

A comparative study of Balochi and English voiced stops

Dr Nasir Abbas Syed¹, Dr Gul Hasan², Daulat Khan³

Abstract

There is a vast literature on the study of voice onset time for plosives in the world language. But no such literature is available on Balochi. Besides, most of the available research on VOT focuses on voiceless stops. The current study focuses on VOT of voiced stops of Balochi and English in comparative perspective. Two groups of Balochi speakers were recorded for this study. The first group comprised of ten Balochi speakers from Turbat and who produced words of Baloch starting with voiced stops. Twelve adult Baloch learners of English living in London were asked to produce words of English starting with voiced stops of English. An acoustic analysis of the recordings confirm that Balochi is a voicing language. Place of articulation and adjacent vowel have strong influence on VOT of voiced stops. The current study also re-affirms the previous findings that speakers of a voicing language find it very hard to produce voiced stops of an aspiration language accurately. The participants of the current study were found to transfer L1 VOT values in production of voiced of English.

Key words: *Balochi, English, Prevoicing, Stops, VOT*

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1. Faculty of Languages LUAWMS
 2. Pro VC and Dean of Faculty of Education LUAWMS
 3. Faculty of Languages LUAWMS

1. Introduction and background

In the second half of the previous century, the study of second language acquisition starting gaining important status as a part of the linguistics and psychology. However, research remained under the influence of behaviorist school of thought during these decades. However, by the commencement of last quarter of the twentieth century, innateness theory had ingrained its roots deeply in the field of education, psychology and linguistics. With the turn of trends in favour of second language acquisition, importance of latest tools of research in linguistics also increased manifold. The research by Daniel Jones and Peter Ladefoged on modern phonetics brought this discipline at par with other branches of science. Latest research techniques like use of computer in various disciplines of sciences is now a common practice in the modern era. In the field of applied linguistics and second language acquisition computational soft-wares are used for analysis of human speech. It provides accurate and scientific data which may be skillfully used and analyzed using modern statistical techniques. The current study uses a latest software Praat (Boersma & Weenink, 2012) to analyze the speech of Baloch speakers and uses the data for comparison of Balochi and English voiced stop consonants to highlight the difficulties that adult Baloch learners of English face in acquisition of some consonants of English.

The main concern of this study is a class of consonants called plosives. Sounds produced with an explosion of air are called plosives (Roca & Johnson, 2007). Consonants like [p b t d k g] are plosives. [p t k] are called voiceless plosives because in production of these consonants vocal folds are not vibrating but [b d g] are called voiced plosives because in production of

A comparative study of Balochi and English voiced stops

these consonants vocal folds vibrate (Davenport & Hannahs, 2010). In production of plosives, the air coming from lungs which is blocked for a while and then it comes out with a burst or explosion (Ladefoged, 2006). Voice onset time commonly called VOT is considered the most important and meaningful acoustic cues of stop (Foulkes, Docherty, & Jones, 2010).

Lisker and Abramson (1964) are considered the first researchers who scientifically studied VOT of stops in the world languages and later on, it became a norm to study stops using VOT as an acoustic correlate of stops (Foulkes et al., 2010). Voice onset time is the interval between burst of a stop and onset of vibration of vocal folds in production of a stop (Docherty, 1992). If vocal folds take longer time in starting vibration for a stop such a stop will be called aspirated stop. [p^h t^h k^h] are examples of aspirated stops. Such a VOT is called long-lag post burst VOT. If vocal folds start vibrating soon after the burst, such a stop will be called voiceless unaspirated stop. [p t k] are examples of voiceless stops. If vocal folds start vibrating before the burst during closure phase, such a stop is called truly voiced stop. [b g], etc. are examples of truly voiced stops in Balochi, Pashto, Saraiki and many other Pakistani languages. The post-burst VOT is measured in positive and pre-burst values also called pre-voicing is measured in negative values. VOT is normally measured in milliseconds. Languages of the world have different ranges of VOT for stops (Ladefoged & Maddieson, 1996). The current study measures voice onset time for voiced stops of Balochi and English produced by Baloch speakers/learners. According to our knowledge and belief, this is

the first large scale published study which scientifically analyzes acoustic correlates of Balochi stops using latest computational techniques.

