

Voice Onset Time in the production of plosives /b/ &/k/ in Algerian Arabic and French language - An Acoustic study

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Abstract

This proposed paper is an attempt to cast light on the voice onset time (VOT) values of initial stops mainly /b/ and /k/ in Algerian Arabic and French language . It aims to measure the VOT Values of each token from the onset of plosive burst to the onset of voicing , and the potential effect of the vowel quality on their production .This study used the Praat speech analysis software to measure the VOT values. The results showed that AA has two types of VOTs , positive VOT with the voiceless stop /k/ and negative VOT with the voiced stop /b/.from the analysis, we also noticed that the two vowel /i/ and /u/ had a significant effect on the VOT values of the preceding consonants.It is found that the VOT pattern in AA and French language are similar but not completely identical This study contribute to better understanding of VOT and to a less acoustic literature on Algerian Arabic.

Key words : Voice onset time ; Algerian Arabic ; French language ; Praat speech analysis

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1. Introduction

The sociolinguistic situation in Algeria is a complex domain because of the coexistence of many languages: Modern Standard Arabic and the whole array of Arabic dialectal varieties. French as the second language; Tamazight (Berber) as the native language of a considerable minority, and English which contribute to the complexity of the linguistic profile in Algeria.

The current study is concerned with language contact and language change in the speech of Algerian bilinguals. We will test Voice onset time values of the plosive /b/ , /k/ in Algerian dialect and French language . Voice onset time refers to the time between the release of the stop and the beginning of the vowel cord vibration .It is very important aspect in the study of speech sounds in which it helps in distinguishing between the types of stop consonants (voiced vs voiceless) across different languages.

Variation in the VOT has been well documented in literature. Lisker and Abramson examined how VOT separate the stop categories of eleven languages. They concluded that voice onset time was a reliable parameter for differentiating the voicing contrasts in several languages. Lisker and Abramson (1971; 770) defined VOT as “the single most effective measure for classifying stops into different phonetics categories with respect to voicing”.

Plosive		
Occlusion phase	Release	The following vowel
If voicing is initiated during this period	If voicing is initiated during this period	
Or earlier; VOT is negative.	Or later; VOT is positive.	

Figure1: Voice Onset Time.

Strictly speaking, the present paper seeks to answer three research questions, which are first, what are the normative patterns for VOT by AA native speakers ? Does Arabic VOT effect the French stops in code- switching? It would be very interesting to study how Algerian produce those Algerian and French stops cross-linguistically.

This study represents the first attempt to compare the VOT variation between Algerian Arabic and French language. This study will thus contribute to literature in many ways, it will uncover the main differences and similarities of phonetically voiced stop/b/ and voiceless stop /k/ in this dialect and that language, and find out the difference between their VOT pattern.

This study will test the following hypotheses;

1. The VOT pattern in Algerian Arabic and the French language are similar but not completely identical.
2. The French language affects the Algerian Arabic.

This paper is organized as follows , Section 2 presents a brief summary of the related literature ; Section 3 covers the methods used to reach the objective of the study ; Section 4 is devoted for reporting the results and finally section 4 interpretes these results.

2. Literature Review

2.1 VOT values of /b/ and /k/ in Arabic

The investigations of VOT in different phonological context have been discussed in MSA and in different Arabic dialects. **AIDahri and Alotaibi (2010)** compared the VOT values of the plosives /b, k/ in Modern Standard Arabic (MSA) with different languages (e.g., Dutch,

Tamil, and English) and other Arabic dialects (JA and SA). The results showed that the MSA stops /b/ and /k/ obtained positive VOT values, in which the bilabial voiced stop /b/ ranges between 10 and 25 ms, whereas the voiceless velar stop /k/ ranges between 34 and 80 ms. The result also revealed that the values of the VOT are different from one language to another and from one dialects to another of one language. For example, in comparing the VOT values between Saudi Arabic (SA) and JA Arabic (JA), they noticed a difference within the velar stop /k/ measured (60 ms) for JA , (42 ms) for SA , and (52 ms) for MSA.

