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Author(s): Catherine E. Snow and Marian Hoefnagel-Höhle

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The Critical Period for Language Acquisition: Evidence from Second Language Learning

Catherine E. Snow and Marian Hoefnagel-Höhle

University of Amsterdam

SNOW, CATHERINE E., and HOEFNAGEL-HÖHLE, MARIAN. *The Critical Period for Language Acquisition: Evidence from Second Language Learning*. CHILD DEVELOPMENT, 1978, 49, 1114-1128. The critical period hypothesis holds that first language acquisition must occur before cerebral lateralization is complete, at about the age of puberty. One prediction of this hypothesis is that second language acquisition will be relatively fast, successful, and qualitatively similar to first language only if it occurs before the age of puberty. This prediction was tested by studying longitudinally the naturalistic acquisition of Dutch by English speakers of different ages. The subjects were tested 3 times during their first year in Holland, with an extensive test battery designed to assess several aspects of their second language ability. It was found that the subjects in the age groups 12-15 and adult made the fastest progress during the first few months of learning Dutch and that at the end of the first year the 8-10- and 12-15-year-olds had achieved the best control of Dutch. The 3-5-year-olds scored lowest on all the tests employed. These data do not support the critical period hypothesis for language acquisition.

The critical period hypothesis (CPH) as proposed by Lenneberg (1967) holds that primary language acquisition must occur during a critical period which ends at about the age of puberty with the establishment of cerebral lateralization of function. A strong implication of this hypothesis is that the processes involved in any language acquisition which takes place after the age of puberty will be qualitatively different from those involved in first language acquisition. A commonly drawn, though not absolutely necessary, corollary of the CPH is that any language learning which occurs after the age of puberty will be slower and less successful than normal first language learning (Krashen 1975; Lenneberg 1967, 1969; Scovel 1969).

There are few reported cases of successful first language acquisition after the age of puberty. Buddenhagen (1971) reported successful establishment of verbal language in a previously mute mental retardate at age 18. Recent reports on Genie, a girl isolated from social interaction until age 13, suggest that although her language acquisition is very slow, it is in many respects following the same course as that of young first language learners (Fromkin, Krashen, Curtiss, Rigler, & Rigler

1974), and her language skills are continuing to improve several years after puberty (Curtiss, Fromkin, Rigler, Rigler, & Krashen 1975). The very small number of cases of postpubertal subjects without any language and the abnormal circumstances which are associated with those cases make it extremely difficult to draw any general conclusion, but the findings of Buddenhagen and those concerning Genie suggest that some degree of postpubertal first language acquisition is possible.

Another area for collecting data relevant to the CPH is second language acquisition. Two research designs can be expected to produce data relevant to the evaluation of the CPH: (1) comparing second language acquisition to first language acquisition; (2) comparing second language acquisition across a wide age range, such that the youngest subjects tested are still well within the critical period age range. Several recent studies using the first approach have shown that the course of second language acquisition is similar to that of first language acquisition, in terms of the order in which rules and structures are acquired (Dulay & Burt 1974; Fathman 1975), of the learning strategies employed (Cook 1973; Ervin-Tripp 1974) and of the errors made (Taylor 1975).

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In addition, a few studies using the second approach have shown that older children are faster than younger children in acquiring second language morphology and syntax (Ervin-Tripp 1974; Fathman 1975, Ekstrand, Note 1) and listening comprehension (Asher & Price 1967). Studies of age differences in the acquisition of second language pronunciation have produced conflicting results. Ekstrand (Note 1) and Snow and Hoefnagel-Höhle (1978) found better pronunciation in older subjects, whereas Fathman (1975) and Seliger, Krashen, and Ladefoged (1975) found a negative effect of age. However, Seliger et al. did report on a few postpubertal second language learners who had achieved accentless pronunciation in their second language, as well as some cases of prepubertal learners who maintained foreign accents.

Although these studies do not generally support the prediction of the CPH, it would be premature to reject the CPH on their basis, for several reasons:

1. The studies cited have looked at only a restricted age range: 6–15 in Fathman's study, 8–16 in Ekstrand's, 8–adult in Asher and Price's, and 4–9 in Ervin-Tripp's. No single study has included subjects in the entire age range of interest, from 3 to several years post puberty, and none except Asher and Price has compared adult to child second language learners. The fact that children younger than 5 have rarely been studied is especially unfortunate in view of (a) the evidence that some degree of cerebral asymmetry is present at birth (reviewed in Buffery 1978; Kinsbourne 1975) and (b) the suggestion, based on dichotic listening techniques, that lateralization of receptive language function is fully established by age 5 (Krashen & Harshman 1972).

2. Age differences have been assessed cross-sectionally rather than longitudinally. Since age differences found at any given point after the commencement of second language acquisition might reflect recent spurts of acquisition for a particular group, rather than constant differences in rate of acquisition, only a longitudinal study can provide the basis for conclusions concerning overall age differences in rate of acquisition and in ultimate achievement.

3. A relatively restricted range of second language abilities has been tested in most studies. A complete test of the CPH requires

that different language abilities be tested separately, since the acquisition of different language abilities may depend on differing degrees on brain plasticity. Testing different language abilities in the same set of subjects may enable one to explain the contradictory findings, cited above, for morphology, syntax, and listening comprehension on the one hand and pronunciation on the other.

The present study.—In this paper the acquisition of several components of second language ability by subjects of different ages is described, and the implications of these observations for the CPH are considered. The acquisition of Dutch as a second language by 51 English-speaking subjects in five age groups was followed for a period of 1 year. All the subjects were learning Dutch by "picking it up" at school or at work, with little or no formal instruction. The context of acquisition was thus very similar to the normal context of first language acquisition—communicative interactions with native speakers. The subjects' accomplishments at three points during their first year in the Netherlands were compared both quantitatively and qualitatively with the accomplishments of two additional groups: advanced speakers of Dutch as a second language, and native speakers.

The subjects were tested on as many components of skill in speaking a language as possible, and some open-ended tests which would reveal qualitative differences in language ability were also included. An extensive test of pronunciation was included, since native-like pronunciation is often specifically mentioned as requiring prepubertal exposure to the language (e.g., Lenneberg 1967, p. 176). In addition, tests for knowledge of morphology, syntax, and vocabulary; for the ability to give syntactic judgments; and for the comprehension and production of fluent speech were included.

