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The second formants of the laterals in Turkish

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Abstract

The study shows that there are two distinct lateral phonemes in Turkish with a minimal pair example. 20 male native speakers of Turkish, aged 20-26, were asked to read six short phrases and a minimal pair which contained laterals. The spectrograms were examined by PRAAT to determine whether it is possible to identify the laterals with regard to their second formants. As the laterals could have been greatly affected by the formants of the surrounding sounds, they were detected by following acoustic cues and the F_2 values were gathered at the middle of these sounds, which minimized the impact of the other sounds. The non-velarized lateral /l/ is marked by a higher F_2 than the velarized lateral /ɬ/ because of a tongue raising gesture. In order to distinguish between the two laterals, the Mann-Whitney U test was employed based on their F_2 values in the minimal pair example, for $\alpha = 0.01$. With reference to the data, it appears that there is a statistically significant difference between the F_2 values of the laterals ($p < 0.01$). There is strong evidence that second formants help define the laterals in Turkish.

Keywords: lateral; phoneme; Turkish; formant; phonetics

1. Introduction

Although many languages have been studied regarding their phonetic inventories, Turkish has fallen short in that respect. Laterals, being considerably common sounds in the world languages (Yip, 2011), remain under-researched. This study aims to scratch the surface by demonstrating the lateral phonemes in Turkish. The focus will be on how they behave in different environments and how they differ in terms of F_2 values. PRAAT v6.1.14 will be used in order to show frequencies and determine the specific properties of the laterals in the study (Boersma & Weenink, 2020).

1.1. Literature review

Laterals are generally defined by the blockage of central airflow, in which case the air escapes from one or both sides of that obstruction; however, according to Ladefoged and Maddieson (1996), there is no requirement for a central occlusion as long as the air flows around one or both sides of the tongue. Also, considering 'laterality' as a manner of articulation may seem like an oversimplification since it can be applied to other manners of articulation as well, i.e. lateral fricative, lateral approximant or lateral

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stop (Ladefoged & Johnson, 2010). In line with the interesting nature of laterals, Ladefoged and Johnson (2010) suggest that one should answer up to eight questions, in which laterality and manner of articulation are presented separately, in order to fully classify a consonant. According to Maddieson (1984), almost 80 percent of the languages he studied had laterals, which are grouped together with rhotics because of their common aspects in terms of phonetics.

There is prevailing agreement that the huge majority of laterals are sonorant sounds. Parker (2008) postulates a sonority hierarchy as follows:

Relative sonority of sonorant consonants:

glides > flaps > laterals > trills > nasals

Despite his findings, Parker (2008) further suggests that especially Spanish may demonstrate differences in such a hierarchy due to the onset position of some sounds (Harris & Kaisse, 1999). Another determinant of laterals is that they are continuant, which is much less agreed upon than their sonority. Mielke (2005), in his survey, finds out that there is no consistency of laterals patterning as [+continuant] or [-continuant]. He attributes this to the fact that they behave ambivalently in terms of both phonological and phonetic cues. Another topic that should be concentrated on is alternation process involving laterals as they alternate with the sounds with which they share some articulatory or acoustic similarities. As for stops, /l/ appears to alternate with the voiced alveolar stop /d/ in certain contexts; more specifically they are in free variation, for example, in Palenquero Spanish (Piñeros, 2003). Contrarily, Southern Min possesses /l/ instead of /d/ in its phoneme inventory (Yip, 2011). Regarding their alternation with nasals, Cantonese might be the language to examine. Traditionally, /l/ and /n/ are two distinct phonemes in Cantonese, where both can occur syllable-initially while only /n/ can be in the syllable-final position. Nevertheless, a moderate change has taken place in the last fifty years or so, as a result of which younger speakers replace the initial /n/ with /l/. Therefore, they are becoming the allophones of a single phoneme: [n] as the syllable-final and [l] as the syllable-initial variant (Bauer & Benedict, 1997). A quick examination of the languages where such alternations occur may exhibit that there are common features between stops and laterals, or nasals and laterals, but what those properties exactly are remains the main question. In summary, it is still in dispute whether laterals form a natural class just as stops or fricatives do.

Ladefoged and Johnson (2010) gather all laterals and give their respective IPA symbols as such: ɭ, ɬ, ɮ, ɺ, ʎ and ǁ. Below is a table that shows the descriptions of these sounds.

