Ability to Discriminate and Pronounce Foreign Language Phonemes as a Function of Age

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ABILITY TO DISCRIMINATE AND PRONOUNCE FOREIGN LANGUAGE PHONEMES AS A FUNCTION OF AGE

BY

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B.S., Florida State University, 1982

THESIS

Submitted in partial fulfillment of the requirements for the Master of Science degree in Clinical Psychology in the Graduate Studies Program of the College of Arts and Sciences University of Central Florida Orlando, Florida

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ABSTRACT

Fifty native English speakers (ages: 3, 9, 11 and adults) were asked to discriminate and pronounce Spanish words. The Wepman Auditory Discrimination Test was administered to the subjects to assess their discrimination abilities in their native language. A training session using English pairs of words showed that five-year-olds improved in their discrimination abilities after training but three-year-olds did not. Pronunciation was scored by two native Spanish speakers. Analyses revealed that older subjects pronounced the Spanish words significantly better than did younger subjects. Similar results were obtained for the analyses of Spanish phoneme pronunciation. Moreover, analyses of discrimination abilities on the Wepman Test also showed that the older subjects discriminated better than did the three-year-olds but discrimination appeared to remain constant after the five-year-old level. Finally, discrimination abilities for the Spanish words improved as a function of age. Older subjects discriminated better than did younger ones; however, this improvement was seen only up to the nine-year-old level after which performance remained constant.
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INTRODUCTION

When a second language (L2) is acquired in adulthood, can the learner ever hope to achieve native-like pronunciation, or is an accent inevitable? Although there is much disagreement among linguists and educators regarding the correct answer to this question, it is true that most research has found a negative relationship between the age at which L2 acquisition was begun and the ability to exhibit native-like pronunciation. For example, Asher and Garcia (1969) compared Cuban children to American children with respect to their ability to pronounce English sentences. Cuban immigrants, 7 to 19 years of age, participated in the study. Most of the subjects had been residing in the United States for about 5 years. Findings indicated that children who begin L2 acquisition before 6 years of age have a higher probability of achieving a nearly native pronunciation than do children who begin learning L2 after 13 years of age. Similar results were reported by Fathman (1975). Two hundred children (ages 6 to 15) from different backgrounds who were learning English as L2, participated in this study. An oral test was administered to assess their ability to pronounce foreign words. It was found that children aged 6 to 10 received significantly higher ratings in English pronunciation than did older children. These findings suggest that preteen children in
general are better than older children in their ability to learn phonology in a new language. Finally, Tahta, Wood and Loewenthal (1981) directed a study to assess the predictors of accent transfer from first language to second language. Subjects whose English acquisition had begun at ages 6 to 15 took part in this study. The ages of the subjects when the study was conducted ranged from 9 to 77. Each subject was asked to read a paragraph of English prose. Results indicated that no foreign accent is observed if acquisition of L2 starts between ages 6 and 7. If L2 is acquired between ages 7 and 11, a slight accent is found; if learning occurs after ages 12 to 13, a marked accent is invariably transferred.

The results of studies such as those cited above have led some theorists to argue that foreign accents are inevitable because of biological constraints on the older learner. For example, in his "Critical Period" theory, Lenneberg (1967) stated that there are optimal maturational periods for learning a foreign language. His theory proposed that it is the period between birth and puberty in which new phonetic sounds can be acquired. Scovel (1969) also supports this notion. He proposed the possibility that lack of complete cerebral lateralization accounts for young children's ability to learn to pronounce new language sounds fluently. He stated that the same brain plasticity that accounts for the potential relocation of language in non-dominant hemispheres of children accounts for their plasticity in learning new sounds.
In contrast, however, Fledge (1981), in his "Phonological Translation Theory," proposed that it is the tendency of older speakers to interpret foreign sounds in terms of sounds found in their native language that produces foreign accents in adults. Therefore, accents are not inevitable but are more probable the older the age at which L2 acquisition begins, due to interference from the first language. Finally, Taylor (1974) suggested that there are also affective psychological variables such as motivation, empathy, ego boundary and desire to identify with a cultural group that contribute to the children's acquisition of native language sounds. It is Taylor's belief that the lack of such strong motivation and desire to identify is what might be responsible for the lack of accent-free speech by adult learners. Therefore, he proposes that to be able to acquire native pronunciation proficiency in L2, adults also must be properly motivated.

