

Non-segmental structure in foreign accent

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ABSTRACT

Typological studies have shown that "voicing" contrast for obstruents is more marked in syllable-final position and least marked in initial position. Also, implicational universal relations suggest that fricatives are more marked than stops and voiced segments are more marked than voiceless ones. The Markedness Differential Hypothesis (MDH), whose underlying claims stem from such studies, predicts that the syllable-final "voicing" contrast should be difficult for Germans speaking English since German neutralizes "voicing" in a **marked** position. MDH, also, predicts more difficulty for Arabs with English/v/ than with/p/, which are absent from Arabic phonemic inventory, on the basis of markedness. A spectrographic test of English minimal pairs spoken by ten Germans, however, revealed that Germans have acquired control of English "voicing" in syllable-final position. Another spectrographic test of English minimal pairs spoken by eight Arabs revealed that they had considerable difficulty learning the correlates of English "voicing". These results prove that MDH can not correctly predict the relative degree of difficulty in second language acquisition. Instead we propose that non-segmental similarities and/or differences between languages play an important role in second language acquisition. Thus, due to the similarity between English and German and the difference between English and Arabic with respect to vowel duration difference as a function of "voicing", Germans contrasted English obstruents for "voicing" but Arabs did not. (Research supported by Yarmouk University).

Introduction :

Eckman (1977) proposes the Markedness Differential Hypothesis on the basis of the typological markedness concept attempting to solve the problem of asymmetry of learning difficulty that faces the Contrastive Analysis Hypothesis. However, before we detail the basic assumption of this elaboration on the contrastive analysis hypothesis, we shall briefly give an idea of the notion of markedness employed in this theory.

The notion of "markedness" for the Prague school of phonology is defined in a language-specific manner while generativists' markedness values are universal and innate. Trubetzkoy (1939/69), for example, proposes that when an opposition between two phonemes is neutralized, it is the unmarked member of the opposition which appears on the surface. For example, German neutralizes the voicing contrast in syllable-final position. Only the voiceless obstruents are found phonetically. Therefore voiceless obstruents in German are said to be unmarked members of the opposition voiced/voiceless (Trubetzkoy, 1939/69). The use of the markedness concept by Chomsky and Halle (1968: Ch. 9), however, marks a point of departure from that of the Prague School (cf. Cairns, 1969) since markedness is defined in a language-universal manner based on "implicational universals" which means that there are languages that possess only X and other languages that possess both X and Y, Yet no languages are found to have only Y. Thus Y is said to be universally more marked than X because its presence implies the presence of X, but not vice versa. Here are some selected implicational universals and the relative markedness deduced from them (cf. Houlihan and Iverson, 1979):

1. Implicational Universals

- a. Since there are languages with only voiceless obstruents but no languages with only voiced obstruents, the presence of voiced obstruents in a language implies the presence of voiceless ones, but not vice versa (Jakobson, 1968: 70). Thus, for example, Korean and Finnish possess only voiceless stops while English and German possess both voiced and voiceless ones but no languages have only voiced obstruents.
 - b. The presence of a voicing contrast word-finally implies a contrast word-medially, which in turn implies a contrast-initially but not vice-versa (Dinnsen and Eckman, 1975). For example, English possesses a voicing contrast word-finally, medially and - initially while German does not possess the contrast word-finally, yet it possesses such a contrast in other positions.
 - c. The presence of fricatives implies the presence of stops, but not vice versa (Jakobson, 1968: 51), etc.
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2. Relative Markedness

- a. Voiced obstruents are marked compared to voiceless ones.
- b. A superficial voicing contrast is the most marked word-finally and is the least marked in initial position.
- c. Fricatives are marked relative to stops.

Thus, these implicational relations between classes of phonemes or positions of contrast are what is generally called markedness. This concept of markedness seems to obtain some support from studies of universals in linguistic change, linguistic typologies and language acquisition (see Hyman, 1975). For example unmarked sounds are found to be generally acquired by children before marked ones and are required in the phonemic inventories of languages (Jakobson, 1968: 320).