Table 1. The descriptions of laterals (Ladefoged & Johnson, 2010).

ɭ	voiced alveolar lateral approximant
ɬ	voiceless alveolar lateral fricative
ɮ	voiced alveolar lateral fricative
ɺ	voiced alveolar or retroflex lateral flap
ʎ	voiced palatal lateral approximant
ǁ	lateral click

Nevertheless, this table definitely needs to accept new applications because it seems that there are a few more different laterals. For instance, retroflex lateral approximant ɻ, palatal lateral approximant ʎ and velar lateral approximant ʟ seem to be missing and can be added to the table.

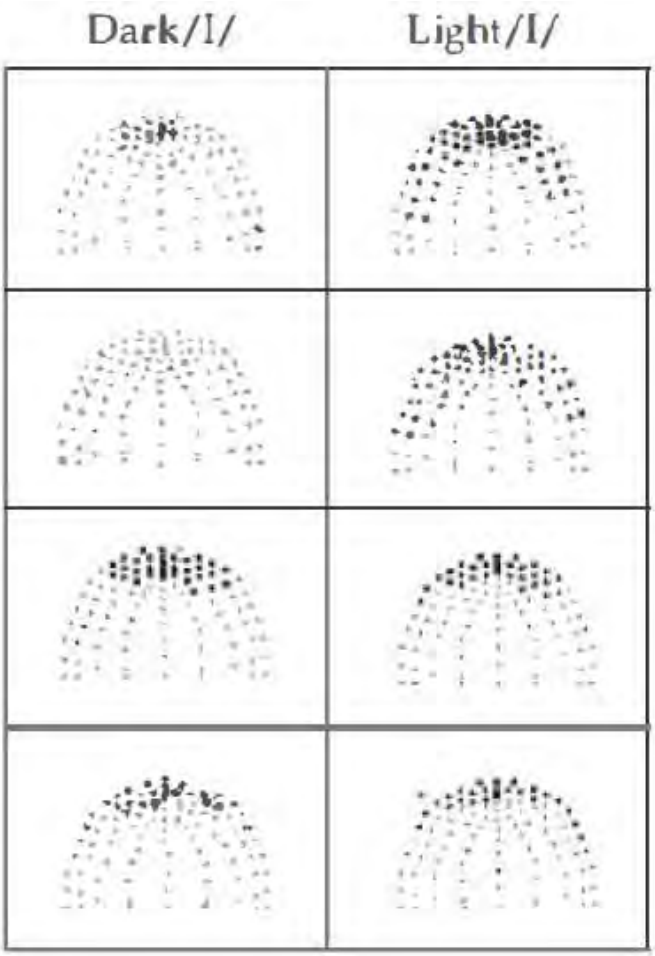

Figure 1. Linguo-palatal contact profiles of dark and light lateral consonants, gathered from four different American English speakers (Narayanan, Alwan, & Haker, 1997).

According to the linguo-palatal contact profiles of dark and light lateral consonants, gathered from four different American English speakers, the contact is made in the front regions rather than the sides, from which the air escapes as can be seen in Figure 1 (Narayanan, Alwan, & Haker, 1997). Therefore, the definition, according to which laterals are characterized by the air flowing from the sides of the tongue, seems sufficient. Also, dark 'l' and light 'l' will be of significance to this study, thus their characteristics on the spectrograms are to be examined. Dark 'l' is said to be velarized or pharyngealized and has a postdorsum retraction gesture, whereas clear 'l', non-velarized or non-pharyngealized, can be produced by a single tongue tip raising gesture (Browman & Goldstein, 1995). Since clear 'l' causes a tongue dorsum raising and fronting, one can see a much higher F_2 in clear 'l' than dark 'l', which seems to be the main point to keep in mind while investigating the spectrograms of laterals (Recasens & Espinosa, 2005).

1.2. Research questions

As this study aims to find the characteristics of the laterals in Turkish, the research questions are formed in light of this endeavor. The research questions are presented as follows:

How many distinct lateral phonemes are there in Turkish?

How do the laterals in Turkish differentiate in terms of F_2 values?

2. Method

2.1. Participants

20 male native speakers of Turkish, aged 20-26, were chosen randomly from a state university in Ankara. They were asked to read six short phrases and a minimal pair which contain laterals. The short phrases, rather than full sentences, were selected in order to minimize any probable coarticulation which could have potentially affected the results. Special attention was given to the environments of the laterals, that is, they were arranged such that one could find word-initial, word-medial and word-final laterals.

