==========
Language in India www.languageinindia.com**ISSN 1930-2940 Vol. 17:3 March 2017**
==========

Comparison of Voice Onset Time of English Stops Produced by Native Kannada and Native Tamil Speakers

Deborah Deanne Athaide, MASLP
Kumudavalli S., M.Sc. (Speech and Hearing)

==========

Abstract

Introduction: In bilingual individuals, there can be an influence of the first language on the production of the second language. The nature of this influence depends on the similarities or differences between the 2 languages. The phonology of the first language can affect the realization of phonological contrasts in the second language. English has 6 oral stops which are either voiced or voiceless; voicing is contrastive in English. In Kannada stops, as in English, the voiced-voiceless distinction is contrastive however, in Tamil voicing is allophonic i.e. voiced and voiceless sounds occur in free variation. Voice Onset Time (VOT) is a measure which distinguishes between voiced and voiceless sounds. The difference in phonologies of Kannada and Tamil could possibly reflect in the production of English as a second language.

Method: 30 first language Kannada Speakers and 30 first language Tamil Speakers all of whom used English as their second language were selected as participants for the study. Voice onset times for the 6 oral stops of English in the initial position of words (a total of 30 words) produced with carrier phrases were compared in the 2 groups. Mann Whitney U test was used to compare the findings of the 2 groups.

Results: There was a significant difference in the VOT for half of the selected stimuli. Results give evidence of transfer from the first language to second language and of effects of exposure and use of second language on its production.

Implications: Results of this study, if elaborated, can be used to develop speech synthesis and speaker identification algorithms, and in algorithms to detect accented English.

Key words: Second language, Voice onset time, Kannada, Tamil

Introduction

There are many languages in India. Many people speak more than one language. English is generally accepted as the formal language and is frequently used for communication by people with different first languages. In fact, after the USA and the UK, India is the country with the largest English-speaking population. Many individuals in India, especially in urban areas, are second-language English speakers who have different first languages; they are those who acquire one language at home and begin learning English when they enter school.

Influences of L1 on L2

Individuals who are learning a second language or a foreign language use knowledge of their first language and strategies in their first language in order to learn the second language. This is known as language transfer; this transfer may happen consciously as the individual attempts to bridge gaps in his knowledge of the language or unconsciously when the individual has not learnt the correct form or if that form is not yet fully automated (Benson, 2002). If the two languages are similar, transfer can be facilitative but in dissimilar languages, transfer can hamper the learning process. Negative transfer is interference (Richard, Platt & Platt 1992).Interference is the automatic transfer, due to habit, of the surface structure of the first language onto the surface of the target language (Dulay, Burt, and Krashen, 1982). It is errors in the learner's use of the foreign language that can be traced back to the mother tongue (Lott, 1983).

Transfer has been evidenced in phonological errors in L2 (Abdulghani M.A. Al-Shuaibi, 2009; Ghatage 2013; J. Preethi, 2013) which may be related to the role of the particular feature in the L1 (McAllister et al., 2002). Transfer also occurs in grammatical aspects while writing (Mahendran Maniam, 2010).

The extent of transfer however varies from individual to individual and depends on multiple factors including immersion in L2 i.e. amount of L2 input (Linck, Kroll, and Sunderman 2009). In general, greater, more authentic, and earlier the input of L2, better is the proficiency of

L2 (Flege& MacKay 2004; Piske, Mackay, &Flege, 2001; MacKay, Meador, &Flege 2001). The transfer also depends up on the similarity or differences between the 2 languages. The features of various components of L1 can affect the corresponding components in L2. One such component of language is phonology.

Phonology of Stops in English, Kannada, and Tamil

Each language has a set of phonemes which are the smallest units of a sound. Phonemes can be either consonants or vowels. Consonants may be classified in various ways, one of which is the manner of articulation. Based on the manner of articulation, consonants can be classified into stops, fricatives, affricates, and so on.