In order to further explore the causes of accented speech in L2, a number of investigators have compared children and adults with respect to their ability to mimic foreign language sounds. If either the "Critical Period" or "Phonological Translation" theory is correct, it would be anticipated that the ability to correctly mimic foreign phonemes and stress patterns would decline with age. Indeed, several studies report such an effect. Tahta, Wood, and Loewenthal (1981) studied monolingual English school children's ability to replicate foreign pronunciation and intonation. These five- to fifteen-year-old subjects were presented with 13 words and
short phrases that they were supposed to repeat. Results showed a linear decline in performance with increasing age. However, problems with the tape recording in this study made it impossible for interjudge reliability of the pronunciation ratings to be measured. Therefore, the investigator who administered the test was the only judge of the children's pronunciation. This represents a problem with the reliability of the study which has to be taken into consideration in the interpretation of the results.

Cochran and Sachs (1979) conducted a study with children and adults to compare their ability to pronounce foreign words and to determine if subjects can acquire a new stress rule from hearing examples. They compared the performance of adults (27 to 38 years of age) to that of seven-year-olds. The subjects' task was to imitate Spanish words recorded by a native speaker and to read different Spanish words. They reported that children's imitation of Spanish words excelled that of adults. Finally, Misrachi and Wadsworth (1979) looked at age range and subjects' ability to pronounce foreign words. Subjects between the ages of 4 and 19 listened to French words pronounced by a native speaker. A pretest and a posttest were administered to assess the subjects' pronunciation. The subjects were instructed to repeat each French word after it was said once by the experimenter. It was found that pronunciation improved up to age 8 and 9 and decreased thereafter. Despite the findings mentioned above which indicate that the probability of correct mimicry decreases with increasing age, other
studies show the opposite relationship. For example, Snow and Hoefnagel-Hohle (1977) conducted a laboratory study in which speakers of British English ranging from 5 to 31 years were instructed to listen to Dutch words and then pronounce each one immediately after hearing it. The results of this study indicated that the subjects' ability to pronounce words increased linearly with age. In a second, naturalistic study, they tested 47 subjects between the ages of 3 and 60 who were beginning to learn Dutch. A pronunciation test was administered to each subject three times; when they were first starting to learn Dutch and twice over two subsequent four- to five-month intervals. It was reported that older subjects have an initial advantage in the pronunciation of L2 over younger subjects.

Another study which revealed a positive relationship between age and pronunciation was done by Olson and Samuels (1973). Elementary school children aged 9.5 to 10.5 years, junior high students aged 14 to 15 years and college students aged 18 to 26 years were tested over 10 sessions. In each session the subject listened to a 15 to 25 minute tape recording of German phonemes. All students were pretested and posttested in their ability to pronounce German phonemes. In the posttest, it was found that junior high and college students performed significantly better than did the elementary school children.

In summary then, the existing data are quite inconsistent and confusing. In view of these inconsistencies, it is surprising that
little attention has been paid to the possible role which the ability to discriminate sounds plays on pronunciation skills. One of the studies which considered these variables was done by Politzer and Weiss (1969). Auditory discrimination and pronunciation were investigated to assess whether or not achievement in those areas varies significantly with age. Subjects selected from 1st, 3rd, 5th, 7th and 9th grades participated. In the auditory discrimination test, 48 items designed to test auditory discrimination between French vowel phonemes and similar but nonidentical English vowel sounds were presented. The students were instructed to indicate whether the words of each pair were the same or different. The pronunciation test required the subjects to pronounce 14 words or short phrases. Some of the items presented contained vowels on which English speakers are likely to impose their dipthongal vowel sound, and other items included rounded front vowels which are absent in English. Also, nasal vowels which are phonemically absent in English, and words which are extremely similar to English words were included in the test. Results of the three tests in this study indicate that performance in ability to discriminate foreign sounds and to pronounce them increased with age. This improvement was most noticeable after fifth grade.

