

A cura di
Lidia Costamagna
Stefania Giannini

LA FONOLOGIA DELL'INTERLINGUA

Principi e metodi di analisi

FRANCOANGELI

Comitato di direzione: Anna Giacalone Ramat, Giuliano Bernini, Marina Chini, Sonia Cristofaro, Pierluigi Cuzzolin, Silvia Luraghi, Gianguido Manzelli, Maria Pavesi, Michele Prandi, Paolo Ramat, Massimo Vedovelli

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Segreteria: Elisa Roma

Dipartimento di Linguistica. Corso Strada Nuova 65, I-27100 Pavia (tel. 0382/504484)

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Second Language Comprehension: a discussion of some influencing factors

Robert McAllister, James E. Flege and Thorsten Piske

1. Introduction

Much of the recent research that has been done on the acquisition of second language phonology and phonetics has been concerned with the concept of foreign accent. In Crystal's *A Dictionary of Linguistics and Phonetics* "accent" is defined as "... the cumulative auditory effect of those features of pronunciation which identify where a person is from, regionally or socially". Foreign accent can thus "... relate to... national groups speaking the same language (foreign accent, Slavic accent)". The term is typically used to refer to the inability of non-native language users to produce the target language with the phonetic accuracy required by native listeners for acceptance as native speech. Although there is, in all languages, a large variation in the native production of the contrastive phonological elements, depending on a number of regional, social and stylistic factors, native speakers, presumably because of extensive experience with the language, seem to have little difficulty in recognizing the deviant phonetic realization of the language usually known as foreign accent. McAllister (1997) suggested a broadening of the concept of foreign accent to include not only the mastery of the production of a second or foreign language but also the mastery of its perception. The generic term "perceptual foreign accent" was tentatively introduced to refer to this perceptual correspondent to the term "foreign accent" which, as noted above, usually refers to the production of a second language (L2). Strange (1995) used the term "perceptual foreign accent" to refer to the "significant difficulty" which adults have "perceiving most (but not all) phonetic contrasts that are not functional in their native language" and she notes that this can interfere with learning an L2 phonology. The aim of the present paper is to discuss some aspects of the global effect of this perceptual difficulty that could reasonably be viewed as the net result of the "significant difficulty" referred to by Strange above. Recent research into the

causes of foreign accent has indicated that several factors are likely to influence the success of an L2-learner in the acquisition of L2 production and perception (Piske/Flege/MacKay 2000). The factors discussed in the present paper are among those that have received the most attention in the literature. These are: age of L2 learning (AOL), length of residence in an L2-speaking environment (LOR), amount of L2 use and the influence of the native language (L1) phonology on L2 phonological acquisition. Experimental data demonstrating L2 performance will be presented as a basis for a discussion of the above mentioned factors and their relation to one of the current models of the process of L2 phonological acquisition. Selected results from three different studies will be presented as examples of the influence of these factors on the acquisition of three basic types of phonetic categories, namely vowels, consonants and prosody.

2. Study 1: The perception L2 vowels

This study was done by Flege/MacKay/Meador (1999). Two of the three specific aims of this study were relevant to our discussion of the perception of L2 in the present paper. The first of these was to compare the L2 performance of groups of native Italian subjects who had arrived in the L2 environment (Canada) at different ages. The second of these aims was to assess the effect of L1 use on the native Italians production and perception of the L2. Regarding the first of these two questions, the effect of AOA (age of arrival in the L2 environment), this study was among the first attempts to examine the influence of this factor on the perception of L2 vowels. Previous studies would predict that the accuracy of L2 vowel production would decrease with increasing AOA but the literature provided little insight as to the accuracy of L2 vowel perception with varying AOA. Flege's Speech Learning Model (SLM) (1995) proposes that L2 learners become less likely to establish new phonetic categories for L2 vowels as AOA increases. It follows, then, that the perception of L2 vowels is related to AOA as is the production of these vowels inasmuch as their production is, according to the SLM, ultimately dependent on the accuracy of perception. As to the effect of amount of L1 use on the perception of L2, the question has been investigated by Flege/Frieda/Nozawa (1977) and it was found that overall degree of foreign accent was related to the self reported use of L1 in AOA matched groups of subjects. Therefore, it might be expected that an investigation of the perception of L2 vowels done along the same lines might also show this effect of amount of L1 use.

