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Voice onset time as an indicator of interlanguage: Evidence from Turkish-accented English

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Abstract

There is controversy in the literature on language acquisition concerning whether L2 learners develop separate systems for the two languages or they construct a unitary system for both (i.e. interlanguage). Here we investigate whether Voice Onset Time (VOT) can provide evidence supporting one of the two perspectives mentioned. To assess the research question, we asked 16 Turkish speakers of English to produce 30 words (both in Turkish and in English) starting with oral plosives in a prevocalic word-initial position. 8 native speakers of English also produced the same English words to provide us with English VOT norms. A comparison of mean VOT values revealed that Turkish speakers of English produce English /b, d, g/ with VOT values that are intermediate to the short-lag phonetic norm of English and the pre-voiced VOT norm of Turkish. We consider this an indication of the development of interlanguage VOT patterns.

Keywords: Voice onset time; interlanguage; plosives

1. Introduction

A pioneer of Contrastive Analysis (CA), Lado (1957) has claimed that what makes second language acquisition different from first language acquisition is not the difficulty of the specific characteristics of the new language, but the first language habits that the second language learner brings to the experience of learning a new language. Native language influences were thought to affect second language learning extensively until the effect of transfer and the necessity of engaging into the practice of contrastively analyzing two languages in order to detect the so-called "problematic areas" started to be challenged. As Odlin (1989) states, "the theoretical significance of transfer seemed dubious to a number of researchers struck by the similarities between first and second language acquisition" (p. 17). Empirical studies illustrated the fact that not all differences between languages cause learning difficulties. Moreover, some second language errors were proven to be due to other sources rather than language transfer. Selinker (1972) has argued that errors may arise from "transfer of training" i.e. the effects of the way students are taught. It was also found in some studies (e.g. Schumann, 1978) that "overgeneralizations" might also cause errors.

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Inquiring into the sources of errors in Second Language Acquistion (SLA), Dulay and Burt (1974) attributed them to universal cognitive mechanisms and claimed "that it is the L2 system [the target language] rather than the L1 system [the native language] that guides the acquisition process" (p. 52). Krashen (1981) has claimed that second language acquisition is not essentially different from child language acquisition and has attributed the differences between the two acquisition processes to individual differences such as motivation to learn a second language, language learning anxiety, environment, and other related factors.

Building upon ideas by Fries (1945) and Lado (1957), who developed a structuralist emphasis on language teaching, and later analyzing the role of error as a central concern in language teaching (Weinreich, 1953), SLA theorists began questioning the role of language interference in second language acquisition. Bright and McGregor (1970) illustrate the assertion that one's L1 has a direct influence on their L2 by stating the existence of "the grammatical apparatus programmed into the mind as the first language interferes with the smooth acquisition of the second" (p. 236). Corder (1967) stressed the significance of learners' errors and stated that they are not only inevitable but also necessary for language learning. He even coined a new term, i.e. "transitional competence", to define the dynamism of the language learner's evolving mental system. He considered a learner's errors a discrepancy between the learner's transitional competence and the target language. He claimed that, if the nature of this discrepancy can be enlightened for learners of a specific target language with a specific native tongue, then the predictability of potential errors will increase, leading to better language teaching methods and techniques. For this end, he proposed a procedure called "Error Analysis" (EA). This was a revolutionary step forward, considering the premises of CA, although EA was not devoid of problems.

Drawing on Corder's EA approach, Selinker published his famous article "Interlanguage" in 1972, claiming that the language of second/foreign language learners is an individual system on its own merit, independent of L1 or L2, and affected by both. Therefore, it can be assumed that the difference between interlanguage and the native speaker system will not be random, but rather systematic. Lennon (2008) states that "interlanguage is a dynamic system moving in the direction of the target language" (p.5), referring to the progressive nature of interlanguage. It is this changeable and dynamic nature of interlanguage that forms the basis for the current study and any other studies with a similar research concern. The present study is, to be precise, an attempt at the discovery of a specific phonetic property of L2 speech that hypothetically can demonstrate the existence of interlanguage as an independent system, namely Voice Onset Time (VOT). We will come back to the discussion of the research question after a brief description of existing literature on VOT.

