

AN ACOUSTIC APPROACH TO ‘Ğ’ SOUND IN TURKISH

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Abstract

The main aim of this study is to specify the phonological role of ‘Ğ’ ([ɣ]) sound in Turkish by approaching it from an acoustic perspective and to confirm whether it has any acoustic difference from long vowels in Turkish. In this way, it aims to contribute to an ongoing discussion on whether the letter ‘Ğ’ is really necessary in Turkish alphabet or not. Within the frame of this objective, the study is composed of two parts which are perception and production. In perception task, the participants choose between two options after listening to word pairs repeated by a computerized voice. In production task, they repeat the word pairs reflected on a computer screen. The voice recordings of production task are analyzed through the program PRAAT. According to the results of perception task, native speakers of Turkish have difficulty in differentiating between the words with long vowels and with the sound ‘Ğ’. As opposed to our expectations, ‘Ğ’ happens to be perceived best when it is in coda position in the middle of a word instead of in onset position. As for the results of production task, the spectrogram pattern of ‘Ğ’ sound differs depending on the pattern of the long vowels preceding it. Although ‘Ğ’ sound seems to assimilate depending on the properties (e.g. backness or height) of the preceding vowel, it has been confirmed that its formant values differ from those of long vowels, which proves that it stands for a separate sound we cannot ignore in Turkish alphabet.

Keywords: Turkish phonology, acoustic phonetics, Turkish phonetics, Turkish consonants

1. INTRODUCTION

Turkish is a language that is pronounced as it is written. Its stress pattern is also easier to follow. If there is no exceptional situation, the stress is put on the right most syllables (Kabak & Vogel, 2001, p.316) [1]. On the other hand, in English people need to consider many factors such as the morphological category of the word, the individual sounds in each syllable and the syllable structure, etc. (Roach, 2002, p.64) [2]. Therefore, there is no such a complication in Turkish in terms of pronunciation or stress distribution as in the case of English. Normally, there is not much discussion about the correct pronunciation of sounds in Turkish, but there is a one sound that causes a lot of debate in terms of its phonetic features. This sound is ‘Ğ’ ([ɣ]) in Turkish.

There is still ongoing discussion whether ‘Ğ’ ([ɣ]) is a consonant or whether it is even a separate sound or it is necessary to show this consonant by using a letter in the alphabet since it only helps lengthen the vowels in Turkish. It does not have its own characteristics. Although there are many studies in the field to explain this particular sound, we realize that very few of them, mostly recent ones focus on the acoustic properties of ‘Ğ’ ([ɣ]) sound and tries to explain it from an acoustic perspective. As a result, the main aim of this paper is to define some properties of ‘Ğ’ ([ɣ]) which are different from the long vowels in Turkish by conducting a perception and a production test on ‘Ğ’ sound and analyzing the results with the help of a spectrogram. Therefore, this paper will start with explaining the previous studies on ‘Ğ’ ([ɣ]) and continue with the research design of the current study and finish by explaining the results and the implications of the findings.

2. REVIEW OF LITERATURE

2.1. The Problem of Consonant 'Ğ' in Turkish and Some Previous Studies on the Topic

It is certain there have been many ideas and studies on 'ğ' to understand the phonetic nature of the sound and its phonological environment. These ongoing discussions can be categorized under 3 main categories:

- Discussions on its phonetic properties
- Discussions on its phonological properties
- Discussions on its orthographical demonstration

2.1.1. Phonetic Properties of 'Ğ'

According to Banguoglu (1990) [3], 'Ğ' is both a voiced and fricative consonant. It occurs as a result of the continuity of front and back 'G' sounds (p.45).

Ergin (1993)[4] suggested that there are three different 'ğ' sounds in Turkish. One of them is the normal [ğ] sound as in bağ, doğum, etc. Second one is the front vowel which is similar to the sound [y] and which occurs through the assimilation of /k/ and front /g/ sound as in geldiği, örneğin, etc. Final one is formed in a consequence of the assimilation of back consonants /g/ and /k/ as in aldığı, kulağın, etc (p.45).

Koç (1996) [5] regards /ğ/ as a half vowel. However, he says that it may change to [y] or [v] sounds or sometimes even disappear depending on its environment. He also supports that /ğ/ is an important separate sound and it should be taught meticulously although it causes to increase the length of vowels by disappearing in natural speech (p. 601).

Selen (1979) [6] also accepts that /ğ/ is a voiced and a palatal consonant. Even though she does not make any explicit explanations about its phonetic nature, the fact that she prefers to use IPA sign [ɣ] as the representative of /ğ/ sound tells us that she treats /ğ/ sound as a separate consonant (p.85).

Deny (1995) [7] also agrees that /ğ/ is a fricative palatal consonant. However, especially in Istanbul Turkish it almost disappears from the speech by lengthening vowels. He also adds that /g/ turns into /ğ/ when it comes after a vowel. This /ğ/ sound is pronounced as [y] with front vowels while it is pronounced as [ğ] with back vowels in his opinion.

Kılıç (1999) [8] thinks that it is possible to lengthen vowels just by using '·'. He states if it will not lead to any meaning difference between the words with ğ and the words with '·', we do not need to consider 'ğ' a separate phoneme for the sake of preserving economy principle (p.960).

Coşkun (2000) [9] examined /ğ/ sound in Turkish by using a spectrogram analysis and came up with the conclusion that /ğ/ cannot be counted as a letter in Turkish since it does not represent a separate sound, or in other words, a phoneme.

Özsoy (2004) [10] does not refer to /ğ/ when she explains consonants; however, when it comes to the explanation of long vowels, she mentions the lengthening effect of /ğ/ sound at that point (p.49).

