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Voice Onset Times in the Kannada Language

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INTRODUCTION

Acoustic cues which differentiate /p t k/ from /b d g/ in normal English speech have been subject to extensive previous investigations. Lisker and Abramson(1964,1967) who defined voice onset [VOT] as the temporal relation between the onset of glottal pulsing and the release of the consonant, concluded that differences in VOT, provided a useful acoustic measure of the various phonemic categories such as "Voiced Stop", "Voiceless stop", and "Voiceless aspirated stop". Voiced plosives in English normally have a short VOT (less than 20-30 msec.) and voiceless plosives on the other hand have relatively longer VOT values (more than 50 msec). Liskar and Abramson (1971) stated that VOT is the "single most effective measure for classifying stops into different phonetic categories with respect to voicing".

After the initial work of Lisker and Abramson [1954, 1967, 1971] on VOTs, several investigators (Homma, 1981; o'Shaughnessy, 1981; Enstrom 1981) reported voice onset times for different languages. More over several investigators (Preston and Yeni-Komshian, 1967; Eguchi and Hirish, 1969; Port and Preston, 1972; Zlatin and Koenigsknecht 1976; and Ravishanker, 1981) have measured VOT to objectively describe the development of voiced and voiceless production in normal children. Lisker and Abramson (1964) in their cross language study of voicing in initial stops Of 11 languages had included 3 Indian languages namely Hindi, Marathi, and Tamil. Basu (1979) reported VOT of the Kannada Language, from the speech sample collected of only five subjects. Ravishanker (1981) measured VOT of the Kannada language in large group of subjects but from the view point of developmental perspective. It was felt that the data with a good sampling of utternces from a larger group of subjects would serve as data base, to compare data from other languages and from clinical population to facilitate objective assessment of disordered speech such as voiced and voiceless distinction problenifof the hearing impaired.

METHODOLOGY:

Thirty individuals with no speech or hearing problems were selected as subjects. The mean age of the subjects was 15 years. 7 months. Test material consisted of five lists of randomly arranged 6 simple, meaningful bisyllabic words. Each bisyllabic word started with a different stop consonant of Kannada language namely /p/, /b/, /t/, /d/, *Ik/,* and *Igl* followed by the vowel /a:/. Voiced and voiceless aspirated stop sounds of the language were not included in the present study because these sounds are no longer used by the speaker of the Kannada language (Mallikarjuna, 1974). Therefore

the Kannada language is treated as having two-way category according to the number of stop categories and not as fourway category language as it was once considered to be.

Each subject read these five lists of words in front of a microphone [Cardioid 33-992A] kept at a distance of 15-20cm from the speakers mouth, and the same was recorded on a tape recorder which is built-in part of the sound spectrograph [VII 700 Series]. Using this spectrograph wide-band bar spectrpgrams were taken for the three lists out five, chosen randomly, to facilitate the measurements of voice onset time which was defined as the duration between the burst and the subsequent onset of voicing of the following vowel.

RESULTS:

Mean VOT values were obtained for /p/, *It/*, /k/, /b/, /d/ and /g/ stop consonants in the pre-vocalic contexts. Each mean value was based on 90 tokens [3 trials X 30 subjects)]. Thus there were 540 tokens for 6 stop consonants. The mean and standard deviations are presented in Table 1.

Table 1: Mean VOT Values (msec) and standard deviations of six stop consonants of Kannada language

	/p/	**/b/**	***hi***	/d/	**/k/**	***/g/***
Mean	**1**	**-67**	12	-76	**30**	**-79**
SD	**3.47**	**24.88**	5.33	33.26	**4.96**	35.79

The mean VOT values are displayed graphically in Figure 1. In the figure the vertical line represents the VOT values in msec. The center point of the vertical line at which the horizontal line joins it represents the moment of articulatory release. This point has a zero value. When the onset of voicing occurred after the articulatory release, the VOT was assigned a positive value [that is, above the horizontal line]. When the onset of voicing occurred before the articulatory release the VOT was assigned a negative value [that is, below the horizontal line].

