

An Acoustical Study of English Plosives in Word Initial Position produced by Malays

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ABSTRACT

This paper presents key findings from a study on the realisation of the initial plosives voicing contrast in the speech performance of learners of English whose first language is Malay. This paper also presents the results of an acoustic study of the Malay voicing contrasts with a focus on acoustic measures. Waveform and spectrogram samples were used for segmentation of utterances and for obtaining values for each measurement. Measurements were taken of VOT of initial phase of selected segments occurring singly. VOT measurements were made (to the nearest msec) from the plosive release burst to the first periodic cycle of the vowel. The release burst refers to the point at which there was a sudden spread in spectral energy indicating articulatory release. For the prevoiced tokens, VOT was measured from the onset of periodicity (which shows a visible periodic signal with low frequency energy) and assigned a negative value. Results are then presented on the realisation of the voicing contrast in English spoken by Malay speakers. The results are discussed in light of the acquisition of L2 (English) sound patterning, focusing in particular on the situation presented by acquiring L2 within an L1 (Malay) context. This study (via spectrographic analysis) demonstrates that where there is phonemic similarity (but phonetic dissimilarity) across Malay and English, L1 phonetic properties are found to be strong for Malay learners of English in the L1 environment.

Keywords: acoustic study; spectrographic analysis; Malay accented English; VOT; plosives

INTRODUCTION

There are some studies on the variety of English used in Malaysia that refer to the Malay ethnic group (for example, Zuraidah 1997) and it is important to note here that this is usually from sociolinguistic perspectives, such as Standard Malaysian English/Acrolectal/Wide Speech-Form or Colloquial Malaysian English/Basilectal/Local Dialect (see, Gill 1999, Baskaran 1987, Wong 1985). A description of Malaysian English is normally based on generally observed *social usage* (such as acrolectal *versus* basilectal) rather than at the level of phonological analysis of specific ethnic speech communities (Gill 1999, Baskaran 1987 & Wong 1985). Schneider (2007,p.44) however, claimed that “phonology of indigenous languages contributes significantly in developing (non-native) ‘local English’ in ex-colonial countries”.

It should be noted that there has been substantial research on L2 acquisition within an L1 environment (for example, Deterding & Nolan 2007, Deterding & Kirkpatrick 2006, Deterding, Wong & Kirkpatrick 2008 [English spoken by Cantonese speakers in Hong Kong]; Poedjianto 2002, 2003, and 2004 [English spoken by Indonesian]) but none of them relates to the Malay Language and people (who are resident in Malaysia). It is for this reason that this study seeks to throw some light on aspects of production of English speech sounds of learners, whose first language is Malay.

In order to scrutinise the phonetic properties of English produced by Malay native speakers, several comparisons between Malay and English need to be made. Here, I first present a description of the phonological pattern of both languages before investigating a selection of their phonetic properties. Henceforth, in this paper I refer to the specific pattern of foreign accented English in the speech performance of learners whose first language is Malay as Malay English, abbreviated ME.

Malay has 27 consonants (M.Yunus Maris 1980) including six plosives. Table 1 below shows the phonemic inventory for Malay:

Table 1: Consonants of Malay

Manner of Articulation \ Place of Articulation	Bilabial		Dental		Labio-Dental		Alveolar-Dental		Palato-Alveolar		Palatal		Velar		Glottal	
	Plosives	p	b					t	d					k	g	
Nasals		m						n				ɲ	ŋ			
Affricates									tʃ	dʒ						
Fricatives			θ	ð	f	v	s	z	ʃ	ʒ			x	ɣ		h
Lateral								l								
Trill								r								
Semi-Vowels		w											j			

(Note: Where symbols appear in pairs, the one to the right represents a voiced consonant while the other [on the left] represents a voiceless consonant)