As subjects, Flege/MacKay/Meador had 72 native speakers of Italian that had been in Canada for an average of 35 years. These subjects were divided

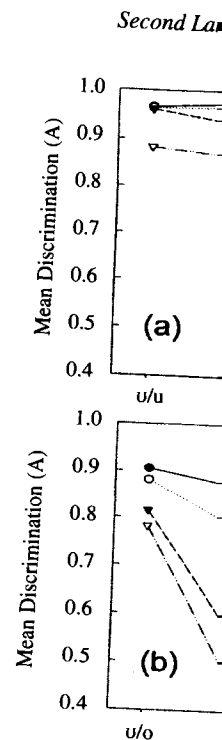


Figure 1 - Mean discrimination of neighboring Italian vowels by Italian groups differing in AOA

into three groups according to AOA: EarlyLo (AOA=7), Middle (AOA=11), and Late (AOA=19). The results show that the Late group had the lowest discrimination, while the other groups which were EarlyLo and Middle had higher discrimination. For example, there were significant differences between the EarlyLo and Middle groups, and between the Middle and Late groups. It was found that the Late group spoke Italian did not have a significant effect on perception. However, as can be seen in panel (a), there does seem to be an effect of AOA on perception. The English native group obtained the highest discrimination. In panel (b) the results of the native Italians discrimination were significantly higher on all contrasts. The results are similar to those of the native Italians decreased as AOA increased.

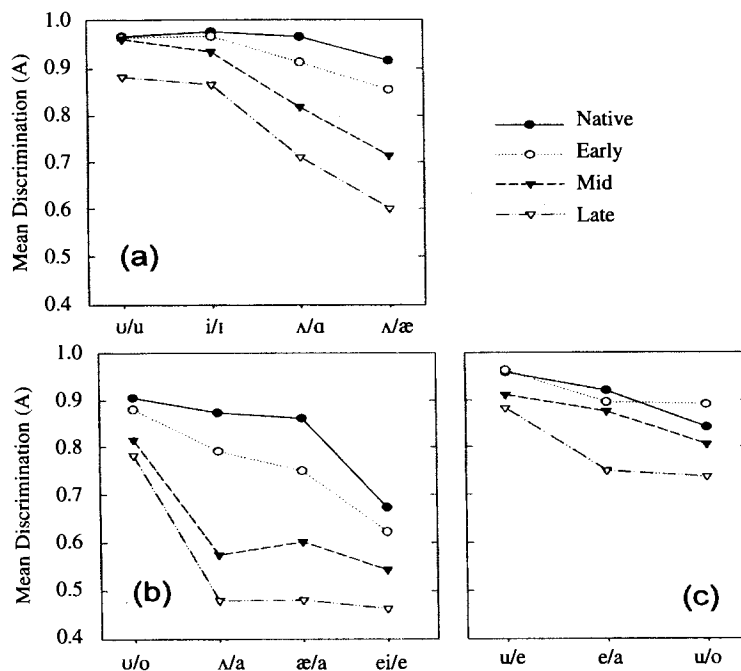


Figure 1 - Mean discrimination of (a) two English vowels, (b) an English vowel and a neighboring Italian vowel, (c) two Italian vowels in native English speakers and three native Italian groups differing in age of arrival

into three groups according to their AOA (Early: AOA=7; Mid: AOA=14; Late: AOA=19). These three groups were matched in terms of AOA three other groups which differed in self reported use of Italian. Therefore, for example, there were two early groups, one called Early and the other called EarlyLo to indicate that the latter group had a lower frequency of use of L1 than the other group.

It was found that the frequency with which the native Italian subjects spoke Italian did not significantly affect their perception of English vowels. However, as can be seen in figure 1 cited from the aforementioned paper, there does seem to be a relationship between AOA and accuracy of perception. The English-English contrasts are shown in figure 1(a). Here, the Native group obtained higher scores than any of the L2 listeners and the native Italians discrimination scores decrease with increasing AOA. In figure panel (b) the results of English-Italian vowel discrimination is shown. These results are similar to those in panel (a). The native English speakers scored higher on all contrasts than the native Italian subjects and the scores for the Italians decreased as AOA increased. In panel (c) it is evident that the native

English speakers were most successful in discriminating the Italian vowels. Here again the effect of AOA can be seen with the Early group being almost as good at discriminating Italian vowels as the native English speakers.