A stop is a sound that is produced by complete obstruction of the oral cavity. Thus, the airflow is stopped completely for a brief duration. There are six oral stops in the English language. They are /p, b, t, d, k, g/. Of these, /p, t, k/ are voiceless as the vocal folds do not vibrate during articulatory closure while /b, d, g/ are voiced as the vocal folds do vibrate during closure. Thus there is a voiced- voiceless contrast in English, that is, voicing is phonemic. Aspiration, on the other hand is allophonic. Voiceless stops are aspirated in the initial position of words and un-aspirated in other positions. Voiced stops are un-aspirated in English.

The Indian languages have varying degrees of similarities and differences in their phonology, syntax and so on. In the Dravidian Language, Kannada, there is a four-way distinction of the 20 stops: voiced versus voiceless and aspirated versus un-aspirated. / p, t, T, c, k/ (T-voiceless retroflex stop, c- voiceless palatal stop) are voiceless stop consonant phonemes, whereas /b, d, D, j ,g/ (D-voiced retroflex stop, j – voiced palatal stop) are voiced stop consonant phonemes in Standard Kannada. /p^h, t^h d^h, T^h, D^h, k^h, g^h, c^h, and j^h/ are aspirated stops present in standard Kannada (L. Manjulakshi, 2003).

The Dravidian Language, Tamil has the following 5 oral stops –/ p, t, T, c, k/. The voiced counterparts of these stops - /b, d, D, j, g/, are allophones of the voiceless stops. So, there is no

voiced- voiceless contrast in the Tamil language; voiced sounds and their voiceless counterparts occur in free variation (Pandey, 2012).

Thus the phonologies of stops in these three languages are different. In Tamil, unlike in Kannada and English, voiced and voiceless cognates of a phoneme are not phonemic- rather, they are allophonic.

Production of Stops, Acoustics of Stops

From an articulatory point of view, in the production of stops there is a closure within the oral cavity, a build- up of pressure behind this closure and a release of the closure allowing the air to be rapidly expelled. Acoustically these events can be divided into five components: occlusion, transient/release burst, frication, aspiration, and transition.

Voice Onset time

Voice Onset Time (VOT) is defined as "the time with respect to release for the onset of voicing" (MacKay 1987). It is the temporal interval from the release burst of the stop consonant to the onset of the first formant (F1) frequency that reflects glottal vibration. Lisker and Abramson (1964) considered the instant of release as their reference point and assigned it zero-time. Measurements of voicing before the lead are assigned negative numbers and called "voicing lead". Measurements of VOT after the release are assigned positive numbers and called "voicing lag". If the release and voicing are simultaneous, VOT is zero.

Lisker and Abramson (1971) stated that VOT is "the single most effective measure for classifying stops into different phonetic categories with respect to voicing".

VOT in English: English voiced stops are sometimes produced with some lead values but mainly with short lag and long lag (Keating, Linker, & Huffman, 1983; Keating, 1984; Docherty, 1992). Lisker and Abramson (1964) found that voiced English stops can have two sets of VOT. They may either have a positive VOT with a short lag or a negative VOT with a voicing lead. Klatt (1975) reported positive values for both voiced /b, d, g/ and voiceless un-aspirated

stops /p, t, k/. MacKay (1987) found that VOT values in English word-initial voiced plosives are usually near zero; they are usually slightly negative or moderately positive.

VOT in Kannada: It has been shown that voiceless plosives (/p/, /t/, /k/) have long positive VOTs in the range of 30 to 100 ms (English) and 1 to 45 ms (Kannada) while voiced plosives (/b/, /d/, /g/) have negative VOTs in the range of -100 to 0 ms (English) and -126 to -60msec (Kannada) (Manjunath, N. et al., 2010).

Savithri (2007) studied voice onset time in Kannada in the initial position of stops in children and adults and found that voiced stops are characterized by lead VOT and unvoiced stops by lag VOT.

VOT in Tamil: Lisker and Abramson (1964) studied one Tamil speaker and found that Tamil has one set of stops with negative values and another set with zero or small positive values.

