

# Tutorials Bilingualism

Psycholinguistic Perspectives

Edited by

Annette M. B. de Groot

Judith F. Kroll



Psychology Press

**TUTORIALS IN BILINGUALISM**  
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## **Psycholinguistic Perspectives**

Edited by

Annette M. B. de Groot  
*University of Amsterdam*

Judith F. Kroll  
*The Pennsylvania State University*

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## Preface

The editors of this volume first met in 1989 when one of us spent a sabbatical at the Netherlands Institute for Advanced Study in the Humanities and Social Sciences. What was planned as a brief meeting at the University of Amsterdam turned into an entire afternoon of lively discussion and debate as we discovered that we were working on virtually the same research problems. The focus of each of our respective programs of research has been on the nature of language representation in the bilingual. Because one of us lives and works in the Netherlands, where the culture itself supports the acquisition of multiple languages, and the other lives and works in the United States, where relatively fluent bilingualism is the exception rather than the rule, we have taken different but converging approaches to this problem. In the 7 years since we met, we and our students have been engaged in a continuous dialogue about the cognitive processes that are influenced by—and themselves influence—second language learning and bilingual language processing. This book represents the first tangible result of our collaboration. Although a number of excellent monographs and edited volumes on bilingualism are available, it seemed to us that among them there was no book that did justice to the exponential growth of recent research on the psycholinguistics of bilingualism, and that could provide a basis for sorting out the complex implications of this work. The purpose of this book is to provide a tutorial overview of the literature on bilingual language processing from a psycholinguistic perspective. The contributors have attempted to address language processing in two languages at many different levels of analysis,



from understanding spoken and written words to comprehending text and producing discourse. The book also considers aspects of second language acquisition and specific consequences of bilingualism for cognition and for special circumstances in which access to language is constrained, for example in the deaf and in aphasics who were previously bilingual. Although we anticipate that some readers will wish that other topics and other emphases were included, we believe that the scope of this volume represents a fair sampling of the most exciting contemporary psycholinguistic research on this topic.

### ACKNOWLEDGMENTS

There are many people we wish to acknowledge. First and foremost are the contributors themselves, who were cooperative in meeting our deadlines and who took seriously the assignment of writing chapters that were broad tutorial overviews. This is not an easy task, even for the seasoned researcher, and we deeply appreciate the efforts that produced the insightful work that follows in this volume. We thank Judi Amsel, our editor at Lawrence Erlbaum Associates, who encouraged us in the most generous way and who was always available to answer our questions. Each of us has also worked with talented students who have contributed to our ideas in many ways, and we thank them for making our lives in the laboratory a spirited experience. Among them, we particularly thank our recent doctoral students, Anny Bosman, Catherine Elsinger, Janet van Hell, Erica Michael, Natasha Miller, Alexandra Sholl, and Natasha Tokowicz. Finally, we wish to acknowledge the love and support of our families and friends. It is to them that we dedicate this book.

*Annette M. B. de Groot*  
*Judith F. Kroll*

# Introduction and Overview

Annette M. B. de Groot  
*University of Amsterdam*

Judith F. Kroll  
*Pennsylvania State University*

The past 15 years have witnessed an increasing interest in the cognitive study of the bilingual. A major reason why psychologists, psycholinguists, applied linguists, neuropsychologists, and educators have pursued this topic at an accelerating pace presumably is the acknowledgment by increasingly large numbers of language researchers that the incidence of monolingualism in individual language users may be lower than that of bilingualism. This alleged numerical imbalance between monolinguals and bilinguals may be expected to become larger due to increasing international travel through, for instance, tourism and trade, to the growing use of international communication networks, and to the fact that in some parts of the world (Europe), the borders between countries are effectively disappearing. The statement that bilingualism, rather than monolingualism, is more the norm is particularly persuasive if one adopts a definition of bilingualism that covers not only balanced bilinguals, of which there may be relatively few, but also unbalanced forms, where one of the languages dominates the other. For a long time, the opposite view of bilingualism as a rather exceptional human state has been entertained. A likely reason for this may be that the United States, where the majority of language researchers reside, represents a prototypical bilingualism-as-exception culture. Students attending public high schools are typically required to take foreign language classes but rarely become fluent, and outside of urban settings with a strong minority language presence, there is little opportunity to use languages other than English. English and monolingualism are thus the norm.

In addition to the growing awareness that bilinguals are very common and may even outnumber monolinguals, there is the dawning understanding that the bilingual mind is not simply the sum of the cognitive processes associated with each of the two monolingual modes, and that the two languages of the bilingual may interact with one another in complicated ways. To gain a genuinely universal account of human cognition will therefore require a detailed understanding of language use by both pure monolinguals as well as bilinguals, unbalanced and balanced, and of the representations and processes involved. That the study of bilingual cognition may lead into muddier waters than that of monolingualism, for instance because the bilingual population is rather heterogeneous in terms of factors such as age of acquisition and proficiency of the second language, and the large number of pairwise combinations of the world's languages involved (estimated at 4,000; Comrie, 1989), should therefore not be a reason to ignore it (see Cook, this volume).

These two insights, that bilingualism is a common human condition and that it may influence cognition, were presumably instrumental in putting bilingualism on the agendas of many researchers of cognition and language in recent years. But other reasons may have played a role, too: The study of bilingualism also provides a unique opportunity to study the relation between language and thought. The Sapir-Whorf hypothesis, that language determines thought, has typically been investigated across speakers of different languages. If the hypothesis holds, an interesting question is whether the thought processes of one and the same bilingual person respond to the language he or she is using at a particular moment in time. For instance, does a French-English bilingual think and feel (more) "French" when speaking French and vice versa, or does this person think and feel the same irrespective of the language used. In the latter case the selection, consciously or unconsciously, of one language over the other at a particular point in time may merely reflect the fact that this bilingual regards that language particularly well suited to express what was on his or her mind. Or, the choice of language may reflect a subtle interaction between the individual's cognitive processes and cues available from the external context.

A final reason for the growing interest in this area of research is the awareness that bilingualism may confer the benefit of broadening one's scope beyond the limits of one's own country and culture. To increase the accessibility of bilingualism to individuals where the culture does not historically support multiple language use, the details of the nature of bilingualism have to be understood and therefore studied thoroughly. With a few carefully chosen additional languages, one's range of action may expand immensely. The statement can be substantiated most clearly by pointing at the English language, estimated to be the mother tongue of 350 million people, the second language of many more, and the principal and/or official

language of well over 30 countries, large and small (Katzner, 1986). In other words, both in terms of number of people that speak it and in terms of countries in which it is spoken, its coverage is immense.

This book constitutes our contribution to this field of study. It is divided into three sections: Part 1, Second Language Acquisition; Part 2, Representation, Comprehension, and Production in Two Languages; and Part 3, The Consequences of Bilingualism for Thought and for Special Forms of Language Processing. The first chapter, by Harley and Wang, reviews the literature on the "critical-period hypothesis," which holds that children have a special ability to acquire languages. The fact that this view is widespread among the general public does not necessarily mean that it is correct. Indeed, among second-language researchers it constitutes an ongoing point of contention, and even among those researchers who accept the main tenet of the hypothesis there is much uncertainty about the details of many of its components (e.g., What are the relevant age limits? What aspects of language are concerned?). Harley and Wang organize their discussion around five reference points that can be used to find out whether the more general notion of a critical period for a particular type of behavior can be applied to language acquisition: A critical period must have an onset, an offset, an intrinsic maturational component, an external component, that is, a stimulus to which the organism is sensitive, and finally, a system that is affected by stimulation during the critical period (Colombo, 1982). The authors' first step is to analyze in detail Lenneberg's (1967) proposal regarding the critical period hypothesis for language on these five components. A central aspect of Lenneberg's theory is that puberty marks the offset of the critical period. Beyond this critical boundary language is not learned naturally anymore, says Lenneberg, but has to be taught and learned through conscious and labored effort. Another central component is that this natural learning within the critical age range is driven by an innate mechanism which is dedicated to language and operates independently of more general cognitive processes. These are the aspects of Lenneberg's theory that have been focused on in much of the ensuing work on first- and second-language acquisition, and there appears to be little consensus on them. This lack of consensus also surfaces in the present volume, where MacWhinney (chapter 4) explicitly opposes the notion of an innate mechanism dedicated to language and driving language acquisition. The main body of Harley and Wang's chapter concerns a review of the empirical data on the critical-period hypothesis, again organized around the five aspects already mentioned. Toward the end of their analysis the reader cannot help concluding that the firm belief of the general public that children are privileged when it comes to learning languages is not based on extremely solid empirical ground. A number of questions concerning even the most basic aspects of the hypothesis do not appear to be definitely settled. Even the central point that puberty constitutes

a turning point in language acquisition remains a point of contention. It seems that much further work is required if we are to understand the exact relationship between age of acquisition and skill in using languages, both native and foreign, and the sources of this relation.