Moreover, several studies have been carried out to examine the VOT values of the stop consonants. Mitleb (2001) examined the average VOT values of the Jordanian) stops /t, d, k, g/. In this study, participants (four male JA speakers) read a list of words containing the stops in the onset of the syllables and the nucleus of the syllable containing the short and long low vowels /a, a:/. The most significant result of this work that JA speakers produced the stops with different measurements. The results showed that the JA stops have different measurements depending on the following vowels. To illustrate this ;voiceless stop /t/ measures (37 ms) in the environment of short vowel and (46 ms) with a long vowel, the voiced stop /d/ measures (10 ms) with the short vowel and (23 ms) with the long vowel. /k/ and /g/ have the VOT values as (59 ms) and (15 ms) with the short vowel and (60 ms) and (20 ms) with the long vowel. Given these results, Mitleb's study reported that the VOT values differ depending on the following vowel (short vs. long)

Another research with the Arabic studies was carried out by Alghamdi (2006). In his study Saudi Arabic (SA) speakers were asked to read a list of words containing the voiceless stops /t, k, tʃ/. The findings showed that SA speakers produced the stops with positive VOT values ranging from (21 to 78 ms) for /t/, (21 to 55 ms) for /k/, and (14 to 33 ms) for /tʃ/.

Furthermore, Kulikov (2021) investigated the VOT of the alveolar stops /t, d/ in Qatari Arabic (QA). Eight females were asked to read a list 25 words, with six repetitions for each word. The results revealed that the voiced stop /d/ measures (-45 ms) while voiceless stop /t/ has a longer VOT value (51 ms). However, we cannot generalized the results to the other Arabic dialects because it deals with one gender of the participants, different genders that may provide more precise findings on the values of VOTs in Arabic and its various dialects.

Study	Dialect	/b/	/d/	/g/	/t/	/k/	/q/	/tʔ/	/dʔ/
AlDahri (2013)	Modern Standard Arabic	X	16	X	52	X	X	18	12
Metlib (2009)	Jordanian Arabic Long vowels	X	23	20	64	60	X	X	X
Metlib (2009)	Jordanian Arabic Short Vowels	X	10	15	37	39	X	X	X
Kullikov (2016)	Qatari Arabic	-65	-80	-70	55	60	X	X	X

2.2 VOT values of the French stops

Few researchers have looked into French VOT. Lein et al. (2016) summarized the results of ten studies on the VOT of voiceless stops /p, t, k/ in French-speaking adults (including Canadian and European French) . The results showed that VOT values are from 14 to 32 ms

for /p/, 18 to 35 ms for /t/ and 32 to 49 ms for /k/. Nearey and Rochet's study (1994) revealed that the voiceless stops /p/: ranges between 18 to 48 ms; /t/: ranges between 21 to 49 ms; and /k/: 32 to 62 ms . the most significant finding of this study is VOT was longer when the voiceless stop consonant preceded a high vowel (e.g., /y, i, u/).

3. Research Methodology

Methods

3.1 Experiment 1

3.1.1 Subjects:

Ten Algerian speakers participated in this experiment who were born and raised in Sidi Bel Abbes. They are native speakers of Algerian Arabic. All of them are MA students at the faculty of letters, languages and art of Sidi Bel Abbes University, aged between 20-24 years old.

3.1.2 Stimuli

The stimuli consisted of two oral stops /b/ and /k/ in Algerian Arabic occur in initial position. Each of the stop is followed by three long vowels /i:/, /u:/ and /a:/, thus giving a total of three variations of each stop. The researcher used long vowels because they have a significant effect on VOT values than short vowels (Klatt ,1975 ; Weismer ,1979 ; port & Rottuno ,1979 ; Fischer & Goberman ,2010)

Algerian Arabic	Gloss
/bibæn/	Doors
/buqæ/	Vase
/ bali/	Old

/kiræki/	How are you
/kuvirtΛ/	a blanket
/Kabus/	a weapon

Table 1: Arabic Stimulus words

3.2 Experiment 2

3.2.1 Stimuli

The second part of the data consisted of bilabial /b/ and velar /k/. Voiced and voiceless stops immediately followed by one of the three vowels /i/, /u/ and /a/. The researcher used Six words which are frequently used by Algerian bilingual speakers in their day- to day conversations .They were asked to repeat each word. Mispronunciation and repetitions were excluded from the final analysis.

French language	Gloss
/bi:zar/	Bizarre
/bulvar/	Boulevard
/baraʒ/	Dam
/ki :/	Who
/ku :ʃaʒ/	Sleeping
/kafeterja/	Cafeteria

Table 2: French Stimulus Words

3.2. 2. Procedures

Participants were asked to start reading each word when they are ready. Each subject reads the list of words three times. The Algerian subjects' recording was made in quite surrounding (most often in speakers' home), using Sony recorder, and were subsequently analysed using

Praat which is free, cross platform program used in linguistics for speech analysis. The release was measured for every stop. The onset of voicing was also measured. Finally the VOT duration was also measured.