According to Coşkun (2016) [9], /ğ/ is a grapheme which has the responsibility of lengthening the vowel that comes before it. He also adds that this situation makes Turkish richer in terms of reservoir of long vowels. To reach this decision, he uses a spectrogram analysis of the consonant /ğ/ in various phonological environments. Environments as shared below in Figure 1 (p.117):

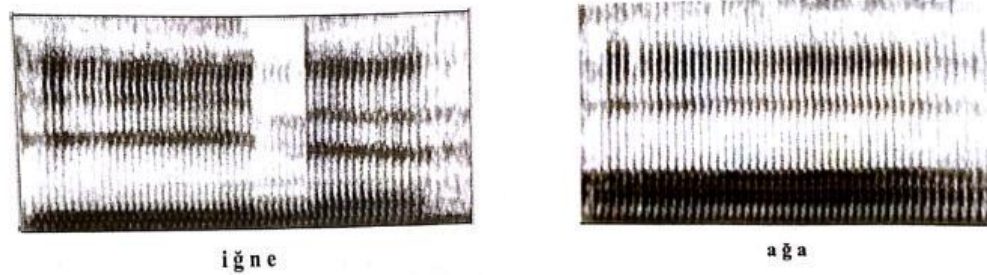


Figure 1. Spectrogram Demonstrations of 'iğne' and 'ağa'

In the spectrogram results of the word 'iğne' above, the formants 1 and 2 which refer to the place of articulation never change their places and the frequencies of *i* and *ğ* stay the same. Also, in the example of 'ağa', all the sounds in *ağ+a* has the same F1 value and frequencies. By depending on those findings, Coşkun (2016) concluded that /ğ/ is a grapheme which has a feature of lengthening the vowels that come before it (p.117).

2.1.2. Phonological Properties of 'Ğ'

Selen (1979) [6] argues that Turkish people do not produce such kind of sound in their speech. Instead, they lengthen the vowel when /ğ/ is used between two similar vowels; /ğ/ causes a diphthong when it is used between two different vowels (p.85).

Ergin (1993) [4] asserts that /ğ/ becomes weaker between two vowels, but it never completely disappears. Although we cannot notice the existence of a consonant between these two vowels in actual speech, /ğ/ consonant always exists there. In case of a disappearance of /ğ/, he supports that these two vowels combine with each other and become one vowel (p.65).

Coşkun (2016) [9] states that /ğ/ sound brings 5 more long vowels by expanding the length of *e, i, o, ö, ü*. In this way, Turkish becomes much richer in terms of the number of long vowels. He supports that the long vowels produced by the addition of /ğ/ sound are completely different long vowels than the ones with 'ˆ' mark (p.119).

2.1.3. Orthographic Properties

In this part of discussion, researchers are searching for answers for the question "Should /Ğ/ be demonstrated as a separate letter?"

As we have specified above, Kılıç (1999) [8] supports that if there is no meaning difference between the words with /ğ/ and /:/, it is not necessary to keep a separate letter for this sound in Turkish alphabet. However, he also adds that it is significant to know that our new Turkish alphabet (1928) is phonemic or morphemic to give such a decision. If it is a phonemic alphabet, we will have to reflect the changes in speech to our written language as well. Otherwise, we can stick to the alphabet we already have without any changes (p.960).

Another consideration about the removal of /ğ/ sound is that there is no consonant in Turkish which can demonstrate the back consonant [ğ] like in *bardağ*, *çanağ*, etc. Therefore, the removal of this sound may lead to some complications, too.

Finally, Coşkun (2016) [9] also agrees that /ğ/ should stay in the alphabet since there are also other consonants that act like a grapheme in Turkish. To illustrate, /h/ could be given as an example to such kind of sound. Therefore, it should hold its place as a letter in Turkish alphabet (p.118).

2.2. Significance of the Project / Study:

By taking the preliminary studies into consideration which was clarified in the previous part, there are mainly 3 motives to follow this study. At first, we will start with the most general idea and continue with more specific ones.

To start with the most general motive, linguistics is quite a new branch of study in Turkey. Therefore, there are very few studies on Turkish linguistics compared to English linguistics. Therefore, the main aim of this study will be both to make a contribution to this field and try to illuminate some debated points such as the situation of the sound Ğ in Turkish within some certain limitations.

The second and more specific motive is that the number of studies which focus on acoustic side of sounds is quite low in Turkey. It is certain that there is an increasing need for more studies on this field. As Eker (2007) [11] suggested, in most of the studies the sounds are classified depending on their physiological properties such as the place of articulation, the position or movement of the tongue while articulating a sound (p.31). IPA alphabet is also designed based on these physiological properties. On the other hand, thanks to the recent improvements in computer science, we can also identify the acoustic properties of many sounds. By depending on this situation, Eker (2007) [11] refers to 2 main criteria to discriminate between sounds one of which is an acoustic and the other one of which is a physiological criterion. First one is the length of a sound which is an acoustic property. The other criterion could be roundness, height or the place of articulation which can be regarded as physiological features (p.31). Although there are both physiological and acoustic categorizations of sounds, the main objective of this study will be focusing on certain acoustic properties of the sounds, especially on the features of the consonant ‘Ğ’ ([ɣ]) and long vowels in Turkish. Thus, this study aims to contribute to the field of acoustic linguistics in Turkey.

When it comes to the last and the most specific motive to conduct this study is the current ongoing discussion on ‘Ğ’ consonant in Turkish. As also Kılıç (1999) [8] claims that ‘Ğ’ sound in Turkish has always been controversial for turcologists due to several reasons below (p.1):

- The sound has too many varieties based on the geographical region (like the difference between East Anatolian and Istanbul dialects)
- It does not change the meaning of a word even if it is not articulated.
- Ğ sound cannot be used at the beginning of a word, which raises the question of whether it is really a consonant.

Based on these three foundations, some regard ‘Ğ’ sound as a ‘zero’ sound, which is not even used in speech while some others still associate it to a velar fricative sound which is shown by the letter ‘ğayn’ in Arabic (Kılıç, 1999, p.1) [8].

The difference of this study is that the analysis of ‘Ğ’ sound will be done both from acoustic and phonological perspective as opposed to other studies which approach to the topic from a phonological perspective by choosing a scientific approach. The sound will also be evaluated in context.

Within the frame of these 3 different motives, the main objective of this study is to figure out whether there is an acoustic difference between the long vowels and the sound ‘Ğ’ ([ɣ]) in terms of both production and perception. The ongoing discussion on whether to count this sound as a separate sound to be demonstrated IPA chart or not also raises the question whether we really need the letter ‘Ğ’ in Turkish alphabet if it only helps us lengthen the vowels that come before it. Based on these ideas, this study aims to answer the research questions provided below:

- Is the sound ‘Ğ’ ([ɣ]) in Turkish a separate sound or is it only responsible for lengthening the vowel that comes before it?
- If ‘Ğ’ is a separate sound, how is it different from the vowels that come before it?
- If ‘Ğ’ only has the function of lengthening the previous vowel, do we really need an orthographical representation of this sound in Turkish alphabet? And why?

