

RESEARCH ON THE BRAIN'S HEMISPHERIC FUNCTIONS: IMPLICATIONS FOR SECOND LANGUAGE PEDAGOGY

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INTRODUCTION

It can be said without hesitation that the last few decades have witnessed the gradual demise of the "method" concept in second language education. From the turn of the present century to the mid-seventies, one finds countless journal articles and monographs scattered throughout the vast literature on the *pros* and *cons* of innumerable methods and their offspring (e.g. the grammar-translation method, the direct method, the audio-lingual method, the contrastive method, etc.). Until recently, there has existed an expectancy on the part of many classroom practitioners that *one* method would eventually come forth as a panacea. But the history of language teaching has recorded otherwise. As soon as a specific method (in its diverse versions) would gain currency for a period of time, enjoying a modicum of success in the initial stages of its implementation (especially in the form of textbook and materials development), the outcome, shortly thereafter, was invariably disenchantment and rejection.

For at least a decade now, the realization has been dawning upon both researchers and practitioners that maybe the concept of "method" may have been at fault in the documented failure of any one method in establishing itself permanently as a mainstream approach to second language education on a worldwide basis. A teaching "method" implies, *a priori*, a monolithic viewpoint of the learning process which, when translated into a finite set of operational procedures and routines, imposes a rigid pedagogical system on teacher and learner alike. The reality of the classroom has always made it clear that this concept is impracticable. It is little wonder, therefore, to find a large-scale abandonment of language teaching methods, as such, in recent years. As Stern (1983: 482) aptly puts it, since "the sixties a number of attempts have been made to develop a broad conceptual framework for language teaching and thereby to break away from the narrowness and partisanship implicit in the method notion."

This break does not imply that randomness is to be preferred to methodological systematicity, but rather that, since the learning process is a complex multi-dimensional one, the only realistic interpretation of this process is a multi-theoretical one. This has come to be known as the "integrated" perspective of language teaching, and it is gaining widespread acceptance as the only workable model of second language education (e.g. Titone, 1973, 1977, Titone and Danesi, 1985). This viewpoint appears to be receiving support, not only from the daily experiences of the classroom, but also from the neuropsychological research on the hemispheric functions of the brain. The purpose

of this paper is, in fact, to extrapolate from the research on cerebral hemispheric functions any evidence to be found in support of the integrated perspective. This would then provide a sound theoretical justification to the notion of integrated language teaching and a testable premise for future research on the psychological appropriateness of integrated teaching models.

Research on the Brain's Hemispheric Functions: A Synopsis

It is now a well-known neuropsychological fact that the two hemispheres develop asymmetrically in terms of function. For nearly two centuries, scientists have known that most language functions are located in the left hemisphere according to the following pattern: for approximately 98% of right-handed individuals, and for nearly two-thirds of left-handed ones. This knowledge was derived largely from observations of brain-damaged people. It became apparent that an injury to the left side of the brain would be consistently more likely to produce some form of speech impairment, or aphasia, than an injury of equal severity to the right side. Given the link that has always been made between the higher mental functions and speech, nineteenth-century neuropsychologists came to designate the left hemisphere as the *dominant* one, and the right hemisphere as the *minor* one. The consequences of this unfortunate nomenclature have been felt in our sociocultural behavior, organizations, and institutions. As the great American neurophysiologist Roger Sperry (1973: 209) eloquently observes, "there appear to be two modes of thinking, verbal and nonverbal, represented rather separately in left and right hemispheres, respectively, and that our educational system, as well as science in general, tends to neglect the nonverbal form of intellect."

It was not until the sixties that the concept of a dominant hemisphere was challenged scientifically. Neurophysiologists such as Sperry, Gazzaniga, Levy, and others (e.g. Sperry, 1968, 1973, Sperry, Gazzaniga and Bogen, 1969, Levy, Trevarthen and Sperry, 1972; see Edwards, 1979:28-32 for a survey of the relevant research findings) carried out detailed studies on commissurotomy, or "split-brain", patients, discovering that both hemispheres were actively involved in higher cognitive functioning with each half of the brain being specialized in a complementary way. In a nutshell, their research has documented, once and for all, that the two cerebral hemispheres will continue to function independently, even when separated surgically by severing the *corpus callosum*--the "cable" of nerve fibres that connects the two hemispheres. This line of investigation suggests very strongly that in individuals with intact brains both hemispheres are active in information processing in a complementary fashion. In other words, it would appear that the brain works as a unit, reconciling two clearly-differentiated modes of perception. This empirical finding suggests, in turn, that both hemispheres will be interacting during the complex process of language learning (e.g. Segalowitz, 1983, Danesi, 1984).

Adopting Edwards' (1983: 38) terminology, it is useful to refer to the left-hemisphere mode of perceiving as the *L-mode*, and to the right-hemisphere one as the *R-mode*. The L-mode is essentially analytical, while the R-mode is synthetic.