Despite the fact that markedness is not clearly defined, an attempt has been made to employ the notion of typological markedness, based on Jakobson's implicational universal relations, to account for second language acquisition. Eckman (1977) has proposed the Markedness Differential Hypothesis (henceforth MDH) to account for some of the problems of the Contrastive Analysis Hypothesis. Eckman claims that areas of difficulty that may face a second language learner can be predicted by systematic comparisons of the grammars of the native language and the second language as well as universal markedness relations. Consequently, he claims that areas of difficulty for second language learners are those which are different from the native language and also are more marked in the second language than in the first. The relative degree of difficulty of these areas corresponds to the relative degree of markedness. Those areas of the target language that differ from the learner's native language but are **not more marked** than those of the native language, should cause no learning difficulty according to Eckman.

But since typological studies have shown, for example, that the voicing contrast for obstruents is more marked in syllable-final position and least marked in initial position (Dinnsen and Eckman, 1975), MDH predicts that a syllable-final voicing contrast should be difficult for Germans speaking English but neutralizing the contrast should not be hard for English speakers when speaking German. This is because English possesses the contrast in a marked position while German does not. Thus, Americans would be able to neutralize German /p-b/ and /f-v/ correctly into (p) and (f), respectively, while Germans would incorrectly produce (p) and (f) for both members of the English 'voicing' contrast in /p-b/ and /f-v/.

Moreover, the implicational universal relations of Jakobson (1968) suggest that the presence of voiced obstruents implies the presence of voiceless ones, but not vice versa. Thus, since both /v/ and /p/ are absent in Arabic (while /f/ and /b/ are present) MDH predicts more dif-

difficulty for Arabs with English /v/ than with /p/ for two reasons. First, fricatives are more highly marked than stops, and second, voiced segments are more marked than voiceless ones. Preliminary observations, and the experience of teachers of English to Arabs, however, suggest the opposite result. Arabs seem to find that /p/ is hard while /v/ is easy.

The Markedness Differential Hypothesis as proposed in Eckman (1977) does correctly predict that /x/ is easier to learn by English speakers learning Arabic than is /v/ 2 that French word initial /z-s/ voicing contrast is similarly easy for English speakers when speaking French (Briere, 1966; Gradman, 1970). However, MDH may not be able to correctly predict the relative degree of difficulty even in some cases where it is supposed to be applicable. For example, /z/ is reported to be more difficult to learn than /o/ for Swedish speakers learning English (Eliasson, 1976) although /o/ is more marked than /z/ 3. Further-more, the Swedish phonemic inventory has the voiceless sound /s/ as well as a voice contrast. so /z/ should not pose the difficulty it apparently does.

Moreover since MDH employs segmental transcriptions based on the universal phonetic segmental features, it fails to predict difficulties that stem from the non-segmental differences between languages. For example, Arabic and English differ with respect to the phonetic implementation rules of voicing contrast in syllable-final position. Accordingly, it has been found that Arabs have difficulty in producing temporal correlates of the 'voicing' contrast the way English speakers do (Flege and Port, 1981; Port and Mitleb, 1983, Mitleb, 1981, 1982). This is because Arabic does not show either a vowel duration difference or a closure duration difference as an effect of voicing (Port, Al-Ani and Maeda, 1980; Mitleb, 1981) while English has these temporal correlates for voicing contrast in word-final position (Port, 1976; Denes, 1955). German, also has voicing effect on vowel duration in both monosyllabic and bisyllabic words (Mitleb, 1981). So we propose that one cannot rely completely on the segmental structure of speech sounds in the absence of non-segmental features to account for the phonetic and phonological aspects of foreign accent. This is based on the grounds that non-segmental features ought to be learned by second language learners since it has been demonstrated that many temporal properties of speech sounds are language-specific rather than universal as implicitly claimed by phonetic transcription-based analysis of speech sounds. This research will compare the voicing correlates in German-accented English and Arabic-accented English.

Experiment 1: German-accented English.