3. MATERIALS AND METHODS

3.1. Participants and Context

19 participants took part in this study. Among these participants, 11 of them were male, and 8 of them were female participants. They were all native Turkish and their age range changes between 17- 19. All the tasks were applied in a silent room. There was only the researcher and participant in the room so that participants would not be distracted throughout the application procedure of the tasks.

3.2. Data Collection Tools

The data collection was achieved through the application of two different tasks one of which was perception and the other one of which was a production task.

In the perception task (Appendix A), the participants were expected to choose between two options depending on the sentence they heard. While preparing this task, four main considerations were given importance. First consideration was that every data set was produced in equal times. For example, in data set "ağrı" and "arı", the production time of the second word was lengthened by extending the sound [a] until their production time is even. The second consideration was that the data sets were not read not by the researcher, but by a computer. To produce these data sets an online and free speech synthesizer program was used. The website of this program was <<https://www.lumenvox.com/products/tts/>>. The main motive behind using a computerized voice was to standardize the quality of data sets with the help this program. As Akcatas (2007) [12] also defended, there are many factors influencing the production time and quality of a sound:

- The sound itself
- Neighboring sounds
- Syllable, Word itself, stress and intonation patterns of the phrases and sentences
- Place of the sound in a word
- The qualifications of the word that a particular sound is in.
- Number of syllables
- Number of words
- Speed of speech
- Emotions and style of the speaker (pp.14-15)

Based on the criteria stated above, the researcher were not be actively involved in reading data sets to the participants since human speech may change depending on emotion, thoughts or distraction. On the other hand, the target sounds (long vowels and ğ sound) were presented in the same environment to the speaker. The neighboring sounds, their position in the words and the sentence stayed the same. The third consideration was that before the task, 3 or 4 data sets were demonstrated to the participants so that they could warm-up for the real task itself. Finally, as stated above, the data sets were presented to participants in a context. This helped us to look at our target sounds (long vowels and ‘Ğ’ ([ɣ])) from a phonological perspective. Thus, they were not evaluated in isolation.

As for production task, a PPT presentation (Appendix B) was prepared and in this presentation, two different words in isolation were presented to participants. The participants were expected to read those words loudly so that we would be able to record their voices. In presentation, the words with long vowels and the words into which Ğ is inserted were used (as in the pairs sude and suğde). To record the voice of participants, a voice recorder application was used.

3.3. Data Analysis

After collecting the data of participants, these recordings were analyzed in a spectrogram so as to see the difference in their production. To analyze the data a free program which was called Praat was used. This program was available on website <<http://www.fon.hum.uva.nl/praat/>>. While analyzing

the data, the place of the target sounds was also be taken into consideration since there might be some changes in the sound quality depending on its place in a word.

4. RESULTS

4.1. Results of Perception Test

The main purpose of this test was to check whether Turkish speakers have any difficulties in discriminating between long vowels and 'ğ' sound when they encounter those sounds in similar environments.

We will start from the very general result and continue with more specific explanations. First of all, as shown in the pie chart below (Figure 2) there is equality between correct and wrong answers to the perception task.

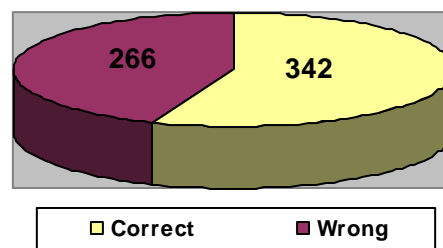


Figure 2. Distribution of Correct and Wrong Answers of the Perception Task

In total, 608 answers were given to all the questions; however, only 342 of them were answered correctly according to the chart above. This clearly shows us that there is a problem in discriminating between long vowels and words with 'ğ' for Turkish native speakers when they are surrounded by the same environment and used in the same context.

As the second step, we wanted to check in which environment the participants could perceive 'ğ' better. Therefore, we selected the questions whose correct answers included words with 'ğ' from the test and put them in groups under 3 main categories based on the position of 'ğ' in these words.

As shown in the column chart below (Figure 3), the group names were:

- Ğ is used in the onset position in a syllable
- Ğ is used in the coda position in a syllable
- Ğ is used at the end of a whole word (mostly a word with one syllable)

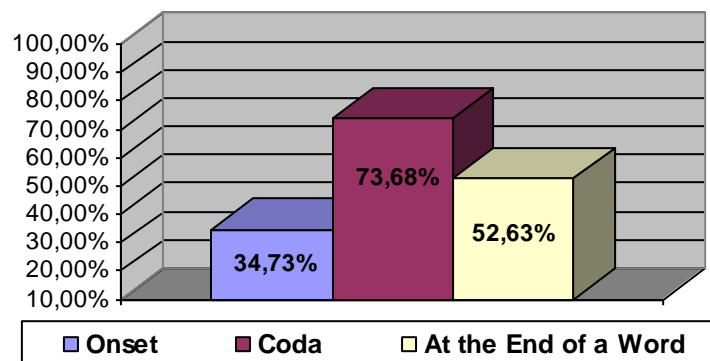


Figure 3. Distribution of the Perception of 'ğ' Sound Depending on its Position in Words

We all know that we cannot use ‘ǧ’ at the very beginning of a word. For this reason, the onset and coda categories here mean that ‘ǧ’ is used in the middle of the word, but their positions in a syllable are different. The last category already means that ‘ǧ’ is used at the very end of a word and naturally in coda position.

When we look at the percentage of correct answers in each category, the results are astonishing since the highest percentage of correct answers belongs to the coda position in the middle of a word. This suggests that ‘ǧ’ is perceived better when it is in the middle of a word and in coda position. On the other hand, the same consistency cannot be observed when it is at the end of a word. The percentage of correct answers for the end of a word is a bit lower than the percentage of the correct answers for coda position. Additionally, it seems that ‘ǧ’ is least perceived when it is in onset position in the middle of a word according to the graph as it has relatively the lowest rate of correct answers when compared to other categories.

4.2. Results of Production Test

In this part, our main aim was to see whether we can discriminate the ‘Ǧ’ sound by looking at its spectrogram graph and how it is different from the sounds that surround it and how it is different from the vowels that precede it.

Within the frame of this aim, we collected samples from all those 19 participants and compared their spectrogram data with each other. There is no significant difference among their data. Therefore, only one sample from a male and a female participant will be provided in the following part to explain the situation of ‘Ǧ’.