Procedure

Subjects

Two groups of English-speaking subjects were included in the study: monolingual English speakers who were just starting to learn Dutch (Beginners), and English speakers who had been living in Holland and speaking Dutch for at least 18 months (Advanced). The Beginners were tested three times at 4–5-month intervals. The first session was held within 6 months of their arrival in Holland and within 6 weeks of their starting at school or

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work in a Dutch language environment. The Advanced subjects were tested only once. The Beginners were distributed in the following way over the age groups: 10 3-5-year-olds, 8 6-7-year-olds, 13 8-10-year-olds, 9 12-15-year-olds, and 11 adults. The Advanced group had the following distribution: 6 6-7-year-olds, 6 8-10-year-olds, 8 12-15-year-olds, and 10 adults. There was some attrition in the course of the year, and a few subjects did not complete all the tests, leading to slight variability in the numbers actually reported on for the various tests.

Although it would have been ideal to match the age groups on factors like social class, IQ, exposure to Dutch, and motivation to learn Dutch, the small size of the potential subject pool made such matching impossible. The majority of the subjects in all age groups were members of middle-class families which had moved to Holland for job-related reasons. The English version of the Peabody Picture Vocabulary Test (PPVT) was administered to all the subjects as a check on verbal intelligence. A comparison of the IQs of the four younger age groups (no IQ norms for adults are available for the PPVT) using a Kruskal-Wallis one-way analysis of variance revealed no significant differences either for the Beginners or for the Advanced subjects. Thus, age differences in speed of second language learning cannot be attributed to differences in verbal intelligence. The age groups differed unavoidably in degree of exposure to Dutch: the 3-15-year-olds were all attending Dutch schools and were therefore exposed to a Dutch language environment a minimum of 30 hours a week. Regular play with Dutch peers may have increased this by several hours for some children. The five adult men were all working in Dutch language environments; however, since most Dutch adults speak English well and readily, none of the men used Dutch regularly as a working language. The six adult women were all housewives, who heard Dutch only in the context of shopping, social encounters, and contacts with their children's schools, government offices, etc. Most of the adults also took courses in Dutch, but these did not exceed 26 hours of total class time in any case. Thus, if exposure to Dutch is considered a crucial variable in determining speed of acquisition, one would expect the adults to learn more slowly than any of the younger groups.

Since entire families of English speakers were tested whenever possible, 10 families

accounted for 28 of the 51 subjects in the Beginners group. A separate statistical analysis of the results within families will be presented, since several extraneous variables which cannot be controlled for the group as a whole are matched for subjects of different ages within any family.

In addition to the English speakers, two groups of monolingual Dutch speakers were tested in order to establish age norms for the tests employed. There were eight 6-7-year-old and eight 12-15-year-old native speakers. They were drawn from a school in the middle-class area where most of the English speakers lived and were selected by their classroom teachers as being of average intelligence and verbal ability.

Testing

The subjects were tested individually at school or at home, in a relaxed session lasting about 1½ hours. The test session was tape-recorded for later scoring or checking, except for the Auditory Discrimination, Sentence Judgment, and Peabody Picture Vocabulary Tests, which were scored during the test session.

Pronunciation.—In order to assess productive control of Dutch phonology, the subjects were asked to pronounce 80 words under each of two conditions: immediately after hearing a native speaker say the word (Imitation) and a few minutes later, with no immediate auditory model (Spontaneous). The words were elicited by means of pictures, and were selected to present initial /r/, initial and final consonant clusters, and all Dutch vowels and diphthongs in various consonantal contexts. The results were scored per word on a six-point scale (0 = English word; 1 = uninterpretable as target word; 2 = target word pronounced with a strong accent; 3 = target word pronounced with noticeable accent; 4 = target word pronounced with a slight accent; 5 = indistinguishable from a native speaker) by a native speaker of Dutch. Rescoring of the subjects several months later produced 89% agreement with the original scores.

Auditory discrimination.—Receptive control of Dutch phonemic distinctions not made in English was tested by asking subjects to point to the correct picture after auditory presentation of a word. Both words of a minimal pair were presented, all words selected to be familiar and picturable, (e.g., *man*/mɑn/ "man" and *maan*/man/ "moon"; *kuiken* /kʏkən/ "chicken" and *keuken* /kœkən/

"kitchen"). The order of presentation was random. Fifty-six items were presented testing 14 oppositions. As the results were affected by knowledge of the vocabulary items, the subjects' scores were computed by taking the ratio of auditory confusions to correct responses plus auditory confusions, thus ignoring mistakes which did not result from auditory confusion (e.g., moon for kitchen).

Morphology.—Berko's (1958) "wug-test" technique was used to test for control of the Dutch morphological rules for formation of plural, diminutive, agentive, past tense, and past participle, as well as for final devoicing when producing the singular form of a word presented in the plural. These rules are quite complicated and do not resemble their English counterparts except in that affixes are used in both cases. The subjects were given real words and asked to produce the appropriate form (e.g., If you have one *boy*, then you have two . . . ?). Pictures were used for the younger children. After the task was explained with real words, nonsense words were introduced as the test items. The subject's score was the number of correct responses (maximum = 82).

Sentence repetition.—Thirty-seven Dutch sentences of increasing length and grammatical complexity were read to the subjects, who were asked to repeat them. The sentences ranged from two to 10 words in length. Vocabulary was kept simple in all the sentences, so that the results could be interpreted as primarily relevant to control of syntax. A subject's score was the number of words correctly produced (maximum = 238).

Sentence translation.—Sixty sentences of increasing length and grammatical complexity were given in English, and the subjects were asked to translate them. Any necessary help was given with lexical items, as the test was designed to reflect control of syntax. Subjects' responses were scored by giving a point for each grammatical structure correctly produced (e.g., verb, auxiliary verb, adverb, prepositional phrase, indirect object) and for correct word order in each clause (maximum = 325).

Sentence judgment.—Fourteen pairs of sentences were read to the subjects. In each case, one was a correct and one an incorrect rendering of the same content. The subjects were asked to say which sentence was better.

Subjects' scores are given as the number of incorrect answers.

Peabody Picture Vocabulary Test.—A version of the PPVT standardized for Dutch up to age 8 was administered (Manschot & Bonnema 1974). This is a passive vocabulary test, in which the subject points to the correct one of four pictures after the experimenter reads a word. The 3–7-year-olds were tested to 50 words and the older subjects to 100 words, since the later vocabulary items were not appropriate for the youngest subjects. Accordingly, age differences on the PPVT were assessed by comparing the 3–5-year-olds with the 6–7-year-olds and by comparing the 8–10, 12–15, and adult groups in a separate analysis.