The research on brain-damaged people has allowed neuropsychologists to identify

and catalogue the specialized functions associated with both modes of perception, some of which are as follows (e.g. Bogen, 1975, Blakeslee, 1980:167):

- | | |
|---|---|
| <p><i>L-Mode Traits</i></p> <ul style="list-style-type: none"> ● speech ● meaning ● verbal memory ● intellectual tasks ● convergent thinking ● abstracting
 ● directed thinking ● propositional tasks ● analytic thinking ● lineal/sequential thinking ● analyzing parts etc. | <p><i>R-Mode Traits</i></p> <ul style="list-style-type: none"> ● understanding of metaphor ● spatial perception ● visual memory ● intuitive tasks ● divergent thinking ● perceiving concrete elements ● free thinking ● intuitive tasks ● relational thinking ● nonlinear/multiple thinking ● synthesizing parts |
|---|---|

The following table, adapted from the study by Hécaen and Sauguet (1971), can be used to illustrate how such findings have been compiled through the research on brain-damaged individuals. A study such as this one constitutes, in fact, a prototypical case in point of how researchers have been able to determine what specialized functions belong to each hemisphere. The table shows which disorders result from damage to one or the other hemisphere. The number of patients included in the data was: 293 right-handers with left-brain damage; 194 right-handers with right-brain damage; 47 left-handers with left-brain damage; 26 left-handers with right-brain damage (p = level of statistical probability/confidence, ns=statistically not significant):

BRAIN DAMAGE SYMPTOMS VS SIDE OF DAMAGE

	Right-handers		P	Left-handers		P
	Left-sided lesions %	Right-sided lesions %		Left-sided lesions %	Right-sided lesions %	
<i>Disturbances of oral language</i>						
Articulatory disorders	13	0	.0005	18	4	ns
Naming disorders	38	0	.0005	31	12	ns
Comprehension	33	0	.0005	11	8	ns
Paraphasias	13	0	.0005	10	12	ns
<i>Disturbances of reading</i>						
Letters	10	0	.0005	13	4	ns
Words	16	0	.0005	14	8	ns
Digits	8	0	.0005	9	8	ns
Numbers 2-3 digits	16	3	.0005	21	8	ns

	Right-handers			Left-handers		
	Left-sided lesions	Right-sided lesions	P	Left-sided lesions	Right-sided lesions	P
	%	%		%	%	
Numbers > 3 digits	28	6	.0005	26	12	ns
Simple commands	23	1	.0005	22	8	ns
Complex commands	33	1	.0005	31	8	.10
Textual material	38	16	.0005	58	23	.025
"Spatial" dyslexia	1	22	.0005	7	31	.01
<i>Disturbances of writing</i>						
Letters-words	29	2	.0005	18	12	ns
Sentences	44	4	.0005	44	16	.05
Story	44	4	.0005	39	14	ns
Copy	20	3	.0005	26	10	ns
Spelling	30	2	.0005	18	5	ns
Digits	12	0	.0005	7	4	ns
Numbers	30	1	.0005	29	8	.10
"Spatial" dysgraphia	4	25	.0005	9	31	.01
<i>Disturbances of calculation</i>						
Anarithmetia	53	18	.0005	56	15	.01
Mental calculation	54	5	.0005	38	10	ns
Arithmetic signs	23	6	.01	21	10	ns
Recognition of position of digits within a number	44	18	.0005	25	29	ns
"Spatial" dyscalculia	0	19	.0005	2	27	ns
Counting	3	25	.0005	4	23	ns
<i>Apraxias</i>						
Ideatory apraxia	1	0	ns	2	0	ns
Ideomotor apraxia	10	0	.0005	2	0	ns
Constructional apraxia	25	45	.0005	26	59	.005
Apraxia for dressing	0	16	.0005	9	9	ns
<i>Disturbances of somatognosis</i>						
<i>Right-left orientation</i>						
On the patient	2	0	ns	2	0	ns
On the observer	10	5	.10	12	17	ns
<i>Finger gnosis</i>						
Naming	19	1	.0005	13	8	ns
Verbal designation	14	1	.0005	3	9	ns
Non-verbal designation	5	1	.05	0	8	ns
Autotopognosis	3	0	.05	2	4	ns
Hemiasomatognosis	0	9	.0005	4	13	ns
<i>Disturbances of visual recognition</i>						
<i>I - Spatial data</i>						
Spatial disorientation	2	11	.0005	0	17	ns
Unilateral spatial agnosia	0	31	.0005	5	32	.001
Topographic notions	8	16	.01	9	9	ns
Depth appreciation	2	6	.01	2	9	ns

	Right-handers		P	Left-handers		P
	Left-sided lesion %	Right-sided lesions %		Left-sided lesions %	Right-sided lesions %	
Metamorphopsias	6	10	.05	11	12	ns
Subjective visual coordinates	21	41	.0005	20	38	.10
<i>II - Recognition of images and colors</i>						
Recognition of complex figurative picture	1	4	.05	0	0	ns
Recognition of designs of well-known symbols	4	7	.05	4	5	ns
Naming of colors	15	0	.0005	16	0	ns
Classification of colors	16	4	.0005	12	0	ns
Color evocation	5	0	.0005	3	0	ns
Color designation	5	0	.005	9	0	ns

(From: Blakeslee, 1980:185-6, adapted from Hécaen and Sauguet, 1971)

When it comes to language learning tasks, this kind of evidence makes it clear that the left hemisphere will be involved in analyzing, abstracting, planning, etc., allowing us to understand the individual concepts and items that make up language structure, while the right hemisphere will be involved in putting the individual "bits and pieces" together, allowing us to "see" how they combine to form discourse "wholes". Essentially, then, the nature of language learning can be designated as "bimodal", i.e. it involves both L-mode and R-mode strategies for processing the incoming language data.

