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Fundamentals of phonetics in terms of Voice onset time

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ABSTRACT

The difference between a voiced and a voiceless sound is that during a voiced sound, the vocal folds are vibrating, but during a voiceless sound, the vocal folds are not vibrating. There is another property by which voiceless sounds can differ: they can be aspirated (accompanied by an [h]-like puff of air) or unaspirated. Aspirated sounds are transcribed with a superscript [ʰ] placed after the symbol for the unaspirated voiceless sound. The difference between voiced, voiceless unaspirated and voiceless aspirated sounds is a matter of the relative timing of oral and glottal closures/openings. These 3 stop consonants were divided into: Voiced (/b, d, g /) and Voiceless (/p, t, k /) categories. It has been found that voice- onset time for voiceless consonants is larger than the voiced consonants.It has been found that Velar has largest VOT following in descending order by Alveolar and Labial. In addition to it, effect of vowel height on voice onset time was studied, which reveal that High vowel /i/ have larger voice- onset time than Low vowel /a/.

KEYWORDS : Voice onset time, Speech recognition, Acoustics.

INTRODUCTION

Both voiceless unaspirated stops like [p] and voiceless aspirated stops like [pʰ] are produced with the vocal folds spread apart so that they cannot vibrate. The way these two kinds of stops differ is in the amount of time between the release of the stop closure and the onset of vocal-fold vibration — this is known as the voice onset time (VOT). This is the time during which aspiration occurs: note that the state of the vocal tract is just like that for [h]. We say that voiceless aspirated stops have a positive VOT, because voicing starts after the oral closure is released.We say that voiceless unaspirated stops have a VOT of (very close to) zero, because voicing starts just about when the oral closure is released. (In real life, many stops that we would classify as voiceless unaspirated stops have a very small positive VOT — voicing starts a few milliseconds after the closure release.) According to Diehl (1991), what has been considered to be purely phonetic is also phonological in character; that is to say, the domains of phonetics and phonology overlap significantly.

Speech refers to the processes associated with the production and perception of sounds used in spoken language. Speech consists of complex sound signals produced by the human vocal apparatus-an apparatus, which has the capability of producing a wide variety of speech. To study the various voice recognition systems of Hindi language, and after seeing the pressing need of the day, it has become necessary to fabricate a voice recognition system of Hindi language. To develop a voice recognition system for Hindi language, we have to study the various acoustic cues or parameters of Hindi speech sounds.

Voice onset time (VOT) refers the time that elapses between the release of the articulators for a stop and the onset of vocal cord vibration of the following segment. This period is usually measured in milliseconds (ms).

For "voiced stops" in certain contexts in English, if we pay careful attention to them or measure them instrumentally, we find that they do not have the negative VOT of true voiced stops — there is no actual voicing during the stop closure. Instead, they have a VOT of approximately zero, making them phonetically voiceless unaspirated stops like those in French, Hindi, or Thai. Contexts where English "voiced stops" are likely to be phonetically realized as voiceless unaspirated stops are at the beginning of a phrase or following a voiceless sound. When English "voiced stops" are preceded by voiced sounds, they are more likely to be phonetically voiced — that is, the voicing is more likely to continue through the stop closure. So why do some linguists call the English stops in situations like bout, door, go "voiced" when most of the time they're voiceless unaspirated? First of all, English speakers consider these stops to be cognitively (phonologically) the same sound as the sounds in about, adore, ago, which usually are truly voiced stops.

It just ends up being voiceless because not enough of an effort is made to expand the size of the oral cavity to compensate for the buildup in pressure that occurs when air is pushed through the glottis during voicing. In words like pout and apple, the [pʰ] is usually produced with the vocal folds actively spread apart to prevent voicing. There are also linguists who argue that the primary distinction between the "voiceless" and "voiced" stops of English should be seen, not as voicing, but as aspiration.

Voice- onset time is greater for voiceless stop as compare to voice stop. In relation to the former, it has been stated that the lag is longer as we move the place of articulation from front to back (i.e., from bilabial stop to alveolar stop and then to velar stop). This is due to degree of abruptness of the pressure drop upon the release of the stop. The more sudden (abrupt) the pressure drop is, the sooner the voicing of the next segment starts. Consequently, this results in less aspiration (i.e., shorter lag). When we look at stops at the three places of articulation, we see that the tongue dorsum separates more slowly (less abrupt) from the velum for /k/ than the tip from the alveolar ridge for /t/, or from the lips for /p/. Voice- onset time increases as we move the place of articulation from front to back.

