Annual Review of Applied Linguistics (2000) **20**, 213–223. Printed in the USA.

A CRITICAL REVIEW OF THE CRITICAL PERIOD RESEARCH

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INTRODUCTION: THE CPH AND APPLIED LINGUISTICS

Two decades of international research in applied linguistics provides a large number and variety of topics from which to choose for this special anniversary edition, but certainly one of the most significant among these choices is the critical period hypothesis (CPH). Few topics in applied linguistics have continued to captivate the interests of researchers and practitioners so intensively and for such a long period of time as the CPH. Indeed, one could easily go back to reviewing three, not two decades of sustained research and continuous interest in this topic (Lenneberg 1967, Scovel 1969). If number and diversity of publications is indicative, the CPH has engendered even more interest and controversy now than in any previous decade. Why is this so?

First and foremost, for the general public, and for language learners and teachers in particular, the CPH taps an inherent fascination with perceived and real contrasts between young children and adults, a fascination which has given birth to the pervasive "the younger, the better" myth concerning second language acquisition (SLA). Although even proponents of at least some version of the CPH have attempted to dispute or at least qualify this belief (Scovel in press), its profuse popularity has fueled general interest in any evidence which suggests that younger learners are more successful than their adult counterparts. This public interest is encouraged by a constant stream of articles and stories in the media, often attributing the reputed linguistic precocity of infants to developmental neurology (Spinney 1999). This myth has also continued to encourage language teachers who believe that one of the best ways to teach a second language to older learners is to attempt to replicate child language acquisition. In fact, more than any other area of applied linguistics, the CPH has directly or indirectly led to the development of methods for teaching foreign languages. Finally, this conviction that younger is better has had an enormous impact on language planning over the past twenty years, where many countries have introduced English at earlier and earlier grade

levels in the belief that this policy will ensure a pool of fluent ESL speakers in the future. Given the pervasiveness of this general interest then, perhaps no topic in applied linguistics so directly affects the popular consciousness and public policy than the CPH.

Among applied linguists themselves, especially those with a specific interest in SLA, the CPH has been and remains a seminal topic. Long (1999) has claimed that research on the critical period has been "critical" to all SLA theory construction. Bialystok and Hakuta write, "The debate over the critical period hypothesis embodies some of the most basic questions about second language acquisition, and indeed, language acquisition in general" (1999:163). And Birdsong talks about "…the unmistakable centrality of the CPH…" to SLA research (1999a:18). Virtually all introductions to SLA devote at least some discussion to CPH research (Cook 1991, Ellis 1994, Larsen-Freeman and Long 1991, Skehan 1998), and over the past twenty years, scores of articles have been published reporting on experiments which supposedly support, refine, or refute the hypothesis. Additionally, there have been several texts and anthologies which have focused specifically on the topic (Birdsong 1999b, Harley 1986, Krashen, Scarcella and Long 1982, Scovel 1988, Singleton and Lengyel 1995, Strotzer 1994).

INITIAL CLAIMS CONCERNING THE CPH

The early work on the CPH was not done by applied linguistics, but it can certainly still be considered as representative of linguistics applied. Though many scholars had written about the apparent advantages that young children enjoy in SLA, Penfield (1963), a Canadian neurosurgeon, was the first to link 'the earlier, the better' view of foreign language learning to the plasticity of a child's developing brain. Because of his frequent public presentations and writings advocating early foreign language exposure, Penfield could justly be considered the father of immersion programs in Canada, thus demonstrating how even early on, the CPH has influenced foreign language pedagogy. Due to the relatively limited knowledge about developmental neurology forty years ago, and due to his own over enthusiastic promulgation of 'the earlier, the better' approach to foreign language teaching, Penfield's contributions have diminished with time. They did serve, however, to encourage Lenneberg, a psycholinguist, to explore the relationship between age and acquisition more intensively. Lenneberg (1967) examined a wide number of brain changes in early life and correlated these with maturational milestones in child development, especially the development of speech and language. It was he who suggested that puberty was the approximate cutoff age for completely successful primary language acquisition and, furthermore, that this was the age when foreign accents emerged. Scovel (1969) summarized and narrowed Penfield's and Lenneberg's views on the CPH into three essential claims: 1) that adult native speakers can identify non-natives by their accent immediately and accurately, 2) that loss of brain plasticity at about the age of puberty accounts for the emergence of foreign accents, and 3) that a CPH is tenable only for speech (a native accent) and does not ultimately affect other areas of linguistic competence.

