J Psycholinguist Res (2018) 47:699–718
https://doi.org/10.1007/s10936-017-9553-4

An Analysis of Speech Disfluencies of Turkish Speakers Based on Age Variable

Ayşe Altıparmak[1] · **Gülmira Kuruoğlu**[2]

Published online: 3 January 2018

Abstract The focus of this research is to verify the influence of the age variable on fluent Turkish native speakers' production of the various types of speech disfluencies. To accomplish this, four groups of native speakers of Turkish between ages 4–8, 18–23, 33–50 years respectively and those over 50-year-olds were constructed. A total of 84 participants took part in this study. Prepared and unprepared speech samples of at least 300 words were collected from each participant via face-to-face interviews that were tape recorded and transcribed; for practical reasons, only the unprepared speech samples were collected from children. As a result, for the prepared speech situation, there was no statistically significant difference in terms of age in the production rates of filled gaps, false starts, slips of the tongue and repetitions; however, participants in the over 50-year-old group produced more hesitations and prolongations than participants in the 18–23 and 33–50-year-old groups. For the unprepared speech situation, age variable was not effective on the production rates of filled gaps. However, 4–8 and over 50-year-old participants produced more hesitations and prolongations than the 18–23 and 33–50-year-old groups. 4–8-year-old children produced more slips of the tongue than the 18–23 and 33–50-year-old groups, and more false starts and repetitions than the participants in the other three age groups (18–23, 33–50, over 50). Further analyses revealed more extensive insights related to the types of disfluencies, the position of disfluencies, and the linguistic units involved in disfluency production in Turkish speech.

Keywords Linguistics · Speech production · Turkish speech · Speech disfluencies

✉ Ayşe Altıparmak
ayseterzialtiparmak@yahoo.com

[1] Foreign Languages Department, National Defense University Turkish Air Academy, Yesilyurt, Istanbul, Turkey

[2] Department of Linguistics Faculty of Letters, Dokuz Eylul University, Izmir, Turkey

Introduction

Researchers from various disciplines have studied speech disfluencies from various perspectives. As a result, there are various definitions and classifications related to speech disfluencies in the literature. Clark and Wasow (1998: 201) mention that "most disfluencies seem to reflect planning problems". When speakers cannot formulate an entire utterance at once, they may suspend their speech and introduce a pause or filler before going on. And when speakers change their minds about what they are saying, they may suspend their speech and then add to, delete, or replace words they have already produced. In a very similar way, Gósy (2001: 57) defines speech disfluency in spontaneous speech as the outcome of a speaker's indecision about what to say next. Bard et al. (2001: 97) state that many disfluencies are edited errors in speech production. They mark those occasions when speakers have not framed an utterance which satisfies their goals before they begin to speak.

Studies with various perspectives on speech disfluencies (psychological, physiological, pathological, linguistic, psycholinguistic, etc.) have put forward that different linguistic (such as phonetic, phonological and morphological constraints of the languages, the similarity of the phonological form of words and semantic relations between the words involved in disfluency production, lexical features, such as word class and word frequency, utterance length, speech rate, etc.), and non-linguistic factors (such as age, gender, familiarity between speakers, cognitive load, speech setting, speech practice, and educational background, or social status of the speaker, etc.) play a role in the occurrence of speech disfluencies. In this study, one factor, the role of the speaker's age in disfluency production, was analyzed under two different speech situations, prepared and unprepared.

"Age" has been chosen as the factor to be examined since it is obvious that human speech undergoes many changes from a very early age until death. How these changes affect speech disfluency production is an interesting research question because of the universal nature of the phenomenon. In addition, there is a lack of research analyzing the differences between the disfluency production rates of children and elderly in the research literature, and the existing research findings are confusing. The bulk of disfluency research has focused on the comparison of speech disfluencies of young, or middle-aged speakers, and most of the research concerning children's speech disfluencies have been conducted to research stuttering in order to put forward some pathological insights related to developmental disfluency production. The inclusion of a wider range of ages in current research is going to make valuable contributions to understand the connections between phenomena such as language acquisition in children, aging and disfluency production.