Voicing is regarded one of the primary segmental properties of stop consonants that helps to differentiate distinct phonemes. It is defined as "the time from the release of a stop to the beginning of vocal fold vibration" (Oh, 2011, p. 59). The vibration of the vocal folds may precede, coincide with, or follow the release of the stop, leading to negative, zero or positive VOT values. Negative VOT is termed "voicing lead" or "pre-voicing", while positive VOT is called "voicing lag". Figure 1 below graphically displays the three possibilities for the onset of vocal fold vibration in the production of plosives.

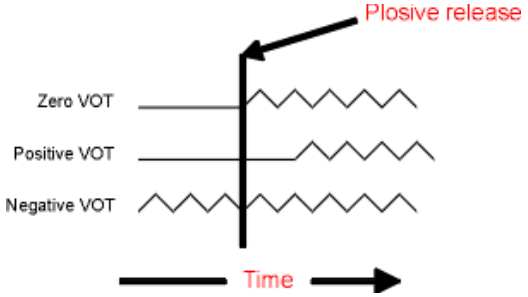

Figure 1. Patterns of overlap between the onset of vocal fold vibration and plosive release

In the literature, oral stops have been shown to be articulated with three different VOT parameters: (1) voicing lead (negative VOT), (2) short-lag (between 0 to +25 ms) and (3) long-lag (between +60 and +100 ms) (Lisker & Abramson, 1964). Languages have been shown to differ from each other in the way stop sounds are articulated. For example, while in English there is a contrast between short-lag and long-lag stops, in French the contrast is between pre-voiced and short-lag stops. On the other hand, Öğüt, Kiliç, Engin, and Midilli (2006) determined the average VOTs for Turkish plosives and showed that Turkish contrasts between pre-voiced and long-lag stops. The difference between English and Turkish average VOTs (that English voiced stops (/b/, /d/, /g/) are articulated with short voicing lag, while Turkish voiced stops are pronounced with voicing lead) forms the basis for the research concern for the current study.

Several studies have attempted to display phonological learning in L2 learners using VOT as a variable. For example, Sancier and Fowler (1997) examined the speech of a bilingual speaker of Brazilian Portuguese (L1) and English (L2) and found that prolonged stays in Brazil and the USA have caused significant changes in the VOTs of voiceless stops in her speech in both languages.

Flege (1987) explored the VOTs of native speakers of English and French who stayed about 12 years in Paris and Chicago, respectively. The author discovered that the VOTs of English /t/ in the speech of French native speakers were considerably shorter than those of monolingual English speakers (+49 ms as opposed to +77 ms), whereas VOTs of French /t/ in the speech of English native speakers were longer than those of monolingual French speakers (+43 ms as opposed to 33 ms).

In another study, Flege (1991) examined whether Spanish-English bilinguals can differentiate Spanish and English /t/ based on VOT if English is learned as an L2 in early childhood. The results of the study demonstrated that learning an L2 in early childhood increases the chances of the L2 speaker to produce sounds in a more similar fashion to native speakers of that L2. Thus, the author claims that age of learning is influential on the authenticity of VOT in stop consonants in an L2. In line with this finding, Major (1987), Flege and Eefting (1987), and Riney and Takagi (1999) displayed correlations between VOT and global foreign accent (GFA), thereby proving that VOT can be considered a measure of accent. Not surprisingly, there have even been studies (Arslan & Hansen, 1996; 1997; Hansen, Gray, & Kim, 2010) conducted by scholars in electrical engineering departments trying to develop algorithms and software for the automatic detection of VOT for an easier classification of accent.

In a longitudinal case study, Simon (2010) looked for the development of VOTs in word-initial stops with a three-year-old native speaker of Dutch acquiring English. Questioning whether the child develops two distinct phonetic systems or a single system for both languages, the author found that the child successfully acquired the contrast between short-lag and long-lag stops in English, but gradually adapted the Dutch system in the direction of the English system, indicating the development of interlanguage patterns.

Harada (2007) investigated the VOTs for /p/, /t/, and /k/ in English and Japanese by English-speaking children in an immersion program in Japan. The most important finding from this study in relation to our research concern is that the VOTs of the participants in Japanese are significantly longer than those of Japanese monolingual children and the VOTs are significantly shorter than their English VOTs. This finding can be interpreted as an indication of the fact that these children displayed a property (VOT) of interlanguage in their L2 speech, supporting the single system perspective.