Intensive research since that time, especially during the past twenty years, has refined these claims and has greatly broadened this initial base of inquiry. Over the past twenty years, applied linguists, especially those who specialize in SLA research, have attempted to resolve the following issues concerning the CPH.

1. Does the preponderance of evidence support the CPH?
2. Is there a CP for acquiring accentless speech?
3. Is there a CP for morphosyntactic competence?
4. If the answers to (1) and either or both (2) and (3) are affirmative, how can age-related differences be explained?

DOES THE PREPONDERANCE OF EVIDENCE SUPPORT THE CPH?

Since this question is the most central one of all, and since it entails the answers and the evidence encapsulated in the three other questions which have just been introduced, it is important to define the scope of this first question. Avoided here is a discussion of the differences that may exist between primary (mother tongue) language learning and the acquisition of an additional (second) language. This review focuses only on age-related constraints on second language acquisition. Still, it should be acknowledged that these constraints may be very similar to CP limitations on first language acquisition. Any discussion of age-related constraints on primary language learning introduces a host of additional topics, however, among them the evolution of animal communication (Hauser 1996), the uniqueness of human speech (Lieberman 1991), and studies of feral children and the so-called "linguistic apes" (Candland 1993, Savage-Rumbaugh, Shanker and Taylor 1998). Also avoided here, for a variety of reasons, will be a discussion of the exact age at which a CP ostensibly ends. For most studies, the CP is loosely defined as the period of time between birth and puberty, but there are several problems in demarcating puberty chronologically (Scovel 1988: Chapter 3). Additionally, there is great variation among researchers on which age spans they use to divide up their subjects, and there may be multiple critical periods at varying age levels for different linguistic modalities, a possibility raised early on by Seliger (1978) and discussed more recently by Eubank and Gregg (1999).

More than twenty years ago, several studies had already suggested that children were not necessarily superior to older learners in acquiring a second language, not even in the area of pronunciation (Olsen and Samuels 1973, Snow and Hoefnagel-Hohle 1978). The majority of researchers seemed skeptical about the existence of a CP (Clark and Clark 1977, McLaughlin 1978), and several explicitly denied its existence (Neufeld 1980, van Els, Bongaerts, Extra, van Os and Janssen-Dieten 1984). It is also important to point out that at that time, with the rare exception of a few studies (Patkowski 1980), virtually all of the discussion focused on the ability of post-pubescent learners to acquire native-like speech. Indeed, several of these early studies on the emergence of foreign accents spawned new methods of foreign language teaching for adults. For example, Asher and Garcia's (1969) survey eventually led to the development of Total Physical

Response, and Krashen's (1973) paper laid the foundation for his well-known contrast between "learning" and "acquisition" which led to the evolution of the Natural Approach.

Now, more than twenty years later, it is my impression that, based on a general reading of the relevant literature in applied linguistics and psycholinguistics (especially writers such as Long [1990] and Pinker [1994]), the belief in some version of the CPH presently represents the majority opinion. Furthermore, this opinion seems buttressed by a constant succession of new research supporting some aspect of the CPH (Major 1999, Spadaro 1998). Conversely, skeptics like Bialystok and Hakuta (1999) and Bongaerts (1999) now appear to represent the minority view on this subject. If this cursory answer to the first question regarding the CPH is at all accurate, a major shift in thinking has taken place at the end of the century on a topic of significant import to applied linguistics.

IS THERE A CP FOR ACQUIRING ACCENTLESS SPEECH?

Recall that one of the earliest claims made about the CPH, based on the initial work of Penfield and Lenneberg, was the presumption that a CP existed only for 'speech' and not for 'language' (Scovel 1969). That is, the original speculations about the existence of a biologically based CP in humans that would be homologous to the profuse and well-documented manifestations of CP's in animal behavior concerned the ability to sound like a native speaker. A proliferation of early studies appeared to document the existence of a CP for human speech; language learned after puberty invariably could be identified as non-native by native speakers of that target language (Asher and Garcia 1969, Fathman 1975, Flege, Munro and MacKay 1995, Harada 1997, Major 1987, Oyama 1976, Seliger, Krashen and Ladefoged 1975, Tahta, Wood and Lowenthal 1981). Studies also suggest that bottom/up measures of a foreign accent (e.g., voice onset timing) correlate with more global, top/down judgments (e.g., "Does this person sound like a native speaker?") (Major 1987, Riney and Takagi 1999). Irrespective of how these results are interpreted, the answer to the second question appears to be resoundingly affirmative. Nevertheless, some of those who hold to the minority view on the first question do so because they believe they have evidence that the answer to this second query is negative. That is, some researchers believe that there are people who can learn a new language after puberty without any trace of a foreign accent.

