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**Background**
Recent empirical studies relevant to the critical period hypothesis either assume or stipulate that evidence of late learners' superiority in studies of initial learning rates (e.g., Snow and Hohfnagel-Hole, 1977) does not disconfirm the hypothesis. Most current proponents of the critical period hypothesis restrict their concern to ultimate proficiency in a second language, which is operationalized as judgments of closeness to native performance. It is also important that a critical period for language learning involves acquisition in a naturalistic setting and not formal learning. This caveat preserves the theoretical motivation, very much a concern with Lenneberg, that presupposes an autonomous language acquisition device that processes language input through the use of innate universal knowledge. Foreign accent, in this view, is a manifestation of the limited ability to acquire second languages outside the biologically determined critical period and is generally considered as evidence supporting a global hypothesis that includes all language skills. Ultimate achievement as the true test of the critical period hypothesis dates from the review of Krashen, et al. (1979) in which it was concluded that adults and older learners exceed younger children in initial gains (with the debatable exception of phonology) in both formal and informal settings, while children, only in naturalistic settings, are superior in terms of ultimate achievement.

**Pronunciation**
In pronunciation, the data are inconsistent, with some studies showing an advantage for younger learners and some reporting an advantage for older learners.

Asher and Garcia (1969) compared the sentence pronunciation of 71 Cuban immigrants who had been in the United States for about five years and found that the earlier the age of arrival, the closer their pronunciation was judged to be native-like. It is cause for reflection that none of the subjects were judged fully native in accent. The early arriving group was most likely judged to be non-native because of dialect differences between the judges and the subjects. It may be impossible to distinguish foreign accent from differences in dialect for bilingual minority groups. In any case, adults who learn English as members of a large Spanish-speaking minority will not try to imitate the cadences of Standard English in the dominant culture but rather will tune in to the dialect of the bilingual community with which they identify.
Oyama (1976) studied 60 Italian male immigrants who were all college or preparatory school educated in the United States. She also found that the earlier the age of arrival, the higher the pronunciation ratings. She was specifically concerned with the hypothesis "that there is some developmental period, stretching roughly from 18 months to puberty, during which it is possible fully to master the phonology of at least one...no-native language, and after which complete acquisition is impossible or extremely unlikely (p.263)."

Patkowski (1980) designed a replication of Oyama's (1976) study into his investigation of a sensitive period for syntax. This study involved 67 immigrants who had resided in the United States for at least five years and were from highly educated backgrounds. The independent variables were age of arrival, years in the United States, amount of informal exposure and amount of formal exposure. He found a strong correlation with age of arrival and accent rating which was not reduced in second order partials controlling for combinations of the other variables. Patkowski does not give any details about the first language of the subjects or the method of selection so the questions of sociolinguistic factors and selection bias cannot be evaluated. In the early arriving bilinguals, the question of which language was dominant is important in validating a theory of second language acquisition.

Seliger et al. (1975) surveyed 394 immigrants to both Israel and the United States for self reports on accent in Hebrew or English. Close to 90% of those who had arrived after the age of 16 reported an accent, whereas only 5.7% of those who had arrived before the age of 10 reported an accent. The total number of years of exposure did not have an effect on reported accent. About 7.6% of the adult learners reported no accent, whereas 85% of the pre-pubertal learners claimed to have no accent. Since graduate students were instructed to find immigrants in each age group, the possibility of ignoring or being unaware of adult learners who had achieved native proficiency is quite high, a possibility that allows for a higher incidence than reflected by the survey of postpubertal learners who are not affected by the critical period constraints.

In a study of 109 subjects with various native languages who had lived in the U.K. from 2 to 55 years, Tahta et al. (1981) found the age of arrival was strongly related to ratings on degree of accent. Factors such as the use of English at home appeared to contribute to achieving a native-like accent only for the age group 7-12. There was no effect for length of stay. This study did not find any sharp discontinuity in the increase of accent rating with age of arrival, which might mark a terminus to the critical period.

Tahta et al. (1981b) studied the ability of 231 children of different ages to imitate foreign pronunciation at first exposure in a laboratory setting and reported a decrease
in ability with age. This study found a slight revival of ability in the group 11-15 years old but they were still below the early group of 5-8 years old. This aberrant peak does not fit the traditional critical period hypothesis, but the unnatural method of learning and the concern with initial gains is beyond the claims of the hypothesis by stipulation. Pronunciation is the one area where some studies show that initial gains are superior for younger learners which has engendered speculation of an earlier termination of a critical period for pronunciation (Seliger, 1978).

Cochrane and Sachs (1979) gave the same amount of instruction to 16 adults and 16 seven-year-olds and then tested them on their ability to learn stress rules and imitate the words. The children were rated higher and judged to exhibit less interference from English stress patterns. Cochrane (1980) found an advantage for Japanese children over adults in the discrimination and production of English /l/ and /r/. In a second experiment it was shown that adults profited from five hours of formal pronunciation training while the children did not. Fathman (1975a) found in his study of 200 children aged 6 to 15 that in sentence completion tasks with picture stimuli older children performed better on syntax and morphology while younger children were rated better on pronunciation. Again, short term assessment and formal learning make these studies merely suggestive as far as proponents of the critical period hypothesis are concerned.