Actually, a closer look at the data on language processing itself reveals that the right hemisphere is more involved in verbal functions than anyone had previously imagined. It has been found, for instance, that the brain handles linguistic material according to physical form (e.g. Benderly, 1981:11). For example, right-handed Westerners and Chinese process vowels in the left if they occur along with consonants, but they process them in the right if the vowels occur alone. Right-handed Japanese and Polynesians, on the other hand, have been found to process all vowels on the left, regardless of the phonetic environment in which they occur.

By tabulating some of the main findings on the functions of the hemispheres during speech processing, it becomes apparent that the right hemisphere is *not* inactive when it comes to language (e.g. Dennis and Whitaker, 1976, Schnitzer, 1978, Paivio and Begg, 1981:348-377, Segalowitz, 1983:85-96):

Left Hemisphere

- infers rules of syntax and morphology
- judges the relations among words in sentences

Right Hemisphere

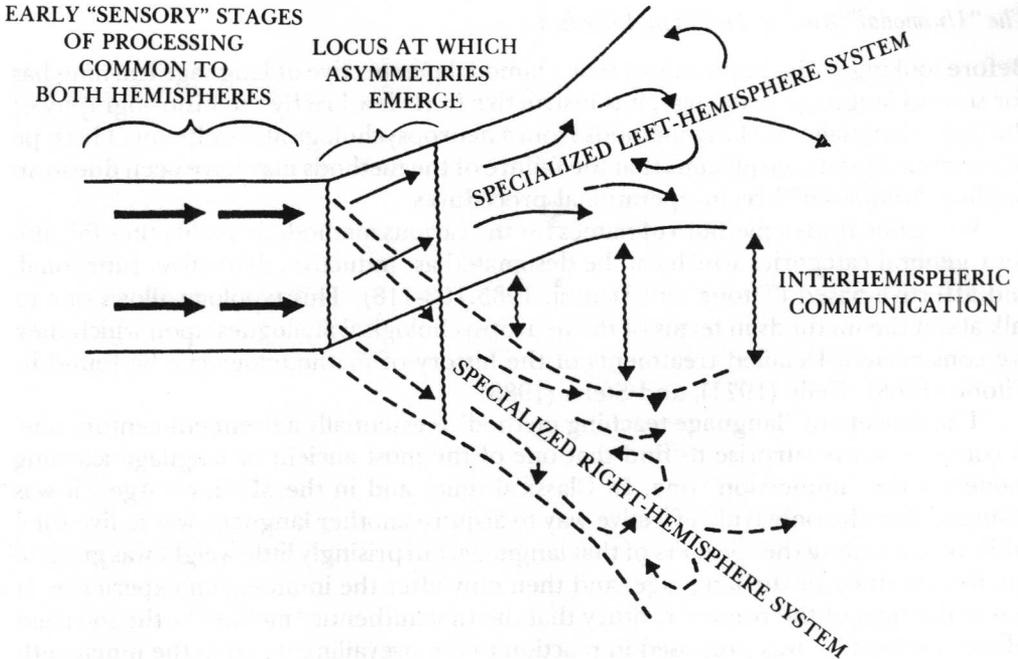
- processes prosodic structure (pitch, intonation, stress, etc.)
- determines whether the utterance is a statement, a condition, a command, or a question

- combines syntactic and semantic information for replacement of missing pronouns
- determines sentence implication
- repeats stylistic variants
- detects and corrects surface-structure errors
- determines connotative/meta-phorical meaning
- understands humor in jokes

Essentially, the left hemisphere processes the incoming language data in terms of its discrete units and its structural relations; the right hemisphere puts the bits and pieces together into discourse units. As Campbell (1982:248) points out, it can be said that the left hemisphere interprets the linguistic "text", whereas the right one contributes to the understanding of "context". Johnson-Weiner (1984:465) makes essentially the same point when she says that "the importance of the role each hemisphere plays in any given speech act depends on the extent to which its particular kind of cognitive functioning is needed, as determined by such factors as the nature of the task, the context within which it is performed, and individual cognitive strategies."

The reason for more right-hemisphere involvement in initial learning tasks than was previously thought might have an anatomical basis. After reviewing an enormous body of research, Goldberg and Costa (1981) come to the conclusion that right-hemisphere involvement may be due to its greater neuronal "interregional connectivity" which allows it to handle novel material better. The left hemisphere, with its sequential neuronal organization, has greater difficulty handling information for which there is no pre-existing code or program. The left hemisphere relies heavily on previously-accumulated and sequentially-organized information. Thus, as Goldberg and Costa suggest, the right hemisphere is specialized for the initial orientation of a task for which no pre-existing routine is available. Once an appropriate system has been discovered, the left hemisphere takes over its utilization.