Ellis and Laporte (chapter 2) address the question, What are the best ways of helping learners acquire a certain level of proficiency in a second language (L2)? A salient dimension on which the methods that have been used in the past can be distinguished is the role played by consciousness in the acquisition process: Some of the methods instantiated a view of L2 learning as a deductive process in which conscious knowledge is exploited; others regarded it as an implicit, unconscious, inductive process. The former type of method has stressed the teaching of formal rules of L2, typically syntactic rules, whereas comprehensible input was considered particularly relevant by the developers of the latter type. Because L1 develops without explicit training of rules, a conclusive finding that formal rules need to be taught in order to attain proficiency in L2 would provide a strong indication that L1 and L2 acquisition proceed in fundamentally different ways. A number of recent views on L2 acquisition all assume some interface between conscious knowledge and implicit performance. From these recent views and those implemented in the earlier methods, Ellis and Laporte derive five questions that they set out to answer on the basis of their review of the relevant literature on both field and laboratory studies. The first is whether the provision of negative evidence regarding the forms of language promotes L2 acquisition. They conclude that this is indeed the case, and more specifically, that negative evidence facilitates the development of L2 syntactic ability, especially when the evidence includes "recasts." An obvious prerequisite for finding a beneficial effect of negative evidence is that such evidence is in fact around in the L2 learning environment. That this is so, even in the field studies, is a noteworthy finding by itself, given that it has been claimed that such feedback on linguistic forms is not typically provided during L1 acquisition. Their second and third questions both concern the role of consciousness in L2 acquisition: Does knowledge acquisition, here regarding L2, require conscious, explicit analysis of the input or is knowledge acquired implicitly, through a process of automatic unconscious abstraction of the relevant language structures from the input? The first of these two questions (Question 2) focuses on the role of explicit learning, that is, strategies on the part of the learner that lead to explicit knowledge, whereas the other one (Question 3) focuses on the role of explicit instruction. Following their analysis of the relevant studies, Ellis and Laporte adopt a compromise between the preceding two extreme positions: Fluent performance and sensitivity to the regularities in language input can arise from mere exposure to the input unaccompanied by explicit knowledge about the underlying rules, but explicit knowledge is generally associated with better performance. This

holds both for explicit knowledge derived by the learners themselves and for explicit knowledge taught through instruction. But the roles of explicit learning and instruction in L2 knowledge acquisition are not straightforward in that they respond to aspects of the input (e.g., is it structured or not?) and to the method of instruction (e.g., are the rule statements clear?). Nevertheless, the authors conclude that a blend of explicit instruction and implicit learning can be more effective than either of the two on its own. The final two questions posed by Ellis and Laporte look at specific ways in which explicit instruction may facilitate the learning process: Is it by focusing attention on the structural patterns in the input while preventing output practice (Question 4) or by output practice (Question 5)? The data from field and laboratory studies alike suggest that both the former and the latter play a role in L2 acquisition.

The scope of chapter 3, by Segalowitz, is a very broad one. His goal is to inform his audience on the reasons why individual L2 users differ so much in the proficiency level that they attain ultimately. The most robust conclusion the reader can draw from Segalowitz' exposition is that many factors, interacting in intricate ways, contribute to ultimate attainment. Age-of-acquisition and instruction method, the topics of the previous two chapters, constitute just two of a much larger set of factors that may be involved. Segalowitz organizes his discussion of this vast topic in four sections. The first is concerned with individual differences from the perspective of research on second language acquisition. In his discussion of this work, Segalowitz adopts a framework employed by Ellis (1994) that distinguishes between "individual learner differences" such as age, aptitude, and motivation, "learner strategies," and "language learning outcomes." Regarding the factor of age, Segalowitz' conclusions agree comfortably with those drawn by Harley and Wang and need not be repeated here. A relevant question to pose with respect to aptitude is whether such a thing as talent for learning languages exists, independent of general intelligence. A main focus in the learner-strategies studies is on the fit between a particular language-learning environment and the way the learner approaches this environment. Finding the best match between these two may enhance learning; mismatches may hamper learning. Finally, a role of learning outcomes in individual differences may be expected because the perceived outcome of a communicative interaction in L2 (Was it successful or not?), is likely to affect the extent to which the learner will seek further opportunities to use L2. In the second section of his contribution, Segalowitz applies the information-processing model of individual differences in the acquisition of any skill as developed by Ackerman (e.g., Ackerman, 1987) to L2 learning. The model posits three stages in skill acquisition, each of which requires a unique set of skills if performance in that stage is to proceed smoothly. As a consequence, different abilities will be implicated in individual differences in each of the three stages of learning. Applied to skill acquisition in L2, the

proper question to ask is not “What causes individual differences in L2 performance?” but “What causes individual differences in L2 performance at particular stages of L2 acquisition?” The question Segalowitz poses in his third section is whether there is a neuropsychological basis for individual differences in language learning and for exceptional language-learning ability. Some indications in the literature on exceptional abilities in general suggest an affirmative answer. In his final section, Segalowitz presents a framework that combines many of the elements of the second-language-acquisition, information-processing, and neuropsychological approaches to individual differences in L2 learning discussed before. A central component of this unifying framework is that the L2 user should approach natural language situations in a way that acknowledges a number of basic characteristics of natural language and the situations in which it is used, for instance, that during natural language conversation the environment changes continuously and that every further state of the environment affords new actions on the part of the interlocutors. An L2 user who does not approach L2 communicative situations this way may perform suboptimally.

A central assumption in much of the work on the critical-age hypothesis (chapter 1) is that first- and (late) second-language learning proceed in fundamentally different ways: First-language learning may be subserved by an innate mechanism and proceed “naturally” and implicitly, whereas second-language learning beyond the critical period may be laborious and require conscious, explicit analysis (cf. chapter 2). In the final chapter of Part 1 (chapter 4), MacWhinney proposes a radically different view of language learning, the competition model. He rejects the idea of a biological mechanism supporting the learning of any language, including the first. Instead, he adheres to a view that emphasizes the role of input. From language input the learner gradually derives a system of form-to-function mappings that enables skillful performance in that particular language. During language comprehension a number of forms are activated that compete for mapping onto a set of functions. Conversely, during language production a number of functions are activated that compete for mapping onto a set of forms. The competition model uses a connectionist architecture to model the form-to-function mappings. This type of architecture assumes that all mental processes exploit a common set of cognitive structures. Among the properties that fall out of this organization is one that is of particular interest for second-language learning, namely, transfer: The competition model predicts massive transfer from L1 during L2 acquisition, on all levels of language processing (e.g., phonological, lexical, and grammatical). MacWhinney describes L2 learning as a process completely parasitic on L1. Through various types of processes, L2 gradually becomes independent of L1. For instance, due to continued L2 exposure, the L1 and L2 lexicons are separated out over time, by the creation of direct connections between L2 forms and meanings on the one hand and through restructuring

of word meanings on the other hand. MacWhinney provides many examples of transfer from L1 to L2 that can be observed in the language behavior of L2 learners, focusing on grammatical transfer. Even though the model was originally developed to account for L1 processing, it does a good job accounting for many of the manifestations of an L1 “accent” (evidence of transfer) in learners’ use of L2 as well. Data from a substantial number of sentence-interpretation studies suggest that the L2-learner starts the acquisition process by setting the weights of the L2 form cues (such as preverbal positioning and sentence-initial position as cues for the function of agent) close to those for L1. With continued L2 exposure the settings gradually change towards those adopted by native speakers of L2, although the exact settings of native speakers may not always be attained (as is evident from the occurrence of tenacious grammatical accents).