It is also important to highlight at this point his study focused on only the situations where ‘Ǧ’ sound follow ‘A, Ī, U, E’ vowels. Among these sounds, two of them (A, U) were back and the other two were front vowels (E, Ī). Because of time limitation problem, other vowels could not be analyzed and were left for further research.

The first situation of ‘Ǧ’ that we want to analyze in this part is its position after the vowel ‘u’.

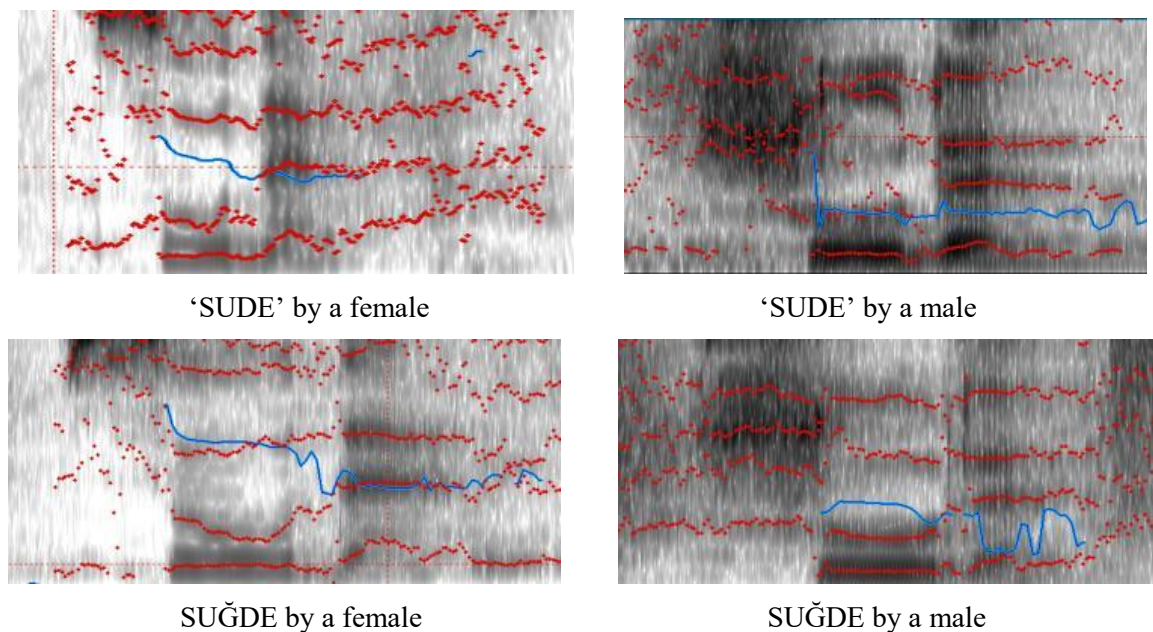


Figure 4. Spectrogram Demonstration ‘Ǧ’ after the Vowel ‘u’

When we look at the spectrogram pictures of both male and female participants in Figure 4, we can observe that SUDE and SUǦDE do not differ from each other in terms of the patterns they follow. For

example, when we look at the graphs above, we can easily discriminate consonants ‘S’ and ‘D’ as ‘S’ causes a dark area on the top as it is a high frequency consonant. ‘D’ is a plosive sound, so there is generally a stop before it and an explosion of sound. This sound is shown with a very thin line. On the other hand, ‘Ĝ’ is not an easy consonant to differentiate as opposed to others as it follows almost the same formant patterns of the previous vowel.

To understand the difference between long vowels and ‘Ĝ’ sound, we decided to look at the formant values more closely. Therefore, we evaluated the mean value of formants for each spectrogram and we also checked the formant values at the end of our target vowel before and after adding a ‘Ĝ’ sound as shown in Table 1 below. Finally, we noted the production time of each pair to see whether they really make the vowel longer.

Table 1. Formant Values and Production Times of the Sound [u] Before and After Adding ‘ĝ’ [ɣ]

INFORMATION OF FEMALE PARTICIPANT					
WORD	F1 Mean Value	F2 Mean Value	The F1 Value at the end of the Highlighted Sound	F2 Value at the end of the Highlighted Sound	Production Time of the Highlighted Sound (ms)
S U DE	393	1039	383	1139	0.21
S UĜ DE	398.	1172	354	1456	0.29
INFORMATION OF MALE PARTICIPANT					
	F1 Mean Value	F2 Mean Value	The F1 Value at the end of the Highlighted Sound	F2 Value at the end of the Highlighted Sound	Production Time of the Highlighted Sound (ms)
S U DE	376	1474	336	1431	0.18
S UĜ DE	364	1074	353	1120	0.21

As can be understood from the table above, there is no significant difference between Ĝ sound and long vowel ‘U’. The only consistent change in the tables is the production time of the sounds. There is a slight increase in the production time of the long vowel ‘U’ after adding ‘Ĝ’.

One other difference between male and female spectrograms that draws our attention is the blue lines. In fact, these blue lines show us the pitch of sound. Pitch occurs as a result of the vibration frequency of vocal cords and its strength is directly related to the size of vocal cords. Vocal cords of men are generally thicker and longer than those of women. Therefore, their vibration frequency is lower compared to women together with their pitch (Martha, 1996, p.148). Due to this difference, we cannot use pitch every time to discriminate between sounds since it could be deceiving in some contexts.

The second position to be discussed is the position of ‘Ĝ [ɣ]’ after the vowel ‘A [a]’ as can be shown in the Figures 5 and 6 below.