From this study we can conclude that the younger an individual is when he begins to learn an L2 the better that individual is at hearing the difference between contrastive L2 vowel categories. As the authors point out, there is another possible explanation of the results obtained. This would be that the late bilinguals, that is, the L2 users with a late AOA, may have altered representations as a result of assimilating to neighboring English vowels.

3. Study 2: The perception of consonants

This study was done by MacKay/Meador/Flege (2000). The authors begin the paper by pointing out the fact that although there is a vast literature dedicated to the phonological abilities of L2 users, the major part of this research has been concerned with production and has little to report on the perception of L2. The study is similar in its aims to the research summarized above, the difference being that the object of scrutiny here is the ability of native speakers of Italian to perceive English consonants in noise. The performance of three groups of native Italian subjects that differed primarily according to the age at which they began to learn the L2 is the focus of this work. This point in time was defined as their age of arrival (AOA) in Canada which was the L2 environment.

A second focus of the study is to compare performance of two groups of native Italian subjects who were matched according to the above mentioned criterion, that is, the age at which they arrived in the L2 environment. These subjects differed, however, with respect to how much they used their native language in their daily lives.

The SLM (Flege 1995) posits that phonetic perception (and production) errors made by an L2 user are due to cross-language phonetic interference that arises from the interlingual identification of position-sensitive allophones. The learning of English by the native Italian subjects used in this study provides an opportunity to test this claim.

There are many phonetic and phonotactic differences between the consonant systems of Italian and English. One of these differences dealt with in this study is the occurrence of final consonants in the two languages under investigation. There is a tendency for Italian to display predominantly CV syllables and few word final consonants whereas English has a much higher occurrence of both single final consonants and consonant clusters. Another difference in the phonetics of the consonant systems in the two languages is in the word initial stops. In English these are implemented as aspirated. In

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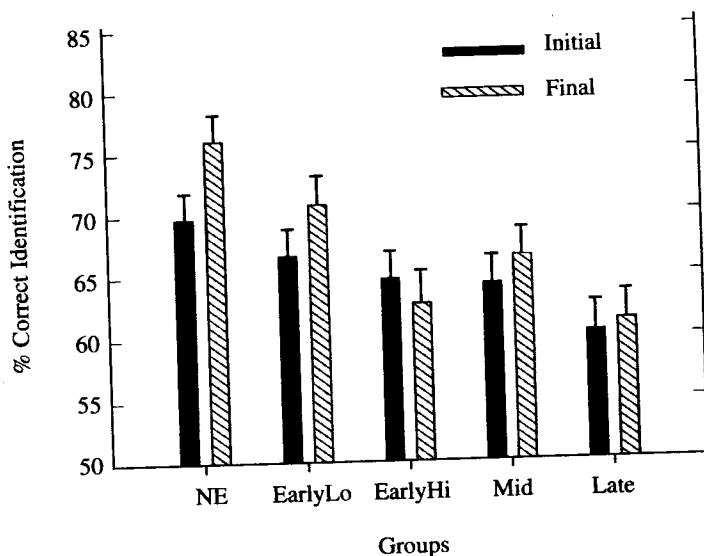


Figure 2 - Mean percent correct identification of 18 English consonants by 18 subjects X 4 noise conditions = 72 forced-choice judgements for group X position interaction

Italian, word initial stops are unaspirated. The starting point for this research was the assumption that if the native Italian subjects did not have long term memory phonological representations that were functionally equivalent to the native English representations they would obtain significantly lower percent correct identification scores than the native listeners. In terms of the SLM interference prediction cited above, the extent to which the native Italian subjects changed their representation of stops when they learned English to be more like the English stops than those of their native language should be reflected in their ability to recognize the L2 stops in noise.

Five groups of 18 subjects participated. One group consisted of native speakers of English. The four native Italian groups differed according to the age at which they had immigrated to Canada and/or the percentage of time they estimated using their L1 at the time of testing. Two of these groups consisted of native Italians who had arrived in Canada at the average age of 6.6 years. These two groups differed in the amount of Italian they reported using at the time of the study. The EarlyLo group used Italian about 5% of their language use whereas the EarlyHi group used Italian about 35% of the time.