However, several methodological problems are seen in this study. First of all, the auditory discrimination test was administered in groups of up to 30 students. This procedure is particularly problematic with children in the lower grades, because it makes it
impossible to find out if the results obtained were due to subjects' inability to discriminate foreign sounds, to subjects' inability to understand the task, or to their inability to maintain their attention on the task. Secondly, all the children above the third grade level (which were the ones who started to show improvement) had had some training in another foreign language which might have facilitated their ability to discriminate the sounds.

The methodological problems mentioned in the above study and the great deal of conflicting data in this area require further exploration of pronunciation and sound discrimination as a function of age. It is the purpose of the present study to try to clarify some of the inconsistencies found in this field by further exploring the relationship between age, sound imitation and sound discrimination. Children of different ages, as well as adults, will be tested in their ability to discriminate sounds in their native language and in a foreign language, and they will be asked to produce the foreign-language sounds. For children aged 3 and 5, first the discrimination of similar English words will be used as part of the auditory discrimination test to assure that the subjects understand the task. No specific predictions will be made in the present study due to the inconsistencies found in previous studies done in this area.
METHOD

Subjects and Experimenter

Fifty subjects participated, including 10 subjects from each of the following groups: three-year-olds, five-year-olds, nine-year-olds, eleven-year-olds, and adults (mean age, 22.8 years). In order to minimize confounding, subjects who had had any previous knowledge of Spanish, Portuguese, or Italian were screened out of the study. Of the remaining subjects, one had had one year of German in college five years earlier, and another had had one year of French while in high school three years earlier. The experimenter was an adult female, bilingual in Spanish and English.

English Discrimination Pretests

All subjects were first tested with respect to their ability to discriminate similar sounding words in English. Subjects of all age groups listened to a tape recording of two native English speakers. Twenty pairs of English words were selected from the Wepman Auditory Discrimination Test (Wepman, 1958). Speaker number 1 pronounced an English word (e.g., pen) and immediately thereafter, speaker number 2 responded either with the same word (e.g., pen) or with one different but similar in pronunciation (e.g., pin). Immediately
after hearing each word pair, the subject was asked to indicate whether the two words were the same or whether they were different.

In the case of three-year-olds and five-year-olds, a preliminary task was included to ascertain whether or not they understood the distinction between "same" and "different," and, if not, to attempt to teach them the concept. These subjects first heard a tape of two English speakers pronouncing another group of English words. Five English words (cat, father, pin, love, doll) were paired with either correct or incorrect responses (bat, bother, pen, live, ball). As on the Wepman test, the subjects were asked to indicate whether the two words just spoken were the same or different. When a subject responded incorrectly, the subject was told that his/her answer was incorrect. Social praise was used to reinforce correct responses. Each subject listened to the same tape until he/she responded perfectly or had heard the tape four times, whichever criterion was reached first.

**Spanish Discrimination**

After the subjects were tested on their ability to discriminate sounds in their native language, they were tested on their ability to discriminate five different pairs of Spanish phonemes. The five pairs and their English equivalent sounds are as follows: (1) a (father) vs e (ate); (2) ua (wan) vs. ue (way); (3) l1 (yes) vs. l (love); (4) n (hen) vs. ñ (canyon); and (5) rr (no close English equivalent, the Spanish rr is trilled) and r (ladder). These
contrasting pairs were chosen on an intuitive basis from a list of phonemes commonly presented in introductory Spanish textbooks for English speakers (e.g., Allen, Sandstedt, & Wegmann, 1976). An attempt was made to include a variety of sounds, some of which have close English equivalents as well as some which have no exact English equivalents.