Studies analyzing the effect of age in the production of speech disfluencies have similar findings in the sense that disfluency rates rise sharply at the end of age 2, and at the beginning of age 3 in children as a result of the normal language development process; however, disfluency rates go down after that time (Ambrose and Yairi 1999; Gordon and Luper 1989; Yairi 1982). There are studies showing that children produce more speech disfluencies than adults and old speakers (Menyhárt 2003; Smith 1990; Wijnen 1992). It has also been put forward that it is the case especially for some specific type of disfluencies. Smith (1990) mentions that children produce more slips of the tongue than adults since adults are, in at least some instances, more skilled in responding to increased demands that may be placed upon their speech production systems than are children. In another study questioning whether the language production mechanism in children differs from the adult system, Wijnen (1992) found that slip of the tongue frequency is considerably higher in children than in adults, and this is an indication of

gradual developmental alterations in the language production mechanism, mainly reflecting the degree of practice and automatization.

In some other studies, it has been observed that adults produce more speech disfluencies than children and young speakers (Bortfeld et al. 2001; Obler and Albert 1984). MacKay and James (2004) mention that omission type of slips is more common for older people (72.4) than young adults (19.1), and Tottie (2011) states that older speakers produce more filled gaps than young speakers.

Some researchers emphasize that some important changes occur with aging which could probably lead to more disfluency production. Menyhárt (2003) states that speech production and its disfluency phenomena change with age quantitatively rather than in qualitative terms, and the highest number of silent pauses is produced by old people. This is seen a result of the aging of the organism, in view of the function that silent pauses have in facilitating breathing. Burke et al. (2000) put forward that older adults exhibit clear deficits in the retrieval of phonology and orthography, with no corresponding deficits in language perception and comprehension, independent of sensory and new learning deficits. Lovelace and Twohig (1990) observed that the majority of healthy, active elderly adults did perceive a decline in their memory function with aging, and in retrieving names was arguably the memory failure of which people were most aware throughout life, and probably the one that showed the greatest subjective increase with aging.

In terms of studies with native speakers of Turkish, Akgün (2005) found that the production rates of repetitions, additions, hesitations and general disfluency tended to decline from 3 years of age to 5 in Turkish speaking, non-stuttering children's speech and no prolongation type of disfluencies were observed at the age of 3; however, prolongation production rates increase from 4 years of age to 5. In another study analyzing the word repetition, part-word repetition, phrase repetition, interjection and prolongation types of disfluency production rates of 2.6–5.6-year-old Turkish speaking children, Doğan (2001) observed that all disfluencies, except interjections and prolongations, had a tendency to increase between the ages of 2.5 and 4–4.5 and to decrease after then. Interjections and prolongations increased between the ages of 2.5–5.5.

Method

In this part, the design and the method of the study are presented.

Participants

Four different groups were comprised of native speakers of Turkish in the ages of 4–8 (mean = 5.9 years, standard deviation = 1.2), 18–23 years of age (mean = 20.2 years, standard deviation = 1.8), 33–50-year-olds (mean = 39.4 years, standard deviation = 3.2) and those over 50-year-olds (mean = 59.5 years, standard deviation = 3.1). The gender distribution was equal in each age group. All participants, except children, declared before the face-to-face interviews that they had no hearing loss, developmental language disorder or neurological problem. The participants were also assessed by the interviewer during the interviews in this sense. For 4–8-year-olds, the researcher talked to the childrens' parents and teachers before the interviews to check if the children had any of the aforementioned health problems. The participants were not informed about the purpose of the study.