The contributions in Part 2 all deal with the representation and use of two languages in bilinguals. Comprehension is covered somewhat more completely than production, reflecting the uneven research efforts in these two areas of bilingual language use. The issue of representation crops up in most of the chapters in this section, some of them focusing on the representation of word knowledge (Smith; Kroll & De Groot), whereas other chapters have a wider scope (Poulisse; Grosjean). A central question regarding representation in bilinguals is whether the bilingual’s word knowledge is represented in two language-specific systems or in one language-independent system. In spite of considerable research efforts covering a couple of decades, this question has never been resolved conclusively. However, it appears that substantial progress has been made from the moment the awareness arose that word representations should not be regarded as monolithic constructions but as composites instead: Their content should be split across (at least) two layers of representation, one layer representing the forms of words and a second representing their meaning. Representational models assuming such a layered structure are often called “hierarchical.” The focus in the chapters by Smith (chapter 5) and by Kroll and De Groot (chapter 6) is on the bilingual versions of such hierarchical models, and this type of model is also common in the literature on bilingual speech production (chapter 7).

Chapter 5 lays the groundwork for chapter 6 in that Smith reviews the empirical support for the bilingual hierarchical model, which Kroll and De Groot take as their starting point. The first step in Smith’s analysis is to scrutinize monolingual studies on findings that evidence a separation between form (or “lexical”) and semantic information. The crucial support comes from studies that demonstrate dissociative effects of lexical and semantic factors in various tasks. The next step is to find out whether or not, at the form level of representation, the language systems of the bilingual are (functionally) separated. On the basis of both neuropsychological and behavioral data Smith



concludes that form representations indeed appear to be language specific. These two steps combined inform us on the various memory stores a model of bilingual memory should contain, yet it says little about the ways these stores connect with one another, a point that is elaborated on in the chapter by Kroll and De Groot. A further topic in Smith's contribution is how the bilingual memory system, the components of which have just been laid out, is accessed: Is lexical access language-specific or language-independent? In other words, does a stimulus selectively activate the lexicon of the appropriate language, or does it activate both lexicons simultaneously? Empirical data from various sources (e.g., interlingual Stroop studies and studies investigating the processing of interlexical homographs) converge on the conclusion that lexical access is language independent, although under a number of narrowly circumscribed conditions language-specific access may occur. Parts of the later chapters by Kroll and De Groot and by Grosjean speak to this same issue and arrive at similar conclusions.

Whereas Smith identifies the memory stores in bilingual memory, Kroll and De Groot (chapter 6) discuss the support for the various views on how the stores are connected and what the implications are for bilingual word processing, more precisely, for the way forms are mapped to meaning and vice versa. They begin their review with a discussion of a number of different versions of the hierarchical model introduced in Smith's chapter. Common features of these models are that they contain two levels of representation, one for word forms and one for word meanings, and that the word-form level contains two memory stores, one for the L1 words and a second for the L2 words. Instances of this type of model are the "concept mediation" model, the "word association" model, and the "revised hierarchical" model. The former two of these models were reintroduced in the recent literature on bilingual memory representation by Potter, So, Von Eckardt, and Feldman (1984), in a paper that boosted current research efforts in this area. The word-association model assumes direct connections between the word-form representations in L1 and L2, but not between the L2 word-form representations and the corresponding representations in conceptual (meaning) memory. Conversely, the concept-mediation model postulates the latter type of connections but not the former. A consequence of a word-association organization is that processing of L2 is mediated via L1. In contrast, given a concept-mediation memory organization, L1 and L2 are processed in exactly the same way. A "developmental" model has been proposed that assumes a word-association organization in bilinguals with a low level of proficiency in L2, and a concept-mediation organization for the higher levels of fluency. This idea agrees with MacWhinney's view (chapter 4) that L2 acquisition progresses from a stage of parasitic use of L1 to a stage where L2 functions independently from L1. The revised hierarchical model is a more recent instantiation of this general class of models. Its unique feature

is that it assumes directionality and differential strength of the connections between the memory stores. As a consequence of the resulting asymmetries in the memory structures, the processing of L2 words is mediated via L1 word-form representations, whereas L1 words access their meaning representations directly. A further recent qualification of the general hierarchical model is the “conceptual feature model,” which posits “distributed” meaning representations: The meaning of a word is no longer represented in a single node in conceptual memory but spread out over a number of more elementary nodes, each of which represents one component of the word’s meaning. Kroll and De Groot review the empirical support for each of these models and discuss results that pose a challenge to them. They conclude their contribution with an outline of a new model, again based on distributed representations, but now both at the form level and at the meaning level. Another new aspect is that this model contains an additional level of representations, namely, a level of language-specific lemma representations. Such a lemma level is a common part of the models of bilingual language production discussed by Poulisse in the next contribution (chapter 7).

In the psycholinguistic study of language use, language comprehension has received much more attention than language production. This imbalance is especially large in research on bilingualism. Poulisse reviews the sparse literature on speech production in bilinguals, with a focus on studies that deal with the entire production process, all the way from conceptualizing the message to articulating it. In monolingual work on speech production, two competing types of models are common: the interactive-activation models, which allow communication between the various processing components of the complete production process, and those that assume autonomy of the processing components. The bilingual production models discussed by Poulisse mostly derive from one of the latter type of models, namely the model proposed by Levelt (1989). This model splits up speech production into four stages, which together are taken care of by three processing components: a conceptualizer, a formulator, and an articulator. In Levelt’s model, unlike in much of the bilingual-representation work reviewed in chapter 6, a lexicon is assumed that, in addition to word forms and word meanings, also specifies syntactic and morphological information: A “lemma” representation contains the semantic and syntactic information, whereas a “lexeme” specifies the morphological and phonological information. In her discussion of the L2 production models that stem from Levelt’s model, Poulisse highlights the question of how each of them accounts for the fact that L2 speech, especially that of beginning learners (cf. MacWhinney, chapter 4) contains L1 code-switches, some intentional and some accidental. In addition to explaining code-switches, any model of bilingual speech production should be able to deal with the fact that most of the time bilinguals, when intent on speaking only one language, are quite successful in keeping their

two languages apart. An explanation of these phenomena in terms of a “language switch” seems to be out, as is indeed also indicated by the position taken by a number of the other contributors to the present volume (e.g., Grosjean, chapter 8). A more contemporary account of code switching and language separation is in terms of the idea that the language system of a bilingual is organized in two subsets, one for each language. These two subsets can be selectively activated, or activated simultaneously to various degrees (see also Grosjean, chapter 8, and Paradis, chapter 12). The latter state of affairs gives rise to code switches. This notion of subsets is taken up in a number of the bilingual production models discussed by Poulisse. Another idea that features in several models is that word meaning is built up from a number of more elementary meaning components. This idea was introduced earlier, in our preview of chapter 6. But presumably the most noteworthy aspect of the models that Poulisse discusses is their large degree of similarity, which suggests that we already know a great deal about language production in bilinguals. This may, however, be more apparent than real, since the similarities may merely be due to the fact that the majority of the L2 production models have taken one and the same monolingual production model (Levelt’s serial model) as their starting point. It would be interesting to see if and how monolingual interactive-activation models could be adapted such that they would cover L2 language production. In chapter 8, Grosjean presents a model of that type.