In order to test discrimination accuracy, each subject was asked to listen to a tape recording of two native Spanish speakers. Speaker number 1 correctly pronounced a Spanish word (e.g., llama), and immediately thereafter, speaker number 2 responded either correctly (e.g., llama) or with a Spanish nonsense word created by substituting the contrasting phoneme (e.g., llama). Each word was presented twice with speaker number 2 responding correctly once and incorrectly once. The order of presentation of the words and correct vs. incorrect reproduction was random. The 10 words (with critical phonemes underscored) were: Ana, Felipe, Juan, consuelo, llama, lavar, canal, señor, cerrado, and cara. The equivalent incorrect pronunciations were: Ena, Falipe, Juen, Consualo, lama, llavar, cañal, senor, cerado and carra. Thus, each subject heard 20 word pairs and after each presentation was asked to indicate whether speaker number 2 had pronounced the word the same as, or differently from, speaker number 1. On half of the presentations of each pair, the correct response was "same" and on half, the correct answer was "different." The word pairs were presented at ten-second intervals to allow time for all subjects to respond. No replays were allowed,
and if a subject indicated he/she was uncertain, he/she was instructed to guess.

Spanish Pronunciation

Immediately following the discrimination task, all subjects were asked to mimic Spanish words. Each stimulus word was pronounced twice by the experimenter. After each pronunciation, the subject repeated the word. Subjects' responses were tape-recorded and were scored later for pronunciation accuracy by two native Spanish speakers. Twenty Spanish words were used (Alma, alto, guapo, guante, denso, lente, fuego, huevo, lluvia, llegar, labio, lavar, cantina, candela, caña, leña, perro, torre, martes, parque) with two examples for each of the 10 phonemes used in the discrimination task. None of these words had been used in the discrimination task.

Rating of Responses

A training tape was made by the experimenter and an English speaker for the rating of pronunciation. The words used in the training tape contained the 10 critical phonemes used in the discrimination and pronunciation tests. Each word was pronounced four times by the experimenter and mimiced by the English speaker following each pronunciation. Each time, the English speaker varied the pronunciation of the critical phoneme, sometimes pronouncing it correctly and at other times pronouncing it incorrectly.
Two native Spanish speakers, originally from Puerto Rico, practiced with the training tapes until 90% agreement was achieved. Percentage agreement for all the tapes was calculated by dividing the number of agreements by the number of agreements plus disagreements.

The raters then proceeded to rate the subjects' tapes. Each rater listened to the tapes independently. They were not aware of the ages of the subjects or the purpose of the study.
RESULTS

English Pretest

On the Wepman test scores, an analysis of variance revealed a significant main effect for age, $F(4,45) = 4.32, p < .01$. The average scores for the Wepman test for each group are presented in Table 1. Post hoc comparisons among the means were made by using the Duncan Multiple Range Test. It was found that three-year-olds scored significantly lower than did subjects in the other age groups ($p < .01$), while the other groups did not differ significantly from one another.

An analysis of variance performed on the average number of correct responses on the last trial of the preliminary discrimination test administered to the three- and five-year-olds revealed that the five-year-olds performed significantly better than did the three-year-olds, $F(1,18) = 17.97, p < .001$. Indeed, the performance of the three-year-old children on the English practice words was quite poor. No three-year-old was able to correctly discriminate all 10 words, even by the fourth and final trial. For this group, the average number of correct responses on the final trial was 7.4. By contrast, all but two children from the five-year-old group reached the criterion of a perfect score. The
Table 1