Table 1 above shows that Malay, like English, has three voiced plosives /b, d, g/ and three voiceless plosives /p, t, k/. The following are some examples of Malay words with plosives in three different word-positions:

a) Voiceless bilabial plosives

Initial	Medial	Final
/padat/ (compact)	/rapat/ (so close)	/asap/ (smoke)
/pisah/ (separate)	/lipat/ (fold)	/sudip/ (ladle)
/pukat/ (fish net)	/rupa/ (appearance)	/tutup/ (close)

b) Voiced bilabial plosives

Initial	Medial	Final
/basah/ (wet)	/tabur/ (scattered with)	/səbab/ (because)
/bibir/ (lips)	/ibu/ (mother)	/ratib/ (chant)
/buku/ (book)	/gubah/ (to compose)	/takdʒub/ (amazed)

c) Voiceless alveolar plosives

Initial	Medial	Final
/tari/ (dance)	/atap/ (roof)	/padat/ (compact)
/tiru/ (copy)	/kita/ (us)	/sakit/ (sick)
/tulis/ (write)	/tutup/ (close)	/rambut/ (hair)

d)	Voiced alveolar plosives		
	Initial	Medial	Final
	/dapat/ (got)	/padat/ (compact)	/abad/ (century)
	/didik/ (educate)	/hidang (serve)	/abid/ (pious)
	/duri/ (spine)	/sudu/ (spoon)	/wudʒud/ (exist)
e)	Voiceless velar plosives		
	Initial	Medial	Final
	/kapal/ (ship)	/akal/ (logic)	/kagak/ (sister)
	/pikir/ (think)	/dʒika/ (if)	/amuk/ (to run amok)
	/kuli/ (labourer)	/pukat/ (fish net)	/batik/ (batik)
f)	Voiced velar plosives		
	Initial	Medial	Final
	/garu/ (scratch)	/lagu/ (song)	/mag / (mug)
	/gila/ (crazy)	/gigi/ (tooth)	/beg / (bag)
	/guru/ (teacher)	/tugas/ (duty)	/dʒag / (jug)

In general, all plosives in Malay and English occur actively in all word positions: initial, intervocalic and word-final (see Malay examples above). Unlike English, Malay voiceless plosives are always unaspirated (*i.e.* there is strictly no audible breath accompanying plosive release. However, aspirated plosives in Malay may occur in the north of peninsula Malaysia, in the areas near the border between Malaysia and Thailand. Here, this Malay dialect is highly influenced by the Thais and includes phonetic properties such as aspiration (Shahidi 2001). Nevertheless, this variety does not represent mainstream varieties of Malay). This applies to all word positions, initial, medial, and final. English, on the other hand, has aspirated and unaspirated voiceless plosives. For example, initial English /p, t, k/ when followed by a vowel in a stressed syllable as in [p^hɪn] ‘pin’, [t^hɪn] ‘tin’, [k^hɪn] ‘kin’, are aspirated strongly. In other positions, such aspiration as may occur is relatively weak, for example, preceding a vowel in an unstressed syllable or word finally (Gimson, 1978). Unaspirated plosives, on the other hand, only occur in a very restricted context, that is, when /s/ precedes the consonants as in [spɪn] ‘spin’, [sti:m] ‘steam’, [skɪn] ‘skin’.

Although Malay and English have a similar voicing pattern of obstruents *i.e.* voiced and voiceless, realisation pattern of the obstruents (according to allophonic positions) may differ across the two languages. It is, therefore, interesting to know to what extent Malay speakers move to adopt a pattern akin to that of native English speakers. The phenomenon of similarity/dissimilarity across the languages thus creates an interesting question for further research. The question is this: how close (or divergent) are the properties of English spoken by Malay native speakers to other English speakers (for example, realisations of /p, b, t, d, k, g/ across the languages)? Such a question needs a further examination of phonetic similarity and dissimilarity, to which I now turn (particularly, the realisations of /p, b, t, d, k, g/ across the languages). The present study therefore sets out to address the specific research objectives as outlined below:

- Examine the acoustic features of Malay and English initial /p, b, t, d, k, g/ as spoken by the Malay speakers.
- Identify contrast of speech sounds of two different varieties of English *via* acoustic study.

- Determine and clarify to what extent the phonetic similarity/dissimilarity influences production and perception of voicing contrast across L1 and L2.

