Voice Onset Time in Egyptian Arabic: A Case where Phonological Categories Dominate

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ABSTRACT

Phonetic categories of voicing- exemplified in voice onset time (VOT)- in Colloquial Egyptian Arabic (CEA) reflect directly the phonological opposition of voicing. CEA has a "model" pattern of long lead versus short lag for voiced and voiceless stops respectively. This phonological domination is further embodied in the complete compliance of data to this pattern. There was not a single case of overlap between the two categories. In addition, our data showed low degrees of variability within each category. VOT has been tested as a function of sex, emphasis, length of the following vowel, place of articulation and stress. Of these variables, only stress and place of articulation have shown significant influence on VOT. However, the effect of neither stress nor place was strong enough to distinctly categorize data or to override the basic pattern of VOT.

1. INTRODUCTION

Studies on Voice Onset Time (VOT) represent the bulk of a large literature on the phonetic manifestations of voicing. This literature exemplifies one of the arenas in which a fierce conflict between phonology and phonetics took place.

Literature on VOT includes two lines of inquiry. The first one is purely phonetic in which phonetic correlates, mainly the acoustic ones, are investigated and the covariates are set up. The mission of this line is – to some extent – successful. We now know that voicing is correlated with several acoustic variables of which VOT is the most important [1, 13, 17, 20, 26,]. We also know that there are several variables influencing these acoustic manifestations, e.g., age, sex, dialect, stress, lexical context, speaking rate, quality of the following vowel, place of articulation. However, the interaction between these variables is complex and we do not know of a study that has investigated the relative weights of these variables in a multidimensional experimental setting. Also the contributions of these variables are language-specific. Studies in different languages reported contradictory results for the same variables so that, as Cho and Ladefoged [5] put it, neither of the so-called universal patterns is inevitable. In addition, it is still vague whether the co-variation between acoustic correlates of voicing is mechanical, due to some physiological or perceptual constraints or of a trading relationship type dictated by higher-order variables [17, 24]. Perhaps the most serious drawback of phonetic investigations of voicing is their limited scope of experimental settings. Experiments were conducted mainly on stops in initial position and with small number of speakers.

The second line of inquiry is phonological in nature. Its major goal is to introduce substitutes for [voice] feature, one of the most stable distinctive features. In the early stages of study, Householder, cited by Lisker and Abramson [15], cast doubt on the primacy of voicing feature based on some anomalous observations. Despite this doubt was immediately rejected by the pioneering work of Lisker and Abramson [15], implicit and explicit challenge of [voice] feature continued. Several substitutes were introduced [6, 14, 23, 27] of which VOT was the most prominent. These trials were unsuccessful, and suggested features could not replace [voice] feature in the universal set of distinctive features or even as universal phonetic categories [18]. The main cause for that failure is the abovementioned drawbacks of phonetic investigations of voicing and the lack of enough research in "cognitive phonetics" [25] or "laboratory phonology" [7, 19] on cognitive interpretations for the complex behavior of acoustic correlates of voicing.

This study adds to the body of knowledge about VOT in different languages by investigating it and its relation to different variables in Colloquial Egyptian

ISBN 1-876346-48-5

Arabic (CEA). It also sheds light upon the relation between phonological and phonetic categories of voicing in CEA and its implications on the phonological representation of voicing.

2. EXPERIMENT

Five females and five males aged between 19 and 25 years old served as the subjects of this study. They uttered 77 minimal pairs in isolation. These minimal pairs were chosen to represent the opposition between /t/, /d/, and /k/, /g/ initially in stressed and unstressed syllables and with plain and emphatic qualities. The bilabial stop /b/ was excluded because CEA does not have /p/ as a phoneme.

Analogue speech material was digitized and analyzed using the Speech Filing System software of University College London. VOT values were measured as the time between the release of the stop and the start of the vibration of the vocal folds as revealed acoustically in the spectrograms.

VOT is seen in this experiment as a function of several independent variables, i.e., sex, emphasis, length of the following vowel, place of articulation and stress. Using a factorial design [21], VOT values of voiced and voiceless consonants under investigation were arranged in paired sets to test the significance of VOT differences between males and females, plain and emphatic qualities, in long and short stressed syllables, dental and velar places of articulation, and in stressed and unstressed syllables.

3. RESULTS AND DISCUSSION

Figure (1) represents the scatter diagram of the VOT data based on 698 values for voiced and voiceless consonants. Several values of the original pooled data (N = 770) were discarded for suspicion of error in measurement.

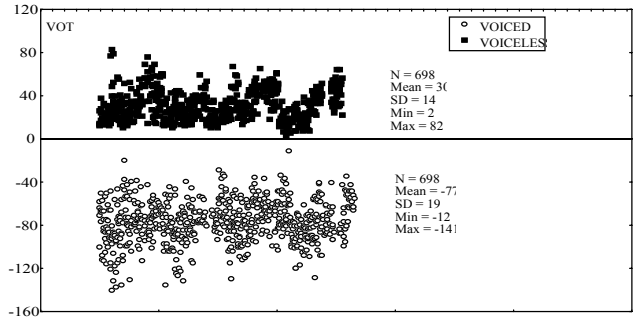

Figure 1. General profile of VOT data.