In this experiment we will examine the "voicing" correlates of English

stops as produced by Germans and American controls. The results of this experiment will be compared with those of the following experiment to assess how a difference in non-segmental structure would affect production of second language sounds and how phonetic transcription based analysis fails to account for certain problems in the process of second language acquisition.

Methods

An experiment was devised in which one group of ten native speakers of German speaking English was compared with a group of ten American controls reading monosyllabic words that exhibit final voicing contrast for /p,b/, /t,d/ and /k,g/. Four tokens of each of the test words **tap**, **tab**, **light**, **lied**, **tack** and **tag** were randomized in a typed list embeddes in the carrier sentence "They tried to Say—last week." and recorded at a comfortable tempo.

Analysis

Wideband spectrograms were made (Voice Identification 700 Series) for each token and three temporal intervals were measured to the nearest 5 msec. following standard criteria:

1. Vowel Duration. The duration of the vowel was measured from the onset of glottal vibration to the closure for the following. A vowel after /l/ was defined by the sudden change from steady formants to onglide and measured from onglide to the closure of the following stop as shown by the cessation of energy in all formants.
2. Final Consonant Constriction Duration. Final stops were measured from the abrupt cessation of all formants to the nose burst signal stop release.
3. Glottal pulsing. The periodic striations during the constriction interval were measured whenever they could be seen on the spectrograms.

Results

The results of vowel and consonant duration are plotted cumulatively for the six test-words, averaging across the three places of articulation in Figure 1.

1. Vowel Duration. Americans and Germans maintained the same voicing effect on vowel duration. That is, vowel shortening before voiceless stops was found to the same degree for both speaker groups. The ratio of vowel duration before a voiceless stop closure to that before voiced one for American controls is .75 ($F(1,3) = 294, P .001$) while it is .76 for Germans ($F(1,3) = 85, P .001$). This shows that the interaction of group with stop voicing does not reach a level of significance ($F(1,5) = .124, n.s.$).

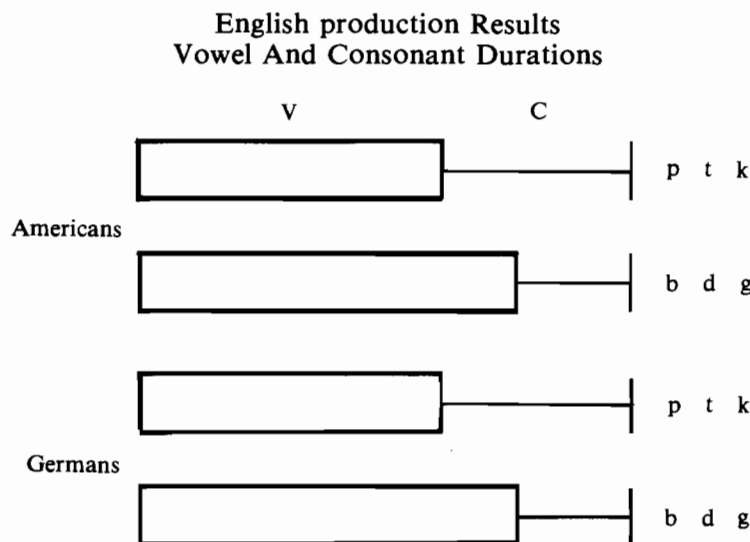


Figure 1: Experiment 1

2. Consonant Constriction Duration. The voiced closure duration is shorter than the voiceless one for both Americans and Germans as expected for English from previous studies. The voiced stop closure is 19 msec. shorter than the voiceless one for Americans ($F(1,3) = 74$, $P = .001$) while it is 14 msec. for Germans ($F(1,3) = 27$, $P = .001$). Due to the small difference between the two groups, the interaction of group with stop closure voicing does not reach a level of significance ($F(1,1) = 2.5$, n.s.).
3. Glottal Pulsing During Stop Closure. We note that Germans equal Americans with respect to the voicing effect on glottal pulsing during consonant constriction. The glottal pulsing duration differences of voicing for Americans amount to 43 msec. ($F(1,1) = 150.61$, $P = .001$) and 41 msec. for Germans ($F(1,1) = 266.82$, $P = .001$). Thus, the interaction of group with stop voicing falls short of significance ($F(1,1) = 2.08$, n.s.).