2. Literature Review

Languages of the world are divided into voicing and aspiration languages (Harris, 1994; Iverson & Salmons, 1995). Those languages in which voiced stops are produced as pre-voiced, are called voiced languages. On the other hand those languages in which voiced stops are produced with short-lag post-burst VOT, are called aspiration languages. It is already proved that English is an aspiration language because its voiced stops [b d g] are produced with short-lag post-burst VOT on word-initial positions (Honeybone, 2005). There was no such study on Balochi stops which may determine whether Balochi is a voicing or aspiration language. The data presented below first time confirms that Balochi is a voicing language. There is a large body of literature available on scientific study of voiceless stops. But there is a scarcity of research on scientific study of voiced stops. The current study fills this gap in the literature and studies VOT of voiced stops of English and Balochi.

The available research on VOT of voiced stops shows that it is very difficult for speakers of a voicing language to acquire voiced stops of an aspiration language. Syed (2013b) studied acquisition of English voiceless stops by those Pakistani learners of English who speak Saraiki as L1 and found that they were able to acquire voiceless stops of English. But in later studies it was found that they cannot acquire English [d] (Syed, 2014) and [b g] (Syed, 2013a) accurately. Dutch is a voicing language (Simon, 2011). According to Simon (2009), Dutch learners of English are relatively better able to produce

A comparative study of Balochi and English voiced stops

voiceless stops of English but they face extreme difficulty in acquisition of English voiced stops. Previous research also shows that Japanese (Nasukawa, 2010), Arabs (Flege & Port, 1981), Korean, Thai, Chinese (Shimizu, 2011), Punjabi and Hindi (Syed, 2015) learners of English also experience difficulty in acquisition of voiced stops of English. This is because all these languages are voicing languages. In a previous paper we studied acquisition of voiceless stops of English by adult Baloch learners of English who are living in and around London (Syed & Hasan, 2015). The current study aims to see if Baloch learners of English can also acquire English voiced stops or not? The current study aims to address the following research questions;

1. What are VOT ranges of voiced stops of Balochi? Is Balochi a voicing or aspiration language?
2. What type of learning difficulties are experienced by adult Baloch learners of English at advanced stage of learning English as a second language?
3. Is there any influence of vocalic context on acquisition of English voiced stops?
4. What is relationship between place of articulation and VOT of voiced stops?

The current experiment was conducted partially in London and partially in Uthal. Recordings of learners' group were completed in London at the places of convenience of the participants and those of Balochi voiced stops in Lasbela University Uthal. The detail of experiment and participants is given in the following section.

3. Research Methodology

Two groups of Balochi speakers were invited to participate in this study. This group consisted of ten native speakers of Balochi who all belong to Turbat. They were students of undergraduate degree courses at Lasbela University Uthal Balochistan. They were asked to produce a list of words of Balochi which were recorded. The words of Balochi started with voiced stops. There were five repetitions for each stop in the list.

Another group of speakers consisted of twelve advanced Baloch learners of English who had been living in England for an average of 79.08 (standard deviation=66.57) years in and around London. They had come to England at a mean age of 23.33 (standard deviation=3.98) years. According to their own statement, they normally speak English with native speakers for an average of 4.92 (standard deviation=2.78) hours and listen to them for 5.92 (standard deviation= 2.15) hours daily. At the time of experiment their average age was 29.92 (standard deviation= 5.65) years. In other words both groups of learners were in the same age group of 20-30 years. Both belong to the same district and speak the same variety of Balochi.

In this study, a structured interview, an audio recording device (M-Audio Track-II digital Recording Device) and Praat software were used for data collection and analysis. In the interview, the participants were asked questions about their linguistic background and about their stay in the United Kingdom. The data provided in the above paragraph is based on the information elicited in the interview. Recordings were analyzed in Praat. For recording two lists of stimuli were prepared. One list consisted of words of Balochi starting with

A comparative study of Balochi and English voiced stops

voiced stops followed by a low vowel [a]. The low vowel was selected for this context because it is considered neutral in its effect (Syed, 2011). Our primary aim to record words of Balochi with voiced stops was to determine if Balochi is a voicing language or an aspiration language. The secondary aim of this acoustic analysis was to obtain VOT values of voiced stops of Balochi for comparison with the VOT measurements of English voiced stops produced by Baloch learners of English. In the second list were included words of English starting with voiced stops followed by three different quantum vowels of English (e.g. deal, dark, do, etc.). The purpose of recording the same sound in three different vocalic context was to identify influence of adjacent vowel on VOT of voiced stops.