All the subjects were asked to listen to a series of English initial and final consonants in various noise conditions. Per cent of correct identification was calculated.

The first important finding that can be observed in figure 2 cited from the study being discussed is that the native Italian speaking subjects did not perceive the initial and final consonants as accurately as did the native speakers of English despite the fact that they had lived in the English speaking environment for an average of 35.4 years and had used English much more than Italian in their daily lives. There does, however, seem to be a relationship between age of arrival and accuracy of identification of initial and final English consonants in noise. The older the subjects were when they arrived in the English speaking environment the less accurate they are at identifying the test items.

This analysis reveals another important finding with respect to EarlyLo and EarlyHi groups. These subjects immigrated at a young age but differed in their daily use of Italian. The EarlyLo group was the most successful of all the subject groups at the identification task. The EarlyHi group was not only less successful at the task as compared to the Mid group, who had arrived significantly later in the English speaking environment, but they had a lower score for the identification of the final consonants than for the initial consonants. This indicates that the interference prediction of the SLM discussed above may apply here. Age of arrival, then, does not seem to be the only factor that is relevant here. Use of the L2 in the daily lives of the native Italians appears also to be an important factor in their perception performance and very possibly in their acquisition of the L2 in general.

To summarize, we have thus far discussed the influence of two factors on the perception of L2 and their possible contribution to perceptual foreign accent. These are age of arrival in the L2 environment and the frequency of L2 use. We have given examples of the influence of these factors from studies of the acquisition of L2 vowels and consonants. We have also touched upon a third factor in the consonant study in which the relation between the contrastive categories of the L1 and L2 could have been the source of perceptual difficulty as predicted by the SLM. Let us now turn to the acquisition of prosody and to this third factor, the influence of the L1 system of contrastive phonetic categories on the acquisition of the new L2 system.

4. Study 3: The perception of prosody

How and to what extent the first language influences the learning of L2 is a primary issue in both past and current discussions of the factors influencing second language speech acquisition. The study reported here in part is by McAllister/Flege/Piske (2000). The experiment reported in this study is designed to test a "feature hypothesis" relevant to the learning of L2 phonology. This hypothesis was implied in Flege's Speech Learning Model

(SLM), one of states that L2 the phonetic f explicitly state contrast in L1 difficulty will on this feature. The authors the acquisition three languages feature. It is we to the use of Traditionally, th the vowels an terminology. No categories and Spanish, have no Among the lar of differences in the durational an contrast. For exam duration plays o (Miller/Grosjean temporal cues and are sensitive to th vowel on the basis p be of little or distinctions, Finnis ted as examples relationships are a of little or no cor The target L2 in ontrast in the vowe relationship betwe phonological distin primary cue utilize contrast in the mid v dies have show mbination of dura teners in the reco tures associated w 4, Behne/Czigler

(SLM), one of the current models of L2 speech acquisition (Flege 1995), and states that L2 phonetic category formation may be blocked by a mismatch in the phonetic features used in the L1 and the L2. The hypothesis could be explicitly stated as follows: L2 features not used to signal phonological contrast in L1 will be difficult to perceive for the L2 learner and this difficulty will be reflected in the learner's production of the contrasts based on this feature.

The authors have attempted to test the feature hypothesis by investigating the acquisition of the Swedish vowel quantity contrast by native speakers of three languages which display varying degrees of prominence for the quantity feature. It is well documented that languages differ considerably with regard to the use of duration and spectral features in quantity distinctions. Traditionally, the distinction has been attributed to durational differences in the vowels and/or consonants, hence the "long-short" or "quantity" terminology. Not all languages use duration as a cue to distinguish phonetic categories and consequently, native users of those languages, such as Spanish, have no experience with the contrastive use of duration cues.

Among the languages that do signal distinctions between vowels by means of differences in duration, there are language-specific relationships between the durational and spectral features which accompany the realization of the contrast. For example, experimental evidence shows that in standard French, duration plays only a minor role as a cue in the phonological system. (Miller/Grosjean 1997). In English, spectral information covaries with the temporal cues and many studies have shown that native speakers of English are sensitive to the durational feature and are sometimes able to identify a vowel on the basis of its length. In contrast to Spanish where duration seems to be of little or no consequence for the identification of phonological distinctions, Finnish (Lehtonen 1970) and Estonian (Lehiste 1997) could be cited as examples of languages in which complex patterns of durational relationships are a salient feature of their phonology and where vowel quality is of little or no consequence to the contrasts signaled by temporal cues.