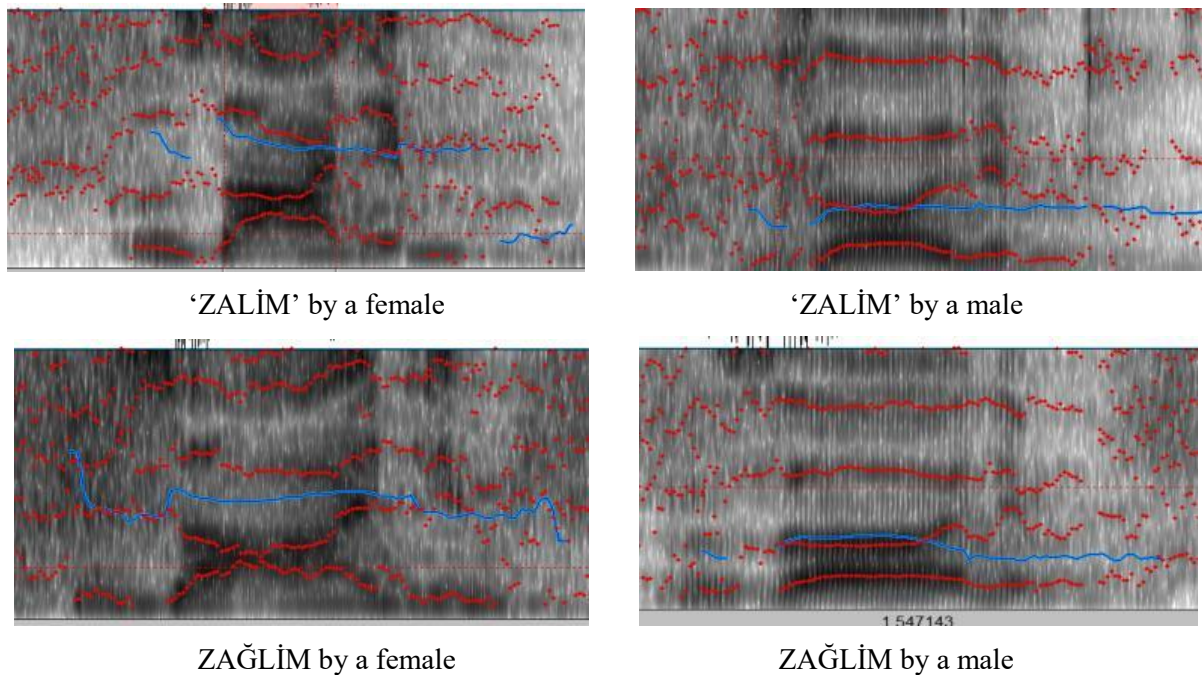


Figure 5. Spectrogram Demonstration ‘Ğ[y]’ after the Vowel ‘A [a]’ in the word ‘ZALİM’

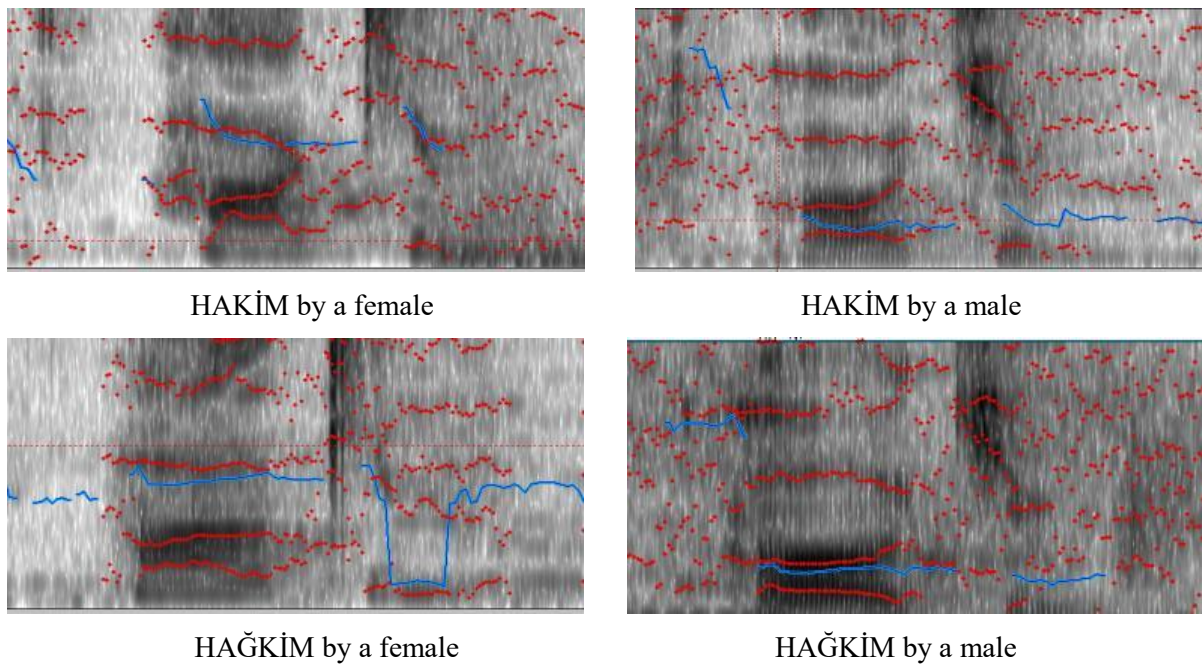


Figure 6. Spectrogram Demonstration ‘Ğ[y]’ after the Vowel ‘A [a]’ in the word ‘HAKİM’

When we look at the spectrogram results, it is very difficult to reach a conclusion about the difference of ‘Ğ’ sound as the patterns are almost the same. We still continue to have difficulty in explicitly identifying the ‘Ğ’ sound simply by looking at the spectrogram outputs above. Because of that, ‘Ğ’ sound was observed in two different words this time.

When we turn to the values provided by the Table 2 below, the mean formant values are so close to each other that we cannot deduce a valid conclusion from such a little value difference. As for the formant values at the end of ‘A’ vowel, we can deduce that although there are some slight changes,

there is a tendency to pronounce the ‘Ĝ’ sound at the end of ‘A’ as a back vowel. However, the results are so variable that we cannot reach a conclusion.

To clarify the situation in a more detailed way, F1 normally stands for height of the sound. On the other hand, F2 represents the part of tongue like front, mid or back. There is an inverse proportion between the value of F1 and height. In addition, F2 value and backness feature are also in an inverse relationship. In the table below, although we cannot reach a conclusion from mean formant values, we can see that F2 values at the end of ‘A’ vowel show little decrease in their values after adding ‘Ĝ’ except for the word ‘ZAĜLİM’. This means that when we add ‘Ĝ’, native speakers try to pronounce ‘Ĝ’ as a back vowel that we cannot define.

As to the time differences, it is stable that the production time of the long vowels in each word set increases after adding ‘Ĝ’.