Moreover, since glottal pulsing is of great importance to our research problem with respect to the prediction of the MDE and other segmental based analyses of German-accented English, we compare Americans and Germans with respect to the number of 'voiced' stops produced with glottal pulsing during at least half of stop closure. Thus, Americans produced 92/120 or 77% of their 'voiced' stop tokens with glottal pulsing during at least 50% of the closure. Germans, on the other hand, made

78/120 or 66% of their tokens with glottal pulsing according to the above criterion. Chisquare test of these proportions did not indicate a significant difference between the two groups (d.f. (2), $X^2 = 3.7$, n.s.).

Experiment 2: Arabic-accented English.

Experiment 2 is designed to examine temporal implementation of the English voicing contrast by Jordanians for stressed vowel duration, post-vocalic consonant constriction and glottal pulsing during consonant constriction. The results of this experiment will be compared with the results of experiment 1.

Methods

An experiment was devised in which a group of native speakers of Arabic was compared with a group of Americans reading CVC English words that exhibit final voicing contrasts for /f.v./ and /p,b/. Four tokens of each of the test words, **Safe**, **Save**, **tap** and **tab** were randomized in a typed list embedded in the carrier sentence "They tried to say—lastweek."

Fourteen subjects participated in this experiment. Seven American speakers were linguistics students and exhibited no prominent regionalisms in their speech. The seven Jordanians had studied English in Jordanian schools from grade 5 through grade 12. Members of this group had lived for 8- 12 months as university students in the United States. Subjects were recorded on a Revox A700 tape recorder using an Altec 627 A microphone in a soundproof booth in the phonetics laboratory at Indiana University. Wideband spectrograms were made (Voice Identification 700 series) for each token and three temporal intervals were measured to the nearest 5 msec.

1. Vowel duration. The duration of the vowel was measured from the onset of glottal vibration to the closure for the following stop (or fricative constriction) shown by the abrupt cessation of energy in all the formants.
2. Final consonant constriction. The duration of consonant constriction was measured from the abrupt cessation of all formants to the onset of voicing of the next word in the carrier sentence.
3. Glottal pulsing. As in experiment 1.

Results

The results for the main variables of vowel duration and consonant constriction duration in tap-tab and safe-save for each group are plotted in Figure 2.

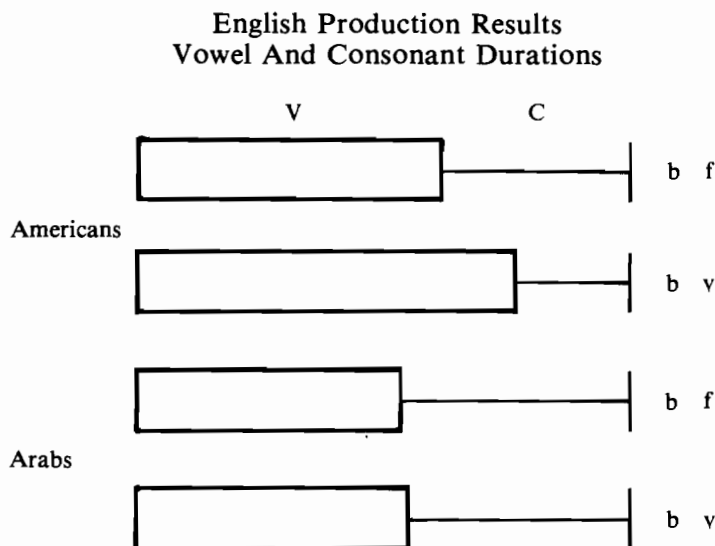


Figure 2: Experiment 2

Vowel Duration. For both pairs of words American subjects showed a significant difference in vowel duration due to voicing ($p < .01$ by t-test), But Arabs did not approach significance in either pairs of words.