The figure shows that the voicing contrast pattern in CEA is long lead versus short lag for voiced and voiceless stops respectively. This pattern is similar to that of other Arabic dialects [9, 10, 12, 22, 27]. However, two observations strike us as being unique to our data. The first is the total consistency of this pattern. There is not a single observation that violated this pattern. This total consistency is uncommon in VOT observations – given comparable number of speakers and tokens - for Arabic (e.g. [27]) or other languages (see [15]). The second noticeable observation is the small values of standard deviations (SD) suggesting the low variability of data. Yeni-Komshian et al. [27] reported values of SD for Lebanese Arabic as low as ours, while Byrd [2] reported much higher values of SD for American English. CEA exhibits a "model" pattern of VOT, a pattern that coincides with the phonological treatment of voicing opposition. Phonetic categories of voicing in CEA conform to phonological ones.

Mann-Whitney U Test was conducted to measure the significance of difference between paired sets of data set out to investigate variables affecting VOT. Table (1) shows the results of the test.

Categories	P value	Significance
Male/female	0.6359	Not significant
Long/short	0.7691	Not significant
Stressed/unstressed	0.0001	Significant
Plain/emphatic	0.1986	Not significant
Dental/velar	< 0.0001	Significant

Table 1. Results of Mann-Whitney U Test.

It is apparent from the table that there are no significant differences between VOT values of male and female, before long and short vowels, and with plain and emphatic qualities. However, stress and place of articulation affect VOT significantly. Figure (2) shows the box plots of voiced and voiceless VOT values in stressed and unstressed positions. VOT tends to increase in effect to stress. This increase comes primarily from voiced VOT values rather than voiceless ones. This is perhaps due to the type of CEA VOT pattern. As voiceless stops always have positive values and are followed by vowels, they do not have a wide space to move in and the effect of stress is kept within narrow margin of dispersion. This effect of stress is characteristic to CEA. Klatt [13] reported no

ISBN 1-876346-48-5

difference in VOT between stressed and unstressed voiced stops in English. He found, contrary to our results, that voiceless stressed stops have longer VOT than unstressed cognates (see also, [16]). His hypothesis that stressed stops are produced with greater glottal opening gesture does not apply to CEA. Cho [4] reported a significant difference between voiceless aspirated stops in stressed and unstressed positions in Lakhota (one of Siouan Languages) but found no such difference between voiceless unaspirated stops (see also similar results for English cited in this study). His suggestion of the feature [spread glottis] to account for his observations does not also apply to CEA.

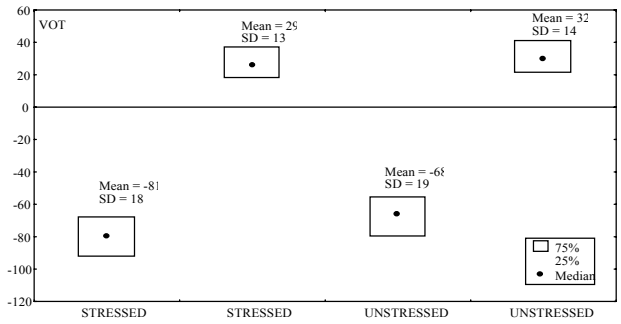

Figure 2.Voiced and voiceless VOT in stressed and unstressed positions.

Figure (3) reveals that VOT increases as the place of articulation moves from dental to velar in voiced and voiceless stops. Similar results have been reported in several studies [1, 2, 3, 5, 8, 11, 13, 15] and arguments presented in these studies to explain place effects on VOT hold true for CEA.

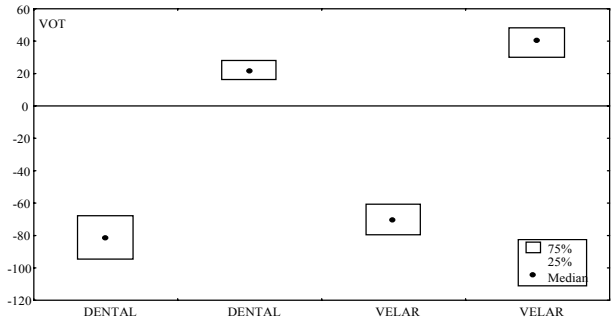

Figure 3.Dental and Velar VOT.

However, it is worth noting that neither of stress or place of articulation effects is completely consistent and the overlap between stressed/unstressed and dental/velar VOT values is frequent. In other words, effects of stress and place of articulation were not strong enough to shape VOT data into distinct categories or to override the long-lead/short-lag pattern of CEA voicing.

4. CONCLUSION

We have perceived results of CEA VOT as being phonologically dominated. This domination materialized in the long lead and short lag pattern of voiced/voiceless categories, and the complete consistency of this pattern that overrode variable phonetic contexts. It is not surprising to see that [voice] feature is not void of solid empirical content; a fact that has been unjustifiably – even to the pioneers of this area [15] − doubted in the early stages of VOT studies. Misguided by enthusiasm to provide alternative voicing features, and busy with indispensable descriptive research, phonetic investigations on voicing in the last four decades failed to address the right issues. Research from both "cognitive phonetics" and "laboratory phonology" should ask the same questions. These questions are primarily concerned with the cognitive nature of voicing. Until such research accumulates it seems that we have to resort to [voice] feature.

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