2.2. Data collection procedures

The phrases that the speakers were asked to read are given below with the translations provided in parentheses:

Lalesiz bahçe (garden without tulips)

Öyle olmazdı (it would not have been that way)

Lanet olsun (damn it)

Solgun güller (faded roses)

Yalan söyleme (do not lie)

Gül gül öldük (we laughed our heads off)

After these six phrases, the homographs *sol* "left" /s̪oɬ̪/ and *sol* "musical note g" /s̪ol/ were recorded since the two form a minimal pair, which is central to phonological analysis. The formants of the lateral sounds in all the utterances above were analyzed with PRAAT v6.1.14.

2.3. Data analysis

Traditionally, Turkish has always defined laterals with the letter <l> just as most of the other languages around the world. Therefore, we should be focused on where the letter <l> occurs most. After the recordings were gathered from the speakers, their spectrograms were examined in PRAAT v6.1.14. In addition, in order to find out whether the laterals are different phonemes in Turkish, a minimal pair was found and analyzed as well. Due to the surrounding consonants, transitions of formants into and out of vowels can strongly vary (Rosner & Pickering, 1994; Stevens & House, 1963). Thus, the vowels in the recordings could have greatly affected the formants of the laterals as well. However, the segmentation of the laterals in all the recordings was carefully done by hand. The laterals were detected by following acoustic cues and the F_2 values were gathered at the middle of these sounds, which helped keep the effect of the other sounds to a minimum.

Along with the findings of Recasens and Espinosa (2005), F_2 played a huge role in determining the different occurrences of the laterals in Turkish. After establishing that there are two distinct lateral phonemes, the Mann-Whitney U test was used to compare F_2 values of the two lateral sounds in the homographs *sol* "left" /s̪oɬ̪/ and *sol* "musical note g" /s̪ol/. The speakers are divided into two groups: the velarized lateral /ɬ̪/ and non-velarized lateral /l/. The results of the Shapiro-Wilk test showed that F_2 values of the laterals did not have a normal distribution, therefore, the nonparametric Mann-Whitney U test was deemed useful to determine if there is any significant difference between the two. The significance level (α) was chosen as 0.01.

3. Results

Below are presented the spectrograms of all the phrases and the minimal pair. A representative spectrogram is selected for all the phrases and the minimal pairs which were articulated by the speakers. Therefore, each phrase is shown with the help of a spectrogram.