Story comprehension.—A simple, tape-recorded story in Dutch was played to the subjects, who were then asked to retell the story in English (or Dutch if they preferred). Comprehension was scored on the basis of mentioning 30 key points in the story.

Storytelling.—Subjects were asked to tell a story on the basis of a set of pictures provided, both in Dutch and in English. A fluency score was calculated by taking the ratio of number of words to seconds talking.

Results

The results for all the groups on the various tests are presented in figures 1 through 9. Age differences between three or more groups were tested with the Kruskal-Wallis one-way analysis of variance. Differences between two groups were tested with the Mann-Whitney *U*.

Significant improvement occurred between time 1 and time 2 for the Beginners on all the tests (tested with the Wilcoxon signed-ranks test) and between time 2 and time 3 for all tests except Auditory Discrimination (see figs. 1–9). Significant differences between the levels of achievement of the Beginners at time 3 and the Advanced groups existed, for the adult group only, on Auditory Discrimination, Sentence Repetition, and Sentence Translation. These differences suggest that further significant improvement could be expected for the adults in these areas after 1 year's exposure to the second language but that the acquisition of Dutch by the 6–15-year-olds was essentially completed within 1 year.

Significant age differences were observed for all the tests at time 1, except for the Imi-

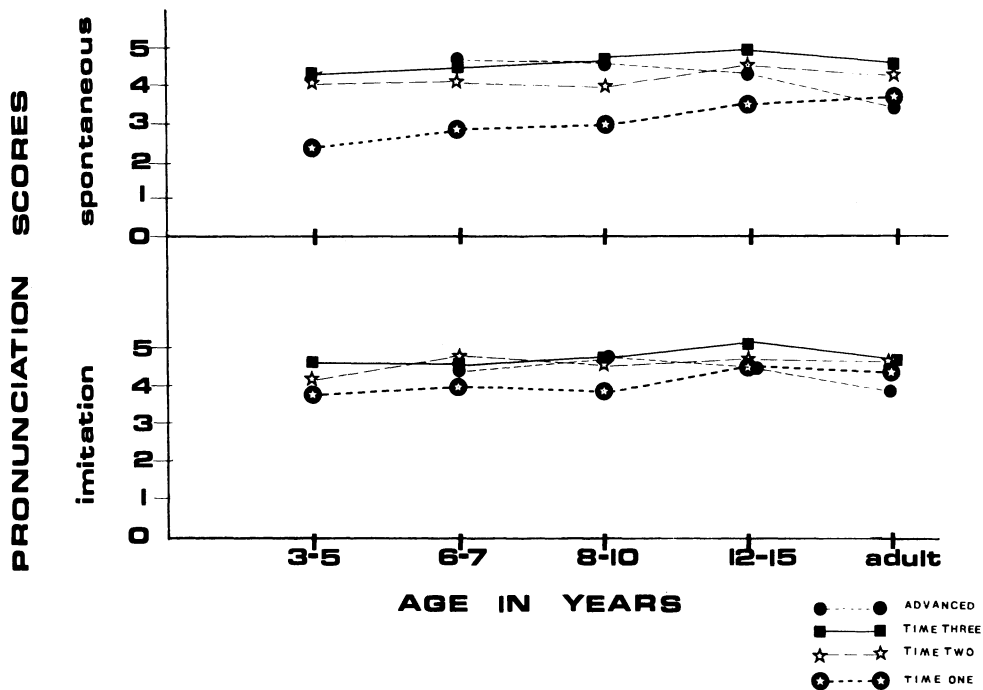


FIG. 1.—Median scores on the Pronunciation Test

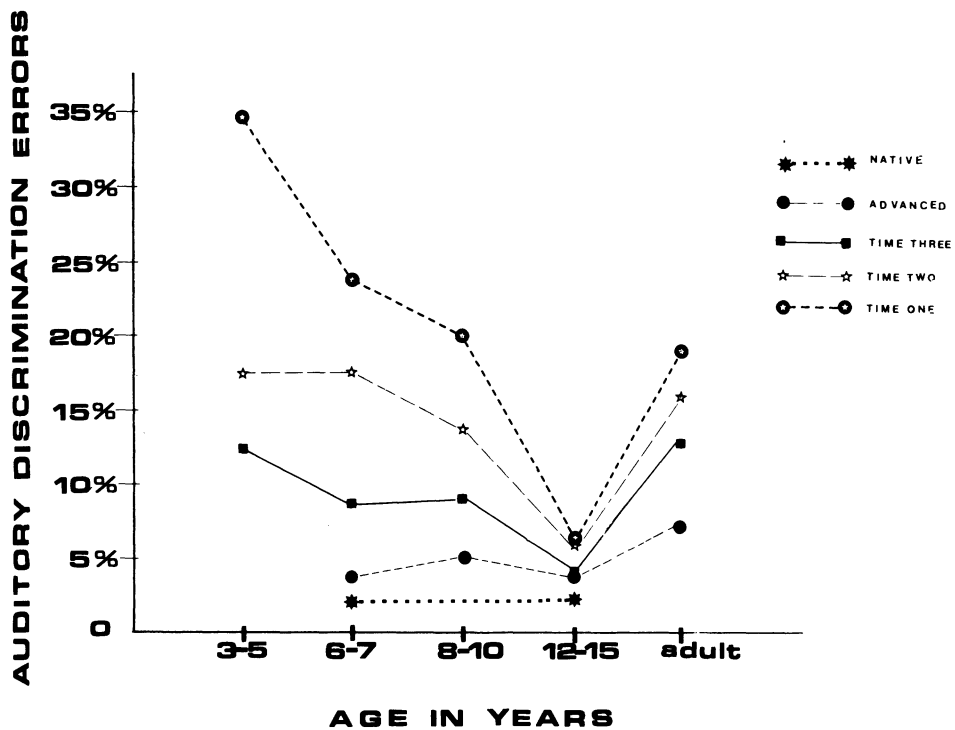


FIG. 2.—Median percentages of relevant responses which were errors on the Auditory Discrimination Test

