

# ACOUSTICS ANALYSIS OF PASHTO PLOSIVES

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**ABSTRACT:** This paper examines the acoustics properties (VOT, Closure duration, Word Duration) of Pashto plosives of the Yousaf Zai dialect L1 speakers. The plosives (bilabial, dental, retroflex, velar, uvular) were recorded by five Pashto speakers in aca context. The results show that the velar plosive /k/ has the longest VOT while that of the bilabial has the shortest. As for the closure duration, the bilabial /p/ has the longest closure duration while that of the dental voiced /d/ has the shortest. Furthermore, unlike English stop, the VOT does not increase as we go further back regarding place of articulation; the VOT of the bilabial stop longer than that of the retroflex.

## 1. INTRODUCTION

All languages in the world have stops and most have at least [p], [t], [k], [n], and [m]. However, there are exceptions: Colloquial Samoan lacks the coronals [t] and [n], and several North American languages, such as the northern Iroquoian languages, lack the labials [p] and [m]. In fact, the labial stop is the least stable of the voiceless stops in the languages of the world, as the unconditioned sound change [p] > [f] (> [h],

“The type of Pashto considered “standard” in N.W.F.P is the Yousafzai types, which is spoken in the North Eastern part of the district Peshawar”

### Plosives of Pashto language ( Yousafzai dialect)

Among the pairs, the one on the left is voiceless while the other is voiced. The uvular [q] has no voiceless counterpart.

### 1.2 English language: its universality

[3] , In his study, pointed out that the majority of the subjects

	Bilabial	Dental	Alveolar	Retroflex	Post-alveolar	Palatal	Velar	Uvular	Glottal
Plosives	P, b	t, d		ʈ, ɖ			k, g	q	

Ø) is quite common in unrelated languages, having occurred in the history of Classical Arabic, for instance. English language, when acquired as L2 is essentially influenced by a speakers L1. The similarities and dissimilarities between L1 and L2 of speaker influence his/her overall performance in L2 [1]. In addition to the four plosives of RP ( p,b,k,g) the standard Pashto has the dental [ t d ] and the uvular [h]. The language substitutes the English alveolar plosives [t,d] by retroflex [ʈ,ɖ]. As is evident, for the Pashto dental plosives [ t d ] English has dental fricatives /θ/ ..... [2]

### Objectives

- To measure the VOT of Pashto stops
- To explore the closure duration of Pashto stops

### 1.1 Pashto Language.

Pashto has a speaker in million in Pakistan and Iran. In Afghanistan it is the official language besides Dari. Furthermore, it is the official language of Khyber Pakhton Khwa province of Pakistan where it is taught as a compulsory subject at primary level. Among different dialects (Central, South-Eastern, South-Western, Middle Tribal Dialect), the Yousafzai Dialect got more prestige [3] about the dialect states,

### English Plosives (R.P):

(Peter Roach. Daniel Jones’ English Pronouncing Dictionary fourteenth edition)

Plosives	Bilabial	Alveolar	Velar
Voiceless	[p]	[t]	[k]
Voiced	[b]	[d]	[g]

### 1.3 Articulation.

The articulation of these consonants is considered from the viewpoint of manner and place. Manner of articulation is the vertical relationship between the articulators, i.e. the distance between them (stricture). Place of articulation is the horizontal relationship between the articulators [4]. In the articulation of bilabial stops the active articulator (lower lip) and the passive articulators (upper lip) are pressed together,

wished to know English more than any other language. Despite the strong language attitude towards English, about only half of the subjects said they could speak English to some extent. The reasons for a Pashto speaker’s low proficiency level, in English according to [3] , are the use of Pashto language is almost all domains.

### Purpose of the study

The purpose of current research is to find out the acoustic properties of Pashto stops’ spoken by Yousafzai dialect speakers. This research also focuses on to determine the Acoustics properties of Pashto stops in comparison to English stops.