Several applied linguists have devoted their attention to experiments which are designed to train (or to find) post-pubescent learners of a second language who can pass themselves off as native speakers of that target language to native-speaking judges. Neufeld and Schneiderman (1980) attempted to train a group of English speakers to speak a few brief phrases in three different languages so that they would sound like native speakers, and the authors concluded they were essentially successful in this endeavor. However, serious criticisms have been levied about their experimental design and the interpretation of their results (Scovel 1988). A

more elegant study was performed by Bongaerts and his colleagues (Bongaerts, Planken and Schils 1995) using, among other groups of speakers, a number of highly proficient post-pubescent Dutch speakers of English, but the results of this experiment are vitiated by the fact that the judges, who were native speakers of British English, had difficulty consistently identifying even the native speaking controls (Scovel 1997). Bongaerts (1999) has reported a more recent and convincing set of experiments in which highly proficient Dutch speakers of French have been identified as speaking with a native accent by native speaking French judges. Even though only a few of the participants in these experiments were able to speak "accentless" French, they appear to be exceptions to the strong version of the CPH for speech espoused by Scovel (1969). Similarly, an exceptional adult learner is discussed by Ioup, *et al.* (1994): They describe an English speaker who first began to learn Egyptian Arabic at the age of twenty-one and eventually acquired such a high proficiency that she was consistently identified as a native speaker. And a more recent study of 24 adult, English-speaking learners highly proficient in German suggests that at least one of the subjects was judged to have native-like pronunciation in his second language (Moyer 1999).

Studies such as these force us to reconsider the answer to question two. It may be that for the vast majority of adult language learners, a native-like accent remains impossible. But for all natural populations, exceptions abound, and these rare examples of precocious pronunciation may represent the exceptions found within plus two or three standard deviations from the norm as speculated by Scovel (1988).

Despite the fact that foreign accents emerge in early adulthood and, with rare exception, remain indelible after puberty, adult learners can, should, and do improve their pronunciation and intelligibility in a second language. Applied linguists who have been influenced by work on the CPH have made promising contributions to this particular area of SLA (Derwing, Munro and Wiebe 1998, Munro and Derwing 1995).

IS THERE A CP FOR MORPHOSYNTACTIC COMPETENCE?

Except for Penfield (1963), most of the early research on the CPH was confined to exploring possible CP effects on pronunciation. Penfield alone was a proponent of 'the earlier, the better' claim and assumed that young children were superior to adults in all aspects of SLA. But beginning with Patkowski (1980), there have been several studies conducted which appear to muster increasing evidence that age constraints may also affect morphosyntactic competence (Coppetiers 1987, Johnson and Newport 1989, Shim 1995, Spadaro 1998, White and Genesee 1996). It is instructive to point out that unlike the pronunciation research, which focused almost exclusively on binary or N-ary judgements by native speakers of the target language whether or not taped subjects spoke with a foreign accent, these morphosyntactic studies tap a range of abilities in both performance and competence (e.g., accurate use of irregular morphological

inflections, accurate and fluent use of idiomatic lexical collocations, and ability to make accurate grammaticality judgments). It is therefore immediately obvious that at least two major differences exist between the phonological work on the CPH and experiments dealing with lexical and grammatical knowledge. The former relies solely on the linguistic performance of non-native speakers, while the latter depends on tapping skills in both performance and competence in the target language. Second, as Scovel (1988) has pointed out, the former provides evidence for a CP for speech; the latter supports the notion that there is a CP for language.

Because the grammaticality-judgment research has garnered the most attention (e.g., the Johnson and Newport [1989] study is the single most cited reference for the CPH in the SLA literature), and because this research paradigm used in applied linguistics is the one most directly related to research in formal linguistics, it seems fair to examine it most critically. Several authors have lodged a variety of criticisms about either the use of grammaticality judgments in SLA or the interpretation of the results of such studies (Birdsong 1992, Eubank and Gregg 1999, Scovel 1988). In addition, a study undertaken by Slavoff and Johnson (1995) quite surprisingly found no differences between younger learners (7–9) and children close to or into the age of puberty (10–12) in a replication of the earlier, well-known work by Johnson and Newport. The authors also found an unantici-pated but significant gender effect with girls outperforming boys. All of this adds support to the suspicion that grammaticality judgment tasks tap a type of target language competence which is difficult to correlate with hypotheses about a CP. Finally, going back to the larger issue of the use of grammaticality judgments as a source of evidence for native speaking competence, many formal linguists hold serious reservations about this particular mode of linguistic inquiry (Schutze 1996).