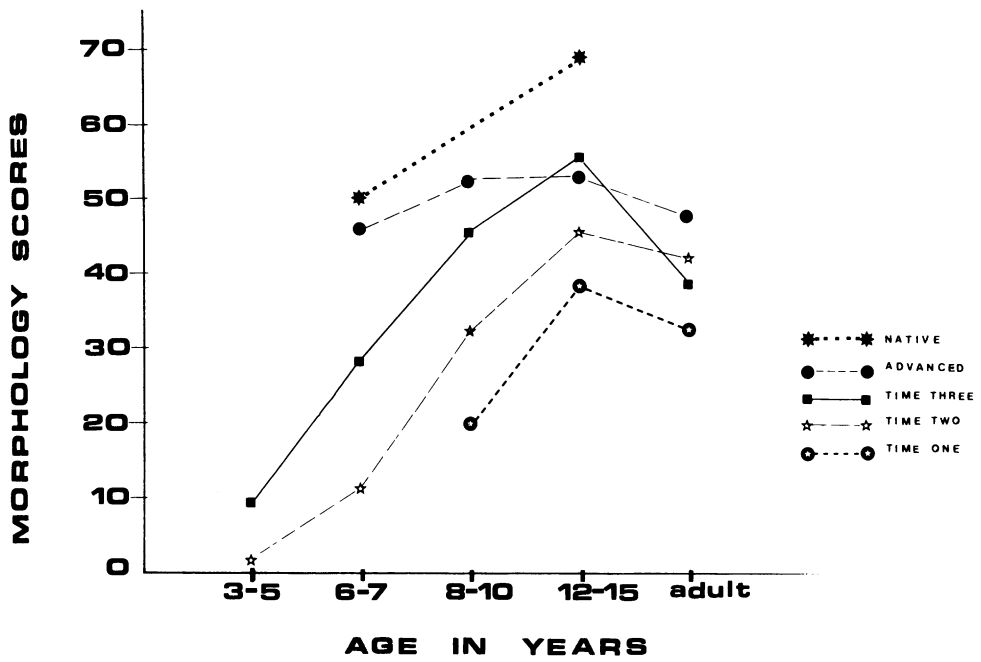


FIG. 3.—Median scores on the Morphology Test

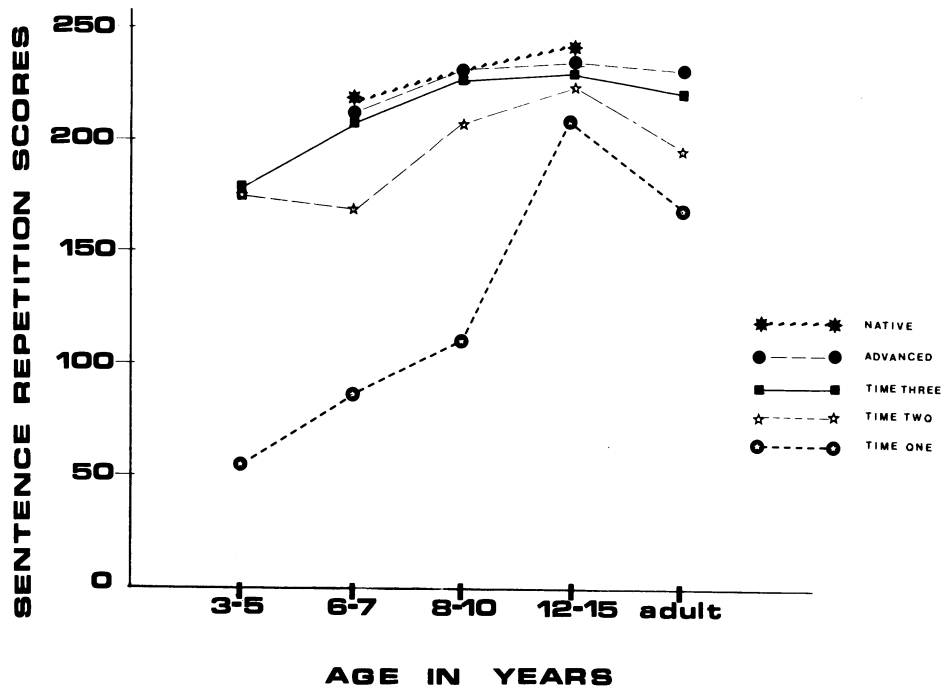


FIG. 4.—Median number of words correctly repeated in the Sentence Repetition Test

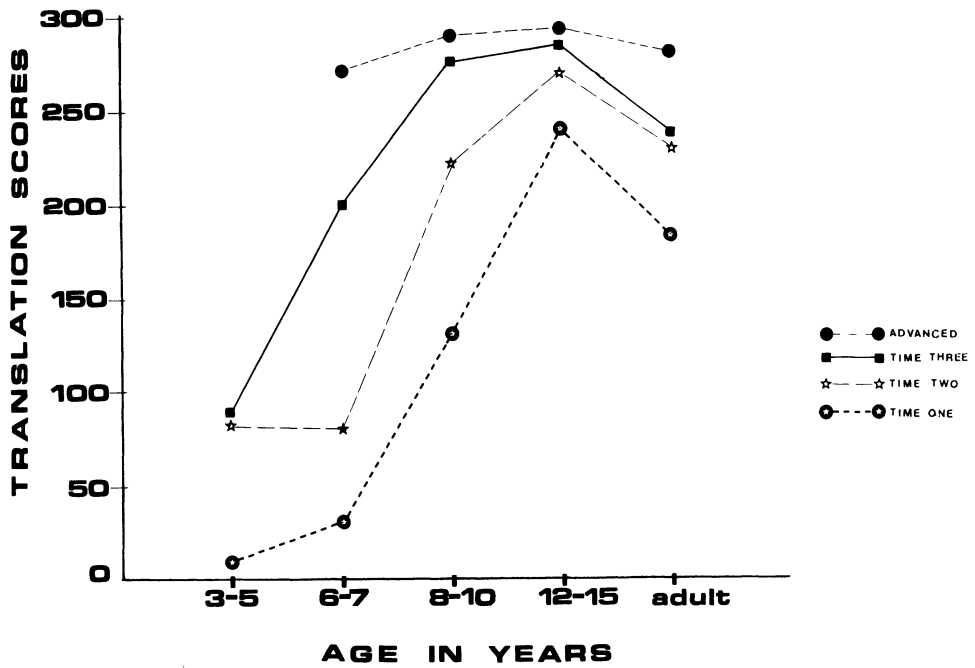


FIG. 5.—Median number of grammatical structures correctly translated in the Translation Test