Influence of L1 on VOT of L2

VOT in the first language can influence the VOT in the second language. Cross-linguistic VOT studies conducted in a variety of languages indicate that stops of L2 may be produced with VOT values that are similar to those in the L1 of bilingual speakers (Chen et al, 2007). Sequential bilinguals tend to use the L1 voicing contrast to produce the voicing contrast in L2 (Shimizu 2011). They may use other acoustic differences that are present in L1 e.g. F0 in addition to VOT to contrast between voiced and voiceless sounds in L2 (Kim 2012). VOT values in simultaneous bilinguals may also show influence of one language on another as Fowler et al (2008) showed that French and English simultaneous bilinguals adopted voiceless stop categories that were intermediate between the two languages to serve both languages.

The extent of L1 influence depends up on the amount of experience with the second language (Flege 1987b, 1991).The age of acquisition of the L2 can also affect the degree of L1 influence. There are distinct patterns of production between early/simultaneous bilinguals and sequential bilinguals. The simultaneous bilinguals had monolingual-like, but not necessarily

identical, productions (MacLeod &Stoel-Gammon, 2005, 2009; MacLeod et al., 2009; Sundara et al., 2006). In contrast, the sequential bilinguals' productions were subject to a unidirectional influence of L1 on L2. The acoustic values of VOT of the bilinguals' L1 affected the acoustic values of their L2 (Caramazza et al., 1973; Hazan & Boulakia, 1993, MacLeod and Stoel-Gammon 2010).

Hence, VOT in the native language can influence VOT in the second language, in many cases. Studies on VOT in English have been done on individuals with different first languages. However, no such studies have been done on first language Kannada and Tamil speakers. Hence, the current study was undertaken to compare voice onset time in English stop consonants produced by first language Kannada and first language Tamil speakers.

Method

Participants

A total of 60 individuals within the age range of 15 to 30 participated in the study. The participants were divided into 2 groups. Group K consisted of 30 persons who were first language Kannada speakers and second language English speakers. Group T consisted of 30 persons who were first language Tamil and second language English speakers. All participants were educated in English medium schools up to at least Standard 12. Each group consisted of 15 male and 15 female participants.

Material

For the purpose of this study, 30 monosyllabic English words with stops in the initial position were chosen. Each of the six English stops /p, b, t, d, k, g/ was in the initial position of five different words. Each stop was combined in words with each of the vowels / a, u, i, e, o/ (30 words in total). Each word was preceded either by the carrier phrase "Now I will say the word" or by "Now we will talk about".

Procedure

A Sony digital recorder was used to record the responses. Recordings were taken either in a sound proof room or a quiet room. The microphone was held approximately 10cm from the subjects' mouths. All subjects were comfortably seated and were asked to read the list before recording. Each subject read each sentence twice. Thus, a total of 60 sentences were read by each subject. All the sentences read by the subjects were recorded. The samples were loaded onto the PRAAT software (Boersma&Weenink, 2008, version 5.0.27) and stored on a computer hard disk. For the initial consonant of each of the target words, voice onset time was measured using PRAAT software. The recordings were sampled at 16kHz, 12 bit quantization. To measure Voice Onset Time, spectrograms were visually inspected in the PRAAT software. For each target stop, a time marker was placed at the onset of the noise burst and another marker was placed at the onset of steady state vocal fold vibration. The first vertical striation in the second formant of the vowel following each stop was visualized to determine steady state vocal fold vibration. Since the spectrogramis displayed with time in milliseconds along the horizontal axis, direct measurement of the time between the markers, and thus measurement of VOT was possible. The point of release was considered as the reference point. It was given a value of zero. Measurements of voice onset time before this point were assigned negative values and measurements after this point were assigned positive values.

In this manner, VOT measures were carried out for all stop consonants (/p/, /t/, /k/, /b/, /d/ and /g/) selected for the study.