METHODOLOGY

The production test was designed to investigate the acoustic features of initial /p, b, t, d, k, g / of Malay and ME, and how they are dissimilar from the performance of native speakers of English.

In order to examine the phonetic properties of L2 as realised by Malay speakers, speech samples of both Malay and ME are submitted to acoustic analysis and compared to determine the acoustic parameters on which the two sets of utterances differ. The production data for ME are also compared with existing research samples of native English speakers in order to establish how divergent the two varieties are.

MATERIAL

The production test involved analysis of segments in words produced in isolation. A list of 12 target words (6 Malay and 6 English) was prepared (Table 2) containing the following Malay /p, b, t, d, k, g / and English /p, b, t, d, k, g phonemes, in word-initial position. Below is the word list:

Table 2: Word List for Production Test

Language	Linguistic Variables	Word- Initial Position
Malay	p	[pas] /pas/
	b	[bas] /bas/
	t	[tas] /tas/
	d	[das] /das/
	k	[kah] /kah/
	g	[gah] /gah/
English	p	[p ^h æd] /pad/
	b	[bæd] /bad/
	t	[t ^h æb] /tab/
	d	[dæb] /dab/
	k	[k ^h æp] /cap/
	g	[gæp] /gap/

SUBJECTS

23 Malaysian university students (16 male and 7 female) with normal hearing and normal speech development participated in the production test. The subjects, aged between 20 and 23 were all Malays with Malay as their L1 and English as their L2. They were able to speak and write in both languages. Malay language was their L1 since birth and they acquired English as an L2 from their early years of education (normally at the age of 5). Throughout earlier meetings and interviews, this study verified that the subjects who were born and lived in KL or Selangor had been well exposed to the use of English as an L2 language and they had a Band 2 or 3 for their Malaysian Entrance Test (MUET) which made them fairly proficient speakers of English. They came from the middle-class socio-

economic group with an educated family background. Their parents either worked as school teachers, government officers, businessmen or politicians. They were born and raised in Malaysia and had never lived abroad.

On the first appointment, a short interview was conducted to gain information about each subject's background, as well as to introduce the study, the process of recording, the materials to be used in the recording session, and how they should be managed during recording time. The experimenter also verified that each subject was a KL/Selangor dialect user and able to pronounce the words used as linguistic materials. In the end, a specific date of recording was set up.

It should be noted that Malays, specifically of the Malay Peninsula, preserve their own dialect which is classified into four basic groups; the North Eastern, North Coastal and Southern Peninsula groups, and Negeri Sembilan (Farid 1980). The Southern Peninsula group comprises the varieties of Johore, Melaka, Central Perak, and Kuala Lumpur/Selangor. Hence, speakers of Kuala Lumpur/Selangor dialects were chosen to provide the main data for analysis in this study as these dialects represent mainstream variety of Malay.

PROCEDURE

Lists of 6 Malay and 6 English words (consisting target words and additional words) were read by the subjects. They were instructed to read the written material at a comfortable speech rate – that is, not too fast and not too slow. Additional words (which were excluded from analysis) were added at the beginning and at the end of each list in order to have the particular target words spoken with constant speech rate, *i.e.* to avoid having data produced with unstable voice.

RECORDING AND ANALYSIS

Recordings were made in a recording studio equipped with Sony condenser microphones and TASCAM 202 MK III tape recorders. Each subject was placed in the studio and had an individual microphone. Two recording sessions were carried out consecutively in Malay (first session) and English medium (second session). That is, in the English testing situation, instructions, materials, and the atmosphere in general were accentuated as being English, while in the Malay context the occasion was emphasized as being Malay. An attempt was made to divide the whole session into two separate sessions in this way.

For both languages, the same recording procedure was followed beginning with reading the Malay word list. The words to be spoken appeared on a written list placed in front of the subjects, which they were then required to read at a comfortable rate with minimum tone and stress differences. I monitored each session from outside the recording booth to ensure that my subjects did not introduce pauses or noticeable changes in speaking tempo. Such activities will affect the speech signal of the utterances and thus affect the quality of the target sounds. The second slot followed soon after the subjects finished the first slot; the same recording procedure was repeated, with all the communication or interaction in the studio made fully in English.