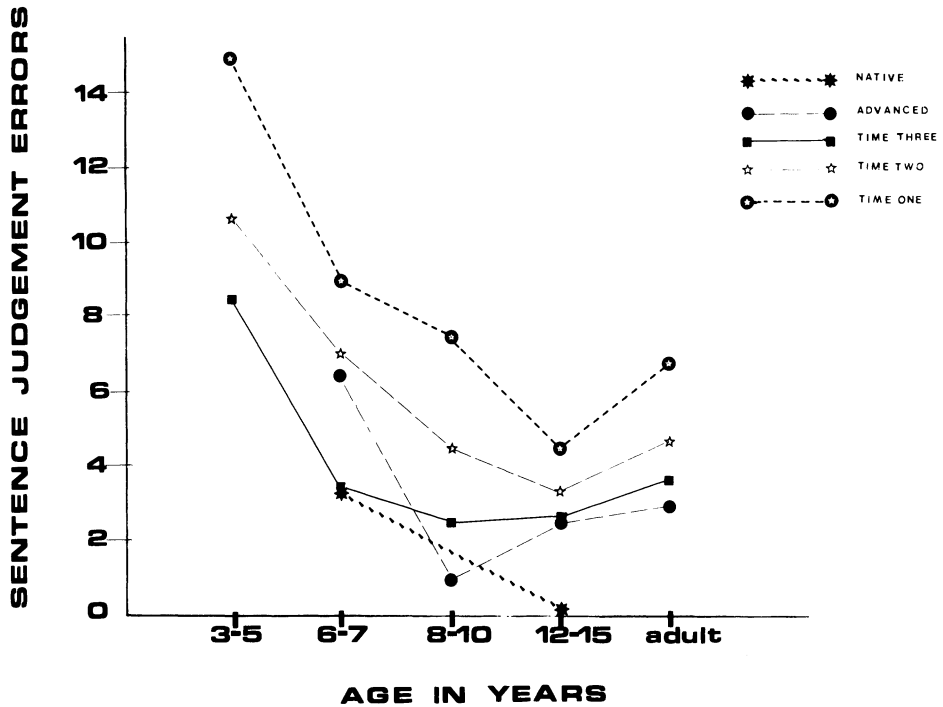


FIG. 6.—Median numbers of errors on the Sentence Judgment Test

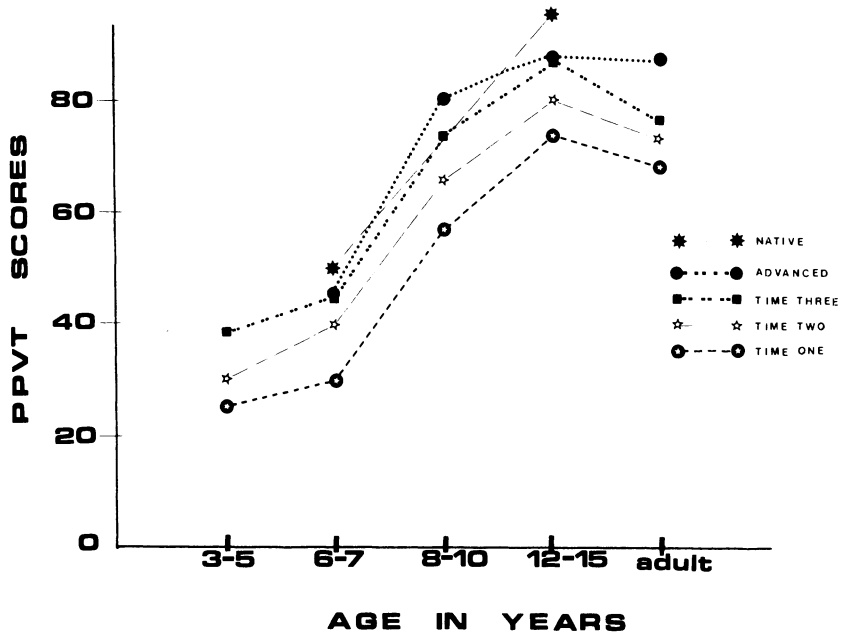


FIG. 7.—Median scores on the PPVT

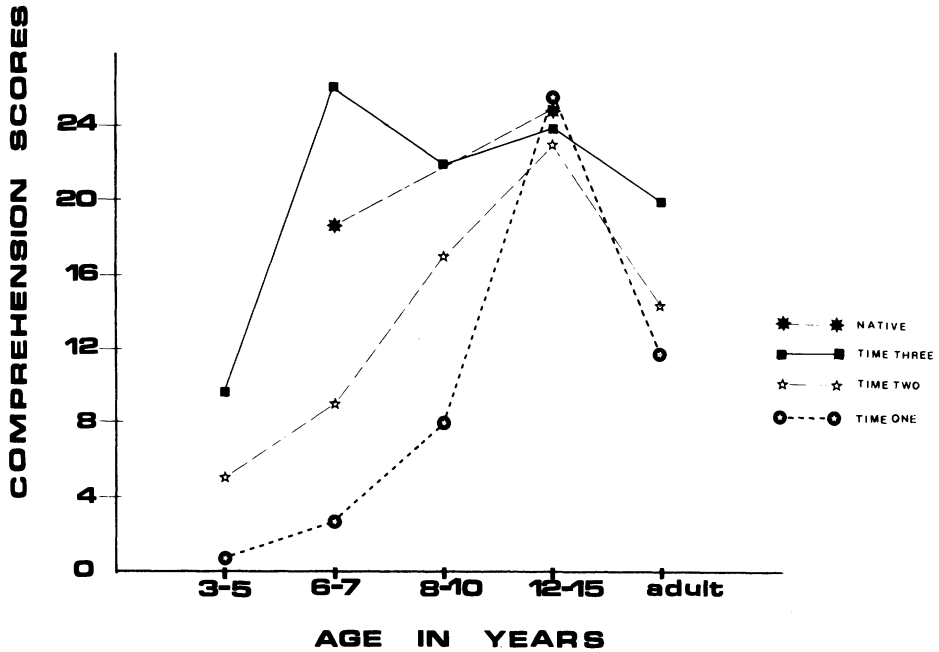


FIG. 8.—Median number of points correctly retold in the Story Comprehension Test

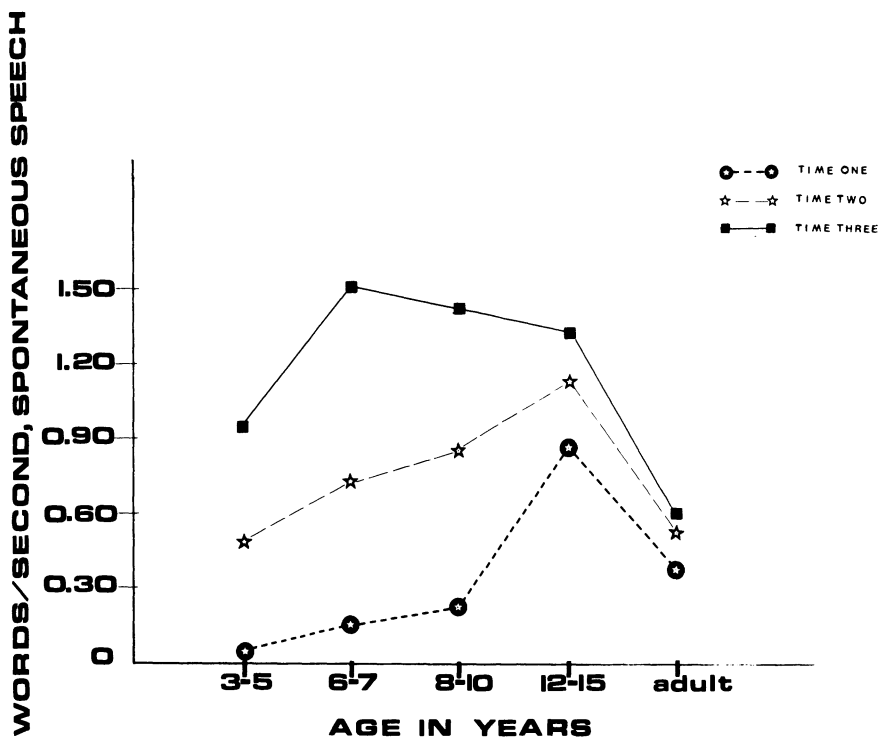


FIG. 9.—Median number of words produced per second in the Dutch Storytelling Task

tation condition of the Pronunciation Test. In all cases, the age differences favored the older subjects over the younger ones (see figs. 1-9). For all tests except Pronunciation, the order of the groups, from proficient to poor, was: 12-15, adult, 8-10, 6-7, 3-5. Spontaneous Pronunciation showed a linear increase with age. At times 2 and 3 the size of the age differences had decreased, though they remained significant for all tests except Pronunciation at times 2 and 3 and Auditory Discrimination at time 2. The 8-10-year-olds had surpassed the adults in Auditory Discrimination, Sentence Repetition, Sentence Judgment, Story Comprehension, and Spontaneous Speech Fluency by time 2 and in Morphology and Sentence Translation by time 3. The 6-7-year-olds had also surpassed the adults on Spontaneous Speech Fluency and Auditory Discrimination by time 3. On the PPVT, the 6-7-year-olds were significantly better than the 3-5-year-olds and the 12-15-year-olds and adults were significantly better than the 8-10-year-olds at all test sessions. All the tests, then, except Pronunciation, on which the age differences disappeared very quickly, showed a similar pattern: most rapid learning by the 12-15-year-olds and adults

during the first few months of acquisition, those preceding the first test session, and by the 6-10-year-olds during the last three-quarters of the first year. The adults, despite their initial rapid acquisition, fell increasingly behind because their subsequent improvement was very slow. The teenagers had achieved almost native performance extremely quickly, within a few months of starting to speak Dutch. They maintained superiority on most tests because their initial advantage was so great; they were, however, surpassed on Story Comprehension and Spontaneous Speech Fluency by the 6-10-year-olds.

The crucial findings of relevance for evaluating the CPH were that the 3-5-year-olds scored consistently worse than the older groups on all the tests and that the 12-15-year-olds showed the most rapid acquisition of all the skills tested. These findings are basis for rejecting the hypothesis that the period 2-12 years constitutes an optimal time for language acquisition.

The notion that younger children are better than older children or adults in second language learning must also be rejected on