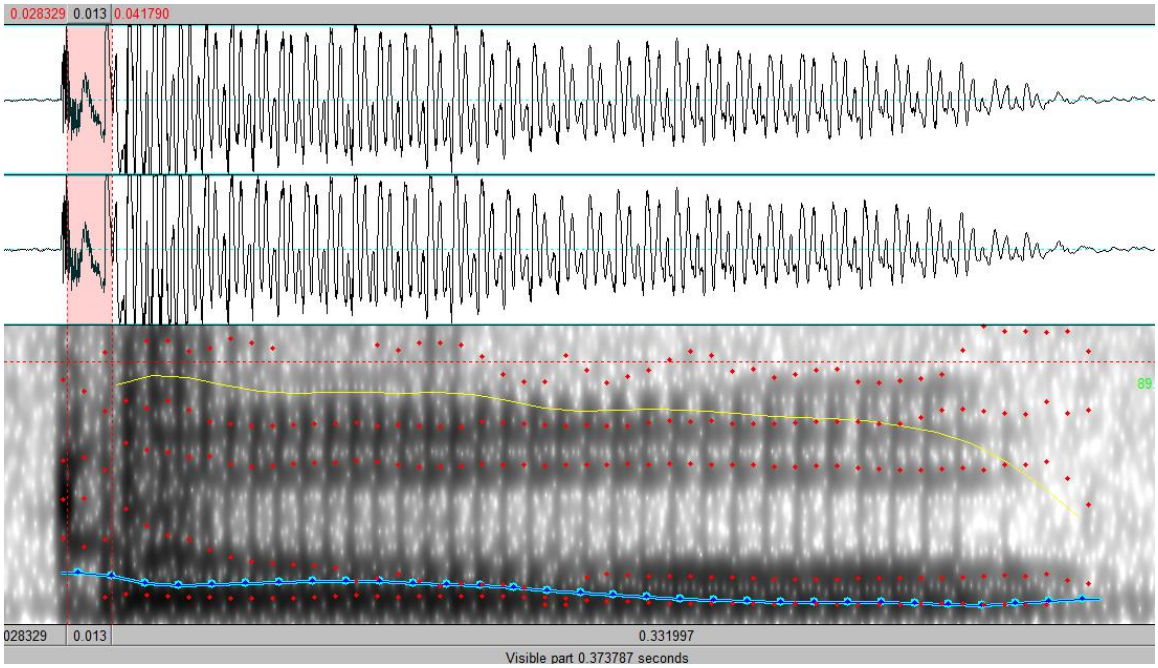

Figure 1: PRAAT window showing measurement of VOT for the word 'two' produced by a male Kannada speaker (subject 11)

In total, VOT for 60 tokens was measured for each of the 60 participants. So, a total of 3,600 (6 plosives X 5 vowels X 2 repetitions X 60 participants) tokens were acoustically analysed.

For analysis, the two productions of each word were averaged for each participant.

Statistical Analysis

The data were subjected to statistical analysis. Median and Range of VOT was determined for the initial consonants of each word of each group. Since the data did not follow normal distribution, Mann- Whitney U test was applied to determine group differences in voice onset time. The level of significance was fixed at 0.05.

Results

Results for Consonant /p/

Words	Language		U –value	p value
	Kannada	Tamil		
	Median VOT (Range) in ms			
Pour	30 (9-50)	32 (-35-79)	400.000	.460
Peel	24 (7-102)	26 (10-64)	376.000	.274
Parks	27 (16-45)	28 (-46-74)	438.000	.859
Pools	27 (0-91)	35 (0-86)	301.500	**.028**
Pay	25 (8-79)	24 (-12-54)	435.000	.824

Table 1: shows the median and range of VOT in milliseconds of the consonant /p/ in the initial position of the five target words. Mann-Whitney U values and p values are also stated.

The difference between the two groups was significant only for the word 'pools'. The results also indicate that the Kannada group produced /p/ with positive VOT values in all words. The Tamil group, however, produced /p/ with either a voicing lead or a voicing lag in 'pour', 'parks' and 'pay'.

Results for Consonant /t/

Words	Language		U-value	p value
	Kannada	Tamil		
	Median VOT (Range) in ms			
Toe	21 (10-61)	27 (11-48)	327.0	0.69

Tea	22 (8-81)	27 (11-59)	324.0	0.62
Task	28 (9-55)	27 (-24-61)	431.0	.779
Two	23 (9-78)	30 (14-71)	308.0	**0.036**
Take	25 (9-47)	28 (16-47)	344.00	.117

Table 2: shows the median and range of VOT in milliseconds of the consonant /t/. Mann-Whitney U value and p value are also stated.