Means of Discrimination and Pronunciation Scores by Age Groups

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Wepman Test</th>
<th>Training Tape</th>
<th>Spanish Words</th>
<th>Pronunciation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Spanish Words</td>
<td>Spanish Phonemes</td>
</tr>
<tr>
<td>3-yr olds</td>
<td>11.8_b</td>
<td>7.4_a</td>
<td>11.7_c</td>
<td>25.1_b</td>
</tr>
<tr>
<td>5-yr olds</td>
<td>14.8_a</td>
<td>9.7_b</td>
<td>13.6_b</td>
<td>29.9_a</td>
</tr>
<tr>
<td>9-yr olds</td>
<td>15.0_a</td>
<td>-</td>
<td>16.0_a</td>
<td>32.5_ac</td>
</tr>
<tr>
<td>11-yr olds</td>
<td>15.5_a</td>
<td>-</td>
<td>15.0_{ab}</td>
<td>32.8_ac</td>
</tr>
<tr>
<td>adults</td>
<td>15.2_a</td>
<td>-</td>
<td>16.5_a</td>
<td>35.3_c</td>
</tr>
</tbody>
</table>

Note. Within each column, means with different subscripts differ significantly at p < .05.
average number of trials to criterion was 2.8, and the average number of correct responses on the final trial was 9.7. It would seem then, that with respect to the ability to discriminate English words, subjects five years of age or older display equivalent capabilities. The performance of three-year-olds, however, was distinctly inferior to that of older subjects. Unfortunately, it is impossible to isolate the cause of this discrepancy from these data because there are at least two different viable explanations. Three-year-old children may not have yet developed accurate discrimination abilities, or they simply may not have understood the meaning of "same" and "different."

Spanish Discrimination

The means for correct Spanish discrimination made by subjects in each age group are presented in Table 1. The main effect of age was highly significant, $F (4,45) = 8.91, p < .01$. Discrimination ability increased with age until the nine-year-old level, after which it remained relatively constant. Comparisons by the Duncan Multiple Range Test showed all groups to be significantly more proficient than three-year-olds, and adults and nine-year-olds significantly outperformed five-year-olds ($p < .05$).

Reliability of Ratings of Spanish Pronunciation

The raters rated each subject's responses twice. First, they judged the whole word and then the accuracy of the critical phoneme alone. Percentage of agreement between the two raters was
calculated by dividing number of agreements by number of agreements plus disagreements. For the ratings of words, the raters agreed at 88.8%; for phonemes, the agreement rate was 93.5%.

Spanish Pronunciation

Analyses of variance performed using the total number of Spanish words correctly pronounced by each subject yielded a significant main effect, $F(4,45) = 6.23, p < .01$. Average scores on the pronunciation test are presented in Table 1. Pronunciation abilities increased with age. Comparisons made by the Duncan Multiple Range Test showed that adults, eleven-year-olds and nine-year-olds performed significantly better in their ability to pronounce Spanish words than did three-year-olds ($p < .01$). There was no significant difference at the .01 level between pronunciation scores of the five-year-olds and three-year-olds. However, when means were compared at the .05 level, all age groups performed significantly better than did three-year-olds.

For analyses on phonemes, the total number of correct responses were added, yielding, for each subject, a possible score of from 0 to 40. An analysis of variance on these scores produced a significant main effect for age, $F(4,45) = 7.21, p < .01$. Again, the older subjects outperformed the three-year-olds in their pronunciation. Average scores for the total phoneme pronunciation are presented in Table 1. Post hoc analyses using the Duncan Multiple Range Test indicated that at the .01 level, nine-year-olds,
eleven-year-olds and adults were significantly better than three-year-olds. There was no significant difference between three- and five-year-olds. When comparisons among means were made using \( p < .05 \), adults and eleven-year-olds pronounced the phonemes significantly better than did the three- or five-year-olds. Moreover, a significant difference was found between the nine-year-olds and the three-year-olds, with the nine-year-olds performing significantly better than the three-year-olds.