Moscovitch (1983) gives an interesting account of how the two hemispheres might interact during initial learning behavior. The two hemispheres are viewed as separate, but interdependent, information-processing systems which process the incoming data *in tandem* at an early "sensory" stage. Subsequently, at a certain "*locus*" the functional and structural differences of the two hemispheres will process the data further according to their specialized systems:



(Moscovitch's Model of Information-Processing, 1983:95).

Some intriguing evidence that language processing involves both hemispheres in a cooperative fashion comes from the research on metaphors (e.g. Schwartz, Davidson and Maer, 1975, Winner and Gardner, 1977, Ortony, 1979, Ross and Mesulam, 1979, Heilman, Scholes and Watson, 1977, Danly and Shapiro, 1982; for surveys of the relevant research see Paivio and Begg, 1981:269-287, Hoffman, 1983, Danesi, 1984). Essentially, the experimental evidence shows that metaphorical processing results from the interaction of both hemispheres. This line of research has revealed that figurative language programming is content-controlled by the right hemisphere and structured verbally by the left one. This kind of finding has led to the conclusion, to use Segalowitz's (1983:41) words, that the right hemisphere "is necessary for normal communication in a broader sense."

The point of the foregoing discussion has been that, from a perusal of the literature on the cerebral hemispheric functions, it is now becoming more and more apparent that, if language is to be viewed as a vehicle of communication and not solely as an agglomeration of forms and structures, there is little doubt, as Zaidel (1983:120) aptly puts it, that "both hemispheres are used for total communication and that in the resulting interaction it is difficult to separate strictly linguistic from cognitive factors." From a pedagogical perspective, the "integrated" model of cerebral functioning leads to the inescapable conclusion, expressed eloquently by Levy (1985:44), that it "is impossible to educate one hemisphere at a time." Language learning is a bimodal process that involves both L-mode and R-mode strategies for handling the input to which the learner is exposed. This fact clearly points in the direction of integrated models of teaching as appropriate pedagogical responses.

The "Unimodal" Bias of Traditional Methods

Before looking at the implications that a bimodal perspective of language learning has for second language pedagogy, it is instructive to review briefly the historiography of the major language teaching methods from a neuropsychological standpoint. This type of review makes it conspicuous that the failure of the methods may have been due to an implicit "unimodal" bias in operational procedures.

While one finds a plethora of names for the various methods, in reality they fall into four general categories which can be designated as: inductive, deductive, functional, and affective-based (Titone and Danesi, 1985:108-118). This typology allows one to talk about the methods in terms of the neuropsychological analogues upon which they are constructed. Detailed treatments of the history of methodology can be found in Titone (1968), Kelly (1971), and Stern (1983).

The concept of "language teaching method" is essentially a twentieth-century one. It comes as some surprise to find that one of the most ancient of language learning models is the "immersion" one. In Classical times and in the Medieval Ages, it was assumed that the only truly effective way to acquire another language was to live for a while *in loco* among the speakers of that language. Surprisingly little weight was given to the formal study of the language, and then only after the immersion experience. It was at the turn of the present century that the first authentic "method"—the so-called "direct method"—was proposed in reaction to the prevailing trend in the nineteenth century of teaching foreign languages like the Classical ones, namely, through the medium of translation.

The "direct method" came to have all the identifiable characteristics of a method in the modern sense of the word: it was based on a specific psychological view of the learning process (i.e. that the process of learning a foreign language is similar to the process of native language acquisition); it devised procedures and techniques based on this view; and it outlined a standardized set of instructions for the construction of teaching materials. The key point to be made here is that the particular psychological viewpoint of the "direct method" provided the platform upon which teaching practices and routines were built. Specifically, it was believed that, like infants developing their mother tongue, foreign language learners needed to have constant exposure to the target language and needed to practice it frequently, especially through imitation and osmosis. Formal grammatical training was viewed as useless because the learners needed to go through a process of inducing structural patterns in the same way that infants did. This psychological bias was translated into the teaching routines which have become the recognizable features of the "direct method" in all of its forms (including in the so-called "Berlitz" version which is still popular today throughout the world):

- only the foreign language was allowed in the classroom;
- the focus was on the development of audio-oral skills;
- translation was never permitted;
- grammar was never taught directly, but rather imparted inductively by means of pattern practice;
- vocabulary was taught through the visual channel by means of cards, pictures, photographs, and other visual aids.