The difference between the two groups was statistically significant only for the word 'two'.

Results for Consonant /k/

Words	Language		U-value	p value
	Kannada	Tamil		
	Median VOT (Range) in ms			
Coal	47 (28-88)	53 (30-95)	299.000	**.026**
Keys	49 (32-89)	60 (-46-102)	379.00	.294
Cards	44 (19-69)	41 (15-89)	403.000	.487
Cool	50 (25-104)	52 (33-97)	358.000	.174
Cakes	43 (22-75)	44 (28-85)	417.00	.626

Table 3: shows the median and range of VOT in milliseconds of the consonant /k/ in different words. Mann-Whitney U values and p values are also stated.

The difference between the two groups was statistically significant only for the word 'coal'.

Results for Consonant /b/

Words	Language		U-value	p value
	Kannada	Tamil		
	Median VOT (Range) in ms			
Bored	-83 (-114-37)	-61 (-155-60)	384.000	.329
Bees	-82 (-126- -27)	-65(-159-40)	274.000	**.009**
Bark	-72 (-146-37)	-54 (-121-48)	387.000	.352
Boot	-87 (-138 - -47)	-69 (-132-41)	290.000	**.018**
Bays	-79 (-123 - -31)	-67 (-127-33)	335.0	0.089

Table 4: shows the median and range of VOT, Mann-Whitney U values and p values of the two groups for the consonant /b/.

The difference between the two groups was significant only for the words 'boot' and 'bees'. In the words 'bees', 'boot', and 'bays', Kannada speakers always produced /b/ with a voicing lead. However, Tamil speakers produced these words with either a voicing lead or a voicing lag.

Results of Consonant /d/

Words	Language		U-value	p value
	Kannada	Tamil		
	Median VOT (Range) in ms			
Door	-81 (-130 – 30)	-49 (-123 – 31)	284.0	**.014**
Deed	-82 (-122 – 22)	-54 (-123 – 24)	291.0	**.019**
Dark	-69 (-114 – -33)	-51 (-121 – 39)	252.0	**.003**
Do	-93 (-123 – -11)	-56 (-112 – 34)	208.0	**.001**

Day	-77 (-121 – -29)	-49 (-141 – 37)	272.0	**.008**

Table 5: shows the median and range of VOTs in milliseconds, Mann-Whitney U values and p values for the consonant /d/.

The difference between the two groups was statistically significant for all the words of the consonant /d/. The Kannada speakers produced the words 'dark', 'do', and 'day' with a voicing lead while the Tamil speakers produced these words with either a lead or lag VOT.

Results for Consonant /g/

Words	Language		U-value	p value
	Kannada	Tamil		
	Median VOT (Range) in ms			
Goals	-85 (-115 – 0)	-50 (-100 – 66)	197.0	**.001**
Geese	-62 (-112 – 46)	-40 (-119 – 50)	239.0	**.002**
Guards	-66 (-107 – 42)	-28 (-131 – 63)	233.0	**.001**
Goose	-80 (-135 – 62)	-39 (-146 – 69)	277.000	**.011**
Gates	-72 (-113 – 39)	-22 (-143 – 59)	270.000	**.008**

Table 6: shows the median and range of VOT in milliseconds of the consonant /g/, Mann Whitney U values, and p values

The difference between the two groups was statistically significant for all the words of the consonant /g/.

Discussion

Compared to the VOT for Kannada stops found by Savithri (2007), the ranges and medians of English stops produced by Kannada speakers in this study were larger for all the phonemes. The VOT values of the Tamil group could not be compared as data on Tamil VOT were unavailable.

In the English language, voiced and voiceless cognates are phonemic, that is, the voicing contrast exists. In the Kannada language too, this contrast exists. This contrast is similar to the one in English. So, second language Kannada speakers will not have to learn this contrast when they learn English. In the Tamil language, both voiced and voiceless stops are present, as in Kannada. However, in Kannada, these sounds are phonemic while in Tamil they occur in free variation. First language Tamil speakers hence do not need to distinguish between voiced and voiceless sounds in their productions of stops in Tamil. Hence, speakers of Tamil use both voiced and voiceless sounds, but not contrastively, while speaking Tamil. When speaking English however, these distinctions are essential, as the voicing contrast does exist in English. Thus second language English speakers whose first language is Tamil have to learn/acquire this contrast, between voiced and voiceless stops, that is not present in their language.