3.3 Measurement & Statistical Analysis

Release or burst and voice onset time were labelled using Praat. Both waveform and spectrograph were visually displayed on separate portions of the screen. VOT was measured in milliseconds (ms) . In order to avoid confusion; the researchers saved all the tokens as files by each participant name. After that, they re-measured from each group three randomly tokens.

3.4 What is Praat ?

Praat is free program that is used to do the phonetic analysis of speech sounds. It was developed in the Netherlands by Paul Boersma and David Weenink (praat is the Dutch word which means “**speak**”).

For measuring VOT for plosives (voiceless vs. voiced) sounds, you have to follow the followings steps. Firstly download all the files in a folder; secondly open the praat

(double click on the icon). Close the window on the right (the Picture Window). In the ‘Objects’ window, go to the ‘Open’ button on the top. Select ‘Read from file...’.

Next, open the file, It will appear on your list of objects. Select both the files and then click on ‘View & Edit’ on the right side of the window. This will appear as in figure 1

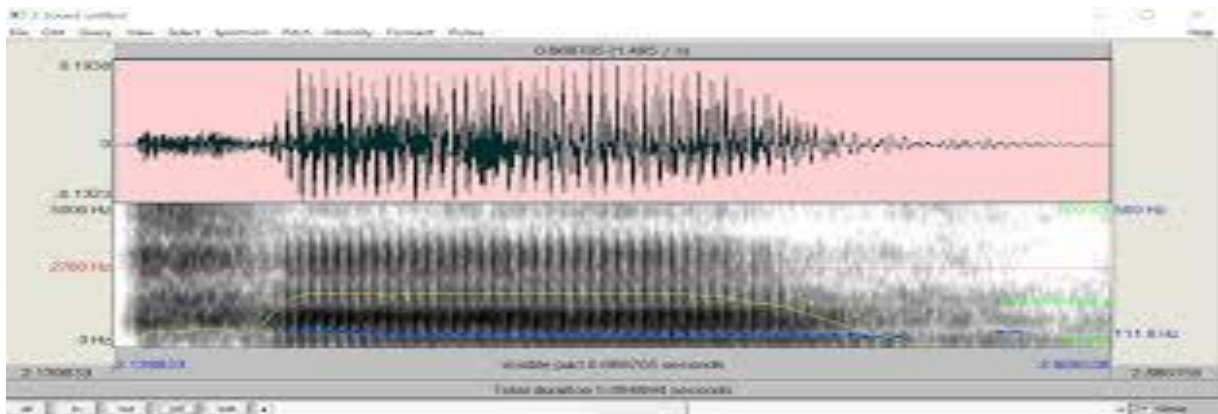


Figure 1: Measuring VOT in Praat

4. Results and discussion

Voice onset time was measured for the ten Algerian sample, three of them starting with the voiced stop /b/ and the others starting with the voiceless stop /k/. VOT duration for /b/ in Algerian Arabic ranged from -85 to -132. The voiced stop /b/ has a negative VOT (voicing begins before the release of stop). Whereas /k/ has a positive VOT. Figures 2 & 3 shows the measurement of the release, the onset of voicing, and the VOT duration.

Moving to the vowel quality which is an important factor influencing the voice onset time. VOTs are longer when followed by tense high vowels (Klatt 1975, Weismer; 1979). Thus; from the analysis, we notice that the two vowel /i/ and /u/ had a significant effect on the VOT values of the preceding consonants.