The “direct method” exemplifies an inductive method since it is based on the principle that learners should induce target language structure. As a matter of fact, the inductive principle is one of the oldest in existence. It has been assumed, from the time of the Sumerians (*circa* 2500 B.C.) onwards, that the most effective form of language teaching is the inductive one. This viewpoint became even more embedded in the forties and fifties when so-called “audio-lingual methods” came to the forefront. Those methods exemplified a clear behaviorist orientation. They were based on principles similar to those underlying the “direct method”, going even further in employing habit-formation techniques, reinforcement procedures, and inductive training. The only significant difference between “direct” and “audio-lingual” methods lay in the consideration of the role played by the native language in the learning process. Many audio-lingual theorists believed that the stored linguistic knowledge possessed by each learner greatly determined the ways in which the target language was perceived and assimilated. Essentially, they thought that the learner interpreted the new language in terms of the native one. This was considered to be the mechanism that produced the patterns of predictable errors that were seen to characterize all of language learning. This view led to the theory of “Contrastive Analysis” which allowed audio-lingual curriculum designers to arrange the items to be learned on the basis of language contrasts and predicted interlingual difficulties. This did not mean that the learner’s native language was used as a medium of instruction, but rather that the student’s unconscious linguistic habits should be programmed into the structure of the curriculum. Very good discussions of the underlying premises of “Contrastive Analysis” can be found in Richards (1974), Di Pietro (1976), and James (1980).

The various “audio-lingual” methods were at first hailed as panaceas. But practice showed otherwise. The initial optimism was due, in large part, to the disenchantment that had grown up vis-à-vis the “grammar-translation method” that had come to constitute mainstream pedagogical practice in the twenties, thirties, and forties. This method, unlike any other, was not based on any psychological theory of learning nor on any scientific linguistic model of language design, but rather on a utilitarian consideration. In the era after World War I, it became mainstream ideology on university campuses throughout North America to accept as the only realistic and attainable goal the ability to read and translate the foreign language. This became a deeply-rooted viewpoint because it was pointed out that, in the absence of an immersion environment, it was practically impossible to develop genuine audio-oral skills. And since the goal of a university education in a foreign language was the development of a critical/aesthetic verbal apparatus, the only truly useful skill was the ability to read. This viewpoint was converted into a fixed set of pedagogical procedures which came to influence teaching practice and material preparation for a long time: e.g. grammar notions were taught deductively by means of abstract rules based on prescriptive models of grammatical analysis; knowledge of the rules (given in the learner’s native language) was tested by giving the students sentences and passages to translate; vocabulary was imparted by means of bilingual glossaries; etc.

The “grammar-translation method” exemplified a deductive method: i.e. a method which aims to impart grammatical knowledge through rules. However, in this case the method did not have a theoretical apparatus to back it up. As the method filtered down, in its various disguises, into the other levels of education, discontent with

it was bound to ensue. The deductive principle, however, was given a theoretical foundation in the sixties from the domains of transformational linguistics and cognitive psychology. The principle was translated into so-called "Cognitive-Code methods" which stressed the importance of rule acquisition. But, unlike the "grammar-translation method", the "Cognitive-Code" approach avoided translation and utilized the rules based on transformational models of language design. Moreover, it emphasized concept-formation and meaningful practice. The latter was perhaps the most important feature of the method, for it correctly stressed that all samples of the target language used were to be related to the learner's psychological make-up and background. Only then would long-term storage by the memory system be possible.

Both the inductive and deductive approaches received an unexpected jolt when several crucial psycholinguistic experiments in the sixties showed conclusively that there was no significant learning difference between the two (e.g. Scherer and Wertheimer, 1964, Smith, 1970). When viewed from a neuropsychological standpoint, it is obvious that both the inductive and deductive approaches emphasized L-mode teaching, since both focused on the development of linguistic competence in an L-mode way (i.e. on the development of phonological, morphological, syntactic, and semantic control). It was assumed that the ability to apply this linguistic knowledge to communicative settings—an R-mode skill—would emerge spontaneously after the assimilation of language structure had taken place. Both approaches were "stuck", so to speak, on the L-mode of learning and teaching.

In all fairness, it must be pointed out that both the direct method and the various audio-visual methods did use R-mode techniques (e.g. the use of visual aids). This might, in fact, explain why they are still in use in diverse forms to this day. Nevertheless, their focus on linguistic competence did give the L-mode greater prominence at all points in the learning process.

The shift in the seventies in theoretical linguistics away from a narrow view of language as a closed system towards a more sociolinguistic perspective triggered a concomitant change in direction in foreign language teaching. With the rise of "pragmatic" or "functional" linguistics came a corresponding trend in language pedagogy to approach the target language from a communicative angle. The Council of Europe's "Threshold Level", and methodological facsimiles, are products of this theoretical mentality. The most salient characteristic of these methods is the use of speech act typologies (e.g. Austin, 1962, Searle, 1969, Halliday, 1973). Thus, the focus in these methods is not on language form *per se*, but on how to use the target language to express sociolinguistic functions such as "greeting", "requesting", "asking", etc. The focus on discourse—an R-mode strategy—came as a welcome change in pedagogical coordinates.

But the enthusiasm with which such methods were greeted at first has begun to wane in recent years, as practitioners and researchers have come to realize that some form of L-mode knowledge is indeed essential to complement R-mode abilities. In other words, what is becoming increasingly more obvious is that the nature of second language learning is bimodal. This realization has also received some justification by the apparent success of what might be called "affective-based methods" such as Asher's "Total Physical Response" (e.g. 1977), Terrell's "Natural Approach" (e.g. 1977), Gattegno's "Silent Way" (e.g. 1976), and Curran's "Community Counseling" (e.g.