From the table and the figure we can observe that all the voiceless stop consonants have positive VOT values [voicing lag] indicating that voicing started after the release of the articulators. However, in the case of /p/ sound a majority of the subjects, 24 out of the 30, had zero VOT value, [Fig. 2a] indicating that voicing and atriculatory release occured simultaneously in the case of /p/ sound. Figure 2 shows the VOT values of all the thirty subjects for p/b, t/d and k/g stop consonants. The mean VOT increased in duration as the place of articulation moved backward in the oral cavity [Fig 1]. That is, voicing lag increased induration from /p/ to /t/ to *Ik/*. No subject was an exception to this rule [Fig. 2].

In the present study almost all the subjects showed negative VOT values [voicing lead] for /b/, /d/ and *Igl* stop sounds. The number of individuals who had positive VOT values was very small [1 for /b/, 2 for /d/ and 1 for *Igl).* Negative VOT values indicate that the voicing occured before the articulatory release. Mean VOT values produced by the subjects increased in duration as the place of articulation moved backward in the oral cavity [Fig. 1]. However, this pattern was observed only in 11 out of 30 subjects.

DISCUSSION:

A considerable controversy still exists amona researchers concerning the nature of

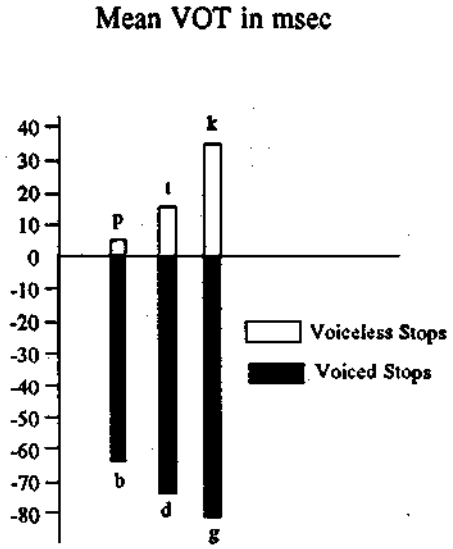

Figure 1 Mean VOT Values of p/b, t/d and k/g stop consonants.

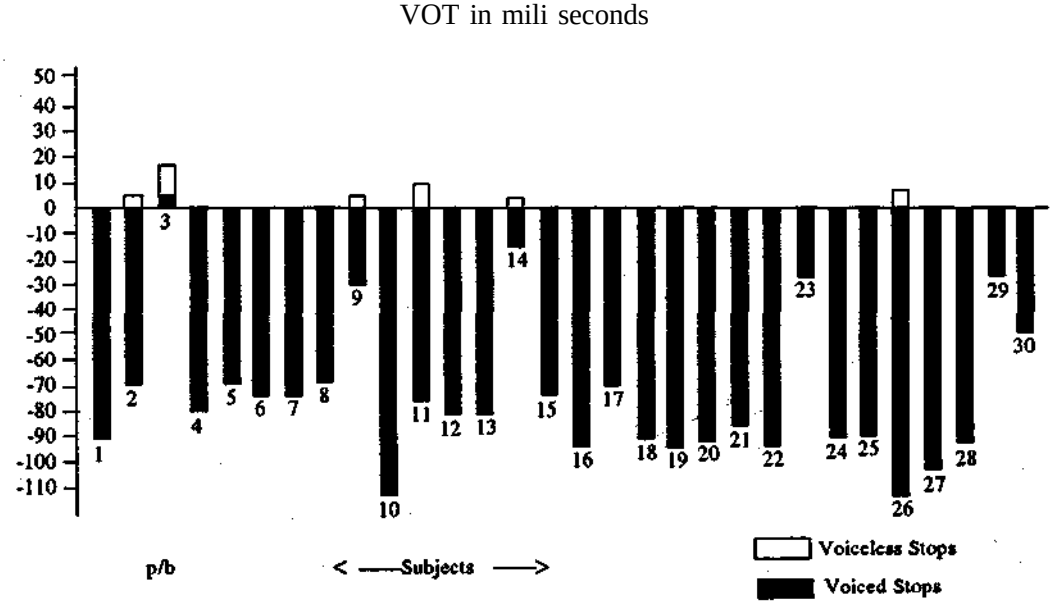

Figure 2-A: Individual VOT values of all the 30 subjects for p/b, stop consonants.