All the recorded speech waveforms were digitised (at a sampling rate of 22 KHz and 32 bit resolution) and stored on a compact disk. The particular section of the recording which consisted only of the production of the token was carefully analysed using the PRAAT software system (a signal processing package). The programme also included the function of expanding and amplifying the waveforms so that any measurement could be done to the nearest msec. These digitised tokens served as the basis for a waveform and wide band spectrogram. Parameters of the spectrograms were

set up at their standard values; that is, a Frequency Range of 0-5000Hz, Window Length of 0.005 seconds, and dynamic range of 50 db. This setting of Frequency Range, however, may vary according to some specific subject's speech. Female subjects, for example, may have frequency up to 8500Hz and thus a Frequency Range of 0-9000Hz needed to be set in order to capture spectral details at higher frequency.

ACOUSTIC MEASUREMENTS

This section details the segmentation procedure and the measurements that were used in the present study (specifically, the description of acoustic measurements on each segment involved this study). Measurements were taken of the initial phase of selected segments occurring singly. Samples of waveforms and spectrograms were used for segmentation of utterances and obtaining values for each measurement. In general, measurements were made by manually positioning two cursors in the display of the waveform/spectrogram in the sampled file. The beginning and ending of a particular measurement of a sound was judged from both the waveform and spectrogram.

Voice Onset Time (henceforth VOT) is the only measurement that was taken for investigating the plosive voicing contrast in the word-initial position of the present data. A plosive is categorised as having a long voicing lag (that is, long lag VOT), short voicing lag (that is, short lag VOT) or prevoicing (that is, voicing lead). Long lag VOT applies when the length of the time between plosive release and voicing onset is relatively long (exceeding around 35 msec [see Kent & Read 2002: 141]). According to Kent & Read (2002) long lag VOT means the onset of voicing begins considerably later than the transient marking the release of the plosive. Short lag VOT, on the other hand, applies when the length of time between plosive release and the initiation of voicing is either relatively short (less than 30 msec) or the plosive is released simultaneously with the start of vocal fold vibration (Kent & Read 2002, Borden, Harris & Raphael 1994). Voicing lead means vibration of the vocal folds is initiated prior to the plosive release. In measuring VOT, the moment of the plosive release is assigned the value '0', and any delay in voice onset following the release is assigned a positive value (Lisker & Abramson 1964, Docherty 1992). If voicing commences prior to the release of the plosive (that is, prevoicing) the voice onset time is given a negative value.

An example of how these word-initial VOT measurements were applied is given below using figures 1 and 2:

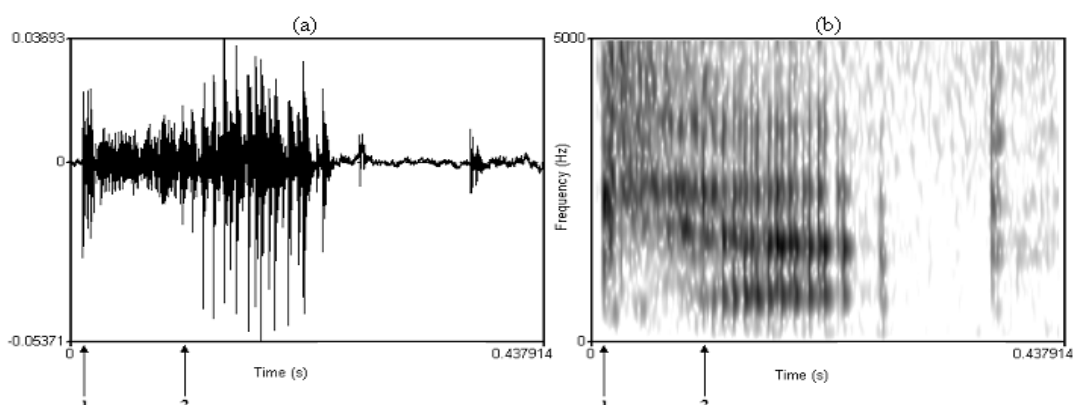


Figure 1: Waveform (a) and spectrogram (b) of word 'cap' [kQp] in English produced by a phonetically trained native English male speaker.