Data Collection Procedure and Disfluency Coding

Speech disfluency data were gathered by using conversations transcribed from tape recordings. By conducting face-to-face interviews, prepared and unprepared speech samples of at least 300 words of each participant were collected and transcribed. Since it was difficult to get prepared speech samples of the children, only unprepared speech samples were gathered and analyzed in this age group. All transcriptions were prepared by one of the researchers of the current study and reviewed by a transcriber who had an educational background in linguistics. To increase the reliability of the disfluency coding, each disfluency type was labeled by hand on the transcriptions by the researcher who also transcribed the recordings. Silent gaps were not analyzed in the current study since there is no consensus among researchers on how long the duration of a gap in speech must be to be considered as a silent gap. [Ee], [ıı], [aa], [ii], [uu] and [mm] sounds were counted as filled gaps in Turkish speech. Hesitations experienced by the participants in producing a whole word at once were marked as hesitation type of disfluencies. The sounds which were produced longer than they should were counted as prolongations. The disfluencies in which the speaker stops the flow of his/her speech and starts his/her utterance again were labeled as false starts. All slips including sounds (shifts, exchanges, anticipations, perseverations, additions, deletions, blends, substitutions) (see Carroll 2008), words, and word groups were marked as slips of the tongue. The repeated sounds, words, and word groups in an utterance were considered to be repetitions.

Except children, all participants answered 12 questions both in prepared and unprepared speech situations. The questions were the same in general with slight changes in wording, or some adaptations according to the age group (e.g. What do you like the most about your job/school?, etc.). There was no specific motivation for the participants to speak; however, the participants had been chosen from volunteers and the questions were from common areas of interest such as jobs, hobbies, career, directions, cooking instructions, etc. Therefore, there was no need for prompting the participants to speak. The questions about giving directions and cooking instructions were included intentionally among the questions for face-to-face interviews since answering them required the ordering of information and could lead to more disfluency production. Before gathering the prepared samples of speech, the questions were given to the participants in advance. In this way, they could think about their answers and plan their speech. For the unprepared speech interview, the participants answered the questions, which they had not seen before. Since it was difficult to keep the children concentrated on something for a long time, topics which could keep them interested and use their imagination were chosen, such as fairy tales, and their favorite cartoons/toys, etc. or questions such as what they would do if they were invisible/they could fly etc. The children answered 23 questions in total. Speech disfluency rates of each participant were determined by calculating the average number of each type of speech disfluency in every 100 words. The gathered data were statistically analyzed in light of age variable.

Findings

In this part of the study, the statistical analysis of the gathered data is presented. First, the disfluency rates of different age groups are given. Next, further analyses on different types of disfluencies are presented. Finally, analyses on the position of disfluencies and the linguistic units involved in disfluency production are displayed.

Disfluency Rates of Different Age Groups

The differences among the various age groups in prepared and unprepared speeches, in terms of different types of disfluency rates, were analyzed with the Kruskal–Wallis One-Way Analysis of Variance. As mentioned before, just unprepared speech samples were collected and analyzed in the 4–8-year-old age group for practical reasons. In other words, prepared speech data were analyzed for 18–23, 33–50 and the over 50-year-old age groups only; however, unprepared speech data were analyzed for the four different age groups (4–8, 18–23, 33–50, over 50).

Influence of Age on "Filled Gap" Type of Disfluency Production

The figures gathered from the statistical analysis of the filled gap type of disfluency data for 4–8, 18–23, 33–50 and over 50-year-old participants are as shown in Table 1.

According to the statistical analysis presented in Table 1, age variable did not affect the "filled gap" type of disfluency production rates.

Influence of Age on "Hesitation" Type of Disfluency Production

The figures gathered from the statistical analysis of the hesitation type of disfluency data for 4–8, 18–23, 33–50 and over 50-year-old participants are as shown in Table 2.

