A COMPARATIVE STUDY OF VOICE ONSET TIME (VOT) IN MADURESE AND ENGLISH WORD-INITIAL PLOSIVES

Misnadin
Program Studi Sastra Inggris
Universitas Trunojoyo Madura
Email: misnadinunijoyo@yahoo.co.id

Abstrak

Artikel ini membahas Voice Onset Time (VOT) bunyi hambat bahasa Madura dan dikomparasikan dengan bunyi hambat bahasa Inggris. Tujuannya adalah untuk mengetahui apakah kedua bahasa tersebut memiliki konfigurasi VOT yang sama mengingat baik bahasa Madura maupun bahasa Inggris memiliki konsonan letup beraspirasi tak bersuara.

Kata kunci: VOT, konsonan letup, aspirasi

INTRODUCTION

This present paper presents a preliminary investigation into some acoustic characteristics of four groups of stops in Madurese, an Austronesian language spoken in Madura, East Java, Indonesia. Madurese exhibits a relatively interesting feature in terms of the number of stops it posseses in comparasion with its neighboring languages such as Javanese, Balinese and Sundanese. Madurese is unique due to the fact that it has a five-way contrast (labial, dental, retroflex, palatal, and velar) as well as a three-way phonation contrast (voiceless, voiced and voiceless aspirated) in the stops (Ham, 2000).

Until recently Madurese has not been well-studied yet and this may indicate that a number of its aspects need further investigation from both phonetic and phonological viewpoints. In conjunction with this, there have been two major studies concerning Madurese phonetics and phonology. The first study was carried out by Steven (1968). Steven’s study dealt with the Madurese phonology and morphology from a very general perspective. The second study was conducted by Ham (1998). He investigated the phonetic and phonological aspects of geminate timing by comparing four languages, one of which is Madurese. However, both studies have not provided comprehensive treatments and examinations on the phonetics and phonology of Madurese.

The present study seeks to investigate and describe some acoustic characteristics of labial stops /p, b, p^h/, dental stops /t, d, t^h/, palatal stops /c, ɟ, c^h/ and velar stops /k, g, k^h/ occurring in word-initial positions, while retroflex stops /ʈ ʈ^h ɖ/ are simply excluded from this study because they never occur word-initially. In fact, they only take place in word-medial positions in Madurese. Specifically, the study focuses on the examination and description of voice onset time (VOT) of the Madurese word-initial stops.

Voice onset time (VOT) is a temporal acoustic parameter defined as the time between the release of the oral constriction for plosive production and the onset of vocal fold vibrations (Lisker & Abramson, 1964). It can also be defined as ‘the interval between the release of a stop and the start of a following vowel’ (Ladefoged, 2001: 120).

In this respect, Lisker & Abramson (1964) divides VOT into two types, namely positive VOT and negative VOT. Positive VOT, also called ‘voicing lag’, occurs when the vocal-fold activity starts after the release of the stop closure, while negative VOT, also called ‘voicing lead’, takes place prior to the closure release. On the basis of the study of initial prevocalic stops in 11 languages, they also categorized stops across languages into three types based on mean VOT values: (1) voiceless unaspirated stops (0 – 25 ms), (2) voiceless aspirated stops (60 – 100 ms), and (3) voiced stops, in which the vibration onset starts before the release of the stop closure.

In their comparative study on Spanish and English initial stop consonants, Lisker & Abramson (1964) also found that Spanish has leading (negative) VOTs for initial /b, d, g/ and short positive VOTs for /p, t, k/. On the contrary, English initial stops /b, d, g/ and /p, t, k/ respectively exhibit short and long positive VOTs. This study shows that stops in languages may behave differently in terms of the characteristics of VOTs they possess.