The cross-linguistic influence of VOT was even investigated for L3 acquisition. Wrembel (2011) examined the sources of influence in the acquisition of VOT patterns in L3 phonology. As a result of the analyses of VOTs in the speech of the participants with Polish L1, English L2, and French L3, the author discovered interlanguage VOT patterns, revealing the combined influence of L1 and L2 on L3.

A controversial issue in L2 and bilingual acquisition relates to the question of whether learners of an L2 produce the VOTs of stop consonants authentically in the two languages or they display "compromise values of VOT" (Yavaş, 2002, p. 341). Some studies (Flege & Eefting, 1987; Flege & Schmidt, 1995) on bilinguals have pointed to the existence of a single set of phonetic VOT representations, whereas others (Flege, 1991; Schmidt & Flege, 1996) have evidenced separate systems for both languages.

Based on the above-mentioned controversy in language acquisition, the current research addresses the following research question:

RQ: Do the Turkish participants of the study display English VOT patterns similar to those of the English participants, similar to their own Turkish VOT patterns, or dissimilar to both languages exhibiting interlanguage patterns?

2. Method

2.1. Participants

The non-native English speaking (NNS) participants of the study were recruited from the English Language Teaching department of a state university in Turkey. Their ages ranged between 19 and 24, with a mean age of 21.5. To eliminate the potential effect of gender, eight male and eight female participants were randomly selected from among a total of 156 students in the same department. Thus, the sampling method used for the research was stratified random sampling. They had all been learning English since the 4th grade in primary school (age 10). 15 of the 16 participants were native speakers of Turkish only, and one was native in both Turkish and Kurdish. That participant was again randomly replaced with another participant, to control for the potential interlingual effect of the second native tongue, i.e. Kurdish. All the participants evinced their English language proficiency having passed the proficiency test prepared by the institution, which measured attainment in all four major skills.

The native English speaking (NS) participants were eight (four male and four female) lecturers from the same state university and a private university in Turkey. They all spoke Standard American English. They were recruited to determine the standard English VOTs against which the VOTs of the NNS participants were compared.

2.2. Data Collection

All participants (NNS and NS) uttered 30 words with the six English plosives (/p, t, k, b, d, g/) in word initial pre-vocalic position (5 for each plosive) (See Appendix A). The NNS participants also uttered 30 Turkish words starting with the six Turkish plosives (/p, t, k, b, d, g/) (See Appendix B). Their speech was recorded with the help of an omni-directional microphone in a sound-treated room (music studio). The recordings were done with Praat version 6.0.37 (Boersma & Weenink, 2018) as stereo sound files.

2.3. Data Analysis

In the analysis of the data, the first step was the measurement of VOT from the recordings of the participants. As mentioned in the data collection section, each NNS participant produced two recordings, one for English and another for Turkish. The NS output consisted only of a single recording for English, since the rationale behind their recruitment for the study was that they would set native English VOT norms. Actually, in the literature, there are various studies (e.g. Lisker & Abramson, 1964; Klatt, 1975; Caruso & Burton, 1987; Kessinger and Blumstein, 1997) reporting standard VOT values for different

varieties of English. We could have used their findings concerning VOTs of English stops as reference values. However, for the sake of consistency with the data we obtained from the NNS participants, we recruited NS participants from whom we obtained recordings which were analyzed to set English VOT norms for the current research.

VOT values for each plosive and for each participant were measured in milliseconds (ms) on wideband spectrograms in Praat as displayed on Figure 2 and Figure 3, which show the measurement of positive (43 ms) and negative (-99 ms) VOT, respectively. In the measurement of VOT, the procedure suggested by Lisker and Abramson (1964) was used. Öğüt et al. (2006) describes the measurement procedure saying that VOT "…is measured from the onset of the energy 'burst' corresponding to the release of an articulatory constriction to the first of the regularly spaced vertical striations of the vocal fold vibrations" (p. 1095).