Table 1 The filled gap rates of different age groups in prepared and unprepared speech

Age	Prepared speech		Unprepared speech	
	Mean ± SD	Median (min–max)	Mean ± SD	Median (min–max)
Filled gaps				
4–8-year-olds n = 14	–	–	4.23 ± 3.73	3.37 (0–11.65)
18–23-year-olds n = 14	5.22 ± 4.25	3.15 (1.21–13.51)	5.06 ± 4.78	2.99 (0.93–18.40)
33–50-year-olds n = 28	5.82 ± 4.55	5.08 (0–14.95)	5.65 ± 4.56	5.03 (0–17.71)
Over 50-year-olds n = 28	4.53 ± 3.73	3.86 (0–13.74)	4.21 ± 3.60	3.15 (0–12.36)
p		0.630		0.673

Mean; arithmetic mean, SD; standard deviation
* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

Table 2 The hesitation rates of different age groups in prepared and unprepared speech

Age	Prepared speech		Unprepared speech	
	Mean ± SD	Median (min–max)	Mean ± SD	Median (min–max)
Hesitations				
4–8-year-olds n = 14	–	–	6.08 ± 3.09	5.67 (2.30–12.61)
18–23-year-olds n = 14	3.27 ± 2.77	2.37 (1.97–10.58)	3.38 ± 2.73	2.09 (0.96–9.56)
33–50-year-olds n = 28	3.06 ± 2.27	2.78 (0–11.31)	2.77 ± 2.03	2.28 (0.19–9.20)
Over 50-year-olds n = 28	4.49 ± 2.72	3.92 (1.07–12.25)	4.06 ± 2.14	3.85 (1.22–8.91)
p		0.02*		0.001**

Mean; arithmetic mean, SD; standard deviation
* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

Table 3 The prolongation rates of different age groups in prepared and unprepared speech

Age	Prepared speech		Unprepared speech	
	Mean ± SD	Median (min–max)	Mean ± SD	Median (min–max)
Prolongations				
4–8-year-olds n = 14	–	–	19.16 ± 7.58	18.90 (9.55–35.19)
18–23-year-olds n = 14	6.79 ± 2.10	6.98 (1.91–12.10)	5.41 ± 2.68	5.11 (1.66–11.61)
33–50-year-olds n = 28	4.87 ± 3.50	4.28 (0.47–13.57)	3.98 ± 2.87	3.67 (0–11.49)
Over 50-year-olds n = 28	16.27 ± 5.42	15.77 (7.86–32.56)	15.05 ± 4.43	14 (9.42–22.92)
p	0.000***		0.000***	

Mean; arithmetic mean, SD; standard deviation
* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

As shown in Table 2, in the prepared speech situation, age is an effective variable in terms of hesitation type of disfluency production ($p = 0.02 < 0.05$). The over 50-year-old age group produced more hesitations than the other two age groups (18–23 and 33–50).

There is a statistically significant difference in the production of hesitation type of disfluency production among different age groups in the unprepared speech situation, too ($p = 0.001 < 0.01$). 4–8-year-olds and the over 50-year-olds produced more hesitations than the other two age groups (18–23 and 33–50).

Influence of Age on "Prolongation" Type of Disfluency Production

The figures gathered from the statistical analysis of the prolongation type of disfluency data for 4–8, 18–23, 33–50 and over 50-year-old participants are as shown in Table 3.

As shown in Table 3, age is an effective variable in terms of prolongation type of disfluency production both in prepared and unprepared speech situations ($p = 0.000 < 0.001$). In the prepared speech situation, the over 50-year-old age group produced more prolongations than the other two age groups (18–23 and 33–50). In the unprepared speech situation, 4–8-year-olds and the over 50-year-olds produced more prolongations than the other two age groups (18–23 and 33–50).

Influence of Age on "False Start" Type of Disfluency Production

The figures gathered from the statistical analysis of the false start type of disfluency data for 4–8, 18–23, 33–50 and over 50-year-old participants are as shown in Table 4.

As shown in Table 4, age is not an effective variable in the false start production rates of the participants in the prepared speech situation ($p = 0.46 > 0.01$). In the unprepared speech situation, the difference between the age groups is statistically significant ($p = 0.031 < 0.05$). 4–8-year-olds produced more false starts than the other three age groups (18–23, 33–50, and over 50).