VOT is found to be much greater in velars than in bilabials, while coronals have typical intermediate values (Stevens & Hajek, 2004; Riney, 2007). The reason for velar stops having a longer VOT than alveolar or bilabial stops is the relative size of the supraglottal cavity behind the constriction. With the velar stop, greater air pressure builds up in the vocal tract because the supraglottal cavity becomes smaller and it takes longer for the pressure to fall at the beginning of the release phase. Another factor that may contribute to voice onset time difference is vowel quality. In this case, it has been suggested that high tense vowels have longer VOTs than low lax vowels (Port & Rotunno 1979; Rosner et al, 2000;). However, the correlation between voice onset time and vowel quality may vary from language to language or tends to be language-specific and until recently no definite conclusion has been reached in relation to this issue (Chao & Chen, 2008).

PROCEDURE

The data comprise a number of target words read in a simple carrier sentence by one adult male native speaker of Madurese, recorded using Praat program. The carrier sentence is *Sengko ngoca’*_____ “I say____”.

The target words are words which contain labial stops /p, b, pʰ/, dental stops /t, d, tʰ/, palatal stops /c, ɟ, cʰ/ and velar stops /k, g, kʰ/ occurring in word-initial positions. For the sake of simplicity, however, the present study does not involve various vowels in combination with the stops. The speaker read the following two-syllable words in the carrier sentence with three repetitions: (1) [padɤ], [bɤdɤ], [pʰɤʊ], (2) [tapɛ], [dɤ:i], [tʰɤr:ɤs], (3) [cɛrɛt], [ɟɤgɤ], [cʰɤkʰɤ], (4) [kala], [gɤgɤʔ], [kʰɤrʊ]. The results were compared with English plosives which were pronounced by the writer as the second language speaker of English. Using spectrographic displays within Praat program, the VOT for each token or word was measured and the measurement results were analyzed.

RESULTS AND DISCUSSION

The following table exhibits the results of the VOT measurement for the word-initial plosives in Madurese.

Table 1. VOT of Madurese initial plosives

	VOT of Madurese Initial Plosives	
	VOT in ms	Phonetic Transcriptions
[p]	18	[padɤ]
[pʰ]	55	[pʰɤʊ]
[b]	-89	[bɤdɤ]
[t]	24	[tapɛ]
[t]	37	[tʰɤr:ɤs]
[d]	-78	[dɤ:i]
[c]	31	[cɛrɛt]
[cʰ]	54	[cʰɤkʰɤ]
[ɟ]	-58	[ɟɤgɤ]
[k]	14	[kala]
[kʰ]	35	[kʰɤrʊ]
[g]	17	[gɤgɤʔ]

As stated by Lisker & Abramson (1964), VOT is divided into two types, namely positive VOT and negative VOT. Positive VOT, also called ‘voicing lag’, occurs when the vocal-fold activity starts after the release of the stop closure, while negative VOT, also called ‘voicing lead’, takes place prior to the closure release. In this case, Madurese plosives can also be categorized into this classification as shown in the table above.

Negative VOT in Madurese plosives

In negative VOT, the vocal-fold vibration starts before the burst of a plosive. There are three word-initial stops in Madurese which can be considered as having negative VOT, namely the voiced bilabial stop /b/, the voiced alveolar stop /d/, and the voiced palatal stop /ɟ/ with VOTs of -89, -78, and -58 ms, respectively.

Table 1 also shows that the VOTs of the stops decrease in relation to the place of articulation in which the stop which occurs at the front of the mouth tends to have a higher negative VOT, while the stop whose place of articulation involves the back of the mouth tends to have a lower VOT.

Positive VOT in Madurese plosives

In positive VOT, the vocal-fold vibration starts after the burst of a plosive. Based on the VOT measurement of word-initial consonants, the number of positive VOT plosives in Madurese is found to be larger than the number of negative VOT plosives, the ratio of which is 9:3, that is, nine positive VOTs and three negative VOTs.

The following section focuses on the classification of positive VOT plosives based on the length of VOTs. To serve this purpose, the VOTs are grouped into three categorizations, namely high, medium, and low VOTs. For the purpose of the present paper, High VOTs range from 50 – 60 ms; medium VOTs from 24 – 40 ms, and low VOTs from 0 – 20 ms.