1976). Suffice it to say here that all these methods are based on the view that the personality dimension is a crucial determinant of learning success. Consequently, they emphasize such "humanistic" techniques as getting the student physically involved in the learning process, letting the student feel comfortable and at ease in the classroom, establishing a friendly relationship with everybody involved in the process, etc. The founders of these methods report them to be effective. If this is indeed the case, the reason is immediately obvious: a learner who feels comfortable in the learning environment is more inclined to acquire skills easily. As such, these methods have been seminal in pointing out the importance of the affective component—an R-mode phenomenon—in any kind of learning situation.

The Bimodal Perspective: Pedagogical Implications

The purpose of the foregoing historical discussion has been to make the point that the unimodal bias of traditional inductive and deductive methodologies was probably the underlying cause of their failure to become embedded in the *modus operandi* of second language pedagogy. The program of procedures, techniques, routines, etc., that determined classroom style was invariably biased in favor of L-mode strategies (e.g. rule-learning, mechanical practice, and so on). The research on the cerebral hemispheric functions makes it saliently clear that the unimodal focus goes counter to neuropsychological reality. The bimodal nature of the language learning process suggests, essentially, that the only truly effective form that language teaching can take is one that aims at exploiting the "two-sided mind". The question for language teaching practice is, therefore, to determine what factors, conditions, techniques, etc., will activate both modes of learning in a syncretic fashion.

The answer to this question lies, in my view, in pursuing the trend towards developing more flexible and integrated teaching styles. As Titone (e.g. 1973, 1977) and others have been arguing, an integrated perspective will find something of value in all methodological practices. Thus, the L-mode emphasis of the inductive and deductive methods can—and should—be integrated with the R-mode features of the functional and affective-based methods. This means that analytic tasks—which have an L-mode focus—should be contextualized in some fashion in order to activate the synthetic abilities of the R-mode. Thus, for instance, the examples used during discrete-point drilling should be selected and organized in such a way as to constitute a semantic category, or to involve the learner in some purposeful communicative task. Instruction should be accompanied by all kinds of visual aids. Realia (e.g. newspapers, magazines, ads, cartoons, etc.) can be used not only to expose the student to the culture of the target language, but also to activate bimodal learning strategies. Indeed, creative reading material of any genre will invariably contribute to discourse-related R-mode learning. See, for example, the interesting and revealing study by Bocaz (1985) on this point. Above all else, the student should feel comfortable in the learning environment, given that personality variables play a crucial role in determining learning outcome. Moreover, by exploiting the learner's personality in the structure of the teaching process (e.g. by using personalized questions, by formulating some of the exercise material on the basis of the learner's interests, etc.), it allows the teacher to gain access to the R-mode.

One type of classroom activity which involves both hemispheres in an interactional way, and which I have found to be unusually effective (e.g. Danesi, 1979, 1980, 1985), is the use of problem-solving tasks to follow-up and complement regular exercise routines. The use of puzzles and games of various kinds (e.g. crosswords, anagrams, logic puzzles, etc.) not only allows teachers to go over linguistic material in a recreational and motivational fashion, but it also allows them to activate the student's bimodal learning strategies (e.g. Hatch, 1983:212). Take, for example, a so-called "word-search" puzzle:

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A B C B O Y G H L O M N O
S D F W U I O P L S Q W G
A X C M O A S D F G H J I
Z M X C V M B N M Q S D R
A A F T B W A G C W F H L
S N G H J K L N Z C B M K
Q W E R T Y U I O P A S L
C V B N M Q S D R F T G M
    
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The learner is asked to find four target language words. Clearly, this cannot be done on the basis of verbal (L-mode) knowledge alone, since the solution relies heavily on the ability to visualize (= an R-mode ability). To make the problem easier to solve, one might wish to utilize L-mode "clues" such as the following:

- Each of the words designates a human being (= a semantic property)
- Each of the words is a noun (= a morphosyntactic property)
- Each of the words begins and ends with a consonant (= an ortho-phonemic property) etc.

On the basis of both this kind of L-mode information, and on the ability to visualize pattern synthetically, the student must look for the following solution:

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A B C B O Y G H L O M N O
S D F W U I O P L S Q W G
A X C M O A S D F G H J I
Z M X C V M B N M Q S D R
A A F T B W A G C W F H L
S N G H J K L N Z C B M K
Q W E R T Y U I O P A S L
C V B N M Q S D R F T G M
    
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In order to solve puzzles such as this one, the student will have to make leaps of insight based on hunches, feelings, or visual images. When such R-mode strategies are activated in doing target language tasks, the learning effects are bound to be greatly enhanced.