Influence of Age on "Slip of the Tongue" Type of Disfluency Production

The figures gathered from the statistical analysis of the slip of the tongue type of disfluency data for 4–8, 18–23, 33–50 and over 50-year-old participants are as shown in Table 5.

As shown in Table 5, age is not an effective variable in the slip of the tongue production rates of the participants in the prepared speech situation ($p = 0.90 > 0.01$). In the unprepared

Table 4 The false start rates of different age groups in prepared and unprepared speech

Age	Prepared speech		Unprepared speech	
	Mean ± SD	Median (min–max)	Mean ± SD	Median (min–max)
False starts				
4–8-year-olds n = 14	–	–	1.38 ± 0.51	1.24 (0.42–2.54)
18–23-year-olds n = 14	1.30 ± 0.92	1.06 (0.24–3.46)	1.08 ± 0.83	1.02 (0–2.73)
33–50-year-olds n = 28	1.13 ± 1.17	0.85 (0–5.04)	0.87 ± 0.78	0.67 (0–3.37)
Over 50-year-olds n = 28	1.00 ± 0.52	0.94 (0.20–2.45)	0.94 ± 0.60	0.84 (0–2.34)
p		0.46		0.031*

Mean; arithmetic mean, SD; standard deviation
* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

Table 5 The slip of the tongue rates of different age groups in prepared and unprepared speech

Age	Prepared speech		Unprepared speech	
	Mean ± SD	Median (min–max)	Mean ± SD	Median (min–max)
Slips of the tongue				
4–8-year-olds n = 14	–	–	0.74 ± 0.51	0.59 (0.19–2.20)
18–23-year-olds n = 14	0.36 ± 0.23	0.32 (0–0.80)	0.24 ± 0.19	0.21 (0–0.55)
33–50-year-olds n = 28	0.42 ± 0.32	0.36 (0–1.11)	0.31 ± 0.23	0.27 (0–0.73)
Over 50-year-olds n = 28	0.42 ± 0.35	0.36 (0–1.24)	0.41 ± 0.28	0.37 (0–1.03)
p		0.90		0.001**

Mean; arithmetic mean, SD; standard deviation
* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

Table 6 The repetition rates of different age groups in prepared and unprepared speech

Age	Prepared speech		Unprepared speech	
	Mean ± SD	Median (min–max)	Mean ± SD	Median (min–max)
Repetitions				
4–8-year-olds n = 14	–	–	0.82 ± 0.54	0.75 (0.15–1.93)
18–23-year-olds n = 14	0.14 ± 0.31	0.00 (0–1.63)	0.10 ± 0.17	0 (0–0.49)
33–50-year-olds n = 28	0.25 ± 0.44	0.11 (0–2.22)	0.16 ± 0.37	0 (0–1.84)
Over 50-year-olds n = 28	0.27 ± 0.34	0.20 (0–1.26)	0.21 ± 0.31	0.09 (0–1.23)
p		0.153		0.000***

Mean; arithmetic mean, SD; standard deviation
* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

speech situation, the difference between the age groups is statistically significant ($p = 0.001 < 0.01$). 4–8-year-olds produced more slips of the tongue than the other three age groups (18–23, 33–50, and over 50).

Influence of Age on "Repetition" Type of Disfluency Production

The figures gathered from the statistical analysis of the repetition type of disfluency data for 4–8, 18–23, 33–50 and over 50-year-old participants are as shown in Table 6.

As shown in Table 6, age is not an effective variable in the repetition production rates of the participants in the prepared speech situation ($p = 0.153 > 0.001$). In the unprepared speech situation, the difference between the age groups is statistically significant ($p = 0.000 < 0.001$). 4–8-year-olds produced more repetitions than the other three age groups (18–23, 33–50, and over 50).

