

THE BILINGUAL BRAIN

Neuropsychological and
Neurolinguistic Aspects of Bilingualism

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THE BILINGUAL BRAIN

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**PERSPECTIVES IN
NEUROLINGUISTICS AND PSYCHOLINGUISTICS**

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Studies in Neurolinguistics, Volume 4

To the memory of Benjamin Albert
and to
Alice Albert, Miriam Dworsky Obler, and Edward Obler

Preface

Working in Jerusalem in behavioral neurology and neurolinguistics, we began to make clinical observations that could not be explained by recourse to traditional teachings. For example, we were seeing more aphasia in right-handers with right hemispheric lesions than we had come to believe was "normal." We also saw a brain-damaged multilingual patient who had a clinical picture of Broca's aphasia in one language and a clinical picture of Wernicke's aphasia in another. This pattern of two different types of aphasia in one patient at the same time, we had been taught, was theoretically impossible. Either our clinical observations were erroneous, or the standard theories of cerebral organization for language needed to be modified.

Since very few adults in Israel speak only one language, we wondered whether the fact of being bilingual influenced cerebral organization for language, thereby causing the unusual clinical situations we were encountering. Perhaps the traditional theories of cerebral organization for language were correct, but only for monolinguals. As Dr. Phyllis Albert suggested, perhaps "an accident of history" had determined that most neurobehavioral investigations of language had been carried out in monolingual societies. It was possible that traditional

theories needed to be modified or expanded to account for the facts of bilingualism.

We did not start out with the intention of writing a book. We set out to discover what had been done by others to study the neurological bases of bilingualism, and to conduct some studies ourselves. We discovered much excellent work that had been done by linguists, psychologists, and neurologists on the neurological bases of bilingualism. We also found that most of this work was widely scattered in diverse publications, and that brought together, the evidence provided a coherent and compelling picture. We decided to bring the evidence together; the result was this book.

At the outset we posed the following question: How is language organized in the brain of a bilingual? Is it the same as in the brain of a monolingual, as most people suppose, or is it somehow different? To answer these questions we collected and analyzed research in various disciplines as they relate to bilingualism. Reflecting this procedure, we consider in separate chapters three main approaches to the study of bilingualism—linguistic, psychological, and neuropsychological. In the chapter on neuropsychological aspects of bilingualism, we present a detailed review of our own research. Following the chapters that consider studies in bilingualism by research field, we select key issues of bilingualism and synthesize data from the various fields in relation to each key issue. By this means we hope to clarify the relationship of neurological organization to linguistic organization.

We conclude by suggesting that the fact of learning a second language seems to distinguish the bilingual from the monolingual, not only in language skills but also in perceptual strategies and even in patterns of cerebral organization. The facts of bilingualism indicate that the right hemisphere plays a major role in the learning of a second language, even in the adult. The brain is seen to be a plastic, dynamically changing organ which may be modified by processes of learning.

Acknowledgments

Our own experiments were carried out for the most part in Jerusalem in the Aranne Laboratory for Human Psychophysiology of the Department of Neurology, Hadassah Hospital and Hebrew University Medical School (Professor S. Feldman, Chairman). Professor T. Najenson opened the facilities of the Beit Loewenstein Rehabilitation Hospital of Tel Aviv Medical School to us. I. Schechter, the aphasia specialist, was most helpful in aiding our research there.

We completed this work with the help of numerous friends and colleagues, whom we take this occasion to thank again. Tirca Gazieli, and Drs. Harold Gordon and Ruth Silverberg contributed considerable professional expertise to collaboration in our research. Joel Walters, Dr. Margaret Fearey, and Professors Norman Geschwind, Harold Goodglass, and D. Frank Benson generously provided critical challenge and insightful comment. For sharing his thoughts about the neurolinguistics of bilingualism, as well as his work on polyglot aphasia, and for critical reading of the manuscript, we thank Dr. Michel Paradis. Dr. Phyllis Albert and David and Michael Albert contributed a series of stimulating questions and several thoughtful answers. Professor W. Lambert kindly supplied us with prepublication manuscripts of current findings from his own laboratory. The support of our editor, Professor Harry Whitaker, is also greatly appreciated.