Without going further into specific pedagogical details, it should be obvious that the key ingredient in an integrated approach to language teaching is never to lose sight of R-mode involvement in the learning process. The bimodal view of second language learning is also in line with Krashen's so-called "Monitor Model" (e.g. 1977, 1981), which distinguishes between conscious and subconscious learning. Despite some reservations one might wish to express with regard to Krashen's theory (e.g. McLaughlin, 1978), the dichotomy between conscious "learning" and subconscious "acquisition" seems to be justifiable, at least intuitively. According to Krashen, traditional classroom activities such as drills are conducive to conscious "learning". Whenever this strategy is activated, the learner is said to be using the "Monitor" which allows the learner to focus on form—an L-mode strategy. The linguistic information gained through monitoring might be used consciously to formulate sentences, to correct errors, to make analogies with the native language, etc. At the subconscious level, however, some of this linguistic information is acquired permanently through, it would appear, the synthetic processes of the R-mode. Since, as discussed above, the R-mode is crucial for novel learning tasks—which Obler (1980) calls the "stage hypothesis"—it is clear that access to the R-mode functions is vital at the very start of the learning process. The neuropsychological evidence suggests, in fact, that conscious L-mode learning follows—not precedes—the subconscious processing of linguistic material. Thus it would appear that the recent orientation towards communication in the classroom from the very start rests on solid theoretical ground.

Concluding Remarks

From a consideration of the research evidence on the brain's hemispheric functions, which is quite convincing because it is cumulative, it is obvious that the only type of language teaching practice that is "brain-compatible" is the one that aims at exploiting the whole mind bimodally. The method approach to second language teaching was an unworkable one because it was unimodal in focus and, therefore, "brain-antagonistic". As teachers learn to understand the true duality of their students' minds, they will be in a better position to enhance the learning outcome. Making fuller use of the two-sided mind does not require giving up books and lectures, which are valuable techniques. It merely requires that we balance them with other techniques that are more compatible with the R-mode. This might require more of the teacher, but it also gives a great deal more to the student. As Williams (1983:9-10) aptly puts it, the "research on the brain supports what many teachers have intuitively known, that students learn in many ways and that the more ways one can present information, the better they will learn".

REFERENCES

- ASHER, J.J. 1977. *Learning another language through actions*. Los Gatos, California: Sky Oaks.
AUSTIN, J. 1962. *How to do things with words*. Cambridge, Mass: Harvard University Press.
BENDERLY, B.F. 1981. The multilingual mind. *Psychology Today* 15: 9-12.
BLAKESLEE, T.R. 1980. *The right brain*. New York: Berkley.

- BOCAZ, A. 1985. Instanciación de esquemas y creatividad narrativa en una lengua extranjera. *Lenguas Modernas* 12: 23-43.
- BOGEN, J.E. 1975. Some educational aspects of hemispheric specialization. *UCLA Educator* 17: 24-32.
- CAMPBELL, J. 1982. *Grammatical man*. New York: Simon and Schuster.
- CARROLL, F.W. 1980. Neurolinguistic processing of a second language. In R.S. Scarcella and S.D. Krashen (eds.), *Research in second language acquisition*, 81-85. Rowley, Mass.: Newbury House.
- CURRAN, C.A. 1976. *Counselling-learning in second languages*. Apple River, Ill.: Apple River Press.
- DANESI, M. 1979. Puzzles in language teaching. *Canadian Modern Language Review* 35: 269-277.
- DANESI, M. 1980. Mathematical games in foreign language courses. *Rassegna Italiana di Linguistica Applicata* 12: 195-204.
- DANESI, M. 1984. *A guide to puzzles and games in second language pedagogy*. Toronto: OISE Press.
- DANLY, M. and SHAPIRO, B. 1982. Speech prosody in Broca's aphasia. *Brain and Language* 16: 171-190.
- DENNIS, M. and WHITAKER, H. 1976. Language acquisition following hemidecortication: Linguistic superiority of the left over the right hemisphere. *Brain and Language* 3: 404-433.
- DI PIETRO, R.J. 1976. *Language structures in contrast*. Rowley, Mass.: Newbury House.
- EDWARDS, B. 1979. *Drawing on right side of the brain*. Los Angeles: J.P. Tarcher.
- GALLOWAY, L. and KRASHEN, S.D. 1980. Cerebral organization in bilingualism and second language. In R.C. Scarcella and S.D. Krashen (eds.), *Research in second language acquisition*, 74-80. Rowley, Mass.: Newbury House.
- GATTEGNO, C. 1976. *The common sense of teaching foreign languages*. New York: Educational Solutions.
- GOLDBERG, E. and COSTA, L.D. 1981. Hemispheric differences in the acquisition and use of descriptive systems. *Brain and Language* 14: 144-173.
- HALLIDAY, M.A.K. 1975. *Learning how to mean: Explorations in the development of language*. London: Arnold.
- HATCH, E.M. 1983. *Psycholinguistics: A second language perspective*. Rowley, Mass.: Newbury House.
- HÉCAEN, J. and SAUGUET, J. 1971. Cerebral dominance in left-handed subjects. *Cortex* 7: 19-48.
- HEILMAN, K.W., SHOLES, R. and WATSON, R.T. 1977. Auditory effective agnosia: Disturbed comprehension of affective speech. *Journal of Neurology, Neurosurgery, and Psychiatry* 38: 69-72.
- HOFFMAN, R.R. 1983. Recent research on metaphor. *Semiotic Inquiry* 3: 35-62.
- JAMES, C. 1980. *Contrastive analysis*. London: Longman.
- JOHNSON-WEINER, K.M. 1984. The effects of right and left hemisphere damage on the comprehension of stress in English. In A. Manning, P. Martin and K. McCalla (eds.), *The Tenth LACUS Forum*, 464-473. Columbia, S.C.: Hornbeam.
- KELLY, L.G. 1969. *25 centuries of language teaching*. Rowley, Mass.: Newbury House.
- KRASHEN, S.D. 1977. The monitor model for adult second language performance. In M. Burt, H. Dulay and M. Finocchiaro (eds.), *Viewpoints on English as a second language*. New York: Regents.
- KRASHEN, S.D. 1981. *Second language acquisition and second language learning*. Oxford: Pergamon.
- LEVY, J. 1985. Right brain, left brain: Fact and fiction. *Psychology Today* 19: 38-44.
- LEVY, J., TREVARTHEN, C. and SPERRY, R.W. 1972. Perception of bilateral chimeric figures following hemispheric disconnection. *Brain* 95: 61-78.
- MCLAUGHLIN, B. 1978. The monitor model: Some methodological considerations. *Language Learning* 28: 309-332.
- MOSCOVITCH, M. 1983. Stages of processing and hemispheric differences in language in the normal subject. In M. Studdert-Kennedy (ed.), *Psychobiology of language*, 88-104. Cambridge, Mass.: MIT Press.
- OBLER, L. 1980. Right hemisphere participation in second language acquisition. In K. Diller (ed.), *Individual differences and universals in language learning aptitude*. Rowley, Mass.: Newbury House.
- ORTONY, A. (ed.) 1979. *Metaphor and thought*. Cambridge: Cambridge University Press.
- PAIVIO, A. and BEGG, I. 1981. *Psychology of language*. Englewood Cliffs, N.J.: Prentice-Hall.
- RICHARDS, J.C. (ed.) 1974. *Error analysis: Perspectives on second-language acquisition*. London: Longman.
- ROSS, E.D. and MESULAM, M.M. 1979. Dominant language functions of the right hemisphere? *Archives of Neurology* 36: 144-148.