Like Poulisse, Grosjean focuses on the phenomenon that bilinguals can mix their two languages and indeed often do so, either intentionally or accidentally. He uses the term *mixed language* to cover both “code-switches,” which involve complete switches from the base language to the guest language, and “borrowings,” or switches that are incomplete in that the guest-language units are partly (e.g., phonologically and morphologically) adapted to the base language. Whereas Poulisse primarily discusses the occurrence of language switches in natural speech, Grosjean demonstrates that they can be induced experimentally, and to varying degrees depending on the specific experimental circumstances. The underlying source of this variability in the amount of language mixing is the “language mode” the bilingual subjects are in: monolingual, bilingual, or anywhere else on the continuum between these two extremes. Bilinguals operate in the monolingual mode when, for instance, communicating with a monolingual interlocutor (or, as the experimental data show, when they imagine communicating with a monolingual person); bilinguals operate at the bilingual end of the continuum when, for instance, interacting with people with whom they share their two languages. The incidence of switches to the guest language is larger the more the bilingual operates towards the bilingual end of the continuum. According to Grosjean, knowing the position on the continuum that the bilingual is at when he or she performs a given task is of utmost importance if one is to interpret correctly

his or her behavior on that task. A couple of central issues in bilingualism research, such as the debate about language-specific versus language-independent representation and about selective versus nonselective lexical access (see chapters 5 and 6), cannot be resolved, he argues, without knowing about the participants' language mode in the relevant studies. Adopting a particular position on the language-mode continuum is associated with particular levels of activation of the base and guest language. Like the originators of a number of the L2 production models discussed by Poulishse, Grosjean adheres to the view that the language system of the bilingual is organized in two subsets that can be activated and deactivated independently of one another, at least within certain limits, or activated simultaneously, each to a particular degree. In the monolingual mode the guest language is deactivated as best as possible, and, as a consequence, does not intrude upon the base language very often. In the bilingual mode the guest language is activated to a relatively high level (but less so than the base language), giving rise to many intrusions. So, in a way, the language mode chosen and the relative degree of activation of the base and guest languages can be regarded as the ultimate and proximate causes, respectively, of the amount of language mixing that takes place in the speech of a bilingual. Grosjean substantiates these theoretical notions with empirical data from both production and comprehension studies and proposes an interactive-activation model of bilingual language processing that can readily account for the data. This model incorporates, but now in an interactive-activation architecture, the "subsets" notion of the language system as one extended system containing two subsystems, one for each of the bilingual's two languages.

In the last chapter of Part 2 (chapter 9), Durgunoğlu reviews work on bilingual reading, emphasizing the higher levels of the entire reading process, such as syntactic analysis, sentence comprehension, and the role of prior knowledge in bilingual reading. Reading in L2 has much in common with L1 reading, but it has unique features as well. Therefore, Durgunoğlu argues, L2 reading should constitute a separate field of research. The author organizes her discussion around three sources of knowledge that affect reading in both L1 and L2: linguistic and metalinguistic knowledge, literacy knowledge, and prior knowledge. The first of these three knowledge sources concerns variables that affect both listening and reading comprehension, such as syntactic and vocabulary knowledge and metalinguistic knowledge regarding the structural characteristics of language. The second of the relevant knowledge sources, literacy knowledge, concerns knowledge sources that are specific to reading, such as the knowledge underlying the decontextualized nature of written language material and the knowledge that enables the exploitation of what are called "good meaning-making strategies," especially those that are unique to reading. The role of the third relevant source of knowledge in reading comprehension, prior knowledge, has long been

acknowledged: The more readers know about the topic of the text, the better their comprehension of that text. The contribution of this factor may be boosted in L2 reading, because readers may lack the relevant cultural background knowledge. Durgunoğlu concludes her contribution with a discussion of a number of issues that are specific to reading in L2. A central topic in this section concerns the question of what causes problems in L2 reading comprehension: limited literacy in L1, sufficient L1 literacy but a failure to transfer it to L2 reading (cf. MacWhinney, chapter 4, who discusses the role of transfer in relation to both oral and literacy development in L2), limited linguistic knowledge of L2, or a bit of all of these. One of the remaining issues addressed in this last section is how the specific nature of the environment causes the learning of a second language to have a beneficial or a detrimental effect on cognitive functioning. This particular topic, the cognitive implications of bilingualism, is highlighted by Cook in the next chapter.

In the first chapter of Part 3 (chapter 10), Cook addresses the question of what effects bilingualism may have on cognitive processing. This question has been tackled from two opposite perspectives, introduced earlier: that monolingualism is the norm and bilingualism the deviant state (the “monolingualist” view), and, conversely, that bilingualism is the norm with monolingualism constituting the abnormal constitution (the “multilingualist” view). A monolingualist view *per se* does not yet specify the direction of the deviation in the case of bilingualism: It may be negative, where being a bilingual means there is something to be lost (the “subtractive” view); it may be positive, where benefits are associated with bilingualism (the “additive” view); or both may be the case, with the gains and losses bearing upon different aspects of cognitive functioning. Cook organizes his discussion of the work relating to the monolingualist view in two sections. The first of these covers the studies that provide support for the subtractive view; the second deals with work that substantiates the additive view. To start with the former, one of the robust findings turns out to be that bilinguals use their L2 more slowly than native speakers of that language do. This, of course, comes as no surprise, and cannot really be considered “subtractive” in the proper sense of the word, because, whatever the level of their skill in using L2, the fact that they can use it to at least some extent may be considered a benefit as compared to a pure monolingual state. More pertinent to this issue is whether being able to use a second language has a detrimental effect on the use of L1. Some empirical support for this idea exists. Furthermore, there are data suggesting that bilinguals’ short-term-memory and working-memory capacities are smaller in L2 than in L1 and that their long-term memory of text presented in L2 is impaired as compared to that of text presented in L1. But again, this *per se* does not point at a deficit in bilinguals as compared to monolinguals; only a finding that the short-term-memory and working-memory capacities of bilinguals, especially in their L1, were smaller and/or that their long-term memory

was worse than the analogous values observed for monolingual speakers of that language, would support the notion of a deficit. In his discussion of the additive monolingualist view, Cook focuses on the alleged greater metalinguistic (e.g., phonological and grammatical) awareness of bilinguals as compared to monolinguals (see also chapter 9 by Durgunoğlu). This may, for instance, lead to a more precise choice of words. In addition, there are some data that indicate a higher degree of cognitive flexibility in bilinguals than in monolinguals. But overall, both the cognitive losses and the cognitive gains that may be associated with bilingualism appear to be quite modest and, as Cook concludes, the deficits have to be balanced by the enormous gain of being able to use a second language and, through that language, to become familiar with a culture different from one's own. He finishes his discussion by elaborating on two important new insights, also alluded to in a number of other chapters in this book as well as earlier in this introduction: that it is not monolingualism that is the common human state but instead multilingualism (see, e.g., Paradis, chapter 12) and that bilinguals should not be regarded as two monolinguals in one and the same person but as language users in their own right, whose performance should not be assessed against that of monolinguals (see, e.g., Harley & Wang, chapter 1, and Grosjean, chapter 8).

In chapter 11, Dufour takes up the challenge to tread beyond the common view of bilingualism as a state in which an individual has a certain level of command over two spoken languages. If, as is indeed generally acknowledged, sign languages are full languages in their own right, the study of bilingualism should encompass language combinations in which at least one of the languages involved is a sign language. In his contribution Dufour reviews the few studies that have addressed the psycholinguistics of sign-language bilingualism. This topic of study is not only interesting in itself, but may also be expected to inform theories of bilingualism based on studying combinations of spoken languages. The approach adopted by Dufour fits in with this latter potential of the bilingual study of sign languages. It takes as a starting point a generic hierarchical model of bilingual memory representation, developed on the basis of work on spoken-language bilingualism (see Smith, chapter 5, and Kroll & De Groot, chapter 6), and then poses the question of whether and to what extent this model may also hold for one or more of the various types of sign-language bilingualism that can be distinguished. Dufour differentiates between three such types and organizes his discussion of the literature around these three: "sign-sign bilinguals," whose bilingualism consists of a sign language as L1 and a second sign language as L2; "speech-sign" bilinguals, who are proficient in a spoken language as L1 and later acquire a sign language as L2; and "sign-text" bilinguals, with a sign language as L1 and only the written form of a spoken language as L2. On the basis of a small set of pertinent studies, Dufour derives the outlines of a number of models of memory representation, often

task-specific, that may be associated with sign-language bilingualism. The different memory structures that he considers are all versions of the familiar class of hierarchical models of representation, but they differ from one another in subtle ways. The differences between them account for the distinctions among the preceding three types of sign-language bilingualism. As a final step in his analysis, he combines the common characteristics of the proposed versions into one generic model of sign-language bilingualism and compares this standard model with a number of versions of the hierarchical model developed to account for spoken-language bilingualism. A few indications of possibly critical differences between memory representation in spoken- and sign-language bilingualism emerge from this comparison. Hopefully, this analysis will stimulate further work in this neglected area of research.