Errol Baker, Jerry Levinson, Peter Soloman, and Gil Stern aided us in collecting and/or analyzing data. Dr. Israel Nachshon, Dr. Robert Cooper, and Joel Walters opened their personal libraries to us, and aided our bibliographic search. Gaila Obstfeld and Claire Sybertz contributed excellent typing services.

Other friends and colleagues, especially from the Aphasia Research Center of the Department of Neurology, Boston University Medical School and Boston Veterans Administration Hospital, provided constructive comments, theories, and disagreements. In particular, we thank Dr. Edgar Zurif for his time, concern, and constructive advice.

We wish to advise the reader that our policy on pronoun gender deviates slightly from standard practice. In order that the reader may bear in mind that third person pronoun reference may apply to both females and males, we have chosen to alternate use of the male and female pronouns, insofar as this will not lead to confusion.

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Introduction

Statement of the Problem

Many people know more than one language; entire societies are bilingual or multilingual. Yet, perhaps by an accident of history, neurobehavioral studies have been conducted mainly in societies that are predominantly monolingual. As a result, much pertinent information about natural language behavior and its neurological basis has been largely ignored. Scientists concerned with the organization of language in the brain should, therefore, consider the neurological implications of bilingualism.

The weight of evidence collected over many years by able scientists in different disciplines has convincingly demonstrated that the left cerebral hemisphere is dominant for language in most humans, that is, that language in some way has a special dependence on the anatomical structures and physiological activity of the left hemisphere. This evidence, however, has been collected almost exclusively from monolinguals. There is no special reason to assume on an a priori basis that the second language sits in the brain of a bilingual in exactly the same manner as does the first and only language in the brain of a monolin-

gual. The hypothesis could be proposed that the learning of a second language in some way influences the subtle interactions between left and right hemispheres, and between cortical and subcortical structures, so that cerebral function is different for monolinguals and bilinguals.

The facts known to date cannot confirm or deny the validity of such a hypothesis. Nevertheless, a number of psychological, linguistic, and neurological investigations have been carried out on subjects who know and speak more than one language. These studies provide some clues for answering the question of how language is organized in the brain of the bilingual. This question is the focus of our monograph.

Background

The history of studies on bilingualism does not fall into a neat, continuous line. Several threads, rather, can be identified, and these threads are seen to intersect with each other during periodic surges of research activity into mechanisms of bilingualism.

Studies on aphasia in polyglots constitute one strand. Such studies have dealt primarily with patterns of recovery. Ribot's (1882) general theory of memory disorders was that earlier-learned items are better preserved in brain damage, and that, in recovery from memory loss, earlier-learned items return before later-learned items. His hypothesis with respect to polyglot aphasics, then, was that the earlier-learned language recovers first. Pitres (1895) suggested that the language to recover first would be the one that has been used most in the extended period prior to the onset of aphasia. Krapf (1957) and Minkowski (1965) felt that affective factors help determine which language will return first.

These theories were proposed to explain the clinical observation that often a polyglot aphasic patient recovers one language before another. Some authors have suggested that differential recovery may result from different premorbid patterns of anatomical organization of the languages (Scoresby-Jackson, 1867; Gloning & Gloning, 1965; Albert & Obler, 1975). Pitres (1895) and others have argued against the possibility that different languages may be organized differently in the brain. Their position is supported by studies of groups of brain-damaged patients (e.g., Charlton, 1964; L'Hermitte, Hécaen, Dubois, Culioli, & Tabouret-Keller, 1966) that suggested that the majority of aphasic polyglots lose and then recover their languages in proportion to the premorbid degree of fluency in the language. Goldstein (1948) attempted to provide a single explanation for the two divergent sets of

studies—those focusing on differential recovery, and those focusing on parallel recovery. He suggested that a cognitive mechanism responsible for switching between the two languages might be impaired in cases of differential recovery.