Consonant constriction Duration. Looking first at the final /p-b/ in Figure 2, we notice that the American subjects' word final /p/ was, as expected, significantly longer than /b/ closure ($p < .01$ by t-test). Turning to the final fricatives in safe and save, we again find a significant difference in fricative constriction due to voicing ($p < .01$). Arab subjects also have a significantly longer duration for /p/ than /b/ ($p < .01$) as well as for /f/ than /v/ ($p < .02$). Thus, Arabs seem to be making progress toward an American pattern of voicing effect on consonant constriction. However, the overall differences of voicing are not as large as those of Americans.

Glottal pulsing. Arabs have produced voiced /b/ and /v/ with glottal pulsing during at least 50% of the consonant constriction. They matched the American subjects with respect to this variable, As for English /p/ and /f/, the glottal pulsing durations produced by Arabs were 22% and 20% of the consonant constriction, respectively. However, the percentage of pulsing during the constriction of /p/ and /f/ was 7% for each in the American production.

Discussion

The possible difficulty of German speakers to produce 'voiced' obstruents in word-final position in English has motivated the claim of the Markedness Differential Hypothesis that typological markedness constraints also play an important role in predicting the ease or difficulty of acquisition of the second language sounds (Eckman, 1977). Our data, however, showed that Germans have correctly acquired control of both the temporal and laryngeal correlates of voicing contrast in an English-like way. (Mitleb 1981) reported that American listeners had no difficulty to identify 'voiced' from 'voiceless' obstruents in the Germans' production of both monosyllabic and bisyllabic words and to the same degree. The Germans' success in controlling the temporal correlates of voicing in English could be attributed, however, either to a learning strategy by which our subjects might have extended the use of the voicing correlates in German bisyllabic words, which are similar to those of English (Kohler, 1979; Mitleb, 1981) in learning English or to the observation that vowels before underlying voiced obstruent are longer than those before underlying voiceless ones (Mitleb, 1981; Port, Mitleb and O'Dell, 1981). Whether or not either of these two possibilities occurred, our data violate the prediction of the Markedness Differential Hypothesis that Germans should have difficulty to produce English voicing in a marked position (word-final position). It will be recalled here that the basic data supporting the MDH was explicitly based on the German English obstruent 'voicing' problem.

As for Arabic-accented English, the Markedness differential Hypothesis would predict more difficulty for Arabs with English /f,v/ contrast than with /p-b/ contrast (both /v/ and /p/ are absent from Arabic) for two reasons. First, voiced segments are more marked than voiceless ones, and second, fricatives are more marked than stops. Our results, however, suggest that Arabs have difficulty to produce the temporal correlates of English voicing in an English like-fashion in both /p-b/ and /f-v/ contrast and to the same degree. In post-stress position, where Arabic has not been found to exhibit significant effect on neither consonant constriction nor vowel duration as a result of voicing (Flege, 1979; Mitleb, 1981; Mitleb, 1982), Arabs acquired an English constriction duration contrast which is smaller than that of American controls even if not vowel duration contrast.

Thus, this study suggests that Arabs, unlike Germans, could not correctly acquire control of the temporal correlates of English voicing because their native language does not exhibit. Vowel duration and consonant duration differences of voicing as it is the case in English and German (Mitleb, 1981; Kohler, 1979). This implies that language learners of different linguistic backgrounds when learning the same target language may differ with respect to the learn ability of non-segmental

structure of features when their native languages differ on the non-segmental level.

Notes

1. A slightly revised version of a paper presented at the 105th Meeting of the Acoustical Society of America, Cincinnati, Ohio, May 8-13. This research was supported by Yarmouk University, Irbid - Jordan.
2. Arabic /&/ differs from /x/ only in voicing. That is, /&/ is marked for /Voice/ in the Sound pattern of English (SPE).
3. According to SPE marking convention /z/ is marked for two features, /Voice/ and /continuant/, while /o/ is marked for /strident/ in addition to /Voice/ and /continuant/.

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