A positive value of VOT was marked between arrows 1 and 2 in Figure 1 above. VOT measurements for word-initial plosives were made (to the nearest msec) from the plosive release burst

(a transient burst of noise) to the first periodic cycle of the vowel; that is the onset of voicing for a following vowel (the first visible striation in the region of F1). The release burst refers to the point at which there was a sudden spread in spectral energy indicating articulatory release.

For the prevoiced tokens (that is, plosives with voicing lead VOT), VOT was measured from the onset of periodicity (which shows a visible periodic signal with low frequency energy – that is, present as low-frequency harmonics of a ‘buzz sound’) and assigned a negative value. See Figure 2 below:

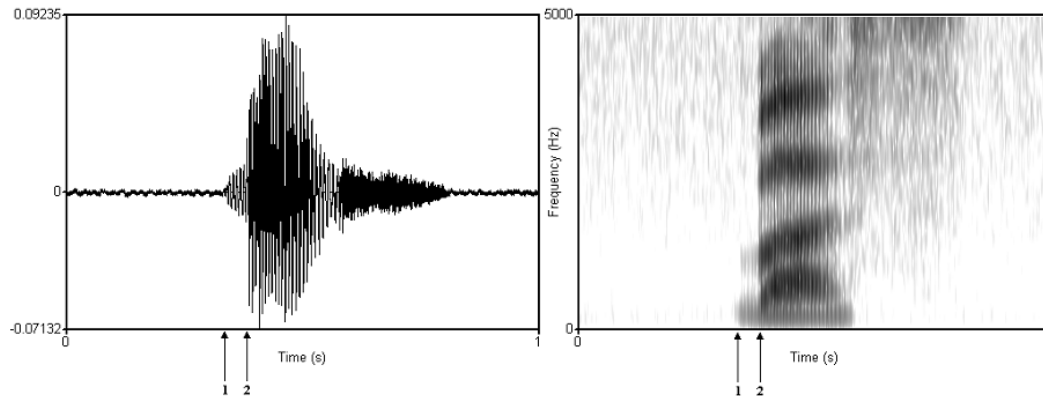


Figure 2: Waveform (a) and spectrogram (b) of word /bas/ [bas] (bus) in Malay.

Figure 2 indicates a negative value of VOT. The low intensity energy – that is, indicating low energy of voicing period at the base line of sound [b] in the spectrogram of word [bas] (pointed out by the interval between arrow 1 and 2) is termed the ‘voice bar’ and shows that voicing commences prior to the release of the plosive.

DATA ANALYSIS

As shown, the study focused on a number of acoustic properties of the initial consonant contrasts in English as realised by speakers whose L1 is Malay. Statistical analysis of the data, then, was carried out to test the significant effect of the differences between Malay and English as realised by Malay speakers, or between variables (for example, Sex and Segments) using analysis of variance (ANOVA). Sex was included in this test (ANOVA) in order to assess the extent to which the findings could be reliably pooled across the male and female subjects.

RESULTS AND DISCUSSION

Acoustic analysis of Malay and English plosives in word-initial position produced by Malay shows that VOT is a sufficient cue to differentiate initial voiced and voiceless plosives in both languages (*i.e.* separating the plosives into phonemic categories). The present investigation also shows that both languages have short lag VOT values for voiceless plosives (ranging between 10 msec and 30 msec) akin to the averages found for a number of other languages (see Lisker & Abramson 1964, Cho & Ladefoged 1999) in contrast to voiced plosives, which show a consistent presence of voicing lead (vocal fold vibration preceding the plosive release).

