators into thinking that our scientific findings and theoretical models are cut-and-dried and ready for easy translation into educational practice.

Finally, all of us—scientists and teachers alike—can profit from learning about the past. Indeed, on the subject of two-brain education, I think it is fitting to give the last word to an educational innovator from an earlier day.

It remains to be seen, whether our own cooler, calmer acceptance of ambidexterity as an important part of the school curriculum will be of lasting good, whether science will support us, teachers (much needed) be found to carry on the teaching of ambidexterity cautiously and consistently, and whether, indeed, generations to come will benefit by our efforts and reap what we have sown.

They will not remember us, but, with the fresh and charming egotism of youth, glory self-contained in their own age, and their more harmonious culture. (Mollett, 1910, p. 329)

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