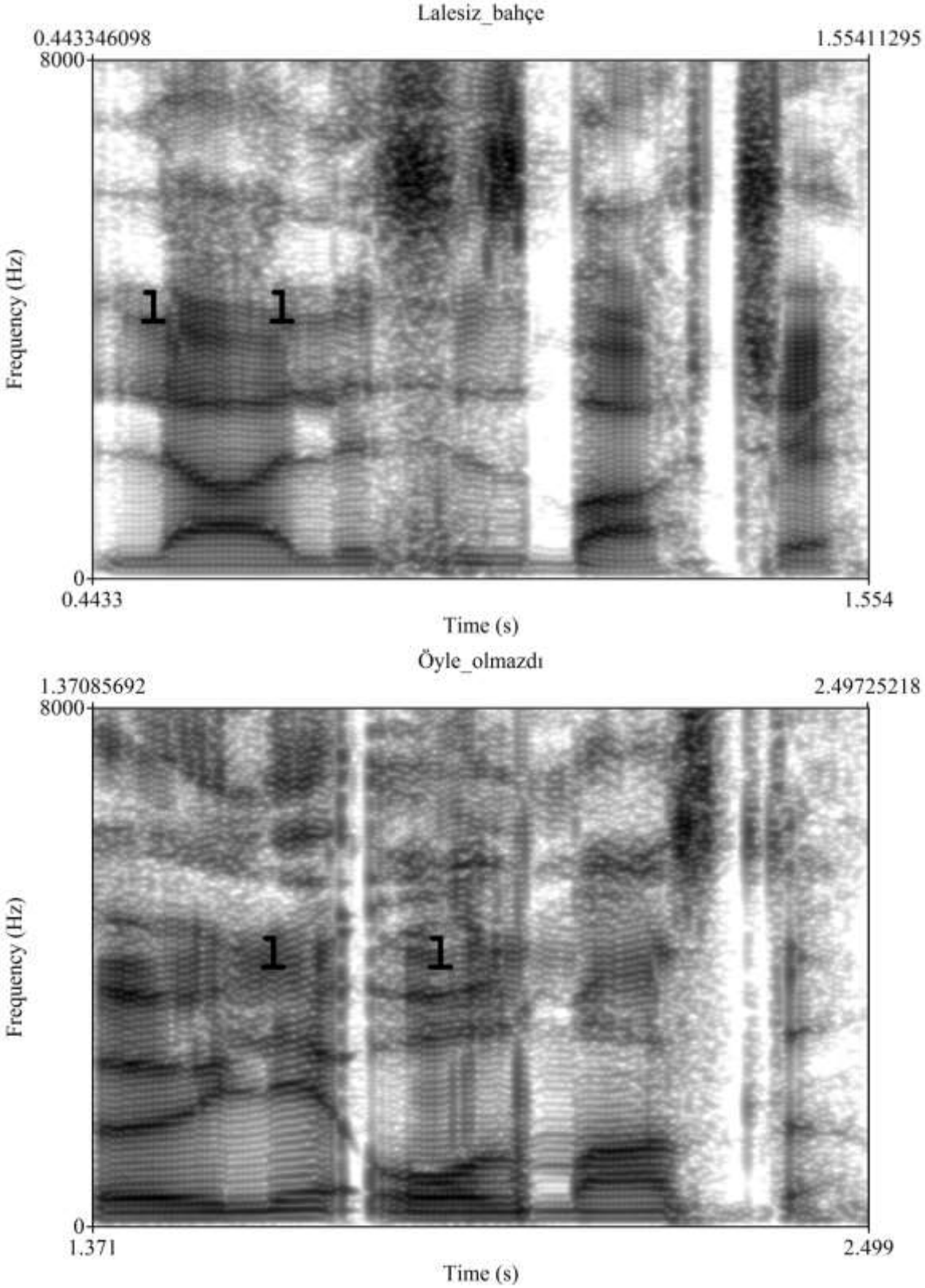

Figure 2. Spectrograms for ‘lalesiz bahçe’ and ‘öyle olmazdı’ respectively.