The result of the VOT measurement shows that there are two Madurese plosives which can be categorized as having high VOTs, that is, the voiceless aspirated bilabial stop /p^h/ and the aspirated palatal stop /c^h/; their VOTs are 55 and 54 ms, respectively. In this case, /p^h/ and /c^h/ tend to be different from the general tendency in which front consonants have smaller VOT than back consonants.

Based on such a tendency, /c^h/ should have a higher VOT than /p^h/ because the articulation of /c^h/ takes place at the back of the mouth in comparison with that of /p^h/, which occurs at the front of the mouth. However, the present paper does not aim to find the reasons why this is the case in Madurese plosives. As stated in the introduction, the purpose of the paper is limited only to the provision of a preliminary investigation of the acoustic characteristics of Madurese plosives on the basis of their VOT measurement.

The voiceless aspirated alveolar stop /t^h/, the voiceless aspirated velar stop /k^h/, the unaspirated palatal stop /c/, and the voiceless unaspirated alveolar stop /t/ with VOTs of 37, 35, 31, and 24 ms, respectively, can be classified as plosives with medium VOT length.

Again, some inconsistency occurs in the Madurese plosives with regard to its VOT length. Notice that /t^h/ with VOT of 37 ms has a higher VOT than /k^h/ with VOT of 35 ms, but the difference does not seem to be statistically significant. However, this is not the case for /c/ and /t/; /c/ has a higher VOT than /t/, meaning that they tend to be consistent with the general tendency in VOT length assumption (recall the concepts of frontedness and backness).

The Madurese plosives which may be classified as having low VOTs include the voiceless unaspirated plosive /p/, the voiced velar plosive /g/, and the voiceless unaspirated velar /k/. This group of plosives has VOTs of 18, 17, and 14 ms, in a respective manner. Notice that the VOT length which each of the plosive has in this group does not correspond to the place of articulation in terms of the frontedness and backwardness. In fact, they are inconsistent with the general tendency which assumes that a back consonant will be of higher VOT than a front one. In the case of the length of VOTs of this group, it seems to be quite obvious that it is the other way around which applies, i.e., the VOT of a front consonant is higher than its back counterpart. Notice that the VOT of /p/ is higher than that of /k/ and /g/.

As a comparison to the Madurese word-initial plosives, the following section discusses the VOTs in English plosives. The words were pronounced by the writer as the second language speaker of English. For simplicity, however, only plosives common to both Madurese and English were analyzed, while those which are not found in English are excluded from data analysis. The following table exhibits the results of the VOT measurement for the English word-initial plosives.

Table 2. VOT of English plosives

	VOT of English Plosives	
	VOT in ms	Phonetic Transcriptions
[b]	-64	[baɪ]
[d]	-97	[daɪ]

[g]	-116	[gaɪ]
[p^h]	67	[p^haɪ]
[t^h]	40	[t^haɪ]
[k^h]	85	[k^haɪ]
[p]	14	[spaɪ]
[t]	18	[staɪ]
[k]	21	[skaɪ]

Table 2 shows that English plosives have three negative VOTs, namely [b, d, g] with VOTs of -64, -97 and -116 ms, respectively. The difference between these three plosives seems to be in a regular interval compared to their Madurese counterparts as shown in the preceding section.

As has been known that English does not employ aspiration as a feature which can distinguish meaning; in other words, aspiration is not distinctive feature in English. Aspiration in English only occurs to the three voiceless stops /p, t, k/ and is predictable, i.e, it only occurs when the voiceless stops are in either word-initially or stressed syllable-initially. This is what distinguishes Madurese from English in the sense that aspiration in Madurese is not predictable and is used as a distinctive feature.

Now let us try to compare the VOTs of the three plosives in both languages. As shown in the preceding section, the VOTs of [p^h, t^h, k^h] in Madurese are 55, 37, 35 ms, while those in English are 67, 40, 85 ms, respectively. Here we can see that there is a difference between the two languages in terms of their VOTs configuration. In addition to the difference in VOT length, they also differ by the fact that in Madurese [p^h] has a higher VOT than [t^h] and [k^h], while in English [k^h] has a higher VOT than [p^h] and [t^h].