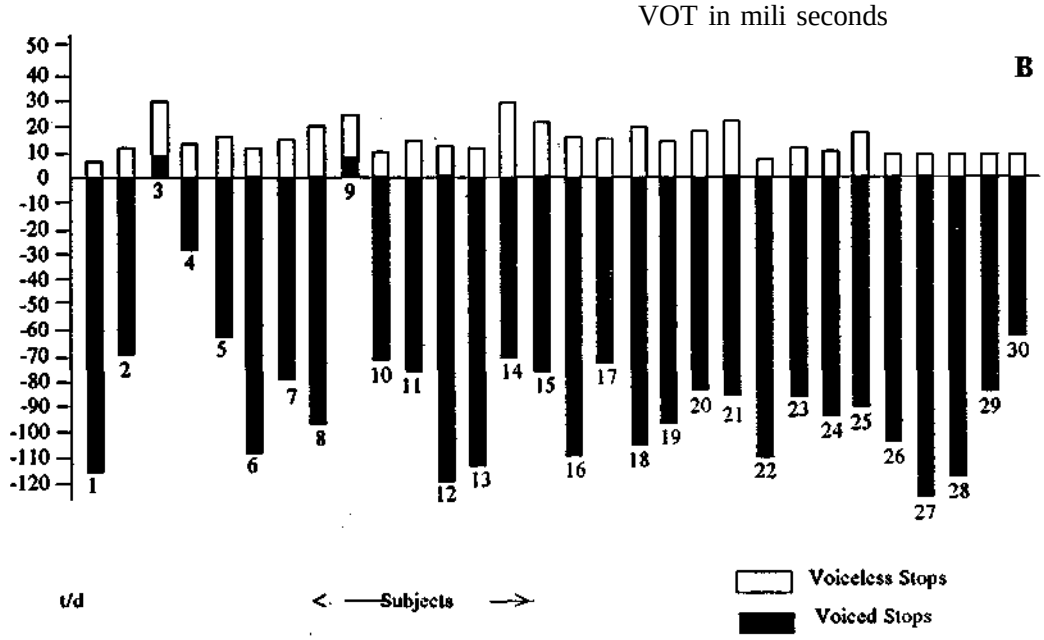

Figure 2-B:

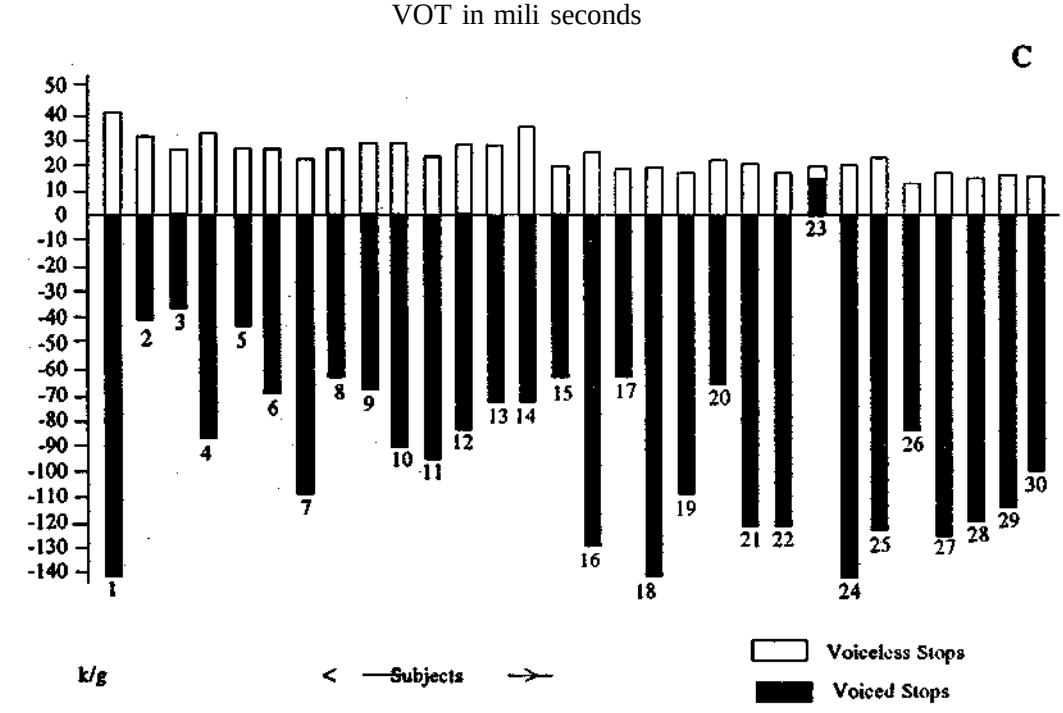

Figure 2-C: Individual VOT values of all the 30 subjects for t/d/ and k/g stop consonants.

those features which serve to characterize stops produced at the same point of articulation (Enstrom, 1981). A number of factors like force of articulation, VOT, degree of aspiration and format transitions of the adjacent vowel have been thought of as together help in distingushing stops produced at the same point of articulation.

Lisker and Abramson (1964) from their study established that VOT reliably categorizes word initial stops consonants in many languages. In the present study all the thirty subjects had positive VOT values for /p/, /t/and/k/stops. Almost all the subjects (29/30 for /b/, 28/30 for /d/ and 29/30 for /g/) had negative VOT values for/b/, /*dl* and /*gl* stop sounds [Fig. 2]. Those who did not exhibit negative VOT values for the voiced stops had positive VOT values, but these VOT values were shorter than the VOT values for voiceless stops. This finding indicates that the importance of VOT as a primary criterion in categorizing word initial stops of the Kannada language also.

Lisker and Abramson (1964) studied VOT values of 11 languages and observed a few patterns in VOT values. One of the patterns noted by them was that the voiceless stop consonants had longer positive VOT values or negative VOT values in some languages, As revealed by the present study occurrence of positive VOT values for voiced sounds in Kannada language were minimal. So we may conclude that in Kannada voiceless stop consonants are characterized by positive VOT values and voiced stop consonants are characterized by negative VOT values, Another pattern observed by Lisker and Abramson (1964 & 1967) and also found in the present study was that VOT for voiceless stops increased induration as the place of articulation moved backward in the oral cavity. This pattern was exhibited by all the thirty subjects of the study. For voiced sounds, however, mean VOT values showed this pattern, but only 11 individuals showed this pattern. Thus there is some indication that the measure of VOT is, to a certain extent, sensitive to the place of stop consonant constriction. Gilbert and Campbell (1975) suggested that the relation between VOT values and place of articulation may be a result of a difference in the speed of constriction release of articulation,

Table 2 Mean VOT of six stop consonants of Kannada and Tamil Language.

	/p/	/bl	/t/	/d/	l/k/	/g/
Kannada (present study)	**1**	**-67**	**14**	**-76**	**30**	**-79**
Tamil (Lisker & Abramson 1964)	**12**	**-74**	**8**	**-78**	**24**	**-62**

Table 2 shows VOT values of the present study along with the VOT values of Tamil language, which is another Dravidian language as reported by Lisker and Abramson (1964). Since their study included only one subject to measure the VOT values of Tamil language it is rather difficult to compare the present study with that of Tamil language. However, the comparison shows some minor differences in VOT values of different stop consonants of the two languages, for example, longer VOT for /p/ and shorter VOT for /t/ in Tamil language and this difference is more probably because of differences in sample size between the two studies, rather than due to any linguistic reasons. But we can observe that even in Tamil language which is a two category language, voiced and voiceless sounds are differentiated on the basis of negative VOT values for voiced and positive VOT values for voiceless stop

sounds. It will be interesting to ascertain whether all Dravidian languages will have similar VOT values by studying VOT values of all Dravidian languages in a large group of subjects.

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