the basis of scores within those families that contributed subjects in more than one age group. In table 1 it is indicated whether the scores on the various tests match the prediction of the CPH for each family at time 1. A plus indicates the ordering predicted by the CPH, that the younger family members scored better than the older ones. Any individual case of a younger family member scoring better than an older one is indicated as a plus, even though the other family members might not be ordered in a way consistent with the CPH. Comparisons were made on the basis of the individual ages, even when two children fell into one age group. Only for cases of two adults was no specific effect of age predicted, nor was a plus scored if a parent scored worse than a teenage child, since this was to be predicted from the total results. An \circ indicates that not all the family members could be scored on that test or that all scored so badly that no comparison would be meaningful. It can be seen that in the vast majority of the cases the CPH was not supported. The probability of finding the number of pluses observed or fewer, given the number of orderings possible within families, is indicated per family and per test. For only one family and one test was $p > .05$. These findings were based on a very conservative estimate of chance within the three families where both parents were included, since either parent could produce a minus by scoring better

than a child, but both parents were counted as one in calculating the number of possible orderings. The intrafamily analysis strongly supports the conclusion from the analysis of all the data that the CPH must be rejected as far as second language acquisition is concerned.

It might be argued that the results found here are an artifact of the test construction, that is, that the nature of the tests favors the older subjects. It is, of course, very difficult to design tests which are equally usable with 5-year-olds and with adults. We approached this problem by choosing test content appropriate to the youngest subjects, with the result that most of the test material was quite childish for the older subjects. An indication that the conclusion drawn about the CPH is correct comes from a comparison of the second language learners with the two groups of Dutch native speakers tested. The scores for the second language learners are presented as percentages of the native speakers' scores in table 2, on the assumption that the native speakers' scores can be taken as the ceiling for the equivalent age groups of second language learners. It can be seen from table 2 that the 12-15-year-old second language speakers approached the native speakers' scores faster (i.e., were closer at time 1, after their first 6 weeks of exposure to Dutch) than the 6-7-year-olds in all cases except Sentence Judgment and that they continued throughout the first year to

TABLE 1
INTRAFAMILY AGE COMPARISONS ON 10 TESTS OF SECOND LANGUAGE ABILITY

FAMILY	PRONUNCIATION		AUDI- TORY DIS- CRIMI- NATION	MOR- PHOLO- GY	SENTENCE			STORY		COM- BINED PROBA- BILITY	
	Imita- tion	Spon- taneous			Repeti- tion	Trans- lation	Judg- ment	PPVT	Com- pre- hension		Telling
1 ^a	-	-	\circ	\circ	-	\circ	\circ	-	-	\circ	.031
2 ^a	-	-	+	\circ	-	-	-	-	-	-	.019
3 ^a	-	-	-	\circ	-	+	+	-	-	\circ	.14
4 ^a	-	-	+	-	-	-	-	-	-	-	.011
5 ^b	-	-	-	-	-	-	-	-	-	-	.0009
6 ^b	-	-	+	-	-	-	-	-	-	-	.011
7 ^c	+	+	-	-	-	-	-	+	-	+	.0024
8 ^c	+	+	-	-	-	-	-	-	-	-	.0002
9 ^c	-	-	-	-	-	-	-	-	-	-	.00001
10 ^d	+	-	+	-	+	-	+	-	+	\circ	.0032
Combined probability .	.012	.0020	.20	.00002	.00013	.00015	.0037	.00013	.00013	.0055	...