The results also show that the VOT differences between the two languages are relatively small, with considerable overlap in the range of VOT values for Malay and Malay accented English plosives in word-initial position as illustrated in Figure 3 below:

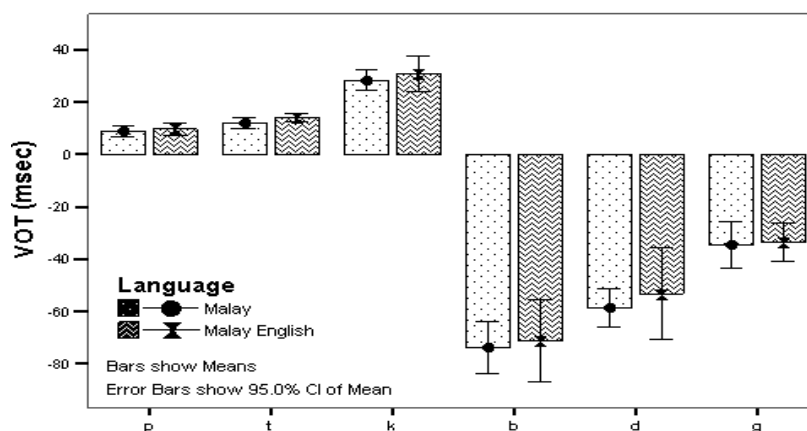


Figure 3: VOT of initial plosives in Malay and English words

A Four-way ANOVA (by Language, Sex, Voicing and Place of Articulation) revealed no significant differences for the factors Language ($p=0.302$) or Sex ($p=0.944$). The test also show significant differences for Voicing ($p<0.001$) and Place of Articulation ($p<0.001$) as well as for the interaction between Voicing and Place of Articulation ($p<0.05$). No other significant interaction was found. In addition, there was no significant inter-subject variability. It appears then that the voicing pattern of Malay and Malay accented English word-initial plosives is identical in terms of their pronunciation.

The key question in this study is to what extent Malay speakers move to adopt a pattern akin to that of native English speakers. Acoustic analysis of VOT of initial Malay accented English plosives here yields an identical pattern of phonetic realisation between Malay and Malay accented English, with plosive VOT values across the languages which are not significantly different. Figure 3 above provides evidence of this pattern. These results show that there is only one such pattern of initial plosive VOT in English and Malay as realised by Malay speakers: a single pattern of short lag *vs.* voicing lead. This finding, therefore, indicates that English as spoken by Malay speakers is totally governed by the pattern of their L1. In other words, acoustic analysis of the VOT of initial Malay accented English plosives confirms the L1 influence on L2 phonetic properties as realised in an L1 context.

Moreover, the findings highlight a distinction in the phonetic realisation of initial English plosives across Malay speakers of English and native speakers of other varieties of English. While the pattern of VOT of initial English plosives as realised by the Malay speakers had short lag *vs.* long lead, the standard varieties from within the UK and USA on the other hand both have long lag for voiceless plosives and most investigators report a bi-modal distribution for the voiced set. Docherty (1992) indicated that initial voiceless plosives as produced by RP speakers are characterised by a relatively long delay in voice onset (a long voicing lag; ranging from 18 to 127 msec). The voiced counterparts, however, show a bi-modal distribution: voicing lead (within the range -19 msec to -143 msec) and voicing lag (ranging from 3 msec to 52 msec). The same study also indicated that the latter pattern is the most common amongst native speakers of the RP variety of British English.

One finding of note in the present results is that VOT of the initial Malay and Malay accented English voiceless velar /k/ is clearly characterised by a relatively longer voicing lag than other Malay and Malay accented English voiceless plosives. The sound is not similar to English /k/. Previous studies report that English /p/, /t/ and /k/ were produced with VOTs that generally exceed

