

## SOME CHARACTERISTICS OF VOT IN PLOSIVES SPOKEN BY ARABIC LEARNERS OF ENGLISH

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### ABSTRACT

The aim of this study is to determine to what extent Arabic learners of English are able to correctly realize the Voice Onset Time (VOT) of both Arabic and English /t/ when they learn English as a second language (L2) in adulthood. Acoustic measurements of VOT revealed that although the Arabic learners of English were able to detect the acoustic differences between Arabic and English /t/ and to produce /t/ with more aspiration in English than Arabic, they were unable to reach the phonetic norms of English /t/ because of equivalence classification.

### 1. INTRODUCTION

It is generally assumed that voicing contrasts are marked differently along the Voice Onset Time (VOT) dimension in languages such as English as opposed to French or Spanish. In English, voiceless stops /p, t, k/ are produced with a long-lag VOT accompanied by aspiration, whilst in Spanish and French, they are realized with a short-lag VOT. Arabic was chosen as the counterpart to English in this study because the phonetic contrast between voiced and voiceless stops in Arabic appears to differ from that of English and because Arabic lacks /p-b/ contrast [1], but not that of /t-d/ and /k-g/. These cross-language differences offered the opportunity to assess how a difference in phonological inventory as well as more subtle differences in the phonetic implementation of a phonological contrast would affect production of foreign language speech sounds by adult language learners. Moreover, cross-language studies [2, 3, 4, 5] that were interested in VOT production of similar consonants by second language (henceforth, L2) learners confirmed that while early learners were able to match VOT values of native speakers of English, late learners manifested VOT values that were intermediate to those

observed in native speakers of their first language (henceforth, L1) and in native speakers of English. In light of these findings, the present study is designed to test the Speech Learning Model (henceforth, SLM) hypothesis [6, 7] regarding the production of similar L2 consonants. More specifically, we want to learn whether Arabic learners of English can accurately produce the VOT of /t/ at the beginning of English words.

### 2. METHODS

The speech material consisted of 10 CVC words in Moroccan Arabic and American English (C1= /t/, V= /a/ and C2= /b, d, p, t, k, q, h, ʒ, ʒ/ inserted in a carrier sentence "He said two times." Twenty-four subjects: 8 native Americans, 8 native Moroccans and 8 Arabic learners of English produced five repetitions of each CVC word. Acoustic measurements of VOT were made in Arabic words spoken by Arabic monolinguals, in English words spoken by American monolinguals, and in Arabic and English words spoken by Arabic learners of English. The speech of Arabic and English speaking subjects was examined to estimate the phonetic norms of Arabic and English. Audio recordings (Sony TCD 5M) were made in a soundbooth with a microphone (Nakamichi CM 300) placed about 6 in. from the mouth. The tape-recorded stimuli were digitized at 10 KHz with a 16-bits amplitude resolution and analyzed with the Unice speech analysis program [8]. The VOT of /t/ was measured from the beginning of the burst release (seen as a wide-frequency vertical striation) to the onset of periodicity in the region of the second and higher formants (seen as quasi-periodic striations) [9].

### 3. RESULTS

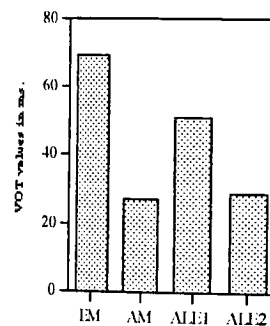


Figure 1. Mean VOT values for the three groups of subjects: EM (English Monolinguals), AM (Arabic Monolinguals) ALE1 (Arabic Learners of English producing English stimuli), ALE2 (Arabic Learners of English producing Arabic Stimuli).

The results presented in figure 1 indicate that:  
- The mean VOT values for /t/ of the American monolinguals (69ms) is substantially longer (42ms) than the Arabic monolinguals (27ms). This implies that English /t/ is marked by the presence of an appreciable interval of aspiration after stop release. Arabic /t/, on the other hand, has less aspiration and thus short VOT [10] (see figure 2).  
- The Arabic learners of English realized Arabic /t/ with a slightly longer VOT (29ms) than the Arabic monolinguals (27ms). However, a paired t-test analysis revealed no significant difference between the two groups ( $t(39) = 0.69$ ;  $p < 0.494$ , two-tailed). This result indicates that learning English as a second language has no significant effect on the production of the native language.