Further Analyses on Disfluency Types

In order to increase the validity and reliability of the research, further nonparametric analyses were added in the scope of the study. In our further analyses, we questioned whether there was a difference between the medians of different disfluency types for different age groups, both in prepared and unprepared speech situations. The Friedman's Rank Test for K Related Samples was used in the analyses to compare the medians of different types of disfluencies of the same participant. According to the Friedman Test, statistically significant differences between the disfluency medians of each participant were observed both in prepared and unprepared speech situations for all age groups ($p = 0.000 < 0.05$).

In order to determine between which disfluency types the difference occurred, the Wilcoxon Signed Rank Test (Two Dependent Samples) was applied to analyze the differences revealed (Bonferroni correction alpha = 0.05/15 = 0.003). In the prepared speech situation, no statistically significant difference was found between filled gap-hesitation, filled gap-prolongation, and slip of the tongue-repetition disfluencies for 18–23-year-old participants. The differences were statistically significant for all the other disfluencies. For 33–50-year-old participants, the differences between filled gap-hesitation, filled gap-prolongation, hesitation-prolongation, and slip of the tongue-repetition disfluencies were not statistically significant. Other than these disfluencies, statistically significant differences were observed according to the Wilcoxon Signed Rank Test. For the over 50-year-olds, the differences between different disfluency types were statistically significant except for filled gap-hesitation, and slip of the tongue-repetition disfluencies. In the unprepared speech situation, for 4–8-year-old participants, there were no statistically significant differences between filled gap-hesitation, filled gap-false start, filled gap-slip of the tongue, filled gap-repetition, false start-slip of the tongue, false start-repetition, or slip of the tongue-repetition disfluencies. The differences between the other disfluencies were statistically significant for this age group. For 18–23-year-olds, the differences between different disfluency types were statistically significant except for filled gap-hesitation, filled gap-prolongation, hesitation-prolongation, and slip of the tongue-repetition disfluencies. For 33–50-year-olds, there were no statistically significant differences between filled gap-prolongation, hesitation-prolongation, or slip of the tongue-repetition disfluencies. For the over 50-year-olds, the differences between different disfluencies were significant except for filled gap-hesitation, and slip of the tongue-repetition disfluencies.

In addition to these analyses, we questioned whether there was a difference between different age groups in terms of the medians of different disfluency types both in prepared and unprepared speech situations once again by using the Kruskal–Wallis Independent K Sample Test. When a difference was revealed, we analyzed between which age groups that difference was observed by using the Mann-Whitney Independent Two-Sample Test. We used different tests in these analyses since we compared the disfluencies of different participants, and since the observations were independent of each other. Our findings could be seen in Tables 7 and 8.

As shown in Table 7, in the prepared speech situation, with the application of the Kruskal–Wallis Test, we observed that there was a statistically significant difference among different

Table 7 Descriptive statistics of all disfluency types for all age groups in prepared speech situation (Kruskal–Wallis and Mann–Whitney tests)

Disfluency types	Mean ± standard deviation (median)	Kruskal–Wallis test *p* values (n = 70)	Mann–Whitney age: 18–23/ 33–50 *p* value (n = 42)	Mann–Whitney age: 18–23 /Over 50 *p* value (n = 42)	Mann–Whitney age: 33–50/over 50 *p* value (n = 56)
Filled gaps	5.19 ± 4.16(4.67)	0.630			
Hesitations	3.68 ± 2.61(3.36)	0.027*	0.749	0.033	0.020*
Prolongations	9.81 ± 6.83(9.06)	0.000*	0.062	0.000*	0.000*
False starts	1.11 ± 0.90(0.93)	0.474			
Slips of the tongue	0.41 ± 0.31(0.35)	0.917			
Repetitions	0.23 ± 0.38(0.10)	0.157			

Table 8 Descriptive statistics of all disfluency types for all age groups in unprepared speech situation (Kruskal–Wallis and Mann–Whitney tests)