HOW CAN AGE-RELATED DIFFERENCES IN SLA BE EXPLAINED?

Over the past twenty years, probably the greatest shift in direction in the debate about the CPH has been from the issue of whether or not age-related differences in SLA do indeed exist, to the question of what actually accounts for the attested discrepancies between child and adult second language learners. Here is where the greatest disagreement emerges among the many researchers who are attracted by this area of applied linguistic inquiry. In a telling metaphor, McLaughlin, referring to Hegel's description of Schelling's philosophy, has aptly described this murky arena of explanation as "a night where all cows are black" (McLaughlin 1978:59)!

Because the whole notion of critical periods comes directly from biology (both from genetics and from ethology), the original application of the term to language has strong biological underpinnings. This orientation is especially evident in the early work explaining the emergence of foreign accents as being linked to the completion of lateralization (hence brain plasticity) by the age of puberty (Lenneberg 1967, Scovel 1969). In a narrow sense, therefore, a CP for SLA can only be viewed as a biologically based explanation for the emergence of non-native

speech and/or language after about the first decade of life. Because only pronunciation has a clear neuromotor etiology, it alone is affected by the loss of plasticity, evidenced in part by the completion of cerebral lateralization at the emergence of puberty. Note that this biologically based explanation for a CP speech does not seem to explain why there might very well be a CP for the acquisition of native-like morphosyntax as well.

Krashen (1973) was the first to criticize this biologically based explanation. From his interpretation of the neurological data, Krashen argued that lateralization (and brain plasticity) was completed at about the age of four, and so, if age constraints exist for SLA, they are not due to developmental neurology. Krashen's reinterpretation of the neurological data has itself been critiqued (Scovel 1988), and there has been a great deal of new evidence supporting the claim that the plasticity of the developing brain provides children with unique opportunities for learning up to the end of the first decade of life (Spreen, Risser and Edgell 1995: Chapter 8). Note, however, that a biological explanation for age constraints in SLA is not nearly as adequate in accounting for any limits in morphosyntactic learning by older adults. As has been already intimated, it is difficult to see how highly abstract concepts such as irregular morphology or the subjacency principle would be directly linked to loss of neuromuscular plasticity. Nevertheless, if we assume that all humans are born with an innate awareness of certain linguistic principles (UG), how can we account for age constraints in morphosyntax? A variety of explanations have been offered.

Several formal linguists believe that, for reasons not yet determined, UG is dismantled at about the age of puberty and therefore older learners lose their "natural" ability to acquire nativelike language competence (Bever 1981, Pinker 1994). On the other hand, Newport (1990) suggests that the relative cognitive immaturity of pre-pubescent children prevents them from over-analyzing the language(s) they are learning and helps contribute to native-like accuracy. Note that this explanation is quite similar to Krashen's claim that children 'acquire' language, but adults tend to "learn" a new language. Bialystok and Hakuta (1999) voice a similar argument in their summary of the most massive study of age effects on second language learning (over 60,000 subjects). They claim that maturational factors and education continually intervene in ultimate SLA success, and so it is misleading to invoke biological explanations such as the CPH for limitations that appear in older second language learners. Finally, there are those such as Birdsong (1999a), who believe that there is nothing "critical" about pubescence and that, as far as morphosyntactic learning is concerned, an earlier age of exposure to a new language is always advantageous, even with adult learners.

SUMMARY

To return to the opening theme of this review, no single area of applied linguistics seems to be as pertinent to non-linguists and to public policy makers as the CPH, and by now, it should be equally apparent that research in this area has a long, diverse, and somewhat controversial history. From this review, it should be apparent that perspectives on the topic have shifted over the past twenty to thirty years thanks to the informative work by applied linguists and by scholars from other fields who have applied their expertise to this area of language behavior. It should also be obvious that, given the conflicting evidence and contrasting viewpoints that still exist, parents, educational institutions, or ministries of education should be exceedingly cautious about translating what they read about the CPH research into personal practice or public policy. If applied linguists have learned anything at this important juncture in history, we have learned to look at the critical period hypothesis a bit more critically.

UNANNOTATED BIBLIOGRAPHY

Asher, J. and R. Garcia. 1969. The optimal age to learn a foreign language. *Modern Language Journal*. 38.334–341.