Studies that show an advantage for older learners in initial gains in pronunciation appear to challenge the critical period hypothesis if such effects are hypothesized as the result of perceptual or motor limitations outside the critical period. Thus Loewenthal and Bull (1984) show that older children are better at imitation of foreign sounds in a study involving 39 English school children imitating non-English sound in Armenian. This finding held after controlling for age-related factors such as failure to respond and length of utterance. Loewenthal and Bull suggest that imitating a recorded sound from a male model might be easier for older students than younger students. In the Tahta et al. (1981b) study which obtained the opposite results, the models were live females who interacted through a game protocol that appealed to the younger subjects. In any case, this study does not show any degradation with age in the ability to produce or perceive native-like second language sounds.

Neufeld (1980) considers a strong version of the critical period to allow no exceptions; that is, it would be impossible for adults learners to acquire native proficiency in accent-free speech. Thus, his demonstration that adult second language learners can pass for native is, for him, a strong counterindication of neurological constraints on phonological competence. In his experiment, tape recordings of five of seven advanced students who had learned French as adults were judged to be
native speakers by a pool of 85 French Canadians. His second experiment reveals an asymmetry in the capacity to recognize native speech and the ability to produce it, suggesting that in adults, at least, phonological competence might precede performance or articulatory capacity. Weaker versions of the critical period hypothesis that constrain only articulatory capacity would not necessarily involve language acquisition.

MacKain et al. (1981) has shown that late immersion adult Japanese bilinguals were capable of performances equal to the native controls on identifying the /r/ and /l/ distinction in English but did poorly on discrimination tasks. This also suggests the possibility of articulatory ability lagging behind phonological competence. Neufeld and Schneiderman (1980) provided instruction for 20 adult English-speakers for 18 hours in intensive Japanese, Chinese or Eskimo phonology. In subsequent evaluation by native speakers, 50 percent were judged to have native-like accents.

Thogmartin (1982) conducted two experiments involving the acquisition of new speech sounds. In one, subjects learned artificial words. In the other, students were tested after a 10-week course in Mandarin Chinese. The older students performed better in both experiments. Politzer and Weiss (1969) also found that older American School children imitated French vowels more accurately than younger children, and Snow and Hoefnagel-Hole (1978) found that accuracy in pronouncing Dutch was positively correlated with age in a study involving English speaking adults and children living in Holland.

The evidence that bears on the critical period and phonology is contradictory in the initial gains studies in formal settings. Although such evidence is rejected by stipulating that the critical period hypothesis only involves ultimate attainment in naturalistic input environments, older learners' ability to produce and perceive non-native sounds as well or better than younger learners is clearly relevant to a notion of biological limitations to phonological competence (see also Ekstrand, 1976; Ervin-Tripp, 1974; Snow & Hoefnagel-Hole, 1978). Rival explanations for the low incidence of late learners who achieve native proficiency based on cognitive, social and cultural factors are given little serious consideration. Ultimately, the most obvious objections to arguments for the critical period based on foreign accents is that they do not necessarily prove that cognitive-linguistic factors are involved. A critical period confined to perceptual-motor aspects of language does not implicate the language acquisition device, a model of innate knowledge of syntax that motivated the construct of critical period for language learning in the first place (Lenneberg, 1967). Most of the studies, subjects were chosen from those having maximum opportunity and motivation to achieve a high level of proficiency in English. The evidence is strong that most adult
second language learners retain a foreign accent, while children generally do not. That there are exceptions to both of these generalizations is also difficult to dispute. The sociolinguistic complexities of accent, register, style, diglossia and dialect are among the confounding effects that were beyond the scope of these studies. As Hill (1970) reports, it is possible that adult learners in other cultures, where different functions and valuations of multilingualism obtain, generally achieve native proficiency in pronunciation. It is also possible that there is interaction between the two language systems of the bilingual which has an effect on performance that does not involve age directly at all. Bilingualism itself could be the cause of differences in pronunciation due to some cognitive economy of blending or approximating phonemic boundaries that differ in each language. This would be contrary to the critical period premise that second languages are learned during the period without interference to native levels of ability. However, as Flege (1987) points out, researchers have found other interpretations for evidence of this phenomenon in balanced bilinguals (Mack, 1984, cited in Flege, 1987: 164).