Whereas aphasiologists have dealt with various forms of behavioral and anatomical distinction between the two languages, linguists and psychologists have focused on various forms of interference between languages. Epstein's (1916) dissertation, *Pensée et Polyglossie*, spoke of the "inhibition" of one language on a second language, and of the "antagonism" between two languages, especially at the phonological and lexical levels. Vildomec's volume *Multilingualism* (1963) provided numerous examples of interference at all linguistic levels, in writing as well as in speech. Within the American structuralist framework, Weinreich's *Languages in Contact* (1953) systematized the notion of bilingual interference at all linguistic levels. In emphasizing the importance of the manner in which a second language is learned, Weinreich paved the way for the Osgood and Ervin (1954a) model of compound as opposed to coordinate bilingualism. In their scheme, the manner in which a second language is learned determines whether the two languages are "stored" as a single, compound system or as a dual coordinate system. Over the past two decades many studies have been conducted to test the viability of the compound-coordinate model. Studies, such as those by Lambert and his colleagues (e.g., 1956a,b,c, 1969), have measured interference in word-list learning or in word association tasks and have correlated this measure with the different language histories of their bilingual subjects.

In other studies (e.g., Riegel, 1968; Diller, 1974) the compound-coordinate notion has not been viewed as a clear-cut dichotomy, but, rather, as a continuum. A new perspective on bilingual interference has developed as a result. Authors interested in how interference is **avoided** have posited a switch mechanism (which would be functionally the same as that proposed by Goldstein, 1948). Macnamara and Kushnir (1971) and Kolars (1966), for example, have developed instruments for measuring the facility and timing involved in forced switching from one language to another.

The majority of psychological and linguistic studies of bilingualism have focused on language production. Only in recent years have researchers begun to investigate systematically the capacity of a bilingual to perceive and comprehend verbal information. Most psycholinguistic tests (e.g., Caramazza, Yeni-Komshian, Zurif, & Carbone, 1973) have focused on phonological perception as well as on production. Various psychological tests—using dichotic, tachistoscopic,

evoked potential, electroencephalographic, and reaction time measures—have also compared perception of stimuli in one language to that in the other (e.g., Genesee, Hamers, Lambert, Mononen, Seitz, & Starck, 1978; Obler, Albert, & Gordon, 1975).

Such studies bring us full cycle to the clinical aphasiological concerns of the last century, since they speak to the issue of how two languages can be housed in one brain.

Definition of Terms

We shall first define bilingualism, then the factors that have been considered to play a part in the development of the bilingual state, and, last, the evaluation measures which have been used to determine the linguistic consequences of bilingualism for the individual.

BILINGUALISM

The range of meaning of the term **bilingualism** varies throughout the literature on the topic. Some authors focus on equal passive competence in both languages (listening and perhaps also reading equally well), whereas others focus on equal productive competence (speaking and perhaps also writing). Researchers also differ on the degree of proficiency necessary to bilingualism; for some a person is bilingual only if she “knows” both languages equally; others may include third-year students of the second language within their definition of the bilingual. Some experimental tests are designed to exclude speakers of more than the two languages in question, whereas others unquestioningly consider polyglots to be “bilinguals.”

Bilingualism is broadly defined by Weinreich (1953) as “the practice of alternately using two languages.” This phrasing starts to serve our purposes as it includes the widest possible population. It should be noted, however, that it leaves unresolved several issues:

1. Is **multilingualism** merely an extension of the bilingual state, or might it be qualitatively different?
2. How does one judge whether two distinct languages are under consideration (i.e., do bidialectalism, diglossia, or even wide register control come under the same rubric?)
3. Does “use” of a language entail any minimal fluency criterion? (To take an extreme example, does the use of “OK” imply that its worldwide users are English speaking? If it does not, then what parameters are to determine fluency?)