Disfluency types	Mean ± standard deviation (median)	Kruskal–Wallis test *p* values (n = 84)	Mann–Whitney test					
			4–8/ 18–23 *p* value (n = 28)	4–8/ 33–50 *p* value (n = 42)	4–8/ over 50 *p* value (n = 42)	18–23/ 33–50 *p* value (n = 42)	18–23/ over 50 *p* value (n = 42)	33–50/ over 50 *p* value (n = 56)
Filled gaps	4.83 ± 4.15 (3.74)	0.670						
Hesitations	3.85 ± 2.61 (3.04)	0.001*	0.005*	0.000*	0.030	0.689	0.161	0.013
Prolongations	10.44 ± 7.59 (9.60)	0.000*	0.000*	0.000*	0.088	0.083	0.000*	0.000*
False starts	1.01 ± 0.71 (1.00)	0.032*	0.168	0.002*	0.036	0.408	0.852	0.298
Slips of the tongue	0.40 ± 0.34 (0.33)	0.001*	0.000*	0.001*	0.014	0.378	0.047	0.146
Repetititons	0.28 ± 0.43 (0.10)	0.000*	0.000*	0.000*	0.000*	0.668	0.098	0.114

age groups (18–23, 33–50, and over 50) with 95% confidence, and among the medians of two different disfluency types (hesitations, and prolongations) with 95% confidence ($p = 0.027$ and $0.000 < 0.05$). According to the Mann–Whitney Test, there is a statistically significant difference between "the 33–50-year-olds and the over 50-year-olds" for hesitations. For prolongations, there is a significant difference between "the 33–50-year-olds and the over 50-year-olds," and "the 18–23-year-olds and the over 50-year-olds" (alpha = 0.05/3 = 0.02; $p = 0.02 \leq 0.02$).

As shown in Table 8, in the unprepared speech situation, with the application of the Kruskal–Wallis Test, we observed that there was a statistically significant difference among different age groups (4–8, 18–23, 33–50, and over 50) with 95% confidence and among the medians of different disfluency types, except for filled gaps with 95% confidence ($p = 0.001$, 0.000, 0.032, 0.001 and $0.000 < 0.05$). According to the Mann–Whitney Test, there is a statistically significant difference between "the 4–8-year-olds and the 18–23-year-olds," and "the 4–8-year-olds and the 33–50-year-olds" for hesitations. For prolongations, there is a significant difference between "the 4–8-year-olds and the 18–23-year-olds," "the 4–8-year-olds and the 33–50-year-olds," "the 18–23-year-olds and the over 50-year-olds," and "the 33–50-year-olds and the over 50-year-olds." For false starts, the significant difference is between "the 4–8-year-olds and the 33–50-year-olds." For slips of the tongue, there is a statistically significant difference between "the 4–8-year-olds and the 18–23-year-olds," "the 4–8-year-olds and the 33–50-year-olds." And for repetitions, there are significant differences between "the 4–8-year-olds and the 18–23-year-olds," "the 4–8-year-olds and the 33–50-year-olds," and "the 4–8-year-olds and the over 50-year-olds" (alpha = 0.05/6 = 0.0083; $p = 0.005$ and $p = 0.000 \leq 0.008$).

Analyses on the Position of Disfluencies and the Linguistic Units Involved in Disfluency Production

The analyses in this section include the data related to the position of disfluencies in an utterance and the linguistic units involved in disfluency production. With this aim, the frequency and the percentage of speech disfluencies regarding the related information both in prepared and unprepared speech situations were calculated. The position of disfluencies (the location where they occur in an utterance) was analyzed at sentence level (sentence-initial/medial/final) for filled gap, hesitation, and false start type of disfluencies; however, it was analyzed at word level (initial/medial/final syllable) for prolongation type of disfluencies, since prolongations were the prolonged sounds in an utterance. For one-syllable words, we analyzed whether the vowels or consonants were prolonged in that syllable. As for the slips of the tongue and repetitions, the linguistic units involved in disfluency production (whether the disfluency involved sounds, words or word groups) were analyzed since that kind of information gave more insights regarding these disfluency types' peculiar characteristics. Table 9 below presents the findings for the prepared speech situation.