**Acquisition of Other Skills**

Johnson and Newport (1989) have conducted the only study of Child-adult differences in ultimate attainment which involves a wide variety of grammatical skills. Forty-six native Korean and Chinese speakers judged the grammaticality of 276 spoken English sentences. The subjects had lived in the United States between 3 and 26 years and had arrived between the ages of 3 and 39. Both t-tests and correlational analysis showed a strong advantage for the early arrivals over those arriving later. Native speakers six and seven years old were administered all the measures to establish a performance baseline with near perfect scores, which suggested to the authors that knowledge of the language and not linguistic insight was being tested. Also, information on attitude, American identification, motivation and amount of total exposure was gathered. The overall correlation between age of acquisition and performance was .77; for the prepubertal arrivals it was .87. Every measure of syntax and morphology obtained a significant correlation between age of arrival and performance. Those who arrived before the age of 7 reached native levels of performance, and for those arriving later, there was a linear decline until after age 15. With postpubertal arrivals there were great individual differences instead of a continuing overall decline. Although there was no effect for years of exposure, American identification did show a significant effect but did not account for a large amount of the variance leaving age of arrival the strongest predictor of performance.

Johnson and Newport consider the fact that there is little individual variation
in subjects before the age of 15, and especially before the age of 10, as evidence for
the influence of maturational factors since "the age effect is present during a time of
ongoing biological and cognitive maturation and absent after maturation is complete
(i.e., at puberty). Thus, it appears as if language learning ability slowly declines as the
human matures and plateaus at a low level after puberty (p. 90)." They also believe
that their evidence supports a "maturational state hypothesis," a strong version of the
critical period hypothesis that applies equally to first and second language acquisition
outside the critical period. However, as Johnson and Newport themselves emphasize,
"the maturational state hypothesis is . . . not in itself an explanation (p. 95)." What
is missing is any attempt to discover the neurological events that are responsible for
the onset and terminus of the critical period. Research has not found any marked
neurological developments that coincide with the traditional time frame of the critical
period. From the results of their study, Johnson and Newport revise the critical period,
claiming that a decline in ability to acquire language begins much earlier than once
thought, perhaps around the age of seven, and continues very gradually until the close
of the critical period during or after puberty, but they do not suggest any neurological
events that coincide with their newly proposed chronology.

In view of the lack of any biological or neurophysiological evidence to support
a critical period hypothesis for second language acquisition, rival hypotheses and
confounding factors should, perhaps, be given more serious and systematic attention
in studies of such differences. Johnson and Newport acknowledge the complexity
of this proposal in considering the experiential and attitudinal variables designed
into their study as a very short list of the possibilities. "[A] more rigorous test of this
question could be performed. Non-maturational hypotheses do not typically purpose
that one attitudinal variable, for example, self-consciousness, will alone predict
performance; rather, they propose that the combination of all of these variables
favors children over adults (p. 67)." In view of this acknowledgement, it is difficult to
conclude that Johnson and Newport believe they have adequately tested attitude with
a self report on identification, self-consciousness and motivation. Language ability
involves complex interactions among sensori-motor, affective, cognitive, social and
cultural domains, and it is only the failure to consider how these factors co-vary with
age that leads to acceptance of the critical period hypothesis in spite of the absence of
any direct neurological or biological evidence for it.

The older a person is upon arrival in an established expatriate community of
their own nationality, the less likely they will achieve complete integration culturally
and linguistically in the dominant community. The possibility of a cohort effect is
greatly enhanced by the selection of the early arrivals from among only freshman and
sophomore undergraduates while late arrivals were research associates, professors and graduate students. Choosing only Chinese and Korean subjects in order to eliminate possible transfer effects from languages closely related to English also eliminates random selection from the design. A balance of different native language subjects and educational backgrounds could cancel effects of common dialects and communicational strategies within such groups. Johnson and Newport were concerned about the possibility that the 2-13 years of mandatory English instruction in the native country of the late learners might "reduce the effects of age of arrival (p. 69)." They believed that this instruction might constitute a head start that would mean an actual earlier age of exposure than that of age of arrival. Greater ultimate achievement might result than predicted by age of arrival. However, an equally plausible effect of formal study in an academic setting in the native country would be fossilization of non-native locutions and communicative strategies. They might acquire a second language dialect with simplifications and non-standard conventions. Selinker (1972) noted that many adult learners' communicational strategies dictate that they stop learning when they succeed in meeting basic functional goals in communicating. This is especially likely when contact with the speech community of the target language is restricted.

Patkowski (1980), in a study of 67 immigrants who had resided in the United States from 5 to 50 years, also found evidence to support the hypothesis that younger is better in terms of ultimate achievement in grammar. In this design, transcripts of speech elicited in tape recorded interviews were judged for syntactic accuracy by trained examiners. Subjects who had arrived before the age of 15 were rated higher than those who had arrived later. Additionally, years of exposure to English in both formal and informal settings was found to have no significant relationship with performance. From his evidence, Patkowski infers the optimal age for learning to be from 12 to 15 years, a period well into the decline of abilities according to Johnson and Newport. Snow and Hoefnagel-Hole (1978) and Fathman (1975a) also found young adolescents to be superior to both children and adults in short-term studies of achievement. However, Snow (1983) explains the superiority of the adolescents as due to more exposure and higher communicative demands. Although Patkowski's study can support the claim that those who begin second language acquisition before adolescents ultimately perform better than those who begin later, there is no evidence that younger children perform better than older children.