- SCHERER, G.A.C. and WERTHEIMER, M. 1964. *A psycholinguistic experiment in foreign language teaching*. New York: McGraw-Hill.
- SCHNITZER, M.L. 1978. Cerebral lateralization and plasticity: Their relevance to language acquisition. In M. Paradis (ed.), *The Fourth LACUS Forum*, 114-120. Columbia, S.C.: Hornbeam.
- SCHWARTZ, G.E., DAVIDSON, R.J. and MAER, F. 1975. Right hemispheric lateralization for emotions in the human brain: Interactions with cognition. *Science* 190: 286-288.
- SEARLE, J.R. 1969. *Speech acts*. Cambridge: Cambridge University Press.
- SEGALOWITZ, S.T. 1983. *Two sides of the brain: Brain lateralization explored*. Englewood Cliffs, N.J.: Prentice-Hall.
- SMITH, P.D. 1970. *A comparison of the cognitive and audiolingual approaches to foreign language instruction: The Pennsylvania project*. Philadelphia: Center for Curriculum Development.
- SPERRY, R.W. 1968. Hemisphere disconnection and unity in conscious awareness. *American Psychologist* 23: 723-733.
- SPERRY, R.W. 1973. Lateral specialization of cerebral function in the surgically separated hemispheres. In F.J. Mc Guigan and R.A. Schooner (eds.), *The psychophysiology of thinking*, 209-229. New York: Academic.
- SPERRY, R.W., GAZZANIGA, M.S. and BOGEN, J.E. 1969. Interhemispheric relationships: The neocortical commissures; syndromes of hemispheric disconnection. In P.J. Vinken and G.W. Bruyn (eds.), *Handbook of clinical neurology*, 273-289. Amsterdam: North-Holland.
- STERN, H.H. 1983. *Fundamental concepts of language teaching*. Oxford: Oxford University Press.
- TERRELL, T.D. 1977. A natural approach to second language learning and acquisition. *Modern Language Journal* 61: 325-337.
- TITONE, R. 1968. *Teaching foreign languages: An historical sketch*. Washington, D.C.: Georgetown University Press.
- TITONE, R. 1973. A psycholinguistic description of the glossodynamic model of language behavior and language learning. *Rassegna Italiana di Linguistica Applicata* 5: 1-18.
- TITONE, R. 1977. A humanistic approach to language behavior and language learning. *Canadian Modern Language Review* 33: 309-317.
- TITONE, R. and DANESI, M. 1985. *Applied psycholinguistics: An introduction to the psychology of second language learning and teaching*. Toronto: University of Toronto Press.
- WILLIAMS, L.V. 1983. *Teaching for the two-sided mind*. Englewood Cliffs, N.J.: Prentice-Hall.
- WINNER, E. and GARDNER, H. 1977. The comprehension of metaphor in brain-damaged patients. *Brain* 100: 77-729.
- ZAIDEL, E. 1983. On multiple representations of the lexicon in the brain: The case of two hemispheres. In M. Studdert-Kennedy (ed.), *Psychobiology of language*, 105-125. Cambridge, Mass.: MIT Press.