In this study, there was no significant difference between the two groups for half of the words. There can be different explanations to account for these findings. Flege et al (1995, 2005), in the Speech Learning Model, posited that new phonetic categories for L2 sounds are established less often as age of L2 learning increases, suggesting that dissimilation is less likely to happen in adult learners. In this study, participants began learning L2 before the age of six (school going age). Thus, it is likely that the English voiced-voiceless category will have been established in some of these individuals. Thus, for many words there is no significant difference between Kannada and Tamil speakers. This is consistent with findings in MacLeod and Stoel-Gammon's (2010), and Sundara, Polka, and Baum's (2006) studies of early bilinguals.

Another factor that influences the extent of establishment of phonemic categories is exposure to L2 and use of L1 and L2 (Ayoama.K et al, 2004). The subjects in this study used English in educational/occupational settings on a regular basis. Since all subjects lived in Bangalore (a city in Karnataka where the language used is Kannada), use of Tamil by Tamil speakers was possibly further limited. This could also have contributed to the similar values of VOT found in Tamil and Kannada speakers.

The material used could also have contributed to similarities in the two groups. The English word list selected for the study consisted largely of frequently-used words which have minimal pairs with only the voiced-voiceless feature distinguishing them. Since, the subjects in this study, had all started learning English at a fairly young age and used English on a regular basis, it is likely that these individuals use this contrast appropriately when producing these words. It is possible that in other instances, like in the use of proper nouns, VOT differences may be prominent as the sounds are used in free variation in Tamil speakers.

However, it can be reasoned that within the group of Tamil speakers, there will be variations in the realization of the voicing contrast. This can help explain the finding that for half of the words there were significant differences between the groups. It can be speculated that Tamil speakers of English, for whom this distinction was still not well established, would produce voiced and voiceless sounds interchangeably when speaking English. This can explain the results which show that for some words (dark, do, day, bees, boot, and bays), Kannada speakers only used a lead VOT while Tamil speakers used either a lead or a lag VOT and for some words (pour, parks, pay and keys), Kannada speakers used only a lag VOT while Tamil speakers used either a lead or lag VOT. In the first language of these speakers there is no contrast between voiced and voiceless sounds so these individuals do not need to distinguish between the sounds in their productions. This may be carried over to their production of English stops too. Therefore, the differences between the two groups can be explained.

The results of this study support the notion that early and continued exposure to a second language can reduce the effect of the first language on the second languge (in this case, on VOT). However, this study also revealed that native language phonetic categories can affect learning of new categories in the second language, to some extent.

Limitations

This study neither measured VOT values in the native language of the participants (Kannada and Tamil) nor did it measure VOT of native English speakers, so direct comparisons between the first and second languages were not possible.

Implications

The findings of the present study, if elaborated, can be used to develop speech synthesis and speaker identification algorithms. It also has a potential application in algorithms that detect accented English. These may be of use to companies with Business Process Outsourcing, where elimination of the Indian accent is focused on.

==========

Appendix 1

The target word list used was as follows:

Words with carrier phrase " Now I will talk about ___"

parks cards keys cakes coal

geese pools bees bays guards tea

Words with carrier phrase " Now I will say the word_____"

twocool goose gates goals

boottask toedark do

daydoor pour take pay

peel barkbored deed

The target words for the phoneme /k/ were cakes, cool, keys, cards and coal.

The target words for the phoneme /p/ were pay, pools, peel, parks and pour.

The target words for the phoneme /t/ were take, two, tea, task and toe.

The target words for the phoneme /g/ were gates, goose, geese, guards, and goals.

The target words for the phoneme /b/ were bays, boot, bees, barks, and bored.

The target words for the phoneme /d/ were day, do, deed, dark, and door.