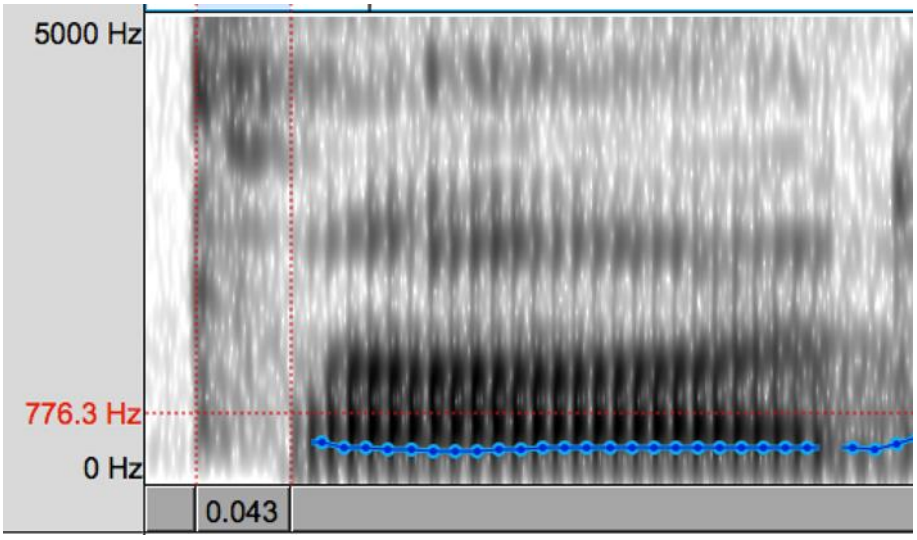

Figure 2. Spectrogram showing the measurement of positive VOT for the Turkish word [tarıf]

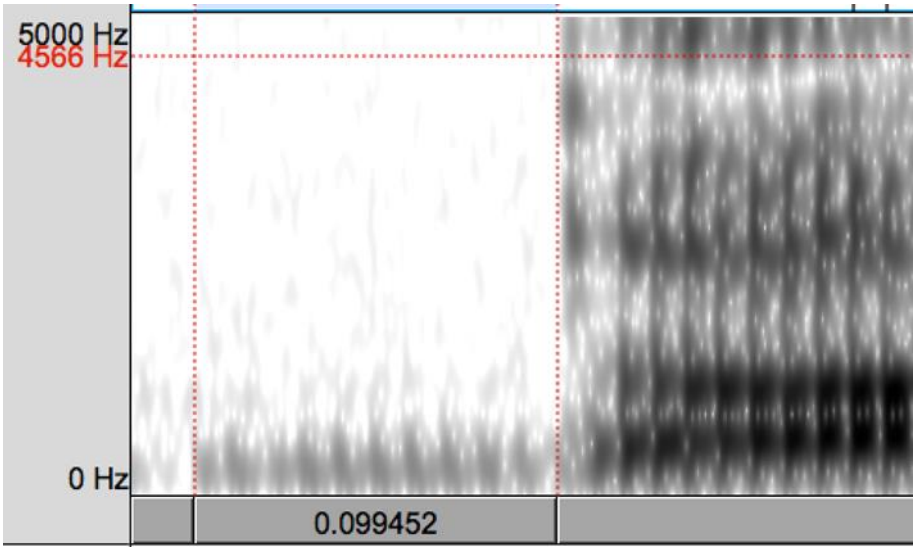

Figure 3. Spectrogram showing the measurement of negative VOT for the Turkish word [dahıl]

The measured VOT values for each plosive (1 repetition x 5 occurrences) yielded a mean VOT value for each plosive for each participant. Then, the mean VOT value for each plosive for the NS or NNS

was calculated as the mean of the mean VOT values obtained for each plosive from all NS or NNS participants.

After obtaining the mean VOT values for (1) English plosives in the speech of NS participants, (2) English plosives in the speech of NNS participants, and (3) Turkish plosives in the speech of NNS participants, inter- and intra-group differences were analyzed for statistical significance using Mann Whitney U and Wilcoxon signed-rank tests. The choice of non-parametric over parametric tests was done based on two concerns. The small size of the sample made it more logical to conduct non-parametric tests. Moreover, the Levene's test for inter-group differences yielded statistical significance for some of the plosives ($p < .05$), rejecting the homoscedasticity hypothesis for the dataset. Therefore, assumptions of normality could not have been met.