Table 2. Formant Values and Production Times of the Sound [a] Before and After Adding ‘ğ’ [ɣ]

INFORMATION OF FEMALE PARTICIPANT					
WORDS	F1 Mean Value	F2 Mean Value	The F1 Value at the end of the Highlighted Sound	F2 Value at the End of the Highlighted Sound	Production Time of the Highlighted Sound (ms)
Z <u>A</u> LİM	888	1479	863	1765	0.20
Z <u>AĜ</u> LİM	840	1489	641	2060	0.31
H <u>A</u> KİM	805	1349	712	1384	0.19
H <u>AĜ</u> KİM	749	1316	879	1296	0.32
INFORMATION OF MALE PARTICIPANT					
	F1 Mean Value	F2 Mean Value	The F1 Value at the end of the Highlighted Sound	F2 Value at the end of the Highlighted Sound	Production Time of the Highlighted Sound (ms)
Z <u>A</u> LİM	606	1341	530	1605	0.22
Z <u>AĜ</u> LİM	596	1277	575	1576	0.27
H <u>A</u> KİM	616	1281	576	1506	0.19
H <u>AĜ</u> KİM	614	1208	505	1409	0.25

Thirdly, the situation of ‘ğ [ɣ]’ after ‘i [i]’ sound will be analyzed both in the first and the last syllable in the following part as can be seen in the Figures 7 and 8.

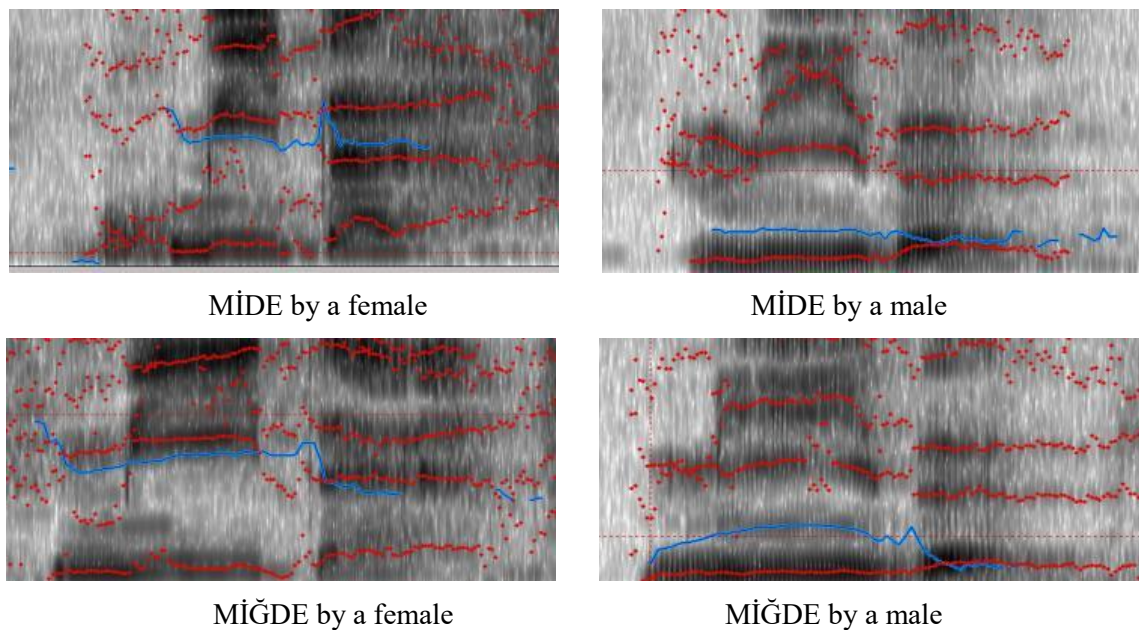


Figure 7. Spectrogram Demonstration ‘Ǟ[y]’ after the Vowel ‘I [i]’ in the word ‘MIDE’

According to the Figure 7, the most salient difference between these word pairs with and without ‘Ǟ’ is the length of formants. They seem to form a longer line in the words including ‘Ǟ’ after the vowel ‘I’. Although there are some minor disturbances in the graphs, the overall schema shows us that ‘Ǟ’ does not have its own spectrographic property to be identified easily. It seems to have copied the shape of the vowel that precedes it.

As to the Figure 8 below, we can see that especially for the female speaker, there are some considerable changes in the pattern of formants and formant values of both F1 and F2.

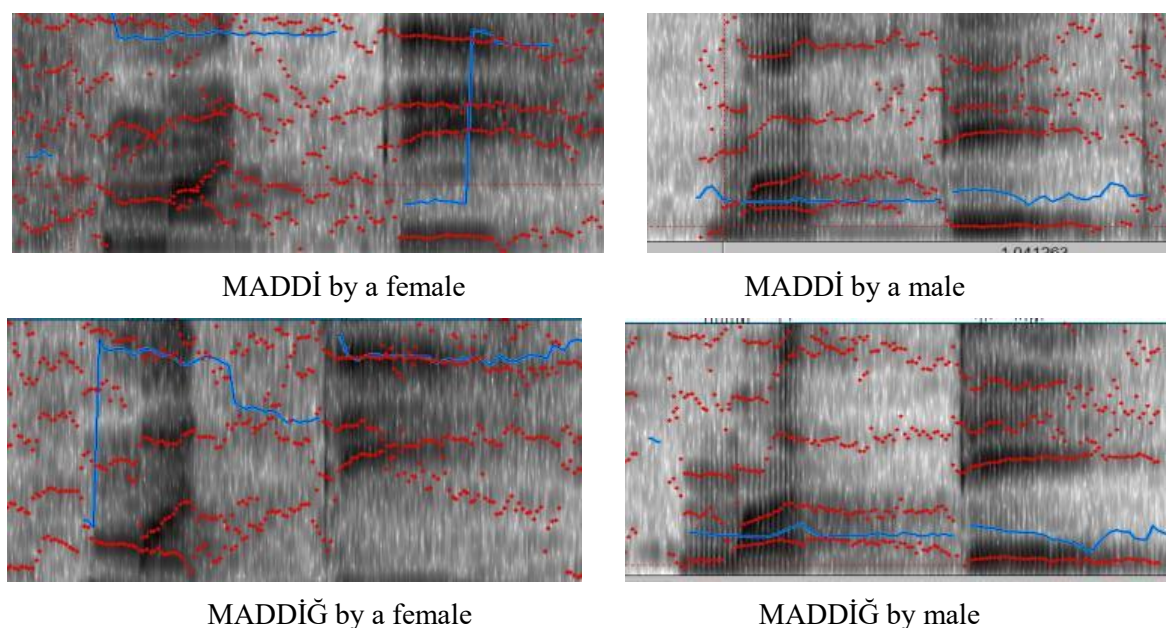


Figure 8. Spectrogram Demonstration ‘Ǟ[y]’ after the Vowel ‘I [i]’ in the word ‘MADDI’

To check the hypothesis, we focused on the data in the Table 3 below. According to the table, we cannot make any comments on the mean F1 and F2 values because there is neither a regularity nor a relation between these data. It is true that especially F2 mean value in ‘MĪĜDE’ shows a considerable increase, yet it is not enough for us to draw some conclusions.