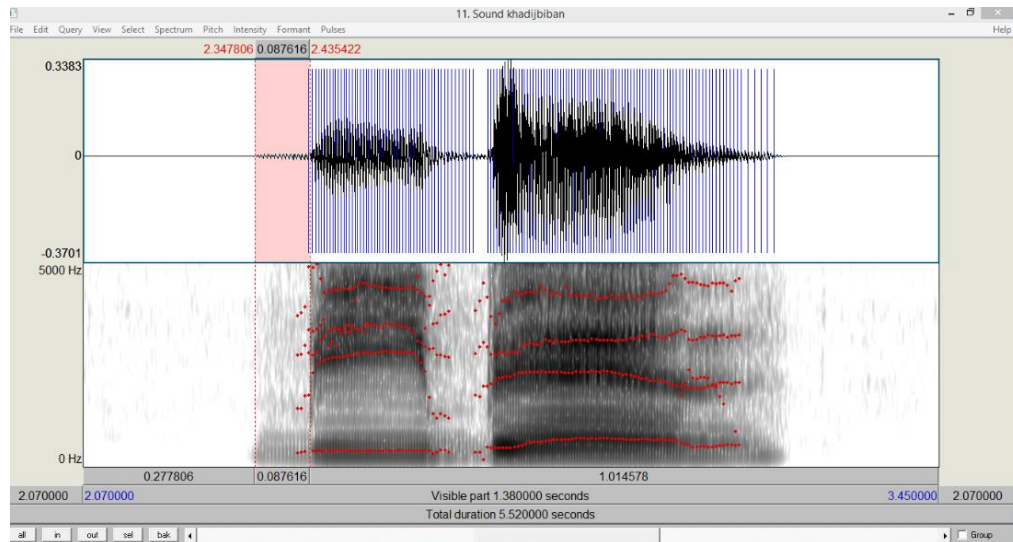


Figure 2: Example of a test word /bibæn/ shown in the acoustic waveform (top panel) and spectrogram (bottom panel) with a negative VOT.

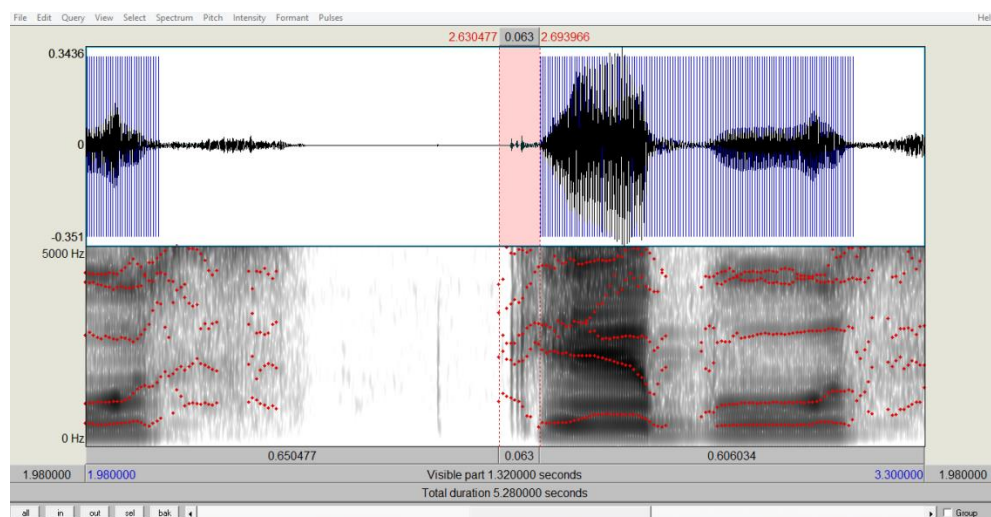


Figure 3: Example of a test word /kirækɪ/ with a positive VOT.

In order to compare the VOT variation between Algerian Arabic and French language, and also to examine the effect of French in Algerian Arabic in terms of VOT . The second experiment was performed, using the same oral stops /b/ and /k/.

VOT was measured for French word sample. French stops /b/and /k/ at the initial position, the tokens were limited to the environment of three long vowels /i/,/u/,and /a/.In the French data, Voiced unaspirated stop/b/ in the French language in words like bizarre, boulevard and

barrage has a negative VOT; meaning that the vocal cords start vibrating before the stop is released.(see figure 4)