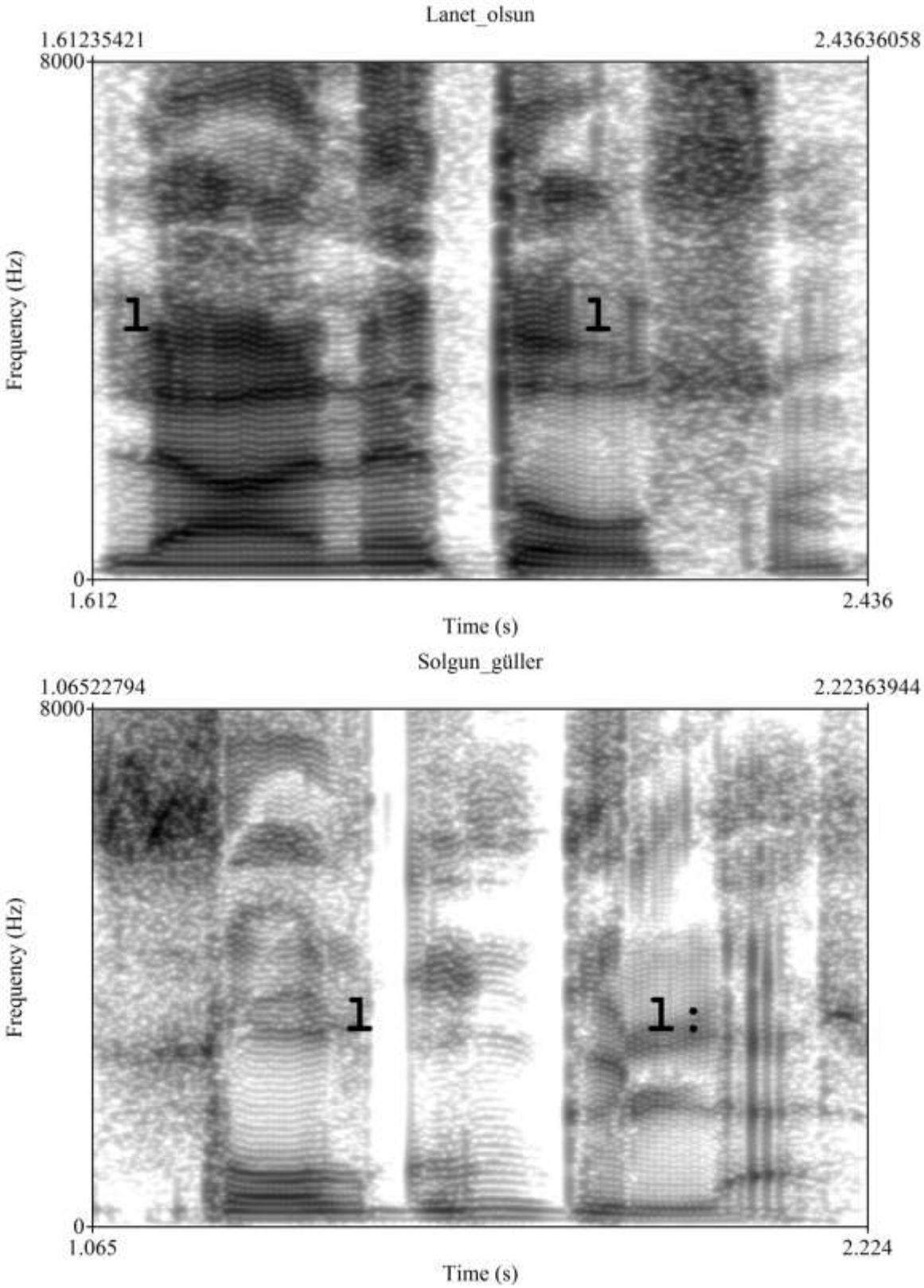

Figure 3. Spectrograms for ‘lanet olsun’ and ‘solgun güller’ respectively.