## 2 LITERATURE REVIEW

Without proper knowledge of English phonetics and Phonology, a speaker cannot use English speech sounds correctly. Learning pronunciation of English on the basis of phonemes rather than on the basis of letters is important some English spellings system has a confusing nature [2]. The English pronunciation considered in the study is R.P, since it is describe in more detail than others varieties of English.

building up pressure behind the blockage. As the blockage is removed the air releases in a rush. Alveolar stops, as the term suggests, are produced by bringing the tip or blade of tongue (active articulator) in close contact with the alveolar ridge (passive articulator). [k] and [g] are velar stops. In the articulation of these stops the back of the tongue touches the velum.

## 1.4 Acoustics properties of English Plosives.

### 2.2.1 Voicing and Aspiration

Voiced stops are articulated with simultaneous vibration of the vocal cords, voiceless stops without. Plosives are commonly voiceless. In word-final position, preceding vowel duration signals the distinction between ‘voiced’ and ‘voiceless’ stops, since vowel duration is longer before /b/, /d/, /g/ than before /p/, /t/, /k/ [5]; finally, closure duration is shorter for the voiced than for the voiceless stops. English and Spanish, for instance, have voiceless aspirated stops at word-initial position. Thai, Urdu and Korean, on the other hand, have both voiceless aspirated and unaspirated at word-initial position. In Pashto language there is no aspiration in the voiceless stops.

Thai : [paa] “forest” vs [paa] “to split”

Korean : [ko] “start” vs [ko] “correct” (Zheng Yuling)

Urdu : [ko d̪ija] “gave to” vs [ko d̪ija] “lost”

Pashto (loan word):[dol] “a drum”( in Pashto) [dol]

A spectrogram shows delay in the onset of voicing for vowels which follows an aspirated stop,

English voiceless plosives are aspirated at word initial position. In the words “peak”, “touch” and “cat”, for insistence, there is an audible puff of air immediately after the release of the plosives. On the other hand, when a voiceless stop follows [s] there is no extra puff of the air at the release stage [4].

In Tenuis stops, the vocal cords come together for voicing immediately following the release, and there is little or no aspiration (a voice onset time close to zero). There may be a brief segment of breathy voice that identifies the stop as voiceless and not voiced.

The Greek consonant system comprises two series of plosives which differ according to voicing; Greek displays fully voiced plosives (/b/, /d/, /g/) with negative voice onset time (VOT) values and voiceless un aspirated plosives (/p/,/t/, /k/) with short VOT. In Greek stops occur word-initially and medially but not word finally [6] and [7]

The comparison of the Greek and English stop system that Greek learners

of English need to acquire a number of features, namely aspiration, differentiation in stop closure duration and in vowel length, too. They also need to suppress voicing both in initial and in word-final position. Irish-English learners of Greek, on the other hand, are faced with the task to suppress a feature their stop system already displays, namely aspiration, and to generalize prevoicing in initial stops. [8]

The acoustic properties of the following English stop consonants are measured in aca context ( Lisker, 1957)

[p], [t], [k], [b], [d], [g]

S.NO	STOP	CLOSURE DURATION	VOICING DURATION	VOT
1	[p]	0.162	0.151	0.025
2	[t]	0.196		0.013

3	[k]	0.158		0.041
4	[b]	0.186	0.169	0.013
5	[d]	0.183	0.116	0.017
6	[g]	0.173	0.132	0.030

### 2.2.3 Acoustics of stops.

Stop has a series of articulatory postures.

1. Gap: during closure the only possible activity is voicing.

2. Burst: when the oral closure is released.

3. Aspiration: a defuse noise generation at the larynx. On the spectrogram for the word “tie” the change from voiceless aspirated /t/ to the diphthong /ai/ is noticeable. The bar is darker for the diphthong. Furthermore, the VOT of the diphthong is delayed. In the word “die” there is no delay in VOT of the diphthong. In addition, the spectrogram shows the voicing for/d/.

### 2.2.2 Stop gap

During closure of stop, the only possible activity on a spectrogram is voicing, shown at the bottom of the column for voiced stop. For voiceless stop, there is a clear column with no voicing activity.