4. Results

This section is divided into two sub-sections. The first section details results of first group of Balochi speakers. In this section voiced onset time for four voiced stops of Balochi are presented. In the second section, voice onset time for voiced stops of second group is given. In this section, the VOT values of English voiced stops [b d g] produced by advanced Baloch learners of English are presented. In this section VOT values of voiced stops of Balochi (L1) and English (L2) are also compared.

4.1. Voice onset time for voiced stops of Balochi

The native speakers of Balochi were asked to produce words of Balochi starting with voiced stops immediately followed by [a] vowel. There were five repetitions of each Balochi word in this list. In this way we elicited five VOT values for each stop by each of the participants. A Cronbach's alpha reliability

test was applied on the repetitions to determine reliability of the data. The results of the reliability test are given below in table 1.

Table 1: VOT of L1 Voiced stops

Sounds	Cronbach's Alpha	Reliability %
[b]	.820	82
[d]	.594	59
[ḍ]	.521	52
[g]	.854	85

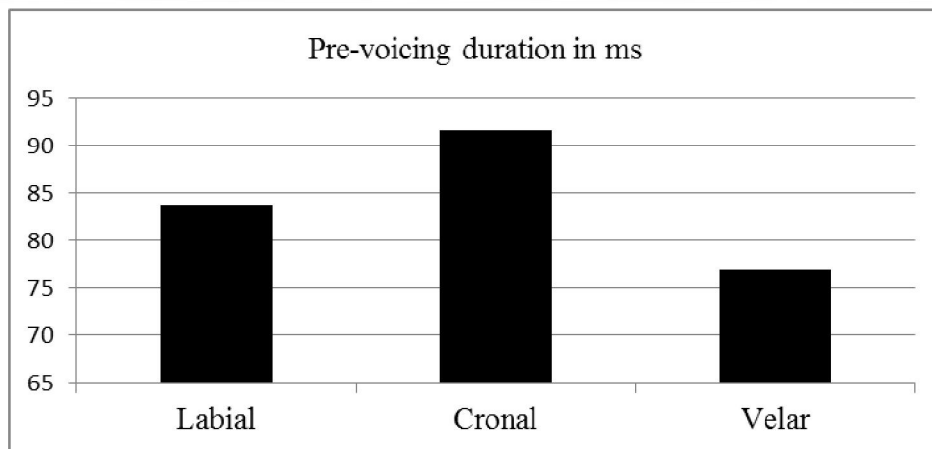
Balochi has two coronal stops namely retroflex and dental stop. Corresponding to this English has one coronal stop. In a reliability analysis, a Cronbach's alpha value which is equal to or more than 0.7 (which indicates 70% reliability) is considered ideal in research (Larson-Hall, 2010) but 60% reliability or a Cronbach's alpha value of 0.6 is considered good by some linguists (Scholfield, 1995). However, 50% reliability or a Cronbach's alpha value is also rated as acceptable in research on social sciences. In the above cases, the reliability of the data for labial [b] and velar [g] is excellent because it shows above 80% consistency in repetitions. However, in coronal stops particularly in dental stop [ḍ] the alpha value is closer to the minimum acceptable range. The reason for this is that the coronal sounds are produced with tip of the tongue which is the most flexible part of human body among all organs of speech. Therefore it causes a lot of variation in articulation of consonants resulting in a wide range of VOT values in repetitions. A wide range of variation in value of repetitions lowers consistency level, inversely affecting the reliability of the data. The following table shows mean values of the repetitions of VOTs of L1 stops.