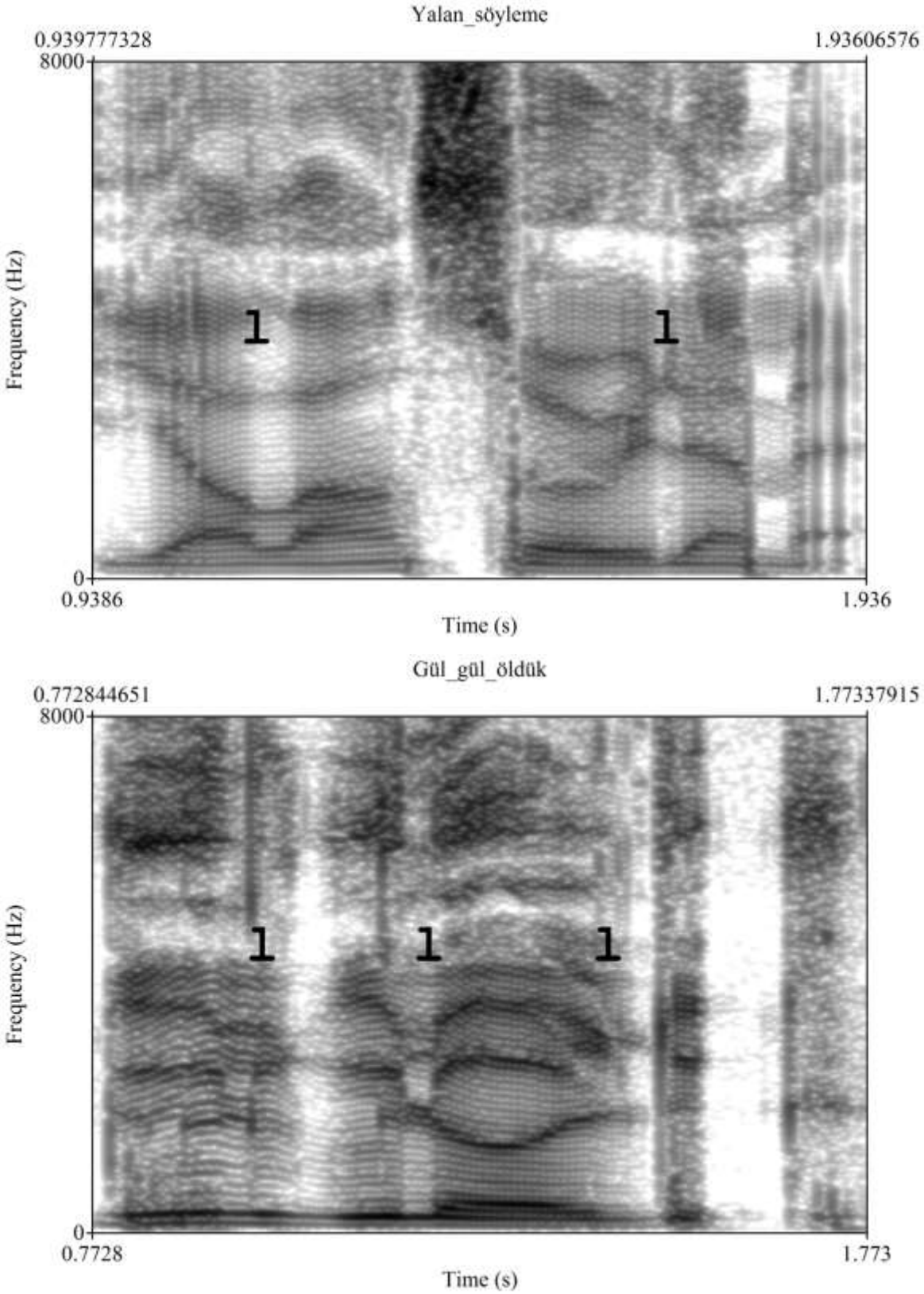

Figure 4. Spectrograms for ‘yalan söyleme’ and ‘gül gül öldük’ respectively.