3. Results

The first test was conducted to check whether the NNS participants' English VOT values statistically significantly deviate from those of the NS participants. Table 1 demonstrates the results of the Mann Whitney U tests for the six English plosives:

Table 1. The results of the Mann Whitney U tests for the six English plosives

Plosive	*Group*	*N*	*Mean Rank*	*Sum of Ranks*	*Z*	*P*
/p/	NNS	16	12.84	205.50	-.337	.736
	NS	8	11.81	94.50		
/t/	NNS	16	8.50	136.00	-3.920	.000*
	NS	8	20.50	164.00		
/k/	NNS	16	13.72	219.50	-1.195	.232
	NS	8	10.06	80.50		
/b/	NNS	16	8.50	136.00	-3.919	.000*
	NS	8	20.50	164.00		
/d/	NNS	16	8.50	136.00	-3.920	.000*
	NS	8	20.50	164.00		
/g/	NNS	16	8.50	136.00	-3.920	.000*
	NS	8	20.50	164.00		

* $p < .001$

Table 1 shows that for four (/t, b, d, g/) of the six plosives, the differences between the NNS and NS participants for the production of VOT are statistically significant ($p < .001$). For /p/, the test did not reveal a significant difference ($Z = -.337$, $p > .05$). Similarly, no statistically significant difference was observed between NNS and NS participants in the production of /k/ ($Z = -1.195$, $p > .05$). The findings from the Mann Whitney U display the fact that the NNS participants of the study deviate from NS norms for the production of VOT for four out of six plosives.

Wilcoxon signed-ranks tests were run to see whether the VOT values in the production of Turkish and English plosives by NNS participants display differences from each other. The results of the tests are reported in Table 2 below:

Table 2. The results of the Wilcoxon signed-ranks tests for the Turkish and English plosives

Plosive	*Group*	*N*	*Z*	*P*
/p/	Turkish	16	-3.206	.001*
	English	16		
/t/	Turkish	16	-1.989	.047**
	English	16		
/k/	Turkish	16	-.698	.485
	English	16		
/b/	Turkish	16	-3.516	.000*
	English	16		
/d/	Turkish	16	-3.517	.000*
	English	16		
/g/	Turkish	16	-3.518	.000*
	English	16		

* p<.001**p<.05

As can be observed in Table 2, the Wilcoxon signed-ranks tests revealed statistically significant differences for five (/p, t, b, d, g/) of the six plosives (p<.05). For only /k/, no statistically significant difference was observed (Z = -698, p>.05). These findings show the fact that the production of VOT by NNS participants in their English speech is significantly different from that in their Turkish for five of the six plosives.

Although the conducted tests give us an idea about the general English VOT patterns of NNS participants of the study, Table 3 and Figure 4 below are presented to clearly observe an overview of the mean VOT differences among native English, native Turkish and nonnative English plosives.

Table 3. Mean VOT differences among native English, native Turkish and nonnative English plosives

Plosive	*Native English*	*Nonnative English*	*Native Turkish*
/p/	45.70	45.71	40.31
/t/	65.58	52.70	50.04
/k/	69.60	72.21	70.50
/b/	11.43	-46.20	-63.39
/d/	16.75	-31.79	-50.94
/g/	27.15	-3.25	-10.98