List of Tables

Table Number	Description
1	Shows the median and range of VOT in milliseconds of the consonant /p/ in the initial position of the five target words. Mann-Whitney U values and p values are also stated.
2	Shows the median and range of VOT in milliseconds of the consonant /t/. Mann-Whitney U value and p value are also stated.
3	Shows the median and range of VOT in milliseconds of the consonant /k/ in different words. Mann-Whitney U values and p values are also stated.
4	Shows the median and range of VOT, Mann-Whitney U values and p values of the two groups for the consonant /b/.
5	Shows the median and range of VOTs in milliseconds, Mann-Whitney U values and p values for the consonant /d/.
6	Shows the median and range of VOT in milliseconds of the consonant /g/, Mann Whitney U values, and p values.

==========

References

Al-Shuaibi, A. (2009). Phonological analysis of English phonotactics of syllable initial and final consonant clusters by Yemeni speakers of English.*Language in India, 9*(11), 195-328.

Aoyama, K., Flege, J. E., Guion, S. G., Akahane-Yamada, R., & Yamada, T. (2004). Perceived phonetic dissimilarity and L2 speech learning: The case of Japanese/r/and English/l/and/r. *Journal of Phonetics, 32*(2), 233-250.

Benson, C. (2002). Transfer/Cross-linguistic influence.*ELTJournal, 56*(1), 68-70.

Boersma, P., &Weenink, D. (2008).Praat: doing phonetics by computer (Version 5.0.27)[Computer program]. Retrieved June 28, 2008.

Caramazza, A., Yeni-Komshian, G. H., Zurif, E. B., & Carbone, E. (1973). The acquisition of a new phonological contrast: The case of stop consonants in French–English bilinguals. *Journal of the Acoustical Society of America, 54*(2), 421–428.

Chen, L. M., Chao, K. Y., & Peng, J. F. (2007). VOT productions of word-initial stops inMandarin and English: A cross-language study. In *Proceedings of the 19th Conference on Computational Linguistics and Speech Processing* (pp. 303-317).

Docherty, G.J. (1992). *The timing of voicing in British English obstruents.*New York: Foris.

Dulay, H., Burt, M. &Krashen, S. (1982). *Language Two*. New York: Oxford University Press.

Flege, J. E. (1987b). The production of "new" and "similar" phones in a foreign language: Evidence for the effect of equivalence classification. *Journal of Phonetics, 15*, 47–65.

Flege, J. E. (1991). Age of learning affects the authenticity of voice-onset time (VOT) in stop consonants produced in a second language. *Journal of the Acoustic Society of America*, *89*, 395–411.

Flege, J. E. (2005). Origins and development of the Speech Learning Model. *Retrieved December*, *13*, 2005.

Flege, J. E., & MacKay, I. R. (2004).Perceiving vowels in a second language. *Studies in second language acquisition*, *26*(01), 1-34.

Flege, J. E., Munro, M. J., & MacKay, I. R. (1995).Effects of age of second-language learning on the production of English consonants. *Speech Communication*, *16*(1), 1-26.

Fowler, C.A., Sramko, V., Ostry, D.J., Rowland, S.A., & Halle, P. (2008).Cross language phonetic influences on the speech of French‐English bilinguals. *Journal of Phonetics*, *36*(4), 649‐663.

Ghatage, M.M. (2013). Pronunciation problems of the Marathi speakers.*Language in India*, *13*(4),107-115.

Hazan, V. L., & Boulakia, G. (1993). Perception and production of a voicing contrast byFrench-English bilinguals. *Language and Speech*, *36*(1), 17–38.

Keating, P., Linker, W., & Huffman, M. (1983).Patterns in allophone distribution for voiced and voiceless stops. *Journal of phonetics*, *11*(3), 277-290.

Keating, P.A. (1984). Phonetic and phonological representation of stop consonant voicing.*Language*, *60*, 286–319.

Kim, M.R. (2012). The effects of first-language sound change on second-language speech production. *Acoustical Society of America, 18*, 60003

Klatt, D.H. (1975). Voice onset time, frication, and aspiration in word-initial consonant clusters.*Journal of Speech and Hearing Research*, *18*, 686–706.