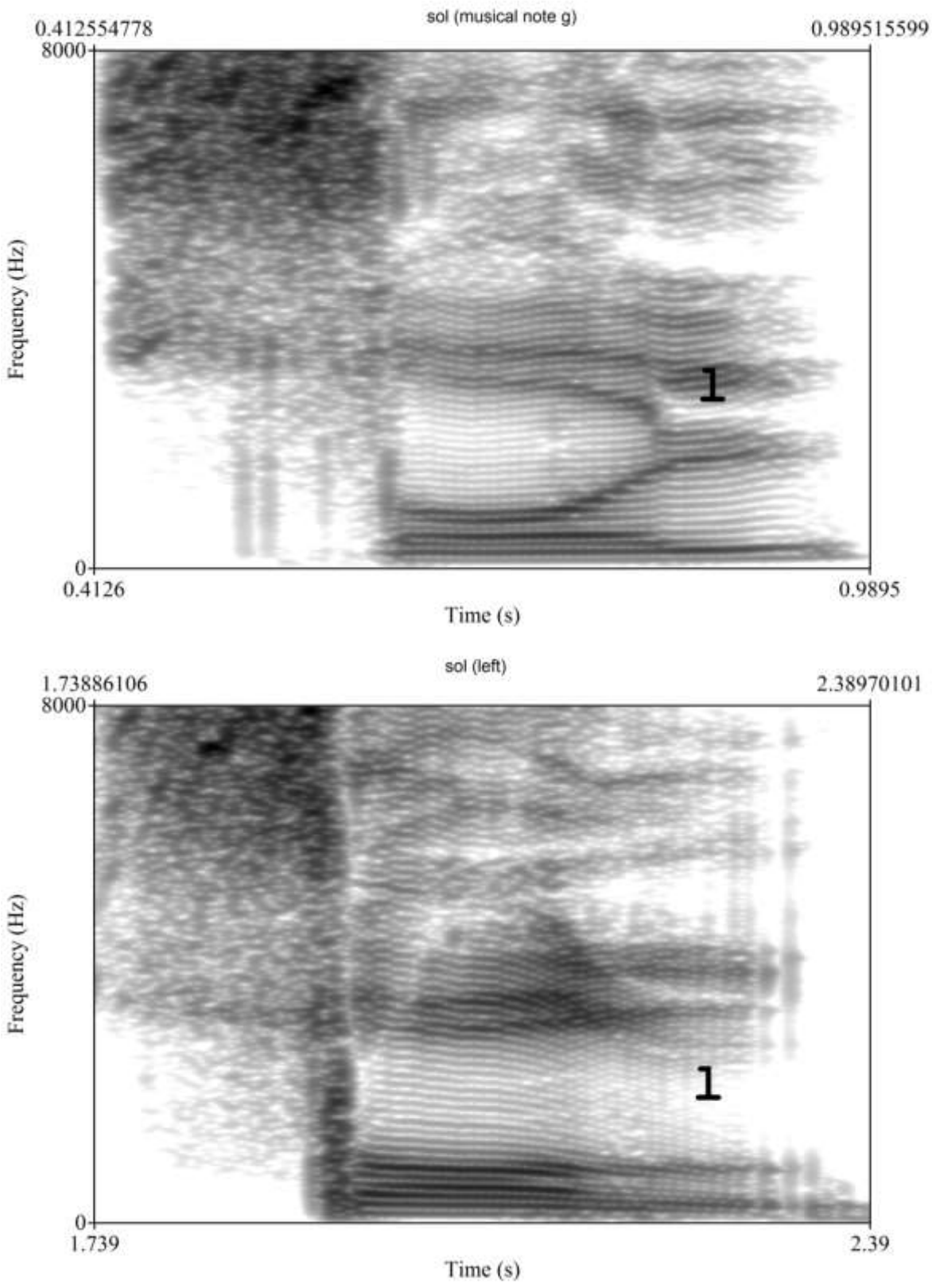

Figure 5. Spectrograms for 'sol' (musical note g) and 'sol' (left) respectively.

All the lateral occurrences are shown inside the spectrograms with the letter <l>. The colon is utilized to denote gemination. Formants can be observed as dark lines along the x-axis. Figure 2, 3 and 4 demonstrate the spectrograms for the phrases and Figure 5 shows the minimal pair differing only in the lateral sound.

The two lateral phonemes in Turkish can be transcribed as /l/ and /ɫ̪/. The latter symbol has a diacritic, sort of a tilde going through it, denoting velarization. There is also a diacritic below the symbol, marking the dental articulation of the sound. The non-velarized lateral /l/ happens to occur word-initially and its environment (i.e. whether there is a back or front vowel preceding or following it) does not affect its quality. Also, when there is a front vowel preceding or following the lateral consonant, then it becomes /l/ again. The velarized lateral /ɫ̪/, on the other hand, needs to be preceded or followed by a back vowel. However, if the following vowel is back and the lateral consonant occurs word-initially, then it is, once again, /l/. In general, the velarized lateral's F_2 values seem to be much lower than those of the non-velarized one, which is in line with Recasens and Espinosa (2005). One can easily see the dissimilarity between the two lateral phonemes in terms of F_2 values especially in 'öyle olmazdı,' 'lanet olsun,' 'yalan söyleme' and 'solgun güller' since these phrases contain both of those phonemes. Both /l/ and /ɫ̪/ are very distinguishable in the spectrograms. F_2 of /ɫ̪/ is low as in the first lateral of 'solgun güller' and F_2 of /l/ appears much higher as can be seen in the second lateral in the same phrase. This procedure can be followed for all the lateral occurrences in the phrases.

Finally, in Figure 5, the spectrograms are given for the recordings of the homographs *sol* "the musical note g" /s̪ol/ and *sol* "left" /s̪oɫ̪/, which form a minimal pair in Turkish, corroborating the evidence that /l/ and /ɫ̪/ are separate phonemes in Turkish. According to the nonparametric Mann-Whitney U test results, based upon the F_2 values of the laterals, it is found that the magnitude of the difference between the two is large. The p-value is $p < 0.01$, thus the null hypothesis is rejected. There is strong evidence that we can differentiate the two laterals in terms of their F_2 values.