NOTE.—+ = ordering within the family confirmed the CPH, for at least one pair of subjects; - = ordering within the family completely disconfirmed the CPH; \circ = too few data were available to make any comparison possible.

^a Two family members; the chance of disconfirming the CPH for one test was .50.

^b Three family members; the chance of disconfirming the CPH for one test was .50.

^c Three family members; the chance of disconfirming the CPH for one test was .17.

^d Five family members; the chance of disconfirming the CPH for one test was .04.

TABLE 2
 MEANS OF THE SECOND LANGUAGE LEARNERS EXPRESSED AS PERCENTAGES
 OF THE NATIVE SPEAKERS' MEANS

TEST	AGE	BEGINNERS			AD- VANCED
		Time 1	Time 2	Time 3	
Auditory ^a	6-7	7.6	10.2	19.8	46.1
Discrimination	12-15	30.0	33.0	47.4	48.6
Morphology	{ 6-7	.0	22.0	57.0	93.0
	{ 12-15	55.8	66.7	80.4	76.8
Sentence	6-7	39.8	78.2	95.4	97.0
Repetition	12-15	88.7	95.7	97.9	100.0
Sentence ^a	6-7	38.9	50.0	100.0	53.8
Judgment	{ 12-15	2.2	3.0	4.0	4.0
	{ 6-7	59.5	81.6	92.2	91.2
PPVT	{ 12-15	75.9	83.9	91.5	91.7
	{ 6-7	14.6	48.6	140.5	81.0
Story Comprehension . .	{ 12-15	102.9	94.7	98.0	N.A. ^b

^a Since these scores represented errors, the entries were calculated by dividing the native speakers' mean by the second language learners' means, then multiplying by 100.

^b Too few advanced 12-15-year-olds performed this task to make any meaningful comparison.

score higher in all cases except Story Comprehension and PPVT. The rather peculiar results for Story Comprehension are very likely an artifact of the attractiveness of the story content; it was an enjoyable story for 6-7-year-olds but too easy and boring to be retold in detail by the older children (as indicated by the decline in performance on this task for the older children). The Sentence Judgment Test is the only one, then, on which the younger second language learners performed better in comparison with native speakers of the same age than older second language learners. The finding that older second language learners are disadvantaged at acquiring the skills associated with giving linguistic judgments, despite their superior linguistic performance, suggests that knowledge of a language comprises several components which are not necessarily related.

A further possibility for explaining the results found is that they represent positive transfer from the first language, English, to the second language, Dutch. Older second language learners would, of course, benefit more from positive transfer than younger ones because their knowledge of English is better. A number of analyses suggest that positive transfer cannot explain the superiority of the older subjects. First, while it is true that English and Dutch are historically closely related, it is not the case that they are highly similar in syntax, morphology, or phonology. The closest relationship, and thus the expectation of greatest positive transfer, exists for vocabulary. Anal-

ysis of two word lists commonly used to determine language relatedness (the 100-word list of Rea [1958] and the 200-word list of Gudchinsky [1956]) reveals that approximately 65% of commonly used words are cognates in the two languages. One would expect, then, a relatively great positive effect of age in the area of vocabulary, whereas it is on the tests of syntax and morphology that the younger children score relatively worse.

Furthermore, if the older subjects were relying to a large degree on transfer, one would expect them to perform much better in those aspects of Dutch morphology and syntax that happen to be isomorphic to English grammar than in those that do not. For example, main clauses in Dutch show the subject-verb-direct object order typical of English sentences, but subordinate clauses show the order subject-direct object-verb. It was not the case that older subjects were more likely to produce main clauses correctly and subordinate clauses incorrectly than younger subjects; subjects of all ages tended, in fact, to overgeneralize the verb-final order to all clauses. Very similar patterns of morphological and syntactic acquisition were observed at all ages, as indicated by the following analysis of the order of difficulty of various items and structures for the different age groups on the tests of Morphology, Sentence Repetition, Sentence Translation, and Sentence Judgment.

Morphology.—Knowledge of six different sets of morphological rules was tested: those

for the formation of the plural, the diminutive, the agentive, the simple past tense, the past participle, and the singular from the plural. The order of acquisition of these six sets of rules was determined for each age group of Beginners by rank ordering their mean scores for the subtest at time 3. Spearman rank-order correlation coefficients calculated for all pairs of age groups showed moderate to high positive correlations (ranging from .13 to .79). The highest correlations were found between adjacent age groups, but the correlations between the adults and all the other groups were in the range .53-.60, suggesting no sharp differences in the order of acquisition between the youngest groups and the adults.

Sentence repetition.—The order of difficulty of the items in the Sentence Repetition task was calculated per age group for the Beginners at time 3 and for the 6-7-year-old native speakers. Each sentence was scored 2 points if it was completely correct, 1 point if only minor errors such as deletion of an adjectival suffix or third person ending were made, and 0 if more serious errors were made. The total score per sentence per group was then used to assign ranks. Spearman rank-order correlation coefficients were calculated among the groups. The correlations for the various groups of beginners were all positive and highly significant (ranging from .47 to .80), as were those for the English speakers with the Dutch native speakers (.71 to .83), suggesting that the same items caused difficulties for the native speakers and second language learners of all ages.

Sentence translation.—The Sentence Translation Test was scored on 24 different grammatical variables, for example, modal auxiliary, tense auxiliary, indefinite article, word order in subordinate clause, etc. For each age group, the percentage of correct answers was determined for each of the 24 variables at time 3, and all 24 were then ranked. Spearman rank-order correlation coefficients were calculated for all pairs of age groups. These correlations were all very high and significant (ranging from .72 to .91), indicating that the same aspects of the grammar of Dutch caused difficulties for all the age groups.