Linck, J. A., Kroll, J. F., &Sunderman, G. (2009).Losing access to the native language while immersed in a second language: Evidence for the role of inhibition in second-language learning. *Psychological Science*, *20*(12), 1507-1515.

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

Lisker, L., & Abramson, A. S. (1971).Distinctive features and laryngeal control. *Language*, 767-785.

Lott, D. (1983). Analysing and counteracting interference errors. *ELT Journal, 37* (3), 256- 261.

MacKay, I. R., &Flege, J. E. (2004). Effects of the age of second language learning on the duration of first and second language sentences: The role of suppression. *Applied Psycholinguistics, 25*(03), 373-396.

MacKay, I., Meador, D., Flege, J. 2001. The identification of English consonants by native speakers of Italian.*Phonetica 58,* 103-125.

MacKay, Ian, R.A. (1987). *Phonetics and the Science of Speech Production*. 2nd ed. Boston: Little, Brown and Co.

Macleod, A. A. N., &Stoel-Gammon, C. (2005). Are bilinguals different? What VOT tells us about simultaneous bilinguals.*Journal of Multilingual Communication Disorders,3*(2), 118–127.

Macleod, A. A. N., &Stoel-Gammon, C. (2009). The use of VOT by early bilinguals to distinguish homorganic stops in Canadian English and Canadian French. *Applied Psycholinguistics, 30,* 53–77.

MacLeod, A. A., &Stoel-Gammon, C. (2010). What is the impact of age of second language acquisition on the production of consonants and vowels among childhood bilinguals? *International Journal of Bilingualism, 14*(4), 400-421.

Maniam, M. (2010). The influence of first language grammar (L1) on the English language (L2) writing of Tamil school students: a case study from Malaysia. *Language in India, 10*(4), 1-209.

Manjulakshmi, L. (2003). A comparative phonology of Mysore district Kannada dialects.*Language in India, 3*.

Manjunath, N., Varghese, S. M., & Narasimhan, S. V. (2010). Variation of Voice Onset Time (VOT) in Kannada Language. *Language in India, 10*(5).

McAllister, R., Flege, J. E., &Piske, T. (2002).The influence of L1 on the acquisition ofSwedish quantity by native speakers of Spanish, English and Estonian. *Journal ofphonetics, 30*(2), 229-258.

Pandey, P. (2012). Phonological inventories.*International Journal of Dravidian Linguistics,* 11-12.

Piske, T., MacKay, I. R., &Flege, J. E. (2001). Factors affecting degree of foreign accent in an L2: A review. *Journal of phonetics*, *29*(2), 191-215.

Preethi, J. (2013). Errors committed by rural students at UG level in learning English as a second language. *Language in India*, *13*(4),211-219.

Richard, Jack C. John Platt and Heidi Platt. 1992. *Longman Dictionary of Language Teaching and Applied Linguistics.* England: Longman.

Savithri, S. R. (2007). Development of voicing contrast: A comparison of VOT in stopperception. *Journal of All India Institute of Speech & Hearing*, *26*, 31-34.

Shimizu, K. (2011). A Study on VOT of Initial Stops in English Produced by Korean,Thai and Chinese Speakers as L2 Learners.In *The 17th International Congress of Phonetic Sciences* (pp. 1818-1821).

Sundara, M, Polka, L., & Baum, S. (2006). Production of coronal stops by simultaneous bilingual adults. *Bilingualism: Language and Cognition*, 9(1), 97–114.

==========

Ms. Deborah Deanne Athaide, Master of Audiology and Speech Language Pathology
Lecturer
Dr. S.R. Chandrasekhar Institute of Speech and Hearing, Bangalore.
G-08, Fortuna Classic, Near Canara Bank Layout, Kodigehalli
Bangalore 560097
Karnataka
India
deborah.athaide@gmail.com

Ms. Kumudavalli. S., M.Sc. (Speech and Hearing)
Reader
Samvaad Institute of Speech and Hearing, Bangalore.
1177, 10th B Cross
Yelahanka New Town
Bangalore 560106
Karnataka
India
kumudavalli@gmail.com