In the last contribution to this volume (chapter 12), Paradis integrates the literature on the cognitive neuropsychology of bilingualism into an analysis that leaves the reader with the reassuring feeling that many findings in this intriguing field of research are not that puzzling after all. As noted by Paradis, much of the literature on the neuropsychology of bilingualism has concentrated on explaining the various recovery patterns in aphasic bilinguals. Such patients may recover both languages to the same extent and in parallel, but it may also be the case that only one of the languages recovers whereas the other seems to be lost permanently, that one language recovers before the other, or, most astonishing, that the two languages are available alternately. If one adheres to the view that different languages are represented in systems that are neuroanatomically separated in the brain, and that these different brain areas may be selectively destroyed in aphasia, particularly the latter type of bilingual aphasia would be hard to explain. Such a state of affairs would seem to force the highly implausible conclusion that at odd times the languages of a patient of this type switch positions in the brain between the damaged and nondamaged areas. In contrast, if one conceives of the bilingual's two languages as systems that are only neurofunctionally independent, all of the preceding recovery patterns can be accounted for. This is the position favored by Paradis: Both of a bilingual's two languages are represented, as two language-specific subsystems of a larger system, the language system, in the language areas of the left hemisphere. The two subsystems can be selectively activated and deactivated or inhibited, a view that we have become familiar with in some of the other chapters, in particular those dealing with code switching (Poulisse, chapter 7, and Grosjean, chapter 8). In addition to the two language-specific subsystems that together constitute the language system, there is a third, language independent, system that stores conceptual information. The general form of this "three-store" model is reminiscent of the models of bilingual memory presented by Smith (chapter 5) and Kroll and De Groot (chapter 6), but the reader should be

aware that Paradis' model differs from the latter in a couple of crucial respects: In the latter class of models the language-specific representations only specify word forms, and word meanings are assumed to be stored in conceptual memory. In other words, no distinction is made between semantic and conceptual information. In contrast, Paradis' language-specific stores contain entities that specify both word form and word meaning, whereas the third, language independent, system represents conceptual information. We have seen this explicit segregation between semantic and conceptual information before in this volume, namely in most of the bilingual production models presented by Poulisse (chapter 7). How, then, given this bilingual mental architecture, can the various forms of bilingual aphasia be explained? Paradis provides a parsimonious account of many of the phenomena in terms of a failure of the aphasic bilingual to adapt the relative degree of activation of his or her two language systems to the specific demands of the communicative setting (cf. Grosjean, chapter 8). In the types of aphasia mentioned previously, the problem appears to be that the elements in one of the language systems of the aphasic bilingual cannot be disinhibited. Such a suppression of one of the language systems can be temporary (successive recovery), permanent (selective recovery), or the suppression may alternate between the two language systems (antagonistic recovery). A form of bilingual aphasia not mentioned yet, where the elements of the two language systems appear to be mixed randomly, can also be readily explained in terms of a failure to control appropriately the level of activation and deactivation/inhibition of the two language systems. In the terminology of Grosjean, an aphasic bilingual of this type fails to suppress the activation level of the guest language to the level appropriate for the position on the language mode continuum that he or she is at.

Localizing both of a bilingual's languages in the language area of the left hemisphere, as Paradis does, opposes the popular view that language representation is less lateralized in bilinguals than in monolinguals. Paradis suggests a solution to this potential conflict in four steps: distinguishing between implicit and explicit aspects of language use; localizing the former in the left and the latter in the right hemisphere; only regarding the former as constituting the language system proper; and, finally, pointing out that different mixes of implicit and explicit language use may be involved when processing one language or the other. The more language processing exploits the implicit aspects, the more the left hemisphere will be involved; conversely, the more the explicit aspects are employed, the more the right hemisphere will be implicated. The latter situation may typically be the case when bilinguals use the weaker of their two languages, in an attempt to compensate for the relatively weak implicit competence regarding that language. But, as Paradis argues, this is not to say that the associated language system is localized in the right hemisphere, because explicit language use



is not part of linguistic competence proper. Paradis' analysis thus highlights the importance of specifying, in any study on language lateralization and localization in bilinguals (and monolinguals, for that matter), the aspects of language that are under study.

Taken together, the chapters included in the present volume represent a comprehensive and interrelated set of topics that we believe form the core of contemporary research on the psycholinguistics of bilingualism. The issues raised within this perspective not only increase our understanding of the nature of language and thought in bilinguals but also of the basic nature of the mental architecture that supports the ability to use more than one language. It is our hope that this book will satisfy the interest of those who seek to learn more about language processing in the bilingual, and that it will invite new research in those areas where clear answers are not yet available.

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PART ONE

**SECOND LANGUAGE  
ACQUISITION**

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## CHAPTER ONE

# **The Critical Period Hypothesis: Where Are We Now?**

Birgit Harley  
Wenxia Wang

*Ontario Institute for Studies in Education*

The idea that children have a special talent for languages that is rarely, if ever, available to older learners is one that has much popular support. Among second language researchers, however, the related hypothesis of a maturationally delimited critical period for language acquisition has been a constant source of controversy. Not everyone accepts the view that young children have an inborn advantage over older learners, and even among those who take this position, debate continues as to what the causes of this advantage are, what the relevant age limits are, what aspects of language development it applies to, and what sort of empirical data provide a crucial test of the critical period hypothesis. In this chapter, we review relevant research findings and consider various proposed explanations of age-related differences in (second) language acquisition. We argue that, despite a number of unresolved problems and even some apparent counterevidence, the critical period concept, as it has evolved, continues to have considerable heuristic value in investigating the language development of learners whose exposure to a new language begins at different ages.

### **THE CRITICAL PERIOD CONCEPT**

The critical period concept is a cross-disciplinary one that has been applied to various aspects of behavioral development in both animals and humans (e.g., Bornstein, 1987; Colombo, 1982; Immelmann & Suomi, 1981; Oyama, 1979). It refers to a period of time during the life cycle when there is greater sensitivity

to certain types of environmental stimuli than at other times (Colombo, 1982), or "a period of competence for specific exchanges with the environment, bounded on both sides by states of lesser responsiveness" (Oyama, 1979, p. 88). A classic example is filial imprinting in birds. Lorenz (1937), for example, found that during a limited period soon after hatching, greylag goslings become irreversibly attached to the first moving object they see, this moving object normally being the parent. If exposure was delayed beyond a critical period lasting only a few days, the filial attachment was weaker or failed to occur. Time-constrained sensitivity to environmental stimuli has since been documented in many other animal species and developmental domains, including the learning of birdsongs, the development of vision in kittens and monkeys, and the social behavior of various species of mammals (e.g., Bornstein, 1987). As Lenneberg (1967), one of the first to apply the critical period concept to human language development,<sup>1</sup> commented, "Many animal forms traverse periods of peculiar sensitivities, response-propensities, or learning potentials. Insofar as we have made such a claim for language acquisition, we have postulated nothing that would be extraordinary in the realm of animal behavior" (p. 175). At the time this statement was made, the idea that human language learning could be compared to animal instincts (cf. Chomsky, 1959; Pinker, 1994) was actually rather more radical than Lenneberg allowed.