The target L2 in this study is standard Swedish which has a quantity contrast in the vowel system. Several studies have been done to document the relationship between the durational and the spectral features in this phonological distinction. Hadding-Koch/Abramson (1964) found that the primary cue utilized by native Swedish listeners for the recognition of contrast in the mid vowel pairs /ɛ:/-/ɛ/ and /ø:/-/ø/ was vowel duration. Other studies have shown that high and low vowels are distinguished by a combination of duration and quality but that the primary cue used by native listeners in the recognition of the quantity contrast tends to be the spectral features associated with the vowel quality (Engstrand 1986, Engstrand/Krull 1994, Behne/Czigler 1997, Behne *et al.* 1999).

According to the feature hypothesis, learning quantity in Swedish for the high and low vowels, where the contrast is based on spectral cues, should not be difficult for most L2 learners since all languages use spectral features in their differentiation of phonetic vowel categories. The contrast for mid vowels should, however, be easier for those subjects whose L1 phonology exploits durational cues.

Our approach here could be viewed as a further development of the feature hypothesis. This development, here called the "feature prominence hypothesis" holds that the prominence of the quantity feature in the L1 will be reflected in the acquisition of the quantity contrast.

A total of 80 adult subjects participated, first in a production experiment, and then in a perception experiment. 20 of these subjects were native speakers of Swedish. There were also 20 native speakers each of South American Spanish, North American English and Estonian. To be included in one of these L2 learner groups subjects had to have arrived in Sweden after their 18th birthday and lived in Sweden for at least ten years.

5. Perception experiment

The purpose of the perception experiment was to find out whether the subjects could determine if the 40 common Swedish words they had produced in the production experiment contained a phonologically short or long vowel. A phonetician who is a native speaker of Swedish recorded productions of the 40 test words. He also produced a set of 40 non-words formed by changing these vowels in the test words from short to long or from long to short. The 80 naturally produced stimuli were randomly presented a single time immediately following a definition. Each real word and the non-word paired to it by changing the phonological length of the vowel were presented following the same definition. The real word and its corresponding non-word were always located on separate halves of the test. The subjects were asked to click a "correct" or "incorrect" button as a response. For example: the phonetician's production of the Swedish word 'spade' [spà:də] (Eng. shovel) and the corresponding non-word containing a short vowel *spadde [spà:də] were played out twice during the experiment, each time followed by the same definition. When the word was presented, the correct answer was "correct" because phonological length was correctly specified, and the item was, in fact, a word that exists in Swedish. However, when the non-word was presented, the correct response was 'incorrect' because the item was not a lexical item in Swedish.

A total of four percent scores was computed for each subject, one for each of the four vowel contrast groups. Each score was based on 20 judgements, 10 for real words, 10 for non-words (where the correct response was "incorrect" because the word does not exist in Swedish).

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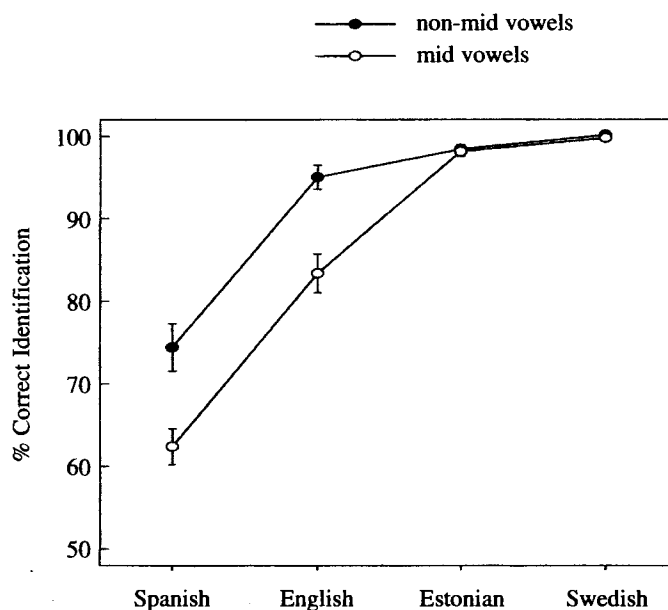