Table 3. Formant Values and Production Times of the Sound [i] Before and After Adding ‘ġ’ [ɣ]

INFORMATION OF FEMALE PARTICIPANT					
WORDS	F1 Mean Value	F2 Mean Value	The F1 Value at the End of the Highlighted Sound	F2 Value at the End of the Highlighted Sound	Production Time of the Highlighted Sound (ms)
M <u>i</u> DE	422	1888	444	1502	0.19
M <u>iĜ</u> DE	407	2609	327	1973	0.31
MADD <u>i</u>	453	2446	391	2486	0.15
MADD <u>iĜ</u>	287	2352	251	2023	0.26
INFORMATION OF MALE PARTICIPANT					
	F1 Mean Value	F2 Mean Value	The F1 Value at the end of the Highlighted Sound	F2 Value at the end of the Highlighted Sound	Production Time of the Highlighted Sound (ms)
M <u>i</u> DE	316	2247	325	2098	0.19
M <u>iĜ</u> DE	331	2241	323	2150	0.26
MADD <u>i</u>	315	2288	308	2246	0.24
MADD <u>iĜ</u>	299	2306	268	2318	0.31

When we look at the formant values in the Table 3 above, we see that F1 value shows a little decrease when the sound ‘i’ in the middle is combined with ‘Ĝ’ sound. However, when the ‘i’ sound is at the end of the word, this decrease rate gets a little higher; however, the difference is so low that we cannot reach a decision just by looking at this small amount of difference. On the other hand, when we look at the F2 value in the table, it increases to a large extent when we bring the consonant ‘Ĝ’ to a mid-positioned ‘i’. Nevertheless, it shows a decrease in amount when Ĝ is put at the end of the word after ‘i’.

Although we cannot make any comments based on F1 values, we still can say by concluding from F2 values that the effect of ‘Ĝ’ on ‘i’ sound may change depending on the position of ‘i’ in a word. For example, ‘Ĝ’ sound shows a tendency to sound like a front vowel when ‘i’ is in mid-position. On the other hand, it is closer to a back vowel when the ‘i’ is in final position. In other words, we can conclude that the tongue pulls itself in a more back position when we add ‘Ĝ’ to a word final ‘i’ according to the results listed in the Table 3.

One other interesting change in this table is the production time of the underlined sound patterns increases again after we add the ‘Ĝ’ consonant, which means that ‘Ĝ’ really, has a function of making vowels sound longer.

Finally, the situation of of ‘ġ [ɣ]’ after ‘e [e]’ sound will be analyzed in the following part as can be seen in the Figure 9.

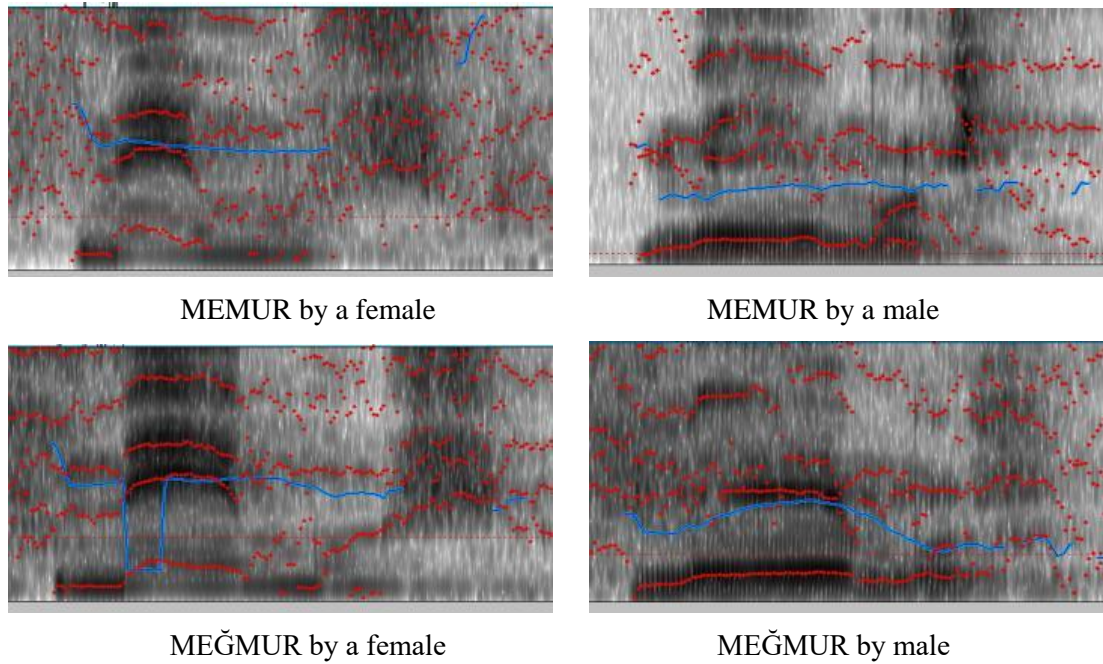


Figure 9. Spectrogram Demonstration ‘Ĝ[y]’ after the Vowel ‘E [e]’ in the word ‘MEMUR’

From the data of female participant (in Figure 9), we can easily infer that there is an extension of the same sound after ‘Ĝ’ is added.

On the other hand, according to the Table 4 below, we see that all the formant values increased after ‘Ĝ’ is added to the word. A possible rise in F1 and F2 values lead to some changes in the sound ‘Ĝ’. The sound here may sound like a lower and at the same time a more frontal vowel. Thus, we can deduce that the consonant ‘Ĝ’ might be affected by the properties (front, back, rounded, etc.) of the sounds that come before it. To clarify, by being a frontal vowel, ‘E’ might have affected the nature of ‘Ĝ’ during the production process.