Separate analyses were also performed on subjects' scores for each of the ten different phonemes that appeared within the 20 words the subjects pronounced. Scores on the four pronunciations of each of the 10 phonemes were added, yielding, for each subject, a possible score from 0 to 4. The average scores for each phoneme are presented in Table 2. Of these 10 phonemes, only three showed effects for age. These phonemes were: \( n \), \( F(4,45) = 3.61, p < .05 \); \( \bar{n} \), \( F(4,45) = 3.75, p < .05 \); and \( r \), \( F(4,45) = 6.27, p < .01 \). Duncan Multiple Range Tests showed that for all three of these phonemes, adults, eleven-year-olds, and nine-year-olds pronounced significantly more phonemes correctly than did three-year-olds or five-year-olds, \( p < .05 \). In addition, for the phoneme, \( n \), adults, eleven-year-olds and nine-year-olds scored significantly higher than did five-year-olds (\( p < .05 \)). For the phoneme, \( r \), five-year-olds scored significantly better than did three-year-olds (\( p < .05 \), but they were not significantly different from the older groups.
Table 2

Mean Number of Correct Pronunciations of Each Spanish Phoneme

<table>
<thead>
<tr>
<th>Age Groups</th>
<th>a</th>
<th>ua</th>
<th>e</th>
<th>uc</th>
<th>l1</th>
<th>l</th>
<th>n</th>
<th>ñ</th>
<th>rr</th>
<th>r</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-yr olds</td>
<td>3.8</td>
<td>3.9</td>
<td>3.8</td>
<td>4.0</td>
<td>3.7</td>
<td>3.9</td>
<td>3.0b</td>
<td>2.6b</td>
<td>0.2</td>
<td>2.0b</td>
</tr>
<tr>
<td>5-yr olds</td>
<td>4.0</td>
<td>4.0</td>
<td>3.6</td>
<td>3.7</td>
<td>3.5</td>
<td>4.0</td>
<td>3.4ab</td>
<td>2.6b</td>
<td>1.5</td>
<td>3.1a</td>
</tr>
<tr>
<td>9-yr olds</td>
<td>4.0</td>
<td>4.0</td>
<td>4.0</td>
<td>4.0</td>
<td>3.9</td>
<td>4.0</td>
<td>4.0a</td>
<td>3.8a</td>
<td>1.3</td>
<td>3.5a</td>
</tr>
<tr>
<td>11-yr olds</td>
<td>4.0</td>
<td>4.0</td>
<td>4.0</td>
<td>4.0</td>
<td>4.0</td>
<td>4.0</td>
<td>4.0a</td>
<td>3.9a</td>
<td>1.6</td>
<td>4.0a</td>
</tr>
<tr>
<td>adults</td>
<td>4.0</td>
<td>4.0</td>
<td>3.9</td>
<td>4.0</td>
<td>4.0</td>
<td>3.8</td>
<td>4.0a</td>
<td>4.0a</td>
<td>1.9</td>
<td>3.8a</td>
</tr>
</tbody>
</table>

Note. Within each column, means with different subscripts differ significantly at p < .05.
For two other phonemes, a and rr, a main effect for age was found at p < .10 level, F (4,45) = 2.23. For the phoneme, a, the Duncan Multiple Range Test revealed no differences between any pair of means at p < .10. On the other hand, for the phoneme, rr, three-year-olds scored lower than did the four older groups (p < .10), while the four older groups did not differ from each other.

**Relationships Between Discrimination and Pronunciation**

A Pearson product-moment correlation revealed a significant positive relation between auditory discrimination of Spanish words and ability to pronounce them, r(48) = .53, p < .01. Therefore, the better the subjects' abilities to hear foreign sounds, the better were their pronunciation abilities. Further analyses within each age group showed no significant relationships between discrimination and pronunciation.
DISCUSSION

One of the questions addressed in this study was whether the ability to discriminate foreign language sounds varies as a function of age. Different age groups were tested in respect to this task. In addition, for the two youngest groups, pretraining was provided on the concepts "same" and "different."