62 msec (Docherty 1992, Weismer 1979). Pooled data shows that the initial Malay/Malay accented English voiceless velar plosive (/k/) ranged from 20 msec to 35 msec, while /p/ and /t/ ranged between 0 msec to 20 msec. A post hoc Tukey test confirmed that VOT of Malay /k/ and /p/ are significantly different ($p < 0.001$), and the same applies to the VOTs for /k/ and /t/ ($p < 0.05$). The test also showed significant differences of between Malay accented English /k/ and /p/ ($p < 0.001$), as well as /k/ and /t/ ($p < 0.001$). Voiced velar /g/, on the other hand, had a very short voicing lead compared to other voiced plosives of Malay or Malay accented English. Pooled data shows that the initial Malay/Malay accented English voiced velar plosive (/g/) ranged between -50 msec to 0 msec while /b/ and /d/ ranged from -120 msec to -20 msec. A post hoc Tukey test confirmed that VOT of Malay /b/ and /d/ are significantly different ($p < 0.001$), and the same applies to the VOTs for /b/ and /g/ ($p < 0.001$), and for /g/ and /d/ ($p < 0.001$). See Figure 4 below:

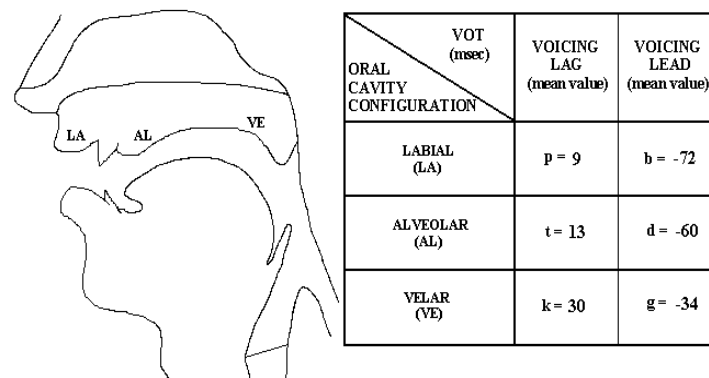


Figure 4: Relationship between plosive consonant place of articulation and VOT in initial Malay/Malay accented English

Figure 4 above also illustrates that the further back the place of articulation, the shorter the duration of voicing lead, and the longer the duration of voicing lag. This, in fact, is similar to what has been found in many other languages (see Lisker & Abramson 1964, Cho & Ladefoged 1999).

CONCLUSION

The aim of this investigation was to examine the realisation of L2 in an L1 environment. Production data shows that although English and Malay have similar phonemic contrasts for plosives, the phonetic property pattern differs (that is, for native speakers of English). As stated, the realisation pattern for the word-initial voicing contrast in Malay plosives is short-lag for voiceless plosives and *vs.* voicing-lead for voiced plosives. English, on the other hand, has a long-lag *vs.* short-lag distinction.

Experimental investigation (*via* acoustic analysis) into this pattern demonstrated that where there is *phonemic similarity* (but *phonetic dissimilarity*) across Malay and English, L1 phonetic properties are thus found to be strong for Malay learners of English in the L1 environment. In this, the data may confirm Corder's (1994), Selinker's (1972), Lado's (1957), and Weinreich (1953) *et al.*'s convictions of 'mother-tongue interference' in L2 learning.

To conclude, the results of this study show that similar phonemes in L1 and L2 are realised identically to L1 sounds. Specifically, this finding suggests that there is significant interference from the speaker's native language on phonetic properties produced in English, a process which is very likely facilitated by the congruence of phonemic systems (the consonants) across the two languages.

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ENDNOTES

A principal factor in such language interaction is that of pronunciation as a carrier of speaker identity in monolingual, bilingual and multilingual environments (Docherty & Khattab 2008).

- ² Research samples of native English speakers were taken from several studies on RP English such as Lisker & Abramson (1964), Docherty (1992), Green, Zampini & Magloire (1997), Cho & Ladefoged (1999) and Poedjianto (2002).
- ³ It should be noted here that *The Oxford Companion to the English Language* (1992) was the main source in providing the target English words (in a phonetic form; see Table 2) as well as a possible source to exemplify, in general, pronunciation of English words.
- ⁴ KL (that is, Kuala Lumpur) is the capital city of Malaysia and it is located in the middle of Selangor state. KL and Selangor are well developed and modern states compared to other states in Malaysia.
- ⁵ The word uttered by a phonetic lecturer of Newcastle upon Tyne University in 2009 and recorded by Shahidi using sony audio-recorder.
- ⁶ It was produced by Shahidi A.H (a native Malay speaker).

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