Since the 1960s, the *critical period* label for such phenomena has fallen out of favor with some investigators, owing to connotations of excessive rigidity and developmental fixity linked to the early imprinting studies. In its place, the term *sensitive period* is now more often preferred as indicative of the typically more gradual and environmentally susceptible nature of behavioral development. With respect to imprinting phenomena, Oyama (1979) noted that "they may be quite gradual, variable, and open to environmental influences" and that "they are not necessarily irreversible or instantaneous" (p. 85). In her review of the sensitive period concept in developmental studies, Oyama observed that the terms *sensitive* and *critical* are still used interchangeably by some researchers. This is the practice that we adopt in this chapter on the grounds that both terms are still current in the language acquisition literature and that no clear distinction is made between them.

In an analysis of the criteria for a critical period, Colombo (1982) outlined five aspects that provide useful reference points for examining the application of the concept to language acquisition and for identifying the locus of the contentious issues that have arisen. A critical period, according to Colombo, must have (a) an onset, (b) a terminus, (c) an intrinsic (maturational) component, (d) an extrinsic component in the shape of a stimulus to which

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<sup>1</sup>The neurologist Penfield (1964; Penfield & Roberts, 1959) had previously argued, based on his clinical studies, that brain plasticity gives children prior to ages 9 to 12 a special advantage in language learning.

the organism is sensitive, and (e) a system that is affected by stimulation during the critical period. A further relevant distinction, discussed by Immelmann and Suomi (1981) and by Bornstein (1987), is the one between ultimate and proximate causes of critical period phenomena. Ultimate causes have to do with the functions and benefits of the critical period, whereas proximate causes are concerned with the (possibly multiple) mechanisms that regulate the growth and decline of sensitivity. Debate in the language domain, as we shall see, has focused more on proximate causes than on the more speculative issue of ultimate causes, though some observations on the latter have also been made.

### LENNEBERG'S CRITICAL PERIOD HYPOTHESIS

The critical period hypothesis proposed by Lenneberg (1967) provides the appropriate starting point for our analysis of the ongoing debate concerning age-related effects in language acquisition. In his oft-cited work entitled *Biological Foundations of Language*, Lenneberg was intent on making the case for a nativist view of language acquisition and on countering the then still prevalent behaviorist view that primary language development is dictated by environmental shaping or training. With his strong emphasis on the role of maturation in language acquisition and his related arguments for a time-bounded decline in language capacity, he set the stage for many empirical studies to follow. We begin by outlining his claims in relation to each of Colombo's five criteria and by identifying some key issues that emerge in relation to each of these.

#### The Onset

Lenneberg (1967) was most specific about the beginning and end of the proposed critical period for language acquisition. Citing the regular timing of speech milestones in early childhood across a wide variety of environmental conditions, he argued that the onset of language is marked by "a peculiar, language-specific maturational schedule" (p. 131) consisting of a gradual unfolding of capacities between the second and third years of life; he attributed lack of speech prior to that time mainly to cerebral immaturity rather than, for example, to the immature state of the vocal tract. In a number of more specific references to age 2 as the onset of language, Lenneberg appears to have had in mind the two-word stage in children's speech—in other words, initial evidence for the use of syntax (cf. Chomsky, 1965). An obvious issue that arises in this connection is whether the two-word stage in production constitutes the onset of language more broadly conceived.

## The Terminus

As for the end of the critical period, Lenneberg (1967) placed it rather firmly at age 13, or puberty. This, he argued, is a time of rapid decline in language acquisition capabilities, coinciding with the completion of lateralization of language function to the dominant left cerebral hemisphere and associated with "a loss of adaptability and inability for reorganization in the brain" (p. 179). Whether puberty is indeed a "turning point" (p. 150) for language acquisition has become the main focus of subsequent debate. Because first language development (barring unfortunate circumstances) normally starts for all children in infancy, it is an issue that has been most readily investigated in the context of second language learning. The theoretical interest of the terminus issue is not the only motivation for this focus. A postpubertal decline in capacity for second language acquisition would be of obvious practical educational relevance, too.

In fact, as Johnson and Newport (1989) have since pointed out, Lenneberg's (1967) brief comments about second language acquisition leave some doubt as to what his predictions about older second language learners might be. On the one hand, he appeared to be arguing that second language learning outside the critical period is different and less natural than that occurring during the critical period. Thus, he claimed: "The incidence of 'language learning blocks' rapidly increases after puberty. Also automatic acquisition from mere exposure to a given language seems to disappear after this age, and foreign languages have to be taught and learned through a conscious and labored effort" (p. 176). As Johnson and Newport noted, this argument suggests a *maturational state* version of the critical period hypothesis, which predicts that children will be inherently better than adults at learning both a first and a second language. The next point that Lenneberg made focused on the fundamental similarity of first and second language learning. Adults can learn to communicate in a second language, he argued, because "the cerebral organization for language learning as such has taken place during childhood, and since natural languages tend to resemble one another in many fundamental respects, the matrix for language skills is present" (p. 176). These comments suggest an *exercise* version of the critical period hypothesis that Johnson and Newport (1989) elaborated as follows: "Early in life, humans have a superior capacity for acquiring languages. If the capacity is not exercised during this time, it will disappear or decline with maturation. If the capacity is exercised, however, further language learning abilities will remain intact throughout life" (p. 64). Based on this interpretation, the critical period hypothesis makes the same prediction with respect to a first language but a different one for second languages, namely, that adults will be at least as capable of learning a second language as children.

Whatever the empirical evidence for a critical period ending at puberty might be, Lenneberg's (1967) explanation for the close of the critical period

at this stage was soon to be challenged by evidence indicating that cerebral lateralization for language is present much earlier in childhood, if not at birth (Kinsbourne, 1975; Kinsbourne & Hiscock, 1977; Krashen, 1973). Moreover, Whitaker, Bub, and Leventer (1981) argued that there were no known neurological correlates for a sudden decline in language ability at puberty. This opened the door to continuing debate about the relevant proximate cause(s) of the hypothesized decline in language capacity.

In summary, although Lenneberg's placement of the terminus for the critical period for primary language acquisition was unambiguously at puberty, the relevance of this turning point for learning a second language was not clearly spelled out. In addition, once his neural basis for the close of the critical period was called into question, the vacuum was filled with a great variety of new explanations for which solid empirical evidence is still generally lacking. Small wonder, then, that the terminus of Lenneberg's critical period has been a major source of contention.

### **The Intrinsic Component**

An important aspect of Lenneberg's critical period hypothesis is the idea that the child is endowed from the outset with an "innate mechanism" (1967, p. 22) dedicated to language, determining not only the underlying form it will take but also the "peculiar language-specific maturational schedule" (p. 131) it will follow. This idea, considered to be a necessary aspect of any sensitive/critical period, bears an obvious resemblance to the current concept of *modularity* (Fodor, 1983) that entails a domain-specific language module, or cluster of modules, operating autonomously from more general cognitive processes and incorporating the principles and parameters of Universal Grammar (Chomsky, 1981). Whether the principles and parameters of Universal Grammar are still fully available to older second language learners is one way in which the critical period question has more recently been conceptualized.

It should be emphasized that Lenneberg (1967) did not claim to have identified the intrinsic neural component—the innate mechanism—of the hypothesized critical period for language acquisition. He discussed various aspects of the physical maturation of the brain, but stressed that knowledge of the anatomical or biochemical basis of language development was, at the time, insufficient to make the search for a specific neural explanation worthwhile. Significantly, however, he argued that it is the way the many parts of the brain interact rather than specific brain structures that should be considered the proper neurological correlate of language. Based on advances in neurobiological research in the intervening years, proposals as to potential neural correlates of language acquisition have recently been made, providing a new forum for debate (e.g., Eubank & Gregg, 1995; Jacobs & Schumann, 1992; Pulvermüller & Schumann, 1994).