Interpreting his results as evidence for a genetically-based language acquisition device that turns off at puberty, Patkowski suggests that older learners use qualitatively different means to learn language. Alternative explanations should be considered equally likely, especially since Patkowski provides no evidence of biological
or neurologicalevents that occur at puberty. Snow and Hoefnagel-Hole (1977) cite evidence that adults are more tenacious in clinging to their far more developed cultural-personal identities while children are more motivated to aspire for native-like abilities. The younger the child is, the less cognitively demanding a 'native proficiency' standard would be; there would simply be less structurally, lexically, functionally and communicatively to remember, comprehend and use. How beginning a second language as an adult, when the standards of adult discourse would be overwhelming, affects ultimate outcome through the operation of sociolinguistic and attitudinal variables has not been the direct concern any research. Much speculation about who has the most demanding challenge cognitively in acquiring novel language, the child or the adult, awaits empirical resolution.

Oyama (1978) tested subjects' ability to repeat English sentences in the presence of varying degrees of masking noise. This task was designed to test global abilities in integrating linguistic knowledge. Syntactic knowledge was assumed to be tested in this task, although it seems possible that another, not purely linguistic skill, such as imitation, was being tapped. Comprehension and the integration of linguistic knowledge may not have been directly tested. Oyama analyzed a number of possible attitudinal and experiential factors, including those adopted by Johnson and Newport: motivation, self-consciousness and identification. When partialing out the effects of age of arrival, these factors were found to be insignificant. The only significant predictor of performance was age of arrival. Oyama's analysis does not meet Johnson and Newport's rigorous test of nonmaturational factors by examining the effect of a combination of such factors.

Rival explanations in the findings of Johnson and Newport (1989), Patkowski (1980) and Oyama (1978) also deserve consideration because the degree of bilingualism was not controlled. For early arrivals, it is possible for attainment in the second language to outstrip that of the first, complicating the issue of primary language of use, of cultural identity, and of maintaining significant interpersonal bonds.

**Rate of Acquisition studies**

Morris and Gerstman (1986) presented a twenty-minute lesson in Hawaiian to 182 school children and subsequently tested them on semantic and syntactical knowledge. The junior high and high school students performed better than the fourth-grade group. In addition, a core of primary language proficiency and academic ratings consistently predicted performance on the test across all age groups. This study was designed to test a strong version of the critical period hypothesis, although advocates would claim that initial gains studies are irrelevant. They believe that a strong version
of the critical period entails superior learning by prepubertal over postpubertal second language learners in spite of variations in (a) relationship between first and second language, (b) the particular subset being learned whether within or across syntax, semantics or phonology, (c) the level of task difficulty whether in terms of memory capacity, or metalinguistic versus linguistic skills and (d) the setting, whether formal or informal. In other words, Morris and Gerstman believe it reasonable to expect superior language learning capacity to operate across many variables perhaps because it is a biologically based capacity. But the critical period hypothesis was first invoked to account for the child’s ability to acquire native competence from limited input. The autonomous acquisition device must follow its own rules in naturalistic settings to function. Therefore, it could be objected that the above factors cannot apply to the critical period hypothesis as envisioned by its advocates. Morris and Gerstman’s list is an intuitively reasonable set of expectations. It does raise the question as to the acceptability of stipulations such as those involving naturalistic settings and ultimate achievement imposed from theories of Universal Grammar on the biological concept of critical period. There is no biological explanation as to why the effects of exposure to the critical stimuli would not be manifested for many years; there is no cognitive explanation of the process by which slower learners are superior learners during just that time when they are slow, the evidence of this superiority emerging much later as ultimate achievement. Critics of the critical period hypothesis are implicitly or explicitly critics of the cognitive/linguistic model of language acquisition in which it plays a central role. Therefore, the authors of the rate of acquisition studies do not acknowledge the irrelevance of their studies to the question of a critical or sensitive period for language acquisition. These researchers are interested in controlling the variables such as those listed by Morris and Gerstman in order to find explanations for observed child adult differences. Burstall et al. (1974) compared the amount of French learned in terms of listening, reading and writing between two large groups of British school children. One group began a brief daily French lesson at the age of eight and the other group began at the age of eleven. Both groups received the same of amount instruction. The older learners performed better in listening, reading and writing skills but those beginning study at a younger age scored higher on a speaking interview test that involved interpersonal communication skills. In terms of Cummins’ (1979) distinction between cognitively demanding context-reduced cognitive/academic language skills and context-embedded interpersonal skills, only the speaking test tapped the latter. It fits Cummins’ interdependence hypothesis that the degree of development of first language context-reduced skills should be reflected in the second language, other variables being equal.
Ekstrand (1978) used the same sound tapes and audio-visual method of presentation, where the role of the teacher was reduced to synchronizing the tapes to test differences in learning between Swedish pupils at different ages. Four groups, aged 8, 9, 10 and 11 were compared after eighteen week of two ten-minute sessions a week of English in terms of ratings of pronunciation, which involved imitating taped speech samples, and comprehension, which required pupils to translate taped speech samples. The results were an increase in scores that was roughly linear with age increase. Again this study seems to be primarily concerned with context-reduced academic skills (both in method and in testing).