Bever, T. 1981. Normal acquisition processes explain the critical period for language learning. In K. Diller (ed.) *Individual differences and universals in language learning aptitude*. Rowley, MA: Newbury House. 176–198.

Bialystok, E. and K. Hakuta. 1999. Confounded age: Linguistic and cognitive factors in age differences for second language acquisition. In D. Birdsong (ed.) *Second language acquisition and the critical period hypothesis*. Mahwah, NJ: L. Erlbaum. 161–181.

Birdsong, D. 1992. Ultimate attainment in second language acquisition. *Language*. 68.706–755.

_____ 1999a. Introduction: Whys and why nots of the critical period hypothesis for second language acquisition. In D. Birdsong (ed.) *Second language acquisition and the critical period hypothesis*. Mahwah, NJ: L. Erlbaum. 1–22.

_____ (ed.) 1999b. *Second language acquisition and the critical period hypothesis*. Mahwah, NJ: L. Erlbaum.

Bongaerts, T. 1999. Native-likeness of pronunciation in naturalistic post-critical period second language acquisition. Paper presented at the 12th World AILA Congress. Tokyo, August 1999.

_____, B. Planken and E. Schils. 1995. Can late starters attain a native accent in a foreign language? A test of the critical period hypothesis. In D. Singleton and Z. Lengyel (eds.) *The age factor in second language acquisition*. Clevedon, UK: Multilingual Matters. 30–50.

Candland, D. 1993. *Feral children and clever animals*. Oxford: Oxford University Press.

Clark, H. and E. Clark. 1977. *Psychology and language: An introduction to psycholinguistics*. New York: Harcourt Brace Jovanovich.

Cook, V. 1991. *Second language learning and language teaching*. London: Edward Arnold.

Coppieters, R. 1987. Competence differences between native and near-native speakers. *Language*. 63.544–573.

Derwing, T., M. Munro and G. Wiebe. 1998. Pronunciation instruction for "fossilized" learners: Can it help? *Applied Language Learning*. 8.185–203.

Ellis, R. 1994. *The study of second language acquisition*. Oxford: Oxford University Press.

Eubank, L. and K. Gregg. 1999. Critical periods and (second) language acquisition: Divide et impera. In D. Birdsong (ed.) *Second language acquisition and the critical period hypothesis*. Mahwah, NJ: L. Erlbaum. 65–99.

Fathman, A. 1975. The relationship between age and second language productive ability. *Language Learning*. 25.245–253.

Flege, J., M. Munro and I. MacKay. 1995. Factors affecting degree of perceived foreign accent in a second language. *Journal of the Acoustical Society of America*. 97.3125–3134.

Harada, T. 1997. Is there a critical period for acquiring aspiration? Paper presented at the annual TESOL Convention. Orlando, FL, March 1997.

Harley, B. 1986. *Age in second language acquisition*. San Diego: College-Hill Press.

Hauser, M. 1996. *The biology of communication*. Cambridge, MA: MIT Press.

Ioup, G., E. Boutagui, M. El Tigi and M. Moselle. 1994. Reexamining the critical period hypothesis: A case study of successful adult SLA in a naturalistic environment. *Studies in Second Language Acquisition*. 16.73–98.

Johnson, J. and E. Newport. 1989. Critical period effects in second language learning: The influence of maturational state on the acquisition of English as a second language. *Cognitive Psychology*. 21.60–99.

Krashen, S. 1973. Lateralization, language learning, and the critical period: Some new evidence. *Language Learning*. 23.63–74.

_____, R. Scarcella and M. Long (eds.) 1982. *Child-adult differences in second language acquisition*. Rowley, MA: Newbury House.

Larsen-Freeman, D. and M. Long. 1991. *An introduction to second language acquisition research*. London: Longman.

Lenneberg, E. 1967. *Biological foundations of language*. New York: John Wiley and Sons.

Lieberman, P. 1991. *Uniquely human*. Cambridge, MA: Harvard University Press.

Long, M. 1990. Maturational constraints on language development. *Studies in Second Language Acquisition*. 12.251–285.

Long, M. 1999. Theories and theory change in SLA. Keynote address presented at the 12th World AILA Congress. Tokyo, August 1999.

Major, R. 1987. Phonological similarity, markedness, and rate of L2 acquisition. *Studies in Second Language Acquisition*. 9.63–82.

_____ 1999. *Foreign accent: The ontogeny and phylogeny of second language phonology*. Phoenix, AZ: Arizona State University. [Unpublished manuscript.]