### **The Extrinsic Component**

As far as the extrinsic stimulus for language acquisition is concerned, Lenneberg's (1967) purpose appears to have been to persuade others that this was less important than was generally believed. He was clearly not interested in elaborating on this aspect, although he recognized that environmental influences on language acquisition were undeniable. The lack of specification of this critical period criterion has since been pointed out as an obvious weakness in the hypothesis (Colombo, 1982). Interestingly, according to Colombo, it is a weakness that is widespread in critical period studies. In the language domain, the question of how environmental factors affect language acquisition during and after the hypothesized period of sensitivity has continued, for the most part, to be underplayed in critical period studies.

### **The Affected System**

Lenneberg (1967) was equally vague about the system affected by the critical period, referring, for the most part, simply to *language* and not specifying what aspect(s) of language he had in mind (e.g., phonology, syntax, or lexis). However, his emphasis on capability in contrast to behavior appears similar to Chomsky's (1965) distinction between linguistic competence (intuitive underlying knowledge of the language) and performance (actual language use). From his discussion of this issue, it is evident that a major motivation for the distinction on Lenneberg's part was the concern that children's behavior in a testing situation or under conditions of deprivation might provide an underestimate of their true language potential, or capabilities.

Despite his general vagueness, there are hints as to the aspects of language Lenneberg (1967) believed were affected by the critical period. The placing of the onset of the critical period at age 2, for example, implies a primary concern with syntax. A comment that foreign accents cannot be overcome after puberty suggests that he also considered phonology to be subject to critical period effects. On the other hand, he seems to have viewed vocabulary learning as exempt from maturational constraints. Subsequent research has concentrated on phonology, morphology, and syntax as the aspects of language that are hypothesized to be most likely affected by age-related constraints. Difficult issues have, at the same time, arisen as to how language learning capacity is appropriately assessed and what the attainment criteria should be.

### **Ultimate Causes**

In the concluding chapter to his volume, Lenneberg (1967) made it clear that he considered human language to be a social adaptation contributing to the survival of the species. The social integration function of language is so important, he argued, that it creates very little tolerance for abnormality

in the latent, or deep, structure of language. A severely abnormal individual has little chance of finding a partner and thus perpetuating a deviant trait. Considerable variation is permissible at the surface structure level of language “because individuals are allowed to enter the group processes despite many kinds of deviations of varying magnitude” (p. 386). Assuming that L2 learner language is not deviant at the deep structure level, this suggests no particular evolutionary pressure for complete mastery of a second language either within or beyond a critical period. In other words, Lenneberg gave no indication as to what the evolutionary function or benefits of a critical period for (second) language acquisition might be.

### **THE EMPIRICAL EVIDENCE**

We now take up the issues raised by Lenneberg's (1967) critical period hypothesis and consider them in relation to recent research findings. In light of earlier comments from Oyama (1979) about the gradual and environmentally susceptible nature of critical/sensitive period phenomena, we might expect that the apparent developmental fixity of Lenneberg's hypothesis would not stand up to scrutiny. In fact, it is clear from subsequent research that, where age-related differences in language outcomes have been found, these tend to apply much more flexibly than Lenneberg proposed. We turn first to the question of onset for primary language acquisition.

#### **When Does Primary Language Acquisition Normally Begin?**

Contrary to Lenneberg's (1967) claim that the onset of language begins around age 2, research in speech perception suggests that linguistically specific aspects of perceptual development are already present by 6 months of age (Grieser & Kuhl, 1989; Werker & Lalonde, 1988). One argument is that there is no particular maturational stage at which primary language acquisition emerges but that the process of acquisition begins at birth and continues on throughout life (Singleton, 1989). If indeed there is no prior state of lesser responsiveness (Oyama, 1979) before language acquisition begins, this is problematic for the critical period hypothesis. This issue remains unresolved. On the one hand, it can be argued that initial signs of phonetic discrimination within a few weeks of birth (e.g., Eimas, Siqueland, Jusczyk, & Vigorito, 1971; Streeter, 1976) do not signify a specifically linguistic capacity because such discrimination has also been found in other mammals (e.g., Kuhl & Miller, 1975). On the other hand, Werker and Lalonde (1988) showed that, by 6 months of age at least, infants are categorizing speech sounds in a distinctly linguistic manner. When they measured 6-month-old infants'

sensitivity to changes in speech stimuli (open CV syllables), Werker and Lalonde found that the infants reacted to such stimuli in terms of phonetic categories and not on a purely acoustic basis as would be expected if their categorizations were based simply on more general auditory processes. Significantly, this infant propensity for the linguistic categorization of speech sounds does not appear to extend to other mammals (Kuhl, 1991). A further important finding reported by Werker and Lalonde was that, in keeping with earlier research (e.g., Streeter, 1976; Trehub, 1976), the 6-month-old infants they studied were sensitive to phonetic categories in a language they had never heard before (Hindi) as well as in the language of their environment (English), pointing to an inborn sensitivity to phonetic universals.

Thus we may conclude that, although Lenneberg (1967) appears to have been overly conservative with respect to the normal timing of the onset for language, there is tentative support from speech perception research for some kind of innate mechanism specialized for language acquisition (for discussion, see Jusczyk & Bertoncini, 1988). Whether this mechanism is operational from birth or emerges during infancy on a language-specific maturational schedule is currently unclear.

### **Do Language Outcomes Decline With Increasing Age of Onset?**

The notion that language learning capacity declines at a time when other cognitive capacities are still on the rise is central to the critical period hypothesis. A major focus of empirical research has been to determine whether there is any more direct evidence for such a decline other than what Lenneberg (1967) was able to muster based mainly on clinical observations. The issue has been examined from a number of different perspectives in both first and second language contexts. Frequently, the question is formulated in terms of whether a later age of onset for language acquisition leads to less successful mastery of the target language. Here we review the evidence for a relationship between age of onset and language outcomes, setting aside, for the time being, the question of whether puberty (or any other age) can be identified as an approximate terminus for a critical period.

***Age of Onset for a First Language.*** In the context of first language acquisition, converging evidence has led to the conclusion that when exposure to language is substantially delayed, ultimate attainment is irregular and incomplete, and no amount of subsequent experience can compensate for the initial deprivation (Long, 1990). Some of the evidence comes from individual cases of extreme social isolation involving child abuse or abandonment (feral children), where later language learning remains severely deficient. This evidence is hard to interpret because the early history is often

sketchy, and much more than language deprivation has been involved. Together with data from other sources, however, late language learning in such cases can provide clues as to the kinds of language features that may be most affected by an early lack of linguistic experience (e.g., Curtiss, 1977, 1988; Goldin-Meadow, 1982; Newport, 1990).

Other, more substantial evidence for a decline in language outcomes associated with early language deprivation comes from studies of congenitally deaf adults whose first experience with a full language of communication, American Sign Language (ASL), has taken place at different ages (e.g., Mayberry, 1993; Mayberry & Eichen, 1991; Newport, 1990). Newport (1990), for example, examined comprehension and production of ASL syntax and morphology in three groups of congenitally deaf adults who had all been using ASL for at least 30 years: one group of native learners of ASL who had been exposed to the language since infancy; a second group of early learners whose exposure had begun at ages 4 to 6; and a third group of late learners who had not been exposed to ASL until after age 12. Whereas all three groups had mastered basic word order in ASL, there was a clear age-related effect for morphology, with native learners outscoring early learners and the latter in turn performing better than the late learners. A similar decline in grammatical accuracy related to age of onset was reported by Mayberry and Eichen and Mayberry. Along with three age-of-onset groups who had begun acquiring ASL as a first language at 0 to 3 years (native), 5 to 8 years (childhood), or 9 to 13 years (late), Mayberry included in her study a group of second language learners of ASL who had become deaf between ages 9 and 15. Only one of the second language learners had received instruction in signing, and all groups had been using ASL continuously for at least 20 years. In this study, the second language learners of ASL received higher scores on several lexical and syntactic aspects of an elicited imitation task than the late first language learners and, in some instances, performed better than the childhood first language learners as well. The second language group did not match the performance of the native first language group, however.