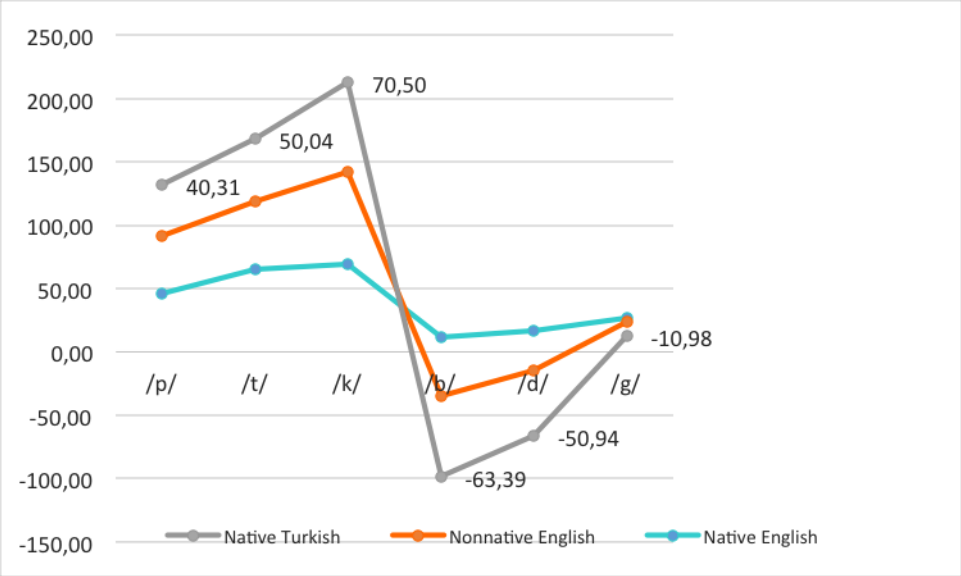

Figure 4. Mean VOT differences among native English, native Turkish and nonnative English plosives

Table 3 and Figure 4 show us that voiceless plosives (/p, t, k/) in native English and native Turkish are normally produced with long lag. When mean VOT values for nonnative English plosive production are analyzed, it can be observed that they are also produced with long voicing lag. Even though some statistically significant differences have been obtained in VOT values among native English, native Turkish and nonnative English for voiceless plosives, all the productions still seem to be done with long voicing lag. Moreover, the differences between native English and nonnative English (for /p/ and /k/) and between native Turkish and nonnative English (for /k/) have been found to be statistically nonsignificant. Therefore, it can be asserted that voiceless plosives, due to the similarity in VOT production between Turkish and English, do not present evidence for the existence of interlanguage patterns. However, the case with voiced plosives (/b, d, g/) presents us with a different picture. As can be seen in Table 3, voiced plosives in native English and native Turkish are produced with short voicing lag and voicing lead, respectively. This cross-language phonetic difference between the two languages gives us an opportunity to understand whether Turkish speakers of English display the characteristics of English or Turkish in the production of voiced plosives based on VOT. When the mean VOT values in their English production are observed, they seem to produce voiced plosives with voicing lead as in native Turkish. Nonetheless, the magnitude of the lead is decreased for all three plosives, growing dissimilar to their production in Turkish and becoming more similar to native English voiced plosives, which are normally produced with short lag. As will be reviewed in more detail and with reference to other studies conducted in the field, the natural assertion from this finding is that Turkish speakers of English display VOT patterns which are similar to neither their production in Turkish nor native English production, falling somewhere in between. We consider this an indication of the development of an interlanguage phonetic system and a natural outcome of SLA.

4. Discussion and Conclusions

In the current study, we tried to investigate whether Turkish L2 speakers of English produce plosives with VOTs similar to English or Turkish or dissimilar to both, displaying interlanguage patterns. Previous research conducted on the issue indicates either a single set of phonetic VOT representations (e.g. Flege & Eefting, 1987) or separate systems (e.g. Flege, 1991) for L2 speakers. The obtained

findings of the present research manifest the existence of interlanguage VOT patterns as it was disclosed that Turkish L2 speakers of English produce English voiced plosives with voicing lead, as they do in Turkish; however, the lead becomes accommodated to native English production, i.e. with short voicing lag. In other words, the voicing lead gets closer to zero VOT, which can be asserted to be an indication of the fact that they produce English /b, d, g/ with VOT values that are intermediate to the short-lag phonetic norm of English and the pre-voiced VOT norm for these plosives in their L1. This finding is in line with previous research that demonstrated intermediate VOT production between, for instance, Canadian English and Canadian French (Caramazza, Yeni-Komshian, Zurif, & Carbone, 1973), English and Brazilian Portuguese (Major, 1987), English and Arabic (Port & Mitleb, 1983), and English and Dutch (Flege & Eefting, 1987; Simon, 2010).