McLaughlin, B. 1978. *Second-language acquisition in children*. New York: L. Erlbaum.

Moyer, A. 1999. Ultimate attainment in L2 phonology: The critical factors of age, motivation, and instruction. *Studies in Second Language Acquisition*. 21.81–108.

Munro, M. and T. Derwing. 1995. Foreign accent, comprehensibility, and intelligibility in the speech of second language learners. *Language Learning*. 45.73–97.

Neufeld, G. 1980. On the adult's ability to acquire phonology. *TESOL Quarterly*. 3.285–298.

_____ and E. Schneiderman. 1980. Prosodic and articulatory features in adult language learning. In R. Scarcella and S. Krashen (eds.) *Research in second language acquisition*. Rowley, MA: Newbury House. 105–109.

Newport. E. 1990. Maturational constraints on language learning. *Cognitive Science*. 14.11–28.

Olsen, L. and J. Samuels. 1973. The relationship between age and accuracy of foreign language pronunciation. *Journal of Educational Research*. 66.263–268.

Oyama, S. 1976. A sensitive period for the acquisition of a nonnative phonological system. *Journal of Psycholinguistic Research*. 5.261–283.

Patkowski, M. 1980. The sensitive period for the acquisition of syntax in a second language. *Language Learning*. 30.449–472.

Penfield, W. 1963. *The second career*. Boston: Little, Brown.

Pinker, S. 1994. *The language instinct: How the mind creates language*. New York: Morrow.

Riney, T. and N. Takagi. 1999. Global foreign accent and voice onset time among Japanese EFL speakers. *Language Learning*. 49.275–302.

Savage-Rumbaugh, S., S. Shanker and T. Taylor. 1998. *Apes, language, and the human mind*. New York: Oxford University Press.

Schutze, C. 1996. *The empirical base of linguistics: Grammaticality judgments and linguistic methodology*. Chicago: University of Chicago Press.

Scovel, T. 1969. Foreign accents, language acquisition, and cerebral dominance. *Language Learning*. 19.245–253.

_____ 1988. *A time to speak: A psycholinguistic inquiry into the critical period for human speech*. Rowley, MA: Newbury House.

_____ 1997. Review of D. Singleton and Z. Lengyel, The age factor in second language acquisition. *Modern Language Journal*. 81.118–119.

Scovel, T. In press. "The younger, the better" myth and bilingual education. In R. Gonzalez (ed.) *Language ideologies: Critical perspectives on the official English movement*. Urbana, IL: NCTE.

Seliger, H. 1978. Implications of a multiple critical periods hypothesis for second language learning. In W. Ritchie (ed.) *Second language research: Issues and implications*. New York: Academic Press. 11–19.

_____, S. Krashen and P. Ladefoged. 1975. Maturational constraints in the acquisition of a second language accent. *Language Sciences*. 36.20–22.

Shim, R. 1995. The sensitive period for language acquisition: An experimental study of age effects on universal grammar and language transfer. Urbana, IL: University of Illinois. Ph.D. diss.

Singleton, D. and Z. Lengyel (eds.) 1995. *The age factor in second language acquisition*. Clevedon, UK: Multilingual Matters.

Skehan, P. 1998. *A cognitive approach to language learning*. Oxford: Oxford University Press.

Slavoff, G. and J. Johnson. 1995. The effects of age on the rate of learning a second language. *Studies in Second Language Acquisition*. 17:1–16.

Snow, K. and M Hoefnagel-Hohle. 1978. The critical period for second language acquisition: Evidence from second language learning. *Child Development*. 49.1112–1128.

Spadaro, K. 1998. Maturational constraints on lexical acquisition in a second language. Perth, Australia: University of West Australia. Ph.D. diss.

Spinney, L. 1999. Tongue tied. *New Scientist*. July 24, 38–41.

Spreen, O., A. Risser and D. Edgell. 1995. *Developmental neuropsychology*. Oxford: Oxford University Press.

Strozer, J. 1994. *Language acquisition after puberty*. Washington, DC: Georgetown University Press.

Tahta, S., M. Wood and K. Loewenthal. 1981. Foreign accents: Factors relating to transfer of accent from the first language to a second language. *Language and Speech*. 24.265–272.

van Els, T., T. Bongaerts, G. Extra, C. van Os and A. Janssen-Dieten. 1984. *Applied linguistics and the learning and teaching of foreign languages*. London: Edward Arnold.

White, L. and F. Genesee. 1996. How native is near-native? The issue of ultimate attainment in adult second language acquisition. *Second Language Research*. 12.238–265.