Table 4. Formant Values and Production Times of the Sound [e] Before and After Adding ‘ĝ’ [y]

INFORMATION OF FEMALE PARTICIPANT					
WORD	F1 Mean Value	F2 Mean Value	The F1 Value at the end of the Highlighted Sound	F2 Value at the end of the Highlighted Sound	Production Time of the Highlighted Sound (ms)
M <u>E</u> MUR	673	2201	556	2175	0.14
M <u>EĜ</u> MUR	680	2344	632	2213	0.22
INFORMATION OF MALE PARTICIPANT					
	F1 Mean Value	F2 Mean Value	The F1 Value at the end of the Highlighted Sound	F2 Value at the end of the Highlighted Sound	Production Time of the Highlighted Sound (ms)
M <u>E</u> MUR	449	1904	473	1505	0.20
M <u>EĜ</u> MUR	522	1970	532	1620	0.25

5. DISCUSSION & CONCLUSION

At the end of our study, we can conclude that ‘Ğ’ consonant is a very special one and it does not resemble to the other consonants in Turkish alphabet by inferring from both spectrogram results and the perception test results.

According to the results of the perception test, we can suggest that it is difficult for native Turkish speakers to recognize the word with a ‘Ğ’ sound in sentences or in word pairs when there is no semantic clue about the meaning of that word. Another striking finding is that before this study, we were assuming that Ğ sound can be best recognized when it is in onset position or at the very end of a word. However, the results conflict with our expectations. At the end of the first part, the results show that ‘Ğ’ consonant is best perceived and best differentiated from long vowels when it is in coda position in the middle of a word.

As to the results of production task, we can again claim that the spectrogram results do not comply with our expectations since we cannot come up with a certain difference of this sound from the long vowels that precede it. As Coşkun (2016) [9] suggested in these graphs we have seen that ‘Ğ’ functions as a grapheme that lengthens the vowels that come before it (p.118). However, there are still some significant findings that we have come up with. Although we cannot understand how exactly ‘Ğ’ consonant sounds, we still can make some inferences from the formant data that we have extracted at the end of the study. By looking at how F1 and F2 values change depending on an interference of ‘Ğ’ sound, we came to the conclusion that although ‘Ğ’ functions as a grapheme as stated above, there are some situations when ‘Ğ’ does not directly copy the sound that comes before it. For most of the time, formant values of ‘Ğ’ are different from the formant values of long vowels. With the effect of previous vowel, the Ğ sound can change into a front vowel or back vowel. For example, if there is an ‘A’ sound before ‘Ğ’, the sound may turn into a back and a higher vowel (something like ‘I’ sound) depending on the context or speaker. This difference in the value of formants could be the result of a tiny articulation taking place in our larynx. However, we unfortunately cannot generalize the data we have come up with because the results show a great variety depending on the word and even on the participants.

Another claim we want to make about the articulation of ‘Ğ’ sound is that it is not always a back consonant as Coşkun (2016, p.116) [9] suggested because there are some situations as in the case of the pair MEMUR - MEĞMUR when ‘Ğ’ sound becomes a frontal sound as a result of getting affected by ‘E’ which is a frontal sound as well.

The final remark that we want to add in this part will be about the necessity of orthographic demonstration of ‘Ğ’ sound. Although we said that ‘Ğ’ sound does not have its own identity as a consonant and it is shaped by the vowel that is a head of it, it is still necessary to show this sound in orthography as Koç (1996) [5] suggested. I agree with the idea that although ‘Ğ’ is a sound that is hard to define and although it may show some differences depending on its context, it should be shown in the alphabet and its features should be taught meticulously to Turkish language learners since the fact that we cannot exactly define a sound does not mean that this sound does not exist (p.601).

Although we cannot clearly show the difference between long vowels and ‘Ğ’ consonant through spectrogram graphs easily, it is an undeniable fact that there are still minor differences in the formant values (F1 and F2 values) remaining and these differences could originate from the articulation taking place in larynx to be able to produce a ‘Ğ’ sound. For this reason, we believe that a study with more data, more participants and with a broader list of words including ‘Ğ’ will bear some more useful outcomes for the future researchers. Therefore, more study should be carried out on this issue.

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Appendix A. Questionnaire

Aşağıda belirtilen cümleyi dinlemiş olduğunuz kayda bağlı olarak en uygun seçeneği seçerek doldurunuz.

(Listen to the recording and choose the option that you heard.)

Ayşe _____ dedi.

- | | | |
|-----|------------|------------|
| 1. | a) ağrı | b) aarı |
| 2. | a) ağrı | b) aarı |
| 3. | a) ağaç | b) aaç |
| 4. | a) ağaç | b) aaç |
| 5. | a) sığır | b) sıır |
| 6. | a) sığır | b) sıır |
| 7. | a) yığılma | b) yılma |
| 8. | a) yığılma | b) yılma |
| 9. | a) sağlık | b) saalık |
| 10. | a) sağlık | b) saalık |
| 11. | a) ağırtma | b) aarıtma |
| 12. | a) ağırtma | b) aarıtma |
| 13. | a) ağcı | b) aacı |
| 14. | a) ağcı | b) aacı |
| 15. | a) ağ | b) Aa |
| 16. | a) ağ | b) Aa |
| 17. | a) beğen | b) been |
| 18. | a) beğen | b) been |
| 19. | a) yağlı | b) yaalı |
| 20. | a) yağlı | b) yaalı |
| 21. | a) çiğ | b) Çii |
| 22. | a) çiğ | b) Çii |
| 23. | a) bağ bağ | b) baa baa |
| 24. | a) bağ bağ | b) baa baa |
| 25. | a) düğün | b) düün |
| 26. | a) düğün | b) düün |
| 27. | a) bağcı | b) baacı |
| 28. | a) bağcı | b) baacı |
| 29. | a) Çağlar | b) çaalar |
| 30. | a) Çağlar | b) çaalar |
| 31. | a) ağla | b) aala |
| 32. | a) ağla | b) aala |

Appendix B

SUDE SUĐDE	BUSE BUĐSE
ZALİM ZAĞLİM	MİDE MİĐDE
HAKİM HAĞKİM	BATIL BAĞTIL

MEMUR MEĞMUR	ZADE ZAĞDE
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CANAN CAĞNAN	AFET AĞFET
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AKIBET AĞKIBET	YAVER YAĞVER
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ASGARİ ASGARİĞ	ASKERİ ASKERİĞ
-------------------	-------------------

AMİR AĞMİR	MADDİ MADDİĞ
---------------	-----------------

MANEVİ MANEVİĞ	SADE SAĞDE
-------------------	---------------

BADE BAĞDE