Although there exist several studies supporting the "separate systems" perspective (Flege, 1991; Schmidt & Flege, 1996), our research adds another brick in the wall for research proving the development of a unitary phonetic system, at least in the production of voiced plosives, in L2 acquisition. Therefore, it is of scientific importance since it augments the pile of research backing the "single system" perspective. It can also be deemed essential as, to the best of our knowledge, the current study is the first in the literature scrutinizing the articulatory difference or similarity between native English and Turkish L2 English with respect to VOT production of plosives.

One criticism about this research can be related to the number of participants recruited for data collection. However, in VOT studies the size of the data is usually not measured based solely on the number of participants as is done in psychometric social science research. Since each participant produced 30 token words (5 for each plosive), the total number of tokens for each plosive on which the analysis was conducted corresponds to 80 (16 participants x 5 words) for the NNS participants and 40 (8 participants x 5 words) for the NS participants. These are actually sufficient numbers to obtain mean VOT values for the plosives. Nevertheless, it needs to be admitted that multiple repetitions by the same participants could have given us a greater dataset to work with.

As previously mentioned, there are not many studies delving into the acoustic properties of Turkish-accented English. Since VOT is considered to be an indicator of GFA (Major, 1987; Flege and Eefting, 1987; Riney and Takagi, 2008), it is plausible to conduct more research into the English VOT patterns of Turkish speakers of English from different levels of English proficiency, different educational and socio-economic backgrounds, and different types of exposure to English. Furthermore, research is needed with Turkish learners of ESL in naturalistic settings to be able to verify the results obtained in the current research. Last but not least, we strongly recommend scholars from various countries to inquire into the English VOT patterns of learners of EFL in their countries to contribute to the resolution of this controversial issue.

To conclude, we would like to once again point out the importance of exposure to input in a foreign language, since it obviously contributes to the development of an interlanguage, as evidenced by the current research. Our study has displayed that even VOT, an auditorily hard-to-detect property of speech, can be improved, contributing to mutual intelligibility. Therefore, one important pedagogical implication of our research is that EFL learners must be subjected to as much input as possible in their language acquisition process to help with the development of interlanguage patterns.

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Appendix A. English Stimuli

/p/	/t/	/k/	/b/	/d/	/g/
peel	time	coke	boot	dear	good
party	tape	kill	beer	dull	gear
pale	tank	cape	born	doom	game
port	tool	cool	bite	dame	gone
pink	team	cart	bull	dill	gill

Appendix B. Turkish Stimuli

/p/	/t/	/k/	/b/	/d/	/g/
pil	tarif	koşu	burun	diyar	gurur
parça	tek	kilo	bira	dahil	giyer
peçe	ters	keyif	boru	durum	geyik
potuk	tutum	kuş	bayan	değer	gazi
pim	tilki	karış	bulut	dilek	gider

Aradilin bir göstergesi olarak seslilik başlama süresi: Türk aksanlı İngilizceden kanıt

Öz

Dil edinim alan yazınında, ikinci dil öğrenicilerinin iki dil için ayrı sistemler mi veya tek bir sistem mi (aradil) oluşturdukları konusunda tartışmalar bulunmaktadır. Bu çalışmada Seslilik Başlama Süresi'nin (SBS) bahsedilen iki bakış açısından birisini destekleyecek kanıt sunabilme olasılığı değerlendirilmiştir. Araştırma sorusunu cevaplamak için İngilizce konuşan 16 Türkçe ana dilli bireyden kelime başı, ses öncesi konumda ağızsıl patlamalıları barındıran 30 kelimeyi (hem İngilizce hem de Türkçe) okumaları istendi. Ana dili İngilizce olan 8 katılımcı da aynı İngilizce kelimeleri okudu. Bundaki amaç İngilizcedeki seslilik başlama süreleri ile ilgili norm değerler elde etmekti. Ortalama SBS değerleri İngilizce konuşan Türklerin /b, d, g/ seslerini İngilizcedeki fonetik norm olan kısa-gecikmeli SBS ile Türkçedeki norm olan ön-sesli SBS değerlerinin ortasında bir noktada telaffuz ettiklerini göstermiştir. Bunu, aradil SBS örüntülerinin bir göstergesi olarak kabul edebiliriz.

Anahtar sözcükler: Seslilik başlama süresi; aradil; ağızsıl patlamalılar

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