A comparative study of Balochi and English voiced stops

Sound	Minimum	Maximum	Mean	Std. Deviation
[b]	-141.40	-31.40	-83.76	32.77
[d]	-125.60	-46.80	-84.34	27.43
[ḍ]	-122.60	-63.00	-98.88	18.24
[g]	-125.60	0.00	-76.94	35.40

An analysis of variance test applied on the mean VOT values confirms the significance of variance between the stops ($F=51.699$, $p<.0001$). However as the above table show, some VOT values are very close to each other. An ANOVA applied on such data which has several variables yields a significant result if only one of the variables is significantly different from all other variables which are similar. Therefore for further confirmation of these results, a pairwise comparison was done to know which sounds are different from which ones. Individual comparisons show that the difference between VOT of [g] and [ḍ] is significant ($t=2.405$, $p=.040$) whereas that between [b] and [ḍ] is marginally (non)-significant ($t=2.254$, $p=.051$). Other pairs are not significantly different from each other ($p>.1$). The following graph shows pre-voicing duration of Balochi stops produced on different places of articulation.

Figure 1: Duration of pre-voicing in production of Balochi voiced stops



The above figure reflects an average VOT duration for retroflex and dental coronal stops. The figure clearly shows that coronal stops have longer VOT duration but the peripheral voiced stops have relatively shorter VOT duration. We shall comment on these data in section 5.

4.2. VOT of voiced stops of English

The second group of participants comprised of advanced Baloch learners of English who were living in and around London. They produced words of English starting with voiced stops immediately followed by three different vowels. The VOTs were taken using Praat. The following table shows VOTs of L2 stops by these participants.

A comparative study of Balochi and English voiced stops

Table 3: VOT of voiced stops of English

Sounds	Context	Mean	Std. Deviation
[b]	[i]	-135.75	26.48
[b]	[u]	-88.25	34.82
[b]	[a]	-69.17	51.89
[d]	[i]	-114.20	24.40
[d]	[u]	-99.58	41.69
[d]	[a]	-79.27	68.39
[g]	[i]	-81.40	53.82
[g]	[u]	-67.75	62.97
[g]	[a]	-48.17	50.33

Each of the three voiced stops of English were produced in three different contexts. Three quantum vowels were selected for determining effect of context on VOT of voiced stops. A 3*3 repeated measures analysis of variance (RM ANOVA) with vocalic context and place of articulation as repeated conditions was applied on the data. The results show that overall, the impact of place of articulation ($F=4.969$, $p=.023$) and adjacent vowel ($F=5.707$, $p=.015$) is significant on pre-voicing duration of stops produced by the participants of this study. The interaction between vowel and place of articulation is non-significant ($F=.662$, $p=.623$). Individual analyses also confirm that impact of vowels on VOT of [b] ($F=21.082$, $p<.0001$), [d] ($F=90.717$, $p<.0001$) and [g] ($F=7.936$, $p=.012$) is highly significant. These results will be analyzed and discussed in the following section.

5. Analysis and discussion

In this section we shall analyze and discuss the results of the experiment.

Before going on to analysis of the data, we need to reproduce the research questions. The current study aimed to answer the following questions;

1. What are VOT ranges of voiced stops of Balochi? Is Balochi a voicing or aspiration language?
2. What type of learning difficulties are experienced by adult Baloch learners of English at advanced stage of learning English as a second language?
3. Is there any influence of vocalic context on acquisition of English voiced stops?
4. What is relationship between place of articulation and VOT of voiced stops?

We shall take up these issues one by one. The first question is about VOT ranges of voiced stops of Balochi. The data in table 2 and figure 1 show that all Balochi stops are pre-voiced which are produced with negative VOT values. Coronal stops have highest VOT and velar stops have the smallest VOT. According to Stevens, Keyser, and Kawasaki (1986), place of articulation of a stop is in positive correlation with post-burst VOT in that a bigger contact area between active and passive articulators will yield a higher VOT for the stop. Therefore, they predict a longer voice onset time for velar and labial plosives because both have active and passive articulators with bigger contact zones. On the other hand, they expect a shorter VOT for coronal voiceless stops because of smaller contact area between active and passive articulators in production of coronal stops. The mechanism of pre-

A comparative study of Balochi and English voiced stops

voicing is a reflex of that of post-burst voicing. Therefore we expect a mirror image picture of relationship between pre-voicing and contact area of articulators. The findings of this study are in accordance with the expectations. The contact area between active and passive articulators in production of coronal stops is smaller; it should have a short post-burst and long pre-burst voice onset time for plosives. The findings of this study are quite in accordance with the predictions. Importantly, negative VOT values clearly confirm that Balochi is a voicing language. Having determined this it may be expected in the light of the previous literature that acquisition of voiced stops of English will be difficult for adult Baloch learners of English.