These studies of acquisition rates in formal, cognitively demanding contexts do not challenge the critical period if the criterion of natural acquisition is invoked. The designers of these studies are concerned with understanding child-adult differences in second language learning in the classroom where it most commonly takes place. In immersion programs, natural acquisition is presumed to be encouraged by necessitating communicative interaction.

Swain (1981) compared late immersion programs with early immersion programs. The late group, in grade ten at the time of the study, had less than half as much exposure to French as the early immersion group, which was in grade eight, yet the older group scored as highly as the early immersion group on a cloze test of French and even higher on a test of reading comprehension. The younger group, however, scored better on a listening comprehension test that utilized recorded samples of speech from natural contexts including the radio. Again the less context-reduced, more naturally communicative tasks appear to be acquired more easily than academic tasks by younger children.

That cognitive maturity is a factor in the performance of context-reduced tasks is further supported by Tremaine's (1975) research in the comprehension of syntactic contrasts in English and French. The subjects in this study were early French immersion pupils and other students studying French in Ottawa. In tests of comprehension of speech and ability to name pictured items, pupils in grades 1 through 3 who were assessed to have reached the stage of concrete operations as hypothesized by Piaget were superior to students who had not yet reached this level of cognitive development. In this comparison the effects of grade and curriculum were controlled so that the effects of cognitive maturity could be assessed.

Natural settings, where the learners lived in the speech community of the target language, would be the most relevant arena in which to test the critical period hypothesis. Ervin-Tripp (1974) assessed the rate of acquisition of French by 31 children from ages four to nine whose native language was English. These children
had been exposed to French in Switzerland in both natural settings and school for a maximum of nine months. All of the tasks--translation, imitation and acting out sentences with the aid of toy animals and dolls--in this experiment were designed to measure aural comprehension of spoken French. Performance in all measures improved greatly with age. The sentences in the acting out task ranged widely in syntactical complexity and length and included structures that the younger children did not control in English. Overall, the tasks were highly decontextualized and often semantically bizarre, so the younger children were often unable to grasp the cognitive subtlety required by the task. There was no measure of interpersonal skills or of phonology.

Snow and Hoefnagel-Hole (1978) studied longitudinally the acquisition of Dutch by English speakers of different ages in naturalist circumstances. Two groups were included in the study. One group, the beginners, had just begun learning Dutch and the other, the advanced, had lived at least 18 months in Holland at the beginning of the experiment. This study was designed to assess a wider range of ages and also a wider range of language abilities than had been found in previous studies concerned with the critical period hypothesis. Tests included pronunciation, auditory discrimination, morphology, sentence repetition, sentence translation, sentence judgment, Peabody Picture Vocabulary Test, story comprehension and storytelling. The findings of this study are that the 3 to 5-year-olds scored consistently below the older groups on all measures, and the 12 to 15-year-olds demonstrated the fastest rate of acquisition in all skills tested. Although the tasks were context-reduced and cognitively demanding compared to natural interpersonal discourse, the authors selected the test content to be appropriate for the youngest subjects and therefore argue against the claim that the types of test favor the more cognitively mature subjects. However, in testing native Dutch speakers to establish base line, the group of older students (12-15) performed better than the younger group (6-7) in vocabulary and morphology tasks (Snow & Hoefnagel-Hole, 1978: 119-1121). Obviously, some of the content of the measures were not completely appropriate for subjects at the youngest age even among native speakers and therefore the test favors the academic skills of the cognitively mature.

In comparing the amount of acquisition for the age groups 6-7 and 12-15 with the native speakers scores for the same age groups, the results indicate that the older students come closer to native performance at the initial testing (within six months after arrival in Holland) than the younger group and that the younger group continues to fall further behind their norm group while the older students approached the norm in their scores. These findings lend support to Cummins interdependence hypothesis,
if it is inferred that the younger students lacked adequate support in English. The authors report that increased fluency in Dutch was associated with some loss of control of English only among the youngest group (3-5).

Ekstrand’s (1976) study of over 2,000 students between the ages of eight and eighteen who had recently immigrated to Sweden (average length of residence was 10.5 months) supports the contention that the advantage of older learners applies only to cognitively demanding academic language proficiencies. Age and scores in tests of free writing, reading comprehension, listening comprehension pronunciation and oral dictation were positively correlated. In contrast, measures of free oral production were not correlated with age but showed the strongest correlation among all the measures with the length of time spent in Sweden.