The importance of such training for young subjects in experiments of this nature is seen in the discrimination scores on the training task. On the first training trial, none of the three- or five-year-old subjects correctly discriminated all 10 of the word pairs; however, by the second trial, 50% of the five-year-olds had perfect discrimination scores, and by the fourth, and last, trial, 80% discriminated perfectly. By contrast, none of the three-year-olds achieved perfect discrimination at the end of the fourth trial. These results suggest that for the three-year-old subjects training was not effective. For the five-year-old subjects, on the other hand, training appeared not only to be effective but also necessary in order to help the children learn the task.

Several speculations can be made with regard to the poor performance of the three-year-old subjects on the training task. First, there is the question of whether the task is too difficult for
three-year-olds. The concept of "same" and "different" appears for the first time on the Stanford-Binet Intelligence Scale (Terman & Merrill, 1973) at age level five. Based on the empirical way the items of this test were located on the scale (at the age at which approximately 50% of the subjects passed), one can conclude that before the age of 5 a majority of the subjects were not able to appropriately understand these concepts. It should be kept in mind, however, that the location of this item on the Stanford-Binet is based on what children understand without specific training. It does not deal with the question of whether or not young children can learn the concepts of "same" vs. "different" with specific training.

In future studies of this kind, a variation on the training session used in this study might help to clarify this question. The use of two words clearly different in sound during training instead of words that are similar (as in the present study) might result in a better understanding of such tasks in younger children.

Subjects of all age groups were given the Wepman Auditory Discrimination Test, which requires that they respond as to whether or not the words they hear are the same or different. Results showed that older subjects scored significantly better than did three-year-old subjects. The poor performance of the three-year-olds, as mentioned above, may be the result of their inability to discriminate or may be the result of their inability to understand the concept "same" vs. "different." However, it appears that the
ability to discriminate native sounds remains constant after the age of five (see Figure 1).

This increase in the ability to discriminate sounds across age was also seen in the Spanish discrimination test. However, the improvement in discrimination scores was seen particularly between the age levels five and nine, after which the scores remained constant (see Figure 1). These results are very similar to the ones found by Politzer and Weiss (1969). Because of methodological problems in their study, specifically, previous exposure to a foreign language and attention factors, further exploration of the discrimination abilities were made in this study. However, the fact that both studies yielded the same results suggests that these factors might not have played as important a role as was expected. If they did play a role, it does not appear to be a significant one.

Even though similar results were found in the study by Politzer and Weiss (1969), the inclusion of the Weprnan Test in this study allows us to see that the ability to discriminate sounds as a function of age is not only true when listening to a foreign language but also when listening to native words. By having a test in the subjects' native language, one can also see that although discrimination abilities improve with age for either language, a large improvement is seen between ages 5 and 9 for the Spanish sounds but not for the English sounds, which remained relatively constant after age 5. It is suggested that future studies in this area include some kind of test in the subject's native language so
Fig. 1. Mean number of pairs of English (Wepman) and Spanish words discriminated correctly by age.
that results can be interpreted with respect to ability to discriminate foreign language sounds or ability to discriminate sounds regardless of the language.

The second question addressed in this study was whether pronunciation abilities in a foreign language varies as a function of age. This question has been of great interest in the field of second language acquisition and has yielded inconsistent results regarding the abilities of older vs. younger individuals to pronounce foreign sounds. Results in this study produced a significant difference in pronunciation abilities across age, with the older subjects pronouncing significantly better than did the younger ones. These results are consistent with the ones found by Snow and Hoefnagel-Hohle (1977) and by Olson and Samuels (1973).

Three major theories have tried to account for differences in pronunciation abilities across age. The one by Taylor (1974) proposes that lack of motivation and lack of desire to identify with another cultural group by older individuals is what might be responsible for the lack of accent-free speech by adults. That theory will not be discussed here due to the lack of similarity in conditions of subjects in a laboratory study, such as this one, to the conditions of individuals for whom Taylor's theory applies.