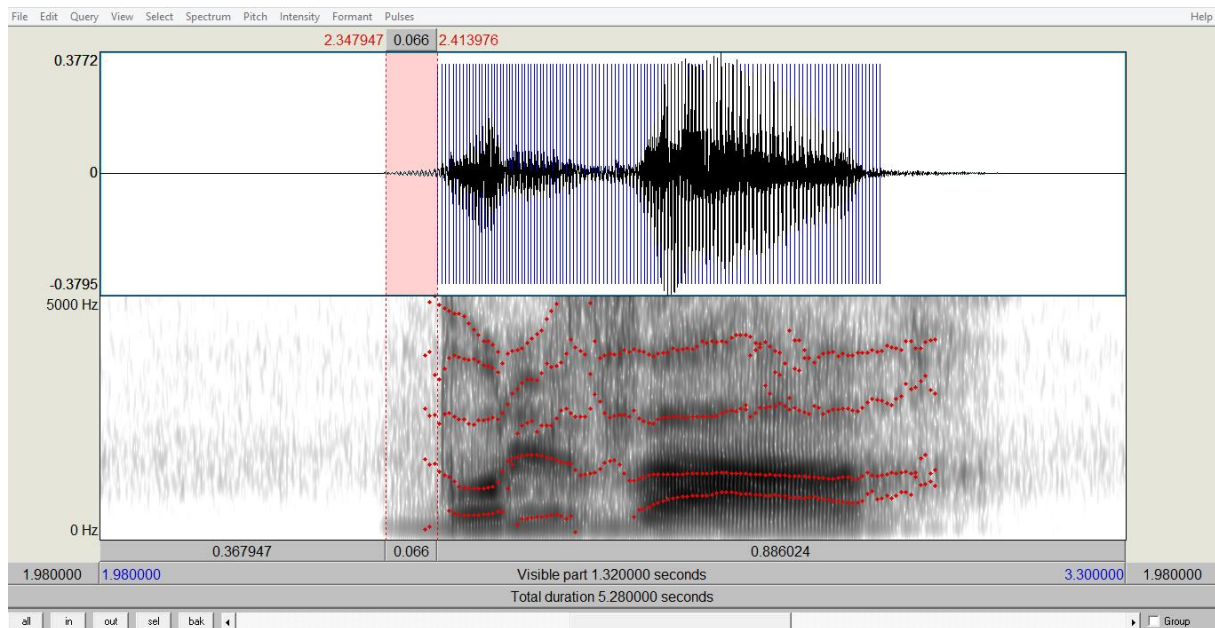


Figure 4: Example of a test word /bulvar/ with a negative VOT.

Whereas the voiceless stop /k/ has a positive VOT (voicing begins after the release of stop).