As explained in the preceding section, Madurese and English are different in terms of aspiration feature. As unaspirated voiceless plosives can only occur after the voiceless alveolar fricative /s/, for the purpose of comparison, they are juxtaposed with the unaspirated voiceless plosives in Madurese which, different from English, may occur in word-initial positions.

As shown in Table 1 and Table 2, the VOTs o f Madurese [p, t, k] are respectively 18, 24, and 14 ms, while their English counterparts are 14, 18, and 21 respectively. Again, the VOT configuration of the two languages looks so different, in which the Madurese plosive [p] has higher VOT than [k], but lower than [t]. In contrast, the English plosive /k/ has higher VOT than [t] and [p] while [t] is higher than [p]. It seems that the difference in VOT length between Madurese and English is quite regular from this comparison.

CONCLUSION

The preliminary investigation into the acoustic characteristics of labial stops /p, b, p^h/, dental stops /t, d, t^h/, palatal stops /c, ɟ, c^h/ and velar stops /k, g, k^h/ occurring word-initially in Madurese shows that a number of the plosives have VOT lengths which are inconsistent with the general tendency proposed by Steven and Hajek (2004), who claim that the VOT is found to be much greater in velars than in bilabials, while coronals have typical intermediate values.

Such an inconsistency can be found in a number of the plosives such as /pʰ/ and /cʰ/, /tʰ/ and /kʰ/, and /p/ and /k/, with VOTs of 55, 54, 37, 35, 18, and 17 ms, respectively. Even though the difference is not markedly significant, this phenomenon shows that the inconsistency does exist. For this reason, a more thorough investigation needs to be conducted to discover why this takes place in Madurese.

It is important to note that the present paper cannot be considered as representing the acoustic characteristics of Madurese plosives due to a number of factors. First, the word lists used in the study were limited in terms of the number of the words and the vowel combinations and the analyses were primarily focused on word-initial plosives excluding the retroflex stops /ʈ ʈʰ ɖ/ which do not occur word-initially. Second, the study involved only one participant. Third, it is related to the quality of voice recording which might have affected the results of the spectrographic analysis. Therefore, a comprehensive study which may overcome the three factors mentioned above is required to obtain a more valid and profound results of the Madurese plosives' acoustic characteristics.

The paper also compared the VOTs of Madurese plosives with those of English plosives and it was found that the two languages differ not only in terms of the VOT length but also in their configurations.

REFERENCES

Chao, K & Chen, L. (2008). A Cross-Linguistic Study of Voice Onset Time in Stop Consonant Productions. *Computational Linguistics and Chinese Language Processing. 13*(2), 215-232.

Ham, W. H. (2001). *Phonetic and Phonological Aspects of Geminate Timing*. New York & London: Routledge.

Ladefoged, P. (2001). *Vowels and Consonants: An Introduction to the Sounds of Languages.* MA: Blackwell.

Lisker, L. & Abramson, A. (1964). A cross-language study of voicing in initial stops: acoustical measurements. *Word. 20*, 384-422.

Port, R.F. & Rotunno, R. (1979). Relation Between Voice-Onset Time and Vowel Duration. *Journal of the Acoustical Society of America*. *66*, 654-662.

Rosner, B.S., Lopez-Bascuas, L.E., Garcia-Albea, J.E., & Fahey, R.P. (2000). Voice-onset times for Castilian Spanish initial stops. *Journal of Phonetics*. *28*, 217-224.

Riney, T.J., Takagi, N., Ota, K., & Uchida, Y. (2007). The intermediate degree of VOT in Japanese initial voiceless stops. *Journal of Phonetics. 35*, 439-443.

Stevens, M. & Hajek, J. (2004). A preliminary investigation of some acoustic characteristics of ejectives in Waima'a: VOT and closure duration. *Proceedings of the 10th Australian International Conference on Speech Science & Technology, 277-282.*