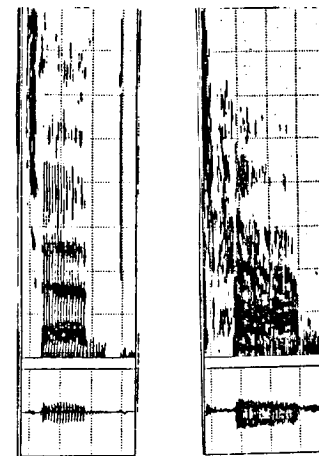


Figure 2. Spectrograms of the word /t/ in Arabic (left) produced by Arabic monolinguals and in English (right) produced by American monolinguals.

- The mean VOT values of the Arabic learners of English vary as a function of the target language: a long-lag VOT (51ms) for English /t/ and a short-lag VOT (29ms) for Arabic /t/ (see figure 3).



Figure 3. Spectrograms of the word /t/ in Arabic (left) and in English (right) produced by Arabic learners of English.

- The mean VOT values for the English /t/ produced by the American monolinguals

are longer (69ms) than those produced by the Arabic learners of English (51ms). A paired t-test analysis revealed a significant difference between the two groups ( $t(39) = 17.07$ ;  $p < 0.001$ , two-tailed). This shows that the Arabic learners of English have not yet reached the phonetic norms of English. This finding is consistent with previous studies of L2 speech production [11, 12, 13].

The overall pattern of results obtained in the present experiment revealed that the Arabic learners of English produced /t/ with significantly longer VOT values in English than Arabic, but with significantly shorter VOT values in English words than the American monolinguals did. This suggests a pattern of partial phonetic approximation rather than of complete mastery of English by Arabic learners of English. A comparison of the three groups of subjects indicated that the Arabic learners of English realized the English /t/ with VOT values intermediate between those of the Arabic monolinguals and those of the Americans.

#### 4. DISCUSSION

The discussion deals with the factors that led the Arabic learners of English to realize English /t/ with intermediate VOT values.

##### 4.1. Age of learning English

The Arabic learners of English began learning English late (at 16 years of age) at a Moroccan University. Even though this late learning helped them to detect auditorily subtle acoustic differences between Arabic and English /t/ and to produce /t/ with more aspiration in English than Arabic, they failed to judge these two sounds as realisations of two different phonetic categories and to establish a new phonetic category for English [t<sup>h</sup>] to produce it correctly. According to the SLM developed by Flege, this failure in phonetic category formation may be blocked by equivalence classification. This perceptual mechanism leads L2 learners into "equating" (identifying) an L2 sound with an auditorily distinct sound in the L1 inventory thereby rendering them unable to make effective use of sensory input in speech learning.

##### 4.2. New phonetic category

Arabic learners of English in this study produced the /t/ in English words with VOT values that were intermediate between short-lag and long-lag values typically observed for Arabic and English, respectively. This means that they merged the phonetic properties of similar L1 and L2 phones within a new phonetic category [t<sup>h</sup>] different from that of the American monolinguals. To realize /t/ accurately in English, Arabic learners of English must, in addition to the establishment of a new phonetic category, either modify the realisation rules used for outputting existing phonetic categories (i.e. [t]); or develop new realisation rules to be used when speaking English.

##### 4.3. Phonetic Input

By phonetic input, we refer to the origin of the learning conveyed to our subjects. That is, who taught English to them?

It is likely that our Arabic subjects were exposed to English spoken by native speakers of Arabic (Moroccan) in which /t/ was realised with VOT values intermediate to the short-lag and long-lag values typifying Arabic and English, respectively. Thus, the subjects examined here may have produced the English /t/ with about the same intermediate VOT values they heard. Perhaps our non-native subjects would have produced better /t/ had they received better (i.e., more accurate) English-language phonetic input.

#### 5. CONCLUSION

The main conclusions to be drawn from this study are as follows: To improve English learning, it seems preferable for the Arabic learners of English to:

- 1- Begin learning English at an early age in order to acquire sufficient L2 experience and more phonetic input.
- 2- Spend more time in a country where English is the dominant language.
- 3- Receive sufficient native-speaker (American English) phonetic input.
- 4- Develop English phonetic realisation rules to lengthen the VOT of English /t/.

1 A similar L2 phone is a phone that is related to a corresponding phone in the

L1 yet differs acoustically from the L1 counterpart. E.g., /t/ is found in both French and English, but it is implemented as a short-lag stop with dental place of articulation in French and as a long-lag stop with alveolar place of articulation in English

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#### INDEX

Speech materials used to elicit production in the Arabic and English stimuli.

##### Arabic stimuli

- tah (wandering)
- tab (repented)
- ta<sup>2</sup>(belong)
- ta<sup>3</sup>(crown)
- taq (believed)

##### English stimuli

- tab
- tap
- tack
- tad
- tat