That the more natural communicative task is correlated with length of residence suggests that communicative skills are not necessarily developed coevally with cognitive maturity as Cummins suggests (1979). It is not simply that interpersonal communicative skills are cognitively less demanding than the academic type language skills; it is rather that the developing child is focused more exclusively on the first before the onset of the latter.

Another Scandinavian study supports Cummins’ interdependence hypothesis rather closely. Skutnabb-Kangas and Toukomaa (1976) studied Finnish migrant workers’ children who were born in Sweden or who moved to Sweden before early puberty. In standardized tests of written language achievement, these children performed worse in both Swedish and Finnish than students who began Swedish as a second language latter. The scores were also found to be below the unilingual norms in both languages for equivalent non-verbal IQ levels. The test results conflicted with the perception of the children’s Swedish school teachers who evaluated the younger students’ verbal skill as fluent. Cummins interdependence hypothesis predicts that lack of support in the native language at an early age in bilingual programs will result in cognitive-linguistic deficits in both languages.

Fathman (1975a) studied 200 immigrant children from various first language backgrounds employing a structured oral interview test using pictures to elicit responses which were judged for control of morphology, syntax and pronunciation. Also a "SLOPE" test similar to the morphology test of Snow and Hoefnagel-Hole (1978) was administered. With length of residence held constant, children in the age group 11-15 performed better on the morphology test than those in the 6-10 year-old group (similar to the results of Snow and Hoefnagel-Hole). The picture description task was assessed by two linguists who found, based on global ratings for pronunciation, grammar and fluency, that the younger children’s pronunciation was superior to the
older children.

Ramirez and Polizter (1978) found a similar advantage for adolescents in rate of acquisition. American children and adolescents whose native language was primarily Spanish were compared on the basis of similar lengths of exposure to English. In a comprehension and production task, the adolescents were found to have made more rapid progress than the children in kindergarten and first grade. The comprehension task required the students to point to the correct picture after listening twice to a verbal stimulus. The production task involved repeating a sentence that matched a stimulus picture. Since neither task involved communication skills, only half of Cummins' proposition that older learners have an advantage only in context-reduced, academic language proficiencies is being tested. Ramirez and Polizter believe that the advantage of the older group is due to cognitive maturity involving such factors as memory capacity and semantic organization (Ramirez and Polizter, 1978, p. 331). The authors observe that the adolescents' advantage levels off with increased exposure time. This is consistent with the findings of Walberg et al. (1978).

A rate-of-acquisition study by Walberg et al. (1978) supports the contention that children arriving in a second language environment later require more language learning in absolute terms to reach the same level of proficiency, relative to their grade norms, than those who arrive at younger age. From a pool of 350 Japanese students from six to eighteen years those up to the high school level were rated by their teachers in reference to their grade norm in English reading and writing. Each age of arrival group received similar ratings. Also, in reading, writing and speaking, the students' self ratings in terms of fluency and ease with the language were similar across age groups. The self ratings are more difficult than the teacher ratings to interpret in absolute terms since there is the tendency to report diminishing gains with length of exposure. Thus Walberg et al. found that the progress in terms of self rating of the first two months were comparable with the next five months which in turn were comparable to the gains of the next year, and those to the next two years, and those finally to the next eight years (p. 436).

Cummins (1981) reanalyzed the results of a study of over 1000 immigrant children by Ramsey and Wright (1974) which had concluded that an earlier age of arrival in Canada resulted in superior English achievement. The children were in the fifth, seventh and ninth grades. The measures aimed at assessing general competence using a picture vocabulary test and a six-part battery of taped and written prompts designed to test control of syntax and morphology. Cummins controlled for length of residence and concluded that the children arriving at an older age had significantly higher scores in absolute terms than those who had arrived at an earlier age. The
effect of age of arrival diminished with length of residence and had a negligible relationship with the amount of time—around five years—it took students to reach the performance norms of the native speakers at their respective grades. The study was aimed at assessing children who were acquiring language in a natural setting yet the tests probe context-reduced academic skills rather than interactive communicative skills.

Cummins et al. (1984) explore the issue further in a study of Japanese and Vietnamese immigrants in Toronto. In measures of academic language proficiency in English, students arriving at a more advanced age were shown to have an advantage. There were about 130 subjects involved in the study. The Japanese were in the second, third, fifth and sixth grades while the Vietnamese were from nine to seventeen years old. English proficiency scores were positively correlated with scores on tests of academic proficiency of Vietnamese and Japanese. These results support Cummins' interdependence hypothesis in that a degree of cognitive maturity in the native language is a prerequisite to transferring cognitive skills to a second language. Control of syntax as reflected in assessments of oral conversation was more strongly related to length of residence that to age of arrival or scores in native language proficiency. Here communicative skills which are to some degree independent of the cognitive/academic skills might be involved.