The second research question is about the difficulties may be experienced by adult Baloch learners of English? The results presented in table 3 show that the participants produced all voiced stops of English with negative VOT whereas English voiced stops are produced with positive short-lag VOT in this context. This is also in accordance with the previous findings that voiced stops of English are difficult for learners whose L1 is a voicing language. To determine the impact of L1 on VOT of L2, a t-test was applied on the VOTs of voiced stops of Balochi and English which confirms that there is no significant difference between L1 and L2 VOT values as the following table shows;

Table 4: Comparison of VOTs of L1 & L2

Sound pairs		t	df	Sig. (2-tailed)
Pair 1	Labial	-.509	9	.623
Pair 2	Coronal	.907	9	.388
Pair 3	Velar	-1.762	9	.112

For applying t-test only those VOT values of English were taken which had been obtained in productions of stops immediately followed by [a] vowel because in the words of L1 used as stimuli the voiced stops were all immediately followed by [a]. In other words, the stimuli of both L1 and L2 had voiced stops immediately followed by the same vowel. In this way, the impact of vowel on adjacent consonant was controlled. The results confirm that the participants transferred L1 VOT values for L2 stops. According to the predictions of Flege (1995), equivalence classification between L1 and L2 phonemes does not allow development of a new phonetic category for L2 sounds. The current findings show that there is a strong equivalence classification between Balochi and English voiced stops which makes acquisition of English voiced stops difficult for Baloch learners of English.

The third research question in this study was about the influence of adjacent vowel on VOT of voiced stops. The results of RM ANOVA confirm that the impact of adjacent vowels on VOTs is significant. This is also apparent from the results given in table 3. However, the interaction between place of

A comparative study of Balochi and English voiced stops

articulation and vowel context is non-significant. Having a look at the results presented in table 3, we can see that the results reflect a single trend which indicates that [i] vowels causes maximum increase in pre-voicing duration whereas [a] vowel decreases that of voiced stops. This trend is consistent in all stops regardless place of articulation.

The last research question is about the relationship between place of articulation and VOT of voiced stops. The results show that there is a significant influence of place of articulation and pre-voicing in VOTs of voiced stops of L1 and L2. The general pattern shows that the distance between place of articulation and vocal folds is in positive correlation with pre-voicing. It means the duration of pre-voicing is increasing from velar to coronal to labial stops. Since, labial stops are at the farthest distance from vocal folds, they have the biggest prevoicing duration. About post-burst positive VOT, Lisker and Abramson (1967) claim that the distance between place of articulation of stops and vocal folds is in negative correlation with VOT in that the closer the distance the bigger the VOT. The current study demonstrates that this correlation is inverse (positive correlation) for negative pre-burst VOT (pre-voicing) i.e. the farther the distance between place of articulation and vocal folds yields the highest pre-voicing duration.

6. Conclusion

This study was conducted with two groups of Baloch speakers. One group comprised of ten native speakers of Balochi who were undergraduate students of Lasbela University Uthal and another of twelve adult advanced Baloch

Dr Nasir Abbas Syed et al

learners of English who were living in and around London. Both were native speakers of Balochi and belonged to the same district Turbat. Their recordings were analyzed in Praat. The findings show that Balochi is a voicing language since its voiced stops are pre-voiced. There is a significant relationship between place of articulation and pre-voicing of L1 and L2 stops. The effect of adjacent vowel is significant on pre-voicing duration of voiced stops of English produced by adult Baloch learners of English. The study also demonstrates that for adult Baloch learners of English, acquisition of voiced stops is very difficult. The findings of this study are in accordance with the findings of previous studies conducted in the similar context.

A comparative study of Balochi and English voiced stops

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A comparative study of Balochi and English voiced stops

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