Figure 3 - Percent correct recognition scores obtained by the four groups of subjects for two pairs of Swedish mid vowels and two pairs of Swedish non-mid vowels

The Swedish subjects obtained perfect or near-perfect scores in every instance. Most Estonian subjects obtained a perfect score for the four contrasts. The lowest score for any Estonian subject was 0.85. Although at least a few native English speaking subjects obtained perfect scores for each contrast, the scores for this group were generally lower than those obtained for the Swedish or Estonian subjects, especially for the two mid vowel contrasts. The scores for the Spanish subjects were lower still. A few native Spanish speaking subjects obtained perfect scores for the high vowel /ɨ:/-/ɨ/ and the low vowel (/a:/-/a/) contrasts. However, none of the native Spanish speaking subjects obtained a perfect score for either of the two mid vowel contrasts (/ø:/-/ø/, /ɛ:/-/ɛ/). Indeed, for these contrasts, many of the native speakers of Spanish received a score of about 0.5, which indicated a lack of phonetic sensitivity.

ANOVAs were carried out to examine the four scores obtained for the native Spanish, English, and Estonian speaking groups. (The data for the native Swedish subjects were not examined in this analysis because there was very little, if any, variance in their scores.) In this analysis, Group served as a between-subjects factor, and vowel height (mid vs. non-mid) served a repeated measure. A question of interest was whether the scores obtained for

the two mid vowel contrasts would be lower than those obtained for the two non-mid (i.e. high and low) vowel contrasts. This question, based on the fact that the quantity distinction was accompanied by large spectral differences in the high and low vowel contrasts examined, but not for either of the mid vowel contrasts, is, in fact, critical for the feature hypothesis being tested in these experiments.

The average identification scores for the non-native subject groups are shown in figure 3. Higher scores were obtained for the native Estonian subjects (98%) than for the native English speaking and Spanish speaking subjects (89%, 68%); and for mid vowel than non-mid vowel contrasts (81% vs. 89%). These differences were used in the ANOVAs which lead to significant main effects of Group, $F(2,57) = 51.5$, $p < 0.01$, and Vowel Height, $F(1,57) = 50.8$, $p < 0.01$. The interaction between Group and Vowel Height, $F(2,57) = 13.8$, $p < 0.01$.

The interaction between Group and Vowel Height, which is shown in Figure 2, was explored by ANOVAs testing the simple effect of Vowel Height for the three groups. The difference between non-mid and mid vowels seen for the native Spanish speaking subjects (62% vs. 74%) was significant, $F(1,19) = 23.1$, $p < 0.01$. The difference for the native English speaking subjects (83% vs. 95%) was also significant, $F(1,19) = 31.5$, $p < 0.01$. However, the difference for the Estonian subjects (97% vs. 98%) was non-significant, $F(1,19) = 0.1$, $p > 0.10$.

The aim of this experiment was to test two related hypotheses, the "L2 feature hypothesis" and the "feature prominence hypothesis". According to the feature hypothesis (see, e.g., Flege 1995), an L2 contrastive category will be difficult to acquire if it is based on a phonetic feature not exploited in the L1. According to the feature prominence hypothesis (e.g., Miller/Grosjean 1997), the relative importance of a feature in the L1 will determine the extent to which it will be used in an L2.

As predicted by the feature prominence hypothesis, we found that the native Estonian speaking subjects were the most successful of the three subject groups of L2 users in correctly perceiving the Swedish quantity contrast. The native Spanish speakers appear to be the least successful of these three groups and the native English speakers were somewhere in between, but show very good success. The results of the perception experiment would seem to mirror the three degrees of importance for duration in Spanish, English and Estonian respectively.

As has previously been stated, we hypothesized that the non-native subjects whose L1 lacks a phonological length distinction (viz., the native English and Spanish speaking subjects), would obtain lower scores for items testing the two mid vowel quantity contrasts than for the items testing non-mid (high, low) quantity contrasts.