Sentence judgment.—The Sentence Judgment Test items tested choice of correct subordinating conjunctions and of correct prepositions following various verbs and adjectives. Order of difficulty of the items was determined

for each age group of Beginners at time 3 and for the 6-7-year-old native speakers (the 12-15-year-old native speakers made too few mistakes to analyze). Spearman rank-order correlation coefficients for the difficulty of the items across the age groups showed a general pattern of moderately high and significant positive correlations among all the groups (ranging from .30 to .78), though the adult Beginners showed the lowest correlations with the other age groups and with the native speakers. The fact that the correlations across age on the Sentence Judgment Test were generally lower than on the Sentence Repetition or Sentence Translation Tests may reflect differences across age groups in ability to acquire metalinguistic skills, related to the relatively poorer performance of the older subjects on this task. However, a firm conclusion about differences between the tasks would require that strictly comparable items be used. This was not the case in the current study.

Discussion

The results of this study fail to support the CPH. The fastest second language acquisition occurred in subjects aged 12-15 years, and the slowest occurred in subjects aged 3-5 years. Furthermore, subjects of all ages were very similar in the aspects of Dutch they found difficult and those they found easy. At least as far as second language acquisition is concerned, then, the conclusion must be drawn that a critical period extending from age 2 to age 12 does not exist.

The primary evidence cited by Lenneberg (1967) in support of the CPH is the fact that complete recovery from acquired aphasia is possible for children but not for adults. Although it is true that children show better recovery from traumatic aphasia than adults, aphasia resulting from vascular disorders rarely shows recovery even in young children (Guttman 1942; Van Dongen & Loonen 1976), and aphasia associated with a convulsive disorder often fails to recover as well (Gascon, Victor, Lambroso, & Goodglass 1973; Van Dongen & Loonen 1976; Worster-Drought 1971). Goorhuis-Brouwer found lasting deficits in four of the nine prepubertal traumatic aphasics she studied (1976). Alajouanine and Lhermitte (1965) found similar incidence of recovery in children aged 6-10 and in children aged 11-15, whereas the CPH would predict better recovery in the younger group. Thus, the evi-

dence concerning recovery from aphasia, like the observations concerning postpubertal first language acquisition (Fromkin et al. 1974) and the evidence presented here about second language acquisition, all fail to support the hypothesis of a critical period for language acquisition extending to the age of puberty.

The results of the present study are compatible with two hypotheses concerning the relationship between brain development and language acquisition: (a) that cerebral dominance becomes established during the period from birth to 5 years (Krashen 1973; Krashen & Harshman 1972), and (b) that cerebral dominance is present from birth and the observation of developing lateralization is an artifact of children's growing tendency to use linguistic strategies in various psychological tests (Kinsbourne 1975). The first hypothesis implies a critical period for first language acquisition ending at 5 years but predicts no necessary differences in speed or ease of second language acquisition among subjects older than 5. The period up to age 5 may be characterized by slower second language acquisition (a) because the effort needed to learn a first language is disadvantageous to second language acquisition, (b) because having already learned a language makes the task of learning a second one easier (Ervin-Tripp 1974), or (c) because the already established specialization of the dominant hemisphere for language facilitates acquisition. An observation suggesting that the 3-5-year-olds were different from all the other groups concerns the effect of second language acquisition on the first language ability. Data concerning fluency in English were collected during the English part of the Storytelling Tests and from the subjects' decision whether to retell the story in Dutch or English during the Story Comprehension Test. With one exception (a 7-year-old girl), it was only among the 3-5-year-old Beginners (and among the 6-7-year-old Advanced subjects, who had learned Dutch while 3-5 years old) that growing control of Dutch was associated with breakdown of control of English. Although a few subjects in all age groups showed some degree of negative interference, mostly at the lexical level, from Dutch into English, large decreases in English fluency and a preference for speaking Dutch were observed only among the youngest subjects. Under the second hypothesis, that cerebral dominance is present from birth, the critical period would have to be redefined as the period during which transfer of

function to the nondominant hemisphere is possible. Observable effects of the critical period would be expected for recovery from injury to the dominant hemisphere, but no negative effect of age on second language acquisition would be predicted since second language acquisition does not involve interhemispheric transfer of function.

In addition to age differences, considerable individual differences were found in the patterning of second language skills achieved by the subjects. All the 6-15-year-old subjects had achieved sufficient control of Dutch by the third test session to be described as good bilinguals. Nonetheless, these subjects differed considerably in the degree to which they had achieved complete control of pronunciation, morphology, grammar, vocabulary, fluency, and metalinguistic skills. Eleven subjects could be tested a fourth time, 1½ years after their first exposure to Dutch, and the scores achieved at this fourth session clearly indicate that some subjects had stopped improving in certain tests before achieving a perfect score. One 7-year-old subject, for example, showed no improvement after session 2 in the Imitation condition of the Pronunciation Test, and his spontaneous pronunciation remained poorer than that of all the other nonadults at session 4, despite the fact that his scores on the other tests were relatively high. Conversely, a 12-year-old achieved almost perfect pronunciation very early but continued to score poorly, even getting worse between session 2 and session 4, on Sentence Judgment and Morphology, the two tests which require the most metalinguistic ability. It is entirely possible that such individual differences in the patterning of language abilities are also present in one's first language. For example, Moscovitz (1973) found large individual differences among a group of English-speaking children in knowledge of English phonological rules and also among another group in the ability to learn a non-English phonological rule. We found considerable differences within the group of native speakers on the Morphology and Auditory Discrimination Tests. Large differences among adult native speakers have also been reported for ability to give syntactic judgments (Snow 1975; Snow & Meijer 1977) and semantic interpretations (Gleitman & Gleitman 1970). If administering a large battery of language tests to native speakers revealed individual differences in patterns of ability similar to those we have found for second language speakers, this would con-

stitute a basis for questioning the usefulness of the concept "native speaker competence," a concept which is, of course, theoretically very closely related to the CPH. Evidence concerning such variation is important to an assessment of the CPH because if native speakers who have had all the advantages of full critical-period exposure to the first language do not achieve equal skill, then the fact that post-critical-period learners show a range of skill is not surprising.

Reference Note

1. Ekstrand, L. H. Age and length of residence as variables related to the adjustment of migrant children, with special reference to second language learning. Paper presented at the International Association of Applied Linguistics, Stuttgart, August 1975.

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