**Acquisition of Sign Language**

Studies of sign language acquisition by deaf children can be designed as deprivation studies, since there is a large number of hearing impaired children who, being born to normal parents who did not sign, were not exposed to a language they could process until they entered special schools. Age of first exposure can be related to the degree of native proficiency as determined by control of morphology. Newport (1981) studied children who had been exposed to American Sign Language at birth, between the ages of 4-6 and after the age of 12. She found that the complex morphemes involving verbs of motion which are indicated by hand shape were not used competently by late learners. Children in the youngest group acquire native competence even if their parents are not native signers. This can be interpreted as evidence of a critical period. Exposure within the critical period would provide the critical stimulus that would allow eventual attainment of native competence. Limited input does not prevent the full elaboration of morphology if it occurs during the critical period. Newport compares this finding to the development of creoles from pidgin languages as the pidgin is elaborated by generations who come to use it as a native language.
There is no clear empirical evidence that the elaboration of pidgin into a more complex and natural creole is the result of the operation of innate language principles in the minds of the very young learners. In any case, the restructuring of the impoverished input observed in deaf children exposed to the frozen morphology of late learning parents is more elaborate than is the case with creoles. Sociolinguistic factors can adequately explain the expansion of pidgins into creoles. The same factors are not well understood in sign language where the regularities of language shift and the direction of evolution are still under scrutiny. This is not to suggest that sign language is less dynamic than other natural languages; it has simply not been studied as extensively by sociolinguists.

Summary

Generally, studies of ultimate achievement show an advantage for children who begin learning a second language at an early age, whereas studies of rate of acquisition demonstrate an initial superiority for adolescents and adults over children. The question of how the process of second language acquisition might be different in children and adults is often viewed as the degree to which the acquisition of different linguistic skills follow the order and proficiency level observed in first language acquisition (the natural order hypothesis of Bailey & Krashen, 1974). Research that would support the critical period hypothesis is, for the most part, not concerned with what Cummins (1979) would call cognitive/academic language proficiency but rather with a native or near-native level of achievement in natural settings. The adult advantage in acquiring context-reduced or academic skills in the second language does not necessarily constitute evidence against the critical period hypothesis. There is evidence that adults enjoy no initial advantage in the acquisition of interpersonal communicative skills in the second language (Cummins et al., 1984; Ekstrand, 1976; Burstal et al., 1974; Fathman, 1975a).

Conclusion

The biological notion of critical period that achieved the status of an explanatory paradigm with the ethological studies of "imprinting" in birds and other animals does not seem to fit human language acquisition in any important way. Biological studies have refined the concept in studying the complex interrelationships of neurophysiological systems, multimodal environmental patterns of stimulation and maturational change and have modified the strong version of critical periods for complex behaviors popularized by Lorenz. The modified view not only seeks to isolate critical stimuli and critical systems at a more basic perceptual and motor level, but it
also views critical or sensitive periods as less rigid, where recovery and compensation are commonly observed in varying degrees (see Colombo, 1982: p. 82).

The critical period hypothesis was originally proposed as a model of biological imprinting in humans and implied irreversibility of learning within the period and inability to acquire outside the period. However, the strong version was generally confined to learning a primary language, since it could not be reasonably maintained that adults did not continue to learn their primary language nor that adults were unable to learn a second language. The extension of the critical period hypothesis to second language acquisition by Penfield and Roberts (1959) and Lenneberg (1967) was largely conjectural. Relearning first language skills lost due to neurological insult may involve completely different processes than those involved for normal children or adults learning a second language.

Laterization of language functions in the left hemisphere (usually) cannot be maintained as an explanation for a critical period in language acquisition because it is complete long before the close of any proposed critical period. Witelson (1987) has proposed that hemispheric specialization is fixed at birth and does not change during development. Loss of plasticity in terms of progressive specialization of the cortex likewise cannot be empirically supported as a cause of a critical period for language learning. Rather, there is no evidence to contradict the assumption that loss of plasticity is very gradual in human beings, extending well beyond the proposed close of the critical period for language.

The term "sensitive period" has generally replaced critical period in biological studies in an effort to accommodate the evidence against rigid timing and irreversibility of effects. A sensitive period is proposed for specific skills during which time learning is easier, more natural and perhaps more complete and permanent than learning outside the period, which is possible but more difficult and, in some models, qualitatively different. Sensitive periods applied to language acquisition suggest the search for many distinct periods of sensitivity in development involving different critical systems and patterns of stimulation.

The empirical evidence in the majority of studies supports skepticism of the critical period hypothesis in that older learners consistently perform better than younger learners, at least in the initial stages of second language acquisition. This is true even in cases where the younger learners have more total exposure to second language than the older learners (Genesee, 1981). It also holds for both formal and informal settings (Genesee, 1981, Snow and Hoefnagel-Hole, 1977). Advocates of the critical period hypothesis have generally abandoned the view that learning within the critical period will be easier than learning outside of it. Instead, the hypothesis
is formulated to favor younger learners over adults in ultimate achievement which is evaluated in terms of native-like proficiency. Studies that find initial gains of older learners superior to that of children within the traditional critical period (2-12 years of age) do not address the issue of ultimate achievement.