### 2.2.4 VOT

VOT varies with place of articulation. The further back the closure the longer the VOT. It is the period of time between the release and the beginning of voicing [9]

VOT for aspirated and unaspirated stops vary from language to language. According to Lisker and Abramson (1964). VOT of unaspirated /p/ in Dutch is 10ms. In Puerto Rican Spanish it is 04ms, in Hungarian 02ms, in Cantonese 09ms, In Korean 25ms, and in Tamil it is 12ms.

VOT of unaspirated /t/ in Dutch is 25ms. In Puerto Rican Spanish it is 29ms, in Hungarian 29ms, in Cantonese 34ms, in East Armenian 30ms, In Korean 47ms, and in Tamil it is 24ms.

In case of the aspirated stop /p/, VOT in Cantonese is 77ms. In English it is 58ms, in East Armenian 78ms and in Korean it is 91ms. For the aspirated /t/, it is 75ms in Cantonese, in English 70ms, East Armenian in 78ms and in Korean it is 94ms. As for the aspirated /k/, VOT in Cantonese is 87, in East Armenian 98ms, in English it is 80ms.

### 2.2.3 Formant transition

During a transition from stop to vowel or vice versa, the formant frequencies change their values. After the release of stop closure there always is a rising in F1. The second and third formants depend upon both the sounds in the contexts.

### Methodology

#### Subjects

Five speakers of native Pashto Yousafzai dialect were selected; they were aged 22-28 and university-educated. They were given list of words in which all stops of Pashto pronounced.

#### Speech materials and recording procedure

These words are recorded in the following context.

1. “aca” context(where a is vowel and c is consonant)

The subjects were recorded reading five repetitions of each word, presented in random order.The recordings were

redigitised at a sampling rate of 8,000Hz. These words were analyzed acoustically with the use of waveforms and digital spectrograms generated by the speech analysis software PRAAT.

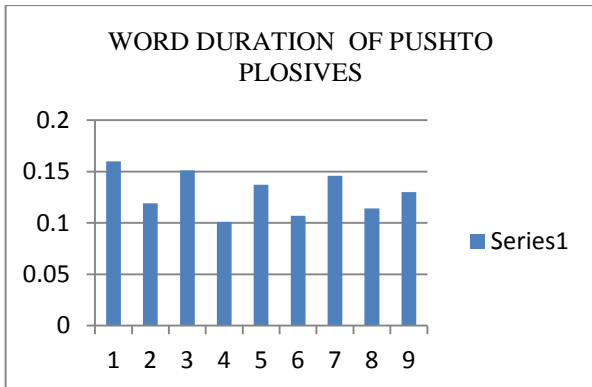
Collected data were analyzed in terms of closing duration, VOT, duration and voicing.

**RESULTS.**

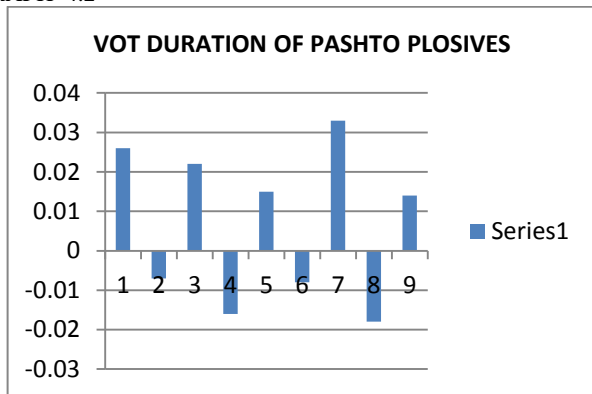
Mean values of all Pashto stops pronounced by Pashto speakers presented below.