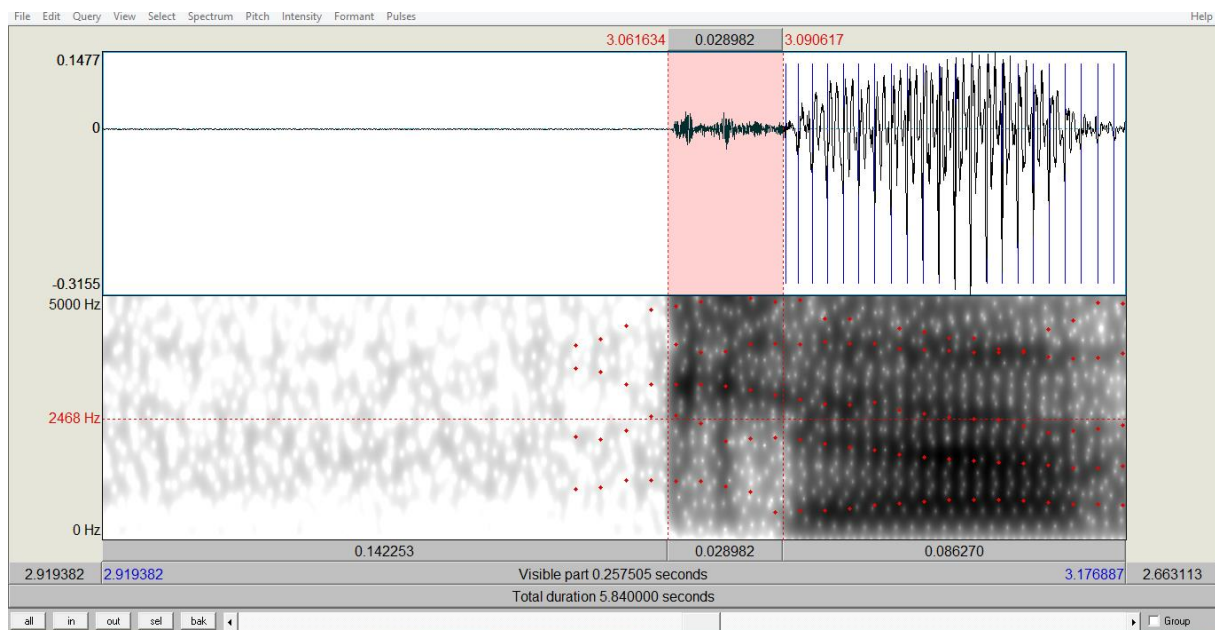


Figure 5: Example of a test word /kafeterja/ with a long positive VOT

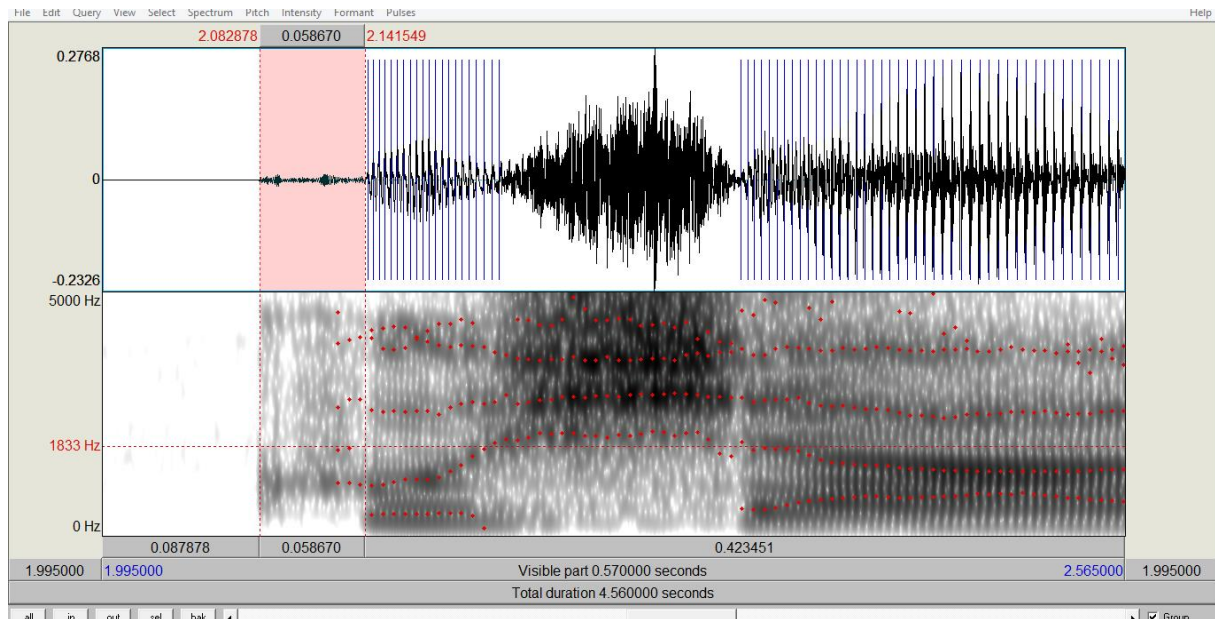


Figure 6: Example of a test word /kuʃaʒ/ with a long positive VOT.

The voiceless stop /k/ in the French language has a long positive VOT, i.e. the voicing begins long after the stop is released. More than that, we notice that the vowel /i/ has more effect on the preceding consonant.

Position	Voiceless	Voiced
Word initial	Qui Cafeteria Couchage	Bizarre Boulevard Barrage
Characteristics	Positive VOT	Negative VOT

Table 3: VOT in the French language

Comparison

The VOT production in Algerian Arabic dialect and French language is examined in order to establish whether they are similar or different. The VOT values of /b/ and /k/ in both AA and French language do not show much difference. The main reason that there is a slight difference in the VOT values would be the long French settlement in the Algerian territories.

More than that what is observed when I was recording in the first experiment. It is noticed that Algerian speakers produced the Algerian stops with the norms of the French language.

The VOT comparison is also made in a controlled environment in which both the oral stops /b/ and /k/ are followed by three long vowels /i/, /u/, /a/. For /b/ in Algerian Arabic, the VOT values in context of long vowel /i/ and /u/ are higher than those for the other vowel. Whereas for /k/, the VOT values in the context of the long vowel /i/ are higher than those for the other two vowels.

Algerian speakers produced the French stops with a significantly similar VOT values like the native speakers of French. Thus, the French language effects on Algerian Arabic is more obvious in terms of the VOT because Algerian population was deeply influenced during the French occupation; today more than 55 years after independence, French language continue to play an important in our daily life especially in our studies.

	Voiceless /k/	Voiced /b/
Algerian Arabic	Positive VOT	Negative VOT
French language	Positive VOT	Negative VOT

Table 4: Phonemic similarity in voicing.

5. General Conclusion

Our main aim from this study is to draw a comparison between Algerian Arabic and French language using the voice onset time. It is found that the VOT pattern in our dialect and that language are similar but not completely identical. It should be also noted that the differences between Algerian Arabic and French language are not stark. We notice also that Algerian speakers are aware of the slight differences between their own dialect and the second language. We reach the same conclusion that Klatt had reached earlier that VOT variation that variation in VOT for voiceless stops, depends on whether high or mid vowel followed the

stop. As mentioned earlier, some studies found that the VOT variations between two languages are different. We find that they are similar.

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