The two other theories proposed to account for the superiority of pronunciation in L2 by individuals who learn L2 at young ages are the "Critical Period" theory by Lenneberg (1976), who proposed that the best maturational period for learning a second language is
between birth and puberty, and the "Phonological Translation Theory" by Fledge (1981), who proposed that accents are produced because older individuals interpret foreign sounds in terms of sounds found in their native language. The results of this study, along with those by Snow and Hoefnagle-Hohle (1977), Olson and Samuels (1973), and Politzer and Weiss (1969), are inconsistent with both of these theories. Nevertheless, without having administered a pronunciation test of native words, it is difficult to judge whether or not older subjects are better than younger ones in their pronunciation abilities of foreign sounds or just better in pronouncing any sounds, including those in their native language. Therefore, it is recommended that future studies include a native pronunciation test to use as a baseline for pronunciation abilities.

Pronunciation accuracy of 10 different foreign phonemes was also measured. Overall results showed that nine-year-olds, eleven-year-olds and adults were significantly better than three-year-olds and that eleven-year-olds and adults were significantly better than both three- and five-year-olds. Thus, results on pronunciation of foreign phonemes are consistent with the results of pronunciation of foreign words. However, as mentioned above, it is impossible to arrive at any firm conclusions due to the lack of a measure of native phonemes with which one can compare performance of foreign phonemes.
In addition to the global analyses described above, pronunciation of each individual phoneme was analyzed. Significant differences in pronunciation abilities across ages were found for the phonemes "n" and "ñ", with nine-year-olds, eleven-year-olds and adults performing significantly better than three- and five-year-olds, and for the phoneme "r" with five-year-olds performing significantly better than three-year-olds, but not significantly different from other groups. For the phoneme "rr", all the older groups performed significantly better than did the three-year-olds. There were not significant differences among the age groups for the other phonemes.

One possible explanation for the poor performance of the younger children is that those subjects were not able to hear the sounds and therefore were unable to pronounce them. A subjective evaluation of the pronunciation tapes suggests that the most common error in pronunciation is the omission of these phonemes by the younger subjects, not the mispronunciation. Hence, there is the possibility of poor performance on pronunciation as a result of poor auditory identification.

The difference among ages in the pronunciation of some phonemes and not others suggests that for future studies of L2 pronunciation, rather than just including a small sample of phonemes, research should systematically explore the pronunciation of a large number of phonemes before concluding that there are or are not significant
differences in the pronunciation of phonemes across age groups.

Finally, a positive correlation between auditory discrimination and pronunciation was found. This finding implies that the subjects who are able to hear and identify foreign sounds are also able to pronounce these sounds better, suggesting that foreign accents are not inevitable if training in discriminatory abilities is provided.

In summary, poor discriminatory abilities of foreign sounds was found in the three-year-old-group. This finding could be the result of the inability of the three-year-olds to discriminate sounds or to their inability to understand the concepts "same" and "different." Comparisons between English and Spanish discrimination abilities suggests that older subjects are not only better in discriminating foreign sounds but also in discriminating sounds in their native language. These results might explain the poor performance of the youngest group of subjects.

Moreover, in the pronunciation test, older groups performed better than did the younger groups. From these findings, no firm conclusions can be made regarding the ability of older subjects to pronounce foreign sounds vs. native-language sounds because of the lack of a measure of native-sound pronunciation. Significant differences in phoneme pronunciation between three-year-olds, five-year-olds and older groups suggests that those subjects might not have heard the phoneme sounds and were thus unable to pronounce them. Finally, a correlation between ability to discriminate
foreign sounds and to pronounce them showed that the better one is
at hearing foreign sounds, the better one is at pronouncing them.

These results have the following implications for future research. A training session using words that are clearly different
from each other should be used for younger children. In addition, a
pronunciation test of native-language sounds should be used as a
baseline for subjects' pronunciation abilities. Finally, a
systematic analysis of the pronunciation of a large number of
phonemes should be conducted before any conclusions are reached
concerning the pronunciation by various age groups of foreign-
language sounds.
REFERENCES