In addition to the place of articulation of the stop, some studies suggest the effect of the height of the following vowel. Specifically, greater lag was observed when stops were followed by high vowels (more open articulations) than when they are followed by low vowels (narrower opening). The reason for this effect again is related to the abruptness of the pressure drop. VOT is an important characteristic of stop consonants that plays a large role in perceptual discrimination of phonemes of the same place of articulation [4]. It is also at play in word segmentation, stress related phenomena, and dialectal and accented variations in speech patterns, [5, 6]. For example, in American English, voiceless stops have a long VOT with aspiration when at the beginning of a word and when in a simple onset of a stressed syllable, but have a shorter, unaspirated VOT when embedded in consonant clusters or when in an onset of an unstressed syllable. For most languages, within a given place of articulation stops are differentiated by their laryngeal setting and its timing with respect to oral closure. In particular, voice onset times and aspiration are common contrastive laryngeal features. Within a given language, these can be represented by the features voiced/voiceless or aspirated/unaspirated. However, when distinguishing the phones of different languages, it is necessary to consider voicing as a continuum represented by VOT.A factor that we have some reason to expect will be significant for the timing of voice onset is one of stress. All phonetic descriptions of the English stops indicate that stressed voiceless (/p, t, k/) stops have greater voicing lag than the unstressed voiceless (/p, t, k/) stops. Therefore stress is an important parameter for voice- onset time.As for the spectrographic readings, VOT intervals from the beginning of the release burst to the onset of voicing were analyzed.

Voice recognition system of a language which will be useful for various voice operated enquiry systems. So a thorough study of Acoustic parameters is a must. Utilization of speech for communication between man and machine has been significant requisite and the main motivation factor behind developing speech interactive systems. The

objectives of the proposed study are:To select a sizeable number of Hindi speech sounds involving words with 3 consonants at word- initial position with two abutted vowels /a/ and /i/.To record these Hindi speech sounds in sound- proof lab, in order to get the required Database.To make use of adopted softwares, to digitize these Hindi speech sound samples. To measure voice onset time from the spectrograms of different Hindi meaningful syllables.

RESULTS: **The Voice onset time** of 3 stop consonants in word-initial position of meaningful Hindi syllables with two abutted vowels /a/ and /i/ for tokens spoken in isolation by speakers is presented. It has been found from Table 1 that voice- onset time for **voiceless consonants** (Avg 50 msec) is larger than the **voiced consonants** (Avg 42 msec)**.**

The bar graph:

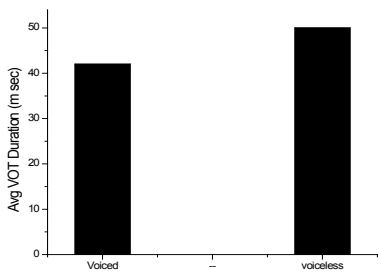

Figure 2.Bar graph showing avg. values of VOT (in m sec) of both voiced and voiceless stops.

It has been found from table that High vowel /i/ have larger voice-onset time (Avg 48 msec) than Low vowel /a/ (Avg 44 msec).Another interesting aspect comes into play from table 2 that bilabial stops have minimum value of voice onset time for both the low as well as for high vowel. Voice onset time for alveolar stops was more than bilabial but less than velar stops.

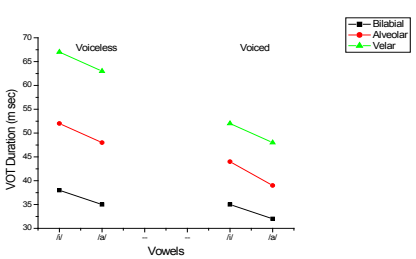

Figure 3. Graph shows VOT for voiceless and voiced stops which show variation for high and low vowels for three different stop categories.

Ohala et.al (1992). Reported initial results of an acoustic phonetic study of Hindi designed to further text- to- speech synthesis of the language. Some phonetic parameters are described for e.g., the effect of stop voicing on preceding vowel duration, the effect of vowel height on intrinsic vowel duration. They measured vowel duration: effect of voicing, vowel duration: effect of aspiration and VOT (voice onset time).

For measuring VOT of both Voiced and voiceless stop in four places of articulation with three vowels /a/,/i/ and /u/, they concluded that Velars show greater VOT than the other places of articulation with all vowels.In addition to the place of articulation of the stop, it also suggests the effect of the height of the following vowel. Specifically, greater lag was observed when stops were followed by high vowels (more open articulations) than when they are followed by low vowels (narrower opening).

Lisker et. al. Concluded that voice onset time increases as the place of articulation moves back in the mouth. They found differences that show certain regularity: the intervals by which voice onset either leads or lags behind release are almost always significantly shorter in sentences, whether the voicing begins before or after release. They concluded that voiced and voiceless categories are very clearly differentiable on the basis of variations in the timing of voice onset when they occur initially in isolated words.

Voice onset time for voiceless consonants is larger than the voiced consonants. VOT also differs in terms of place of articulation velar offers highest VOT than alveolar than bilabial. VOT also varies for high and low vowel. For high vowel it has high value than for low value.

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