S.NO	STOP	CLOSURE DURATION	VOT	WORD DURATION
1.	/p/	0.134	0.026	0.16
2	/b/	0.112	-0.007	0.119
3	/t/	0.129	0.022	0.151
4	/d/	0.085	0.016	0.101
5	/t/	0.122	0.015	0.137
6	/d/	0.099	-0.008	0.107
7	/k/	0.113	0.033	0.146
8	/g/	0.096	0.018	0.114
9	/q/	0.116	0.014	0.13

GRAPH 4-1

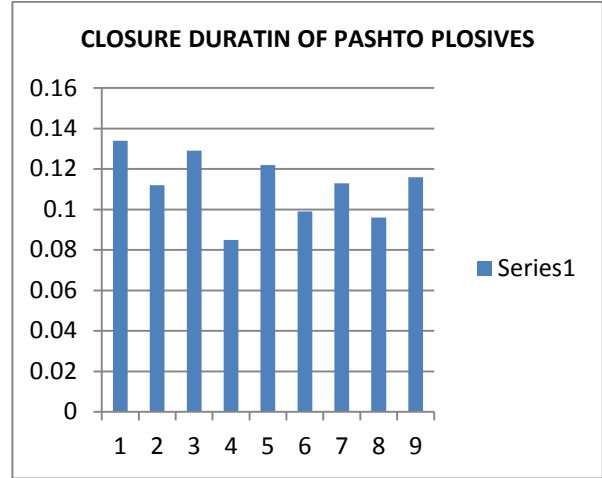


GRAPH 4.2



The graph represented mean values of VOT of Pashto stop. The velar plosive /k/ has the longest VOT duration while that of the voiced bilabial plosives /b/ has the shortest.

GRAPH 4.3



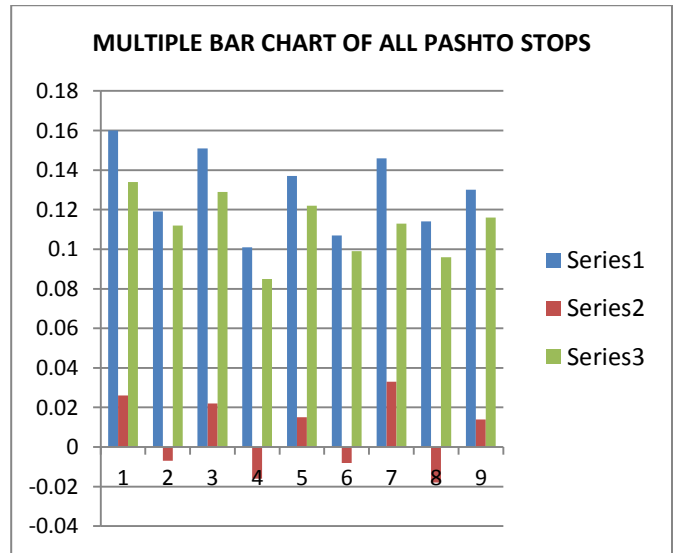
The graph represented mean values of closure duration of Pashto Plosives. The voiceless bilabial /p/ has maximum closure duration while the voiced dental plosives /d/ has minimum closure duration.

GRAPH 4-3

Series 1: VOT

SERIES 2: Closure duration

Series 3: Word duration



The above graph represents the mean VOT, closure and the whole sound duration of Pashto Plosives.

**CONCLUSION:**

The sounds analyzed acoustically were recorded by five native Pashto speakers of the Yousafzai dialect. The results of the study show that among plosives, the VOT of the voiceless velar /k/ is the longest (0.033 sec) while that of the voiced bilabial /b/ is the shortest (0.007sec). Among the remaining, the voiceless dental plosives /t/ has the longest VOT. The closure duration of the voiceless bilabial plosives is the

longest. On the other hand the voiced dental stop /d/ has the shortest closure duration. The voiced uvular /q/ has closure duration of (0.116 sec). Contrary to English, where a voiceless plosives has shorter VOT than its voiced counterpart. As for the VOT regarding the place of articulation, there is no trend in Pashto plosives. For instance, the VOT of the bilabial stops is longer than that of the retroflex. The scope of the present study is limited. It is the acoustic analysis of Pashto stops only. However, it can provided a background for a detail comparative study of the acoustil properties of English and Pashto stop which may yield interesting results.

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