4. What modalities (e.g., speaking, comprehension, writing, reading) are to be considered in the evaluation of "using languages alternately?"

We subscribe to Weinreich's purposely vague definition with the conscious stipulation that any research done on bilinguals must specify the more detailed criteria considered in subject selection, since it is reasonable to expect that distinctive subgroups are to be found among all the people who "alternately use two languages."

THE BILINGUAL STATE

A balanced bilingual has, theoretically, native language proficiency in both languages. The term **dominant bilingual** describes someone who is more fluent in one language than in another; **second language learners** are the subgroup who are somehow actively involved in improving their second language skills. **Fluency** must be considered for the various skills: Reading and auditory understanding are not necessarily interdependent, nor are writing and speaking, although it is likely that the abilities to speak and to write a language are dependent, respectively, on the abilities to understand and to read it.

The question of **interference** between the two languages begs that of the existence of a true balanced bilingual. The speech of a bilingual will often manifest influences of one language on the other, whether this be at the phonological level (accent), the lexical level (word borrowings), or the syntactic level (inappropriate phrase translation or use of grammatical morphemes). At the same time, it is clear that there is some measure of independence between the two languages of a bilingual, that one can speak quite fluently in one language without the obvious intrusion of the other language. It has, thus, been claimed (e.g., Macnamara & Kushnir, 1971) that the bilingual has a more or less voluntary **output switch**, which inhibits one language while permitting the other to be produced. An automatic **input switch** is hypothesized, as well, which alerts or sets the language-processing system to deal with the different languages which it hears or reads. This input switch must be at work in those confusing first seconds of a received telephone call or discovered radio station, in which one initially does not understand a known language, not knowing which language is being spoken.

The psycholinguistic concepts of language independence and language interdependence are related to the concepts of **compound** and **coordinate bilingualism**. A true compound bilingual is assumed to have the two languages organized as a single system, whereas the true coordinate bilingual has the two organized as two separate systems.

These theoretical categories have been much debated. Beyond questioning whether a true compound or coordinate bilingual may exist, one may ask if the two categories are sufficient to account for all cases of bilingualism. For example, one might need to posit a case of **subordinate bilingualism** in which the second learned language is processed not directly but rather via the first. In operationalizing the terms for purposes of defining experimental groups, one must decide whether to choose as a criterion for definition the age of learning the second language (e.g., those who had learned the second language before age 6 would be compounds; those who had learned the second language after age 13 would be coordinates), the manner of learning the second language (e.g., one-parent, one-language situations would result in coordinate bilinguals; teaching in school by a translation method would result in compound bilingualism), or usage patterns (e.g., people in a community which regularly mixed languages would be compounds; jet-setters between monolingual societies would be coordinates).

For the neurolinguist, all the terms discussed in this section must correspond to some mechanism or organizational principle in the brain. Thus, in neurolinguistic research the same questions of independence or interference could be phrased around the (unsatisfactory) notions of **separate** or **same language centers**. Our own studies indicate that factors of cerebral dominance may prove to be relevant in understanding specific parameters and mechanisms of bilingualism (e.g., degrees of cerebral dominance may differ for each language). The issue of switch mechanisms may be seen in the inhibition caused by the assumed breakdown of a switch after brain damage; bilingual aphasics may lose their previous flexibility in appropriately shifting from one language to the other.

PARAMETERS OF LANGUAGE ACQUISITION

The following factors have been proposed as conditioning either the state of the healthy bilingual, or the pattern of recovery from aphasia after brain damage:

THE AGE OF LEARNING THE SECOND LANGUAGE

It would appear that after puberty the likelihood of learning a second language with native accent is reduced (Lenneberg, 1967; Guiora, Brannon, & Dull, 1972). Curtiss (1977) reports a case of difficulty in learning a first language after puberty. Language teachers often subscribe to the theory that the younger the learners are, the better they