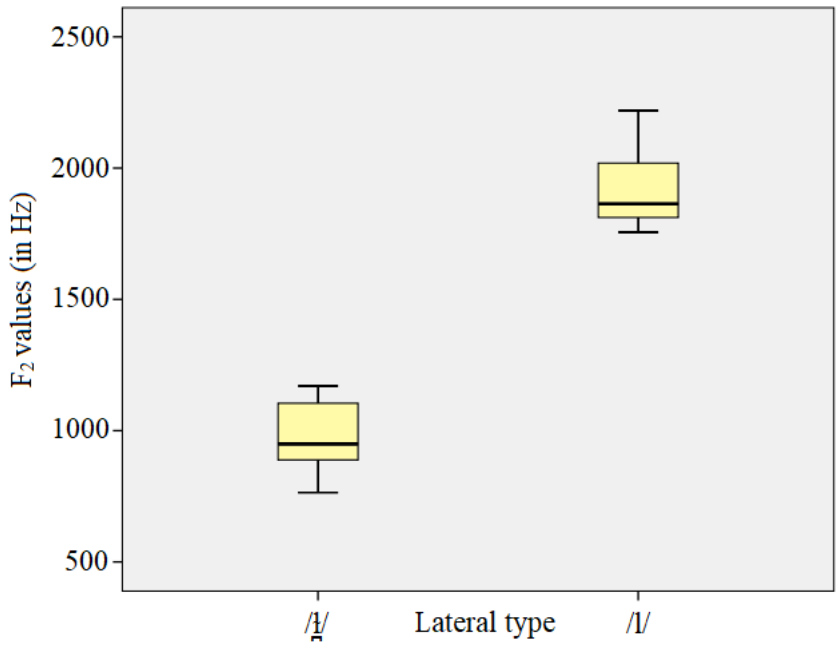

Figure 6. Boxplot of /ɫ̪/ and /l/.

Figure 6 shows a boxplot for the laterals, excluding the outliers. 50% of the lateral occurrences are given in yellow boxes. The medians are marked by dark lines splitting the boxes. The lower and upper

whiskers represent the values which fall outside the middle 50% range. We can also observe that F_2 values of the laterals do not have a normal distribution, which lead to the employment of the Mann-Whitney U test in the study.

4. Conclusions

One conclusion of the study is that there are two distinct lateral phonemes in Turkish, namely /l/ and /ɫ̪/. This is supported by the minimal pair *sol* "left" /s̪oɫ̪/ and *sol* "musical note g" /s̪ol/ which differ only in the lateral sound. Furthermore, the spectrograms of the phrases and the minimal pair, which were created via PRAAT v6.1.14, display that second formants are crucial in the examination of these laterals. Due to tongue raising gesture, F_2 in the non-velarized lateral /l/ is observed to be much higher than that of the velarized lateral /ɫ̪/. F_2 values of two distinct lateral sounds in the study were assessed and compared with the help of the Mann-Whitney U test, which revealed a statistically significant difference between the two laterals in Turkish ($p < 0.01$). It should be noted that the non-velarized lateral /l/ is tentatively treated as an alveolar sound whereas the velarized lateral /ɫ̪/ is shown as a dental sound with the help the diacritic due to the fact that the IPA symbols are used in order to represent the laterals and that the places of articulation of the laterals are beyond the scope of this study. To be able to fully comprehend the nature of these lateral sounds, it is important that their places of articulation be investigated in future studies.

5. Ethics Committee Approval

The author confirms that the ethical approval was obtained from Hacettepe University Ethics Commission (Approval Number: 35853172-300).

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Türkçedeki yanünsüzlerin ikinci formantları

Öz

Bu çalışma, bir en küçük çift yardımıyla, Türkçede iki ayrı yanünsüz sesbirimi olduğunu göstermektedir. 20-26 yaşları arasında, ana dili Türkçe olan 20 erkek konuşucudan, içerisinde yanünsüz bulunan altı kısa ifade ve bir en küçük çift okumaları istenmiştir. Spektrogramlar, yanünsüzlerin, ikinci formantları yönünden ayrıştırılmalarının mümkün olup olmadığını belirlemek amacıyla PRAAT ile incelenmiştir. Söz konusu yanünsüzler, çevrelerindeki seslerin formantlarından büyük ölçüde etkilenebilecekleri için, akustik ipuçlarından yararlanılarak tespit edilmiş ve F_2 değerleri bu seslerin tam orta kısımlarından toplanmıştır. Böylece diğer seslerin etkisi en aza indirilmiştir. Artdamaksıllaşmayan yanünsüz /l/, dilin yükselme hareketi sebebiyle artdamaksıllaşan yanünsüze /l̠/ göre daha yüksek bir F_2 değeri göstermiştir. İki yanünsüzü ayırt etmek için, en küçük çift örneğindeki F_2 değerlerine göre, $\alpha = 0{,}01$ olmak üzere Mann-Whitney U testi uygulanmıştır. Elde edilen veriler ışığında, yanünsüzlerin F_2 değerleri arasında istatistiksel açıdan anlamlı bir fark görülmektedir ($p < 0{,}01$). İkinci formantların, Türkçedeki yanünsüzlerin tanımlanmasında rol oynadığına dair güçlü bir kanıt sunulmuştur.

Anahtar sözcükler: yanünsüz; sesbirim; Türkçe; formant; ses bilgisi

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