The critical period for acquisition of species-specific bird song might fit the strong version of the critical period hypothesis if birds were generally incapable of learning new songs. But in fact the critical period for the acquisition of bird song is much less rigid than once thought and involves complex social interaction, not just exposure to an invariant acoustical pattern. Studies that observe time-independent learning of second dialects and songs by birds thought to be limited to one song acquired in a brief critical period do not fit a maturational states hypothesis (Neapolitan, Pepperberg, and Schenke-Llano, 1988).

As Lamendella (1977) asserts "what is claimed by a (reasonable) critical period hypothesis is that the actual formation and elaboration of the neural components of speech and language systems depend on their becoming operational (and mature up to some point) during some span of time relative to certain other maturational phenomenon (p. 173)." The question of a critical period for second language acquisition, in this formulation, is distinct from that of a critical period for first language acquisition. No evidence of any neurological decline exists to correlate with the proposed loss of an ability to acquire language until late adulthood. Johnson and Newport's (1989) idea of a maturational state critical period entails a decline in language learning abilities regardless of early experience in acquiring a first language. This view of a critical period for language acquisition that includes second language acquisition can only be supported by evidence of long term achievement that is superior or more native-like for learners who begin second language acquisition well within the critical period compared to those who begin after the terminus of the critical period.

Genesee (1988) criticizes ultimate achievement studies on methodological grounds. First, all the studies are limited in terms of which aspects of language are studied. The claims of the critical period hypothesis are not supported by merely showing higher levels of achievement by younger learners nor by showing that a greater number of prepubertal learners attained native-like proficiency than did the late learners. What is central to the hypothesis, in Genesee's view, is determining to what extent the younger learners fail to achieve native-like proficiency or to account for the incidence of adult learners who do achieve native proficiency. A high incidence of exceptions to the critical period is evidence against a biological explanation. In Johnson and Newport's (1989) study, one late learning subject out of 23 achieved a
score close to the mean of the native control group. This is consonant with the 5 to 7 percent of adult second language learners who achieve native proficiency in studies of ultimate achievement reviewed by Genesee (1988) and Schneiderman and Desmarais (1988).

Neufeld and Schneiderman (1980) found adults able to achieve ratings as native speakers in 18 hours of intensive training in Japanese, Chinese and Eskimo phonology. Acknowledging a wide range of individual variation, the investigators maintain that a high rate of exceptions to critical period predictions disprove the theory. On this basis, they rule out simple loss of perceptual-motor abilities in discriminating and reproducing non-English language sounds as the source of a critical period effects.

Genesee (1988) points out that there is no theoretical construal of the critical period hypothesis from which an acceptable percentage of fully proficient late bilinguals can be deduced. The critical period hypothesis for second language learning fails to specify critical systems and critical stimuli in addition to being vague about the maturational windows of critical sensitivity.

Rival hypotheses can more parsimoniously account for the low incidence of native-like ability in late bilinguals. Krashen (1982) and Neufeld (1979) among others have proposed a variety of cognitive, affective and social factors to account for low rates of full bilingualism among late learners. Future research and theory building perhaps should take account of societies where different functions and patterns of use exist for multilingualism. Hill (1970) suggests that there may be cultural factors that are responsible for the persistence of adult learner's foreign accents. She calls attention to the existence of many societies in which learning new languages in adulthood as well as childhood is commonplace. A most interesting example are the Indians of the Vaupes river drainage in Brazil and Columbia. The approximately 24 languages used in this area fall into at least four distinct language families. Each tribal group speaking a common language is exogamous and each person must marry someone from another tribal group who speaks a different language. Children learn the patrilocal father tongue, their mother's native language and Tukano, the lingua franca (if it is not already one of their parents' native languages), which is learned from visitors. Acquiring new languages and perfecting knowledge of all the languages known continues throughout adulthood in this society, and second language proficiency is highly regarded and strictly judged by all involved. Hill suggests that a study of this society and others where bilingualism is highly regarded and multifunctional might call into question assumptions about foreign accents. Studying such societies as well as more familiar ones where many language groups are in contact (e.g., India, East
Asia, Europe) might question the inevitability of adult learners’ foreign accents.

Until hypotheses involving biological factors which adequately explain critical period effects are proposed, the critical period hypothesis remains an unproven model of how language is acquired in early childhood. The facts about second language acquisition that require explanation include those that do not accord at all with the hypothesis, especially those derived from data that show adults, in a number of ways to have an advantage over children. Future research should be concerned with the relative contribution of all the different factors that contribute to child-adult differences as well as to individual differences in second language acquisition including cognitive, affective and social variables.

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