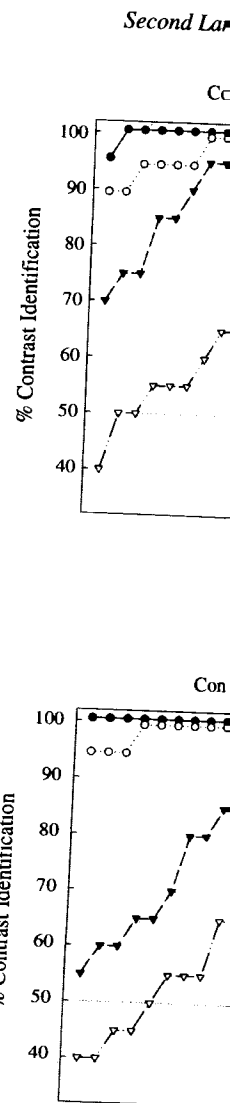


Figure 4 - Correct identification perception experiment

The variation in scores with respect to the acquisition of the feature hypothesis. Spanish subjects have been shown to rely on the native English and Spanish contrast in those vowel contrasts where the duration feature is

those obtained for the two question, based on the fact large spectral differences in not for either of the mid hypothesis being tested in

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height, which is shown in the simple effect of Vowel on non-mid and mid vowels (% vs. 74%) was significant, the native English speaking $F(1,19) = 31.5, p < 0.01$. s (97% vs. 98%) was non-

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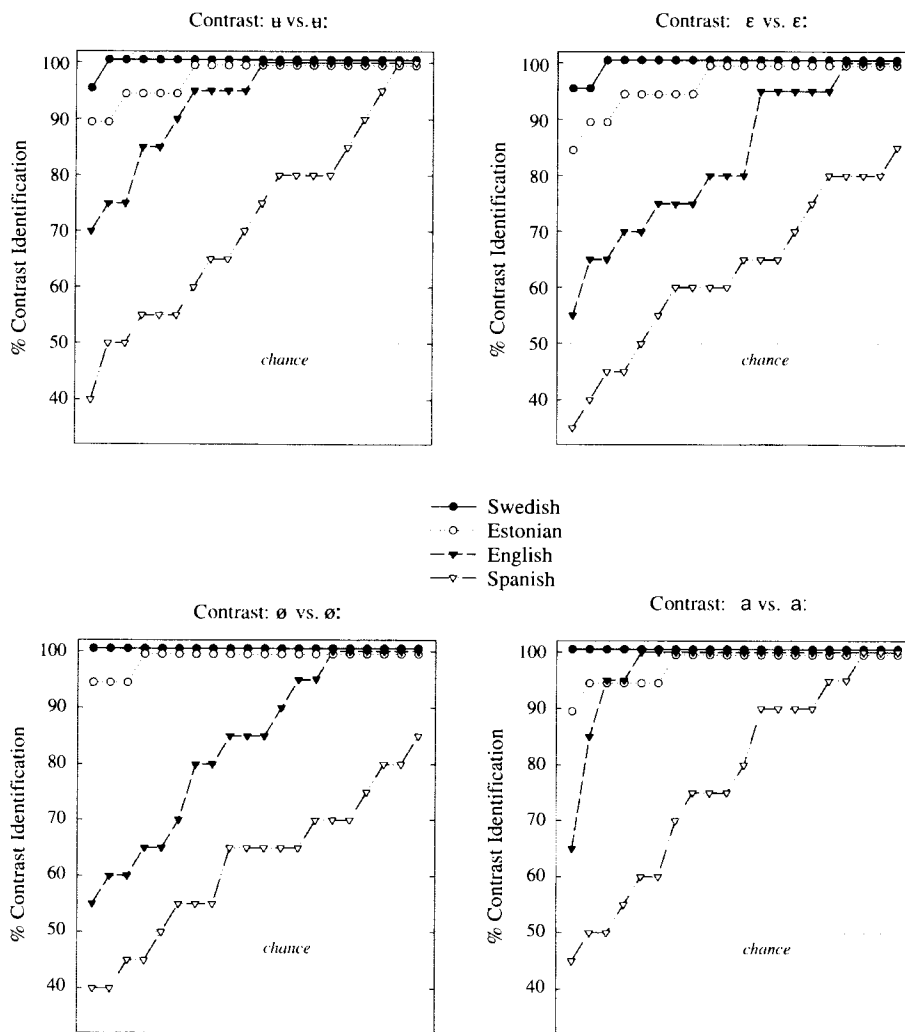


Figure 4 - Correct identification scores for the 4 long-short vowel pairs included in the perception experiment

The variation in success that can clearly be observed in figure 3 with respect to the acquisition of the mid vowel contrast is in accord with the feature hypothesis. Since the mid vowel contrast has, in previous research, been shown to rely on duration differences, we would have expected the native English and Spanish subjects to have the most difficulty with the contrast in those vowels. Again, the results reflect the overall prominence of the duration feature in the L1.