This study provides an indication that the *exercise* and *maturational state* versions of the critical period hypothesis are not mutually exclusive. Support for an exercise hypothesis comes from the finding that later second language learning of ASL between the ages of 9 and 15 was enhanced by having previously had full access to a first language. At the same time, a maturational state hypothesis receives support from the finding that native language experience of ASL in infancy or early childhood was still better than second language learning later on, even if the latter occurred before puberty. In other words, Lenneberg's ambivalence about the interpretation of second language data appears to have been justified. The presence of a *matrix for language skills* is an advantage, but, at the same time, *mere exposure* to a

second language at a later age is likely to be less successful than first language acquisition beginning in infancy (Lenneberg, 1967, p. 176). A further key question in relation to the maturational hypothesis is whether earlier and later ages of onset for second language acquisition are, like first language acquisition, associated with differential outcomes. We turn next to this issue.

***Age of Onset for a Second Language.*** In a 1979 article, Krashen, Long, and Scarcella pointed out that an apparent inconsistency in second language findings on age-related effects could be resolved if a distinction was made between rate of acquisition in the early stages and ultimate attainment in the long run. It is in the ultimate attainment studies and not in rate-of-acquisition studies that evidence for the advantages of early learning has been found.

Rate-of-acquisition studies, holding time and exposure to the second language as constant, have shown that adults and adolescents generally make faster initial progress than children, and older children faster progress than younger children, particularly in acquiring morphosyntactic and lexical aspects of the second language and sometimes, in acquiring phonological aspects, too. This has been the case whether exposure takes place in a classroom context or in a wider second language environment (e.g., Burstall, Jamieson, Cohen, & Hargreaves, 1974; Cummins, 1981; Ekstrand, 1976, 1978; Snow & Hoefnagel-Höhle, 1978; for numerous further studies, see reviews by Singleton, 1989, and Long, 1990). In some cases, the older learners' higher average performance can be attributed to superior test-taking skills compared with younger children, particularly when decontextualized language tasks are involved (Cummins, 1979, 1981). This cannot be the full explanation for the older learners' rate advantage, however, because similar results have emerged with contextualized language measures where native-speaking children of different ages do not demonstrate any differences (e.g., Harley, 1986).

Rate advantages can be short-lived, as Snow and Hoefnagel-Höhle (1978) showed, lasting only a few months for some aspects of performance. Moreover, there may be little or no difference between adjacent age groups. Slavoff and Johnson (1995), for example, examined knowledge of English morphology and syntax among Chinese- and Korean-speaking children who had arrived in the United States at between 7 and 12 years of age and had been living there for 6 months to 3 years. When the 7- to 9-year-old arrivals were compared with the 10- to 12-year-old arrivals, there was no significant difference on a grammaticality judgment task. Instead, length of residence was the main predictor of scores on the test. Slavoff and Johnson argued that the typologically very different first language backgrounds of these learners vis-à-vis English was an important factor in these findings. The older and younger learners had an equally poor command of the more difficult structures on the test after 3 years of stay. Eventually, these difficult structures, where there are differences between a source and target language, could

be the ones that will be less successfully acquired by older than by younger learners, whereas easy shared structures may be acquired at any age (cf. Bialystok, 1995). Bialystok cited two studies (Marinova-Todd, 1994; Yew, 1995) in support of the view that first language similarities and differences are actually more important for second language attainment than age-of-onset differences. In general, the frequent finding of a rate advantage, or greater efficiency, among older learners is one that fits somewhat uncomfortably with a maturationally defined critical period, providing a reason for some researchers to reject the hypothesis altogether (e.g., Burstall et al., 1974; Flege, 1987; Snow, 1987) and leading others to propose explanations that can accommodate these findings while still maintaining the critical period notion (e.g., Felix, 1985; Krashen, 1982).

In contrast to the above studies, those that have analyzed long-term trends in second language outcomes have regularly shown that an increasing age of onset is related to diminishing ultimate success. One of the most robust findings comes from studies of long-term attainment in second language pronunciation, indicating that the younger the age of arrival in a second language environment, the greater the likelihood of eventually achieving native or near-native pronunciation in that language. Although length of residence may be a more important indicator than age of arrival after only a few months in the second language environment (e.g., Ekstrand, 1976; Snow & Hoefnagel-Höhle, 1978), age of arrival emerges as the key predictor of pronunciation rating for residents of at least 2 years' standing (e.g., Oyama, 1976; Patkowski, 1990; Tahta, Wood, & Loewenthal, 1981; Thompson, 1991). Age-of-onset ranges in these studies have varied: ages 6 to 20 in Oyama's study, 5 to 50 in Patkowski's, 6 to 15+ in Tahta et al.'s, and 4 to 42 in Thompson's. The finding of a strong linear relationship between accent rating and arrival age (with length of residence controlled) has nonetheless been consistent, with the youngest child arrivals up to about age 7 typically achieving native or near-native ratings and adult arrivals rarely rising to a near-native level of performance (see also Asher & Garcia, 1969; Piper & Cansin, 1988; Seliger, Krashen, & Ladefoged, 1975).

Further evidence for an age-related decline in long-term second language outcomes is based on studies assessing ultimate attainment in global listening comprehension (Oyama, 1978) and in morphology and syntax (e.g., Johnson, 1992; Johnson & Newport, 1989; Patkowski, 1980). Oyama (1978) found the most native-like performance on a listening comprehension task by Italian immigrants who had arrived before age 11, and a decline in performance by older arrival ages up to age 20. Similarly, based on syntactic ratings of transcribed oral interviews in English, Patkowski (1980) found a strong effect for age of arrival in a sample of 67 adults of varied first language backgrounds. Their ages of arrival in the United States ranged from ages 5 to 50, and they had been residents there for at least 5 years. Patkowski reported

a significant linear correlation of  $-.74$  between age of arrival and syntactic rating, indicating a general tendency for accuracy to decline with increasing age of arrival. Johnson and Newport (1989) likewise reported a substantial correlation of  $-.77$  between age of arrival and English test scores for a sample of long-term U.S. residents of Chinese- and Korean-speaking background who had arrived between ages 3 and 39. In this case, the assessment was based on an oral grammaticality judgment task that focused on a number of basic features of English sentence structure. Only those arriving before age 7 achieved a native level of performance, although older arrivals performed very well on some items (e.g., word order and progressive -ing). In a subsequent study, Johnson (1992) administered an untimed written version of the same grammaticality judgment task to some of the same individuals. On this test, she found a somewhat weaker relationship between age of arrival and outcomes (an overall correlation of  $-.54$ ), with adult arrivals no longer performing significantly differently from those arriving between ages 8 and 15. Johnson noted two possible interpretations of these new findings in relation to the earlier study: (a) that the original auditory task had masked the adult learners' real grammatical competence in some way, or (b) that the adult learners were able in the untimed task to access a form of knowledge (gained perhaps during formal English training before their arrival in the United States) that does not lend itself to online language use.

With these alternative interpretations, Johnson (1992) raised key questions about the ultimate attainment findings in general. Do such findings indicate that underlying language acquisition capabilities (Lenneberg, 1967) decline with maturation? Or do the behaviors demonstrated in these studies provide an underestimate of underlying linguistic competence? We consider first some relevant findings in the area of speech perception and pronunciation suggesting that the problem for older second language learners may be more a question of access to the relevant abilities rather than an outright loss of language learning capacity (for discussion, see Flege, 1992; Flynn & Manuel, 1991; Wode, 1994).

Studies in speech perception have shown that the initial ability of young infants to discriminate phonetic categories that are not part of their language environment begins to wane as early as 10 to 12 months of age (e.g., Werker & Tees, 1983) just as they are about to form the rudiments of a first language phonological system. This suggests an early sensitive period that closes even as speech appears. According to Burnham (1986), there is a further period of declining sensitivity to more robust non-native phonetic contrasts at 4 to 8 years of age when children are beginning to read. The capacity to discriminate non-native phonetic contrasts (or even more subtle acoustic contrasts) is not totally lost even in adulthood, however. Adults with no prior experience of non-native language stimuli can make such discriminations (a) when the contrasts are salient, or robust, enough, or sufficiently distinct