Another important aspect of our results which would merit comment is the extraordinary range of individual differences we observed.

Some native speakers of English performed just like native speakers of Swedish, whereas others performed at a chance level. That is, they were unable to determine if known Swedish words were supposed to have a long vowel, or a short vowel. To be more specific, all 20 of the native Swedish subjects obtained perception scores greater than 95% correct for the mid and non-mid Swedish quantity contrasts. The large range of variability could be observed, however, in the perception experiment for the native English and native Spanish speakers. For the mid contrast, 15 of the 30 native Spanish speaking subjects tested in this study, and four of the 30 native English speaking subjects, obtained scores that were less than 60% correct. However, four of the native Spanish subjects, and 10 of the native English speaking subjects obtained scores greater than 90% correct, and thus resembled the Swedes. For the non-mid contrast, five native Spanish and one native English subject obtained scores less than 60%. However, four native Spanish and 22 native English subjects obtained scores greater than 90% and thus resembled the Swedes. Note that those subjects who were unsuccessful in distinguishing pairs of Swedish vowels differing in phonological quantity failed in this task despite the fact that they had lived in Sweden for about as long as their successful counterparts, used Swedish on a regular basis, and were familiar with the Swedish words used as stimuli.

How can this large variation be accounted for? In the introduction to this study we stated that easily observed large individual variation in L2 performance was one of the indications that many independent factors probably influence the success of L2 learning in any given individual. To provide a preliminary indication of what might account for the inter-subject variability in this particular study, we carried out a series of correlation analyses on the data we have collected. We first examined the correlation obtained for all 30 native English speaking subjects who were tested. We examined the relation between the perceptual scores obtained for mid and non-mid vowels and the native English speaking subjects length of residence (LOR) in Sweden, their age of arrival (AOA) in Sweden, average amount of self-reported use of Swedish in several contexts, and their overall ratings of familiarity of the 40 Swedish words used here. Of the eight correlations, just three were significant (Bonferroni $p < 0.05$). The earlier the native English speaking subjects arrived in Sweden, the higher were their perceptual scores for both the mid and non-mid vowels ($r(28) = -0.56$ and -0.53 , respectively). Also, the greater was their familiarity with the 40 Swedish words, the higher were their scores for non-mid vowels ($r(28) = 0.52$). No correlation involving LOR or L2 use reached significance. Similar analyses were carried out to examine the perception of differences between mid and non-mid vowels by 30 native

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Spanish subjects. None of these 16 correlations reached significance at the 0.05 level (after Bonferroni correction).

In summary, these analyses suggest that for the native English speaking subjects, the age of first exposure to Swedish, how much Swedish was used, and the familiarity with the Swedish lexicon may have played a role in determining the extent to which subjects resembled the native Swedish subjects. We have no basis, even speculative, to account for the inter-subject variability among the native Spanish subjects. Additional research will be needed to determine why certain non-native subjects are more likely to succeed in acquiring this aspect of Swedish than others. Further work is also needed to assess the role of feature differences between L1 and L2 in the L2 acquisition of new distinctions, both segmental and prosodic. It would also be worthwhile in future research to obtain more detailed information about how often, and with whom, Swedish is spoken and to determine if the motivation factor, or differences in auditory acuity, play a role in differentiating the success of individuals in the acquisition of Swedish quantity contrasts. Other individual traits that we have only touched upon in this discussion are also potential objects of future research. These are the familiar themes of language aptitude or talent which relate to the question of imitation ability in pronunciation learning. The role of formal instruction and its methodology could certainly be more thoroughly investigated as could psychosocial factors other than those that are most often referred to under the general heading of motivation. All these factors could make an important contribution to the individual variation that can be observed in the success of learning L2 perception.

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