As shown in Table 9, in prepared speech situation, filled gaps were more common in the sentence-medial position for all age groups (18–23, 33–50 and over 50-year-olds); however, the percentage of sentence-initial filled gaps was also significant. Hesitations were more common in the sentence-medial position than the sentence-initial position as in filled gaps. As for false starts, although the figures were so close, sentence-medial false starts were more common than sentence-initial false starts in 18–23 and 33–50-year-old participants' prepared speech, but that was not the case for the over 50-year-old participants. The percentage of

Table 9 The position of the disfluencies and the Linguistic units involved in prepared speech

Type	Age f (%)		
	18–23	33–50	Over 50
Prepared speech			
Filled gaps			
Sentence-initial	171 (47.8)	519 (38.1)	476 (42.0)
Sentence-medial	187 (52.2)	841 (61.8)	655 (57.8)
Sentence-final	–	1 (0.1)	3 (0.2)
Total	358	1361	1134
Hesitations			
Sentence-initial	39 (17.1)	98 (14.9)	193 (21.5)
Sentence-medial	188 (82.5)	550 (83.6)	689 (76.6)
Sentence-final	1 (0.4)	10 (1.5)	17 (1.9)
Total	228	658	899
False starts			
Sentence-initial	45 (46.9)	92 (42.2)	119 (50.0)
Sentence-medial	50 (52.1)	121 (55.5)	110 (46.2)
Sentence-final	1 (1.0)	6 (2.3)	9 (3.8)
Total	96	218	238
Slips of the tongue			
Sound	24 (85.7)	79 (96.3)	84 (90.3)
Word	4 (14.3)	3 (3.7)	8 (8.6)
Word group	–	–	1 (1.1)
Total	28	82	93
Repetitions			
Sound	–	3 (6.7)	8 (10.8)
Word	6 (75.0)	35 (77.8)	48 (64.9)
Word group	2 (25.0)	7 (15.5)	18 (24.3)
Total	8	45	74
Prolongations			
Initial syllable	32 (6.2)	49 (5.2)	107 (3.3)
Medial syllable	8 (1.6)	10 (1.1)	67 (2.1)
Final syllable	376 (73.4)	649 (69.3)	2406 (75.2)
One-syllable words			
Vowel	73 (14.3)	176 (18.8)	493 (15.4)
Consonant	23 (4.5)	52 (5.6)	128 (4.0)
Total	512	936	3201

sentence-initial false starts were slightly higher than that of sentence-medial false starts. Regarding slips of the tongue, a great number of slips of the tongue were between sounds. So, slips of the tongue mostly occurred at the phonological level in our study on Turkish speech. In respect to repetitions, repetitions at word level were significantly more common than repetitions at the sound and word group level in all three age groups. Concerning prolongations, the final syllable was the most prolonged syllable in multisyllable words by all participants. For one-syllable words, the prolongation of vowels was more common than the prolongation of consonants.

Table 10 The position of the disfluencies and the Linguistic units involved in unprepared speech

Type	Age f (%)			
	4–8	18–23	33–50	Over 50
Unprepared speech				
Filled gaps				
Sentence-initial	261 (82.1)	136 (35.5)	2 (0.1)	419 (35.7)
Sentence-medial	56 (17.6)	247 (64.5)	551 (41.0)	763 (64.1)
Sentence-final	1 (0.3)	–	791 (58.9)	2 (0.2)
Total	318	383	1344	1174
Hesitations				
Sentence-Initial	176 (40.5)	33 (12.3)	126 (18.7)	154 (17.7)
Sentence-Medial	248 (57.0)	233 (87.3)	539 (79.7)	702 (80.7)
Sentence-final	11 (2.5)	1 (0.4)	11 (1.6)	14 (1.6)
Total	435	267	676	870
False starts				
Sentence-initial	66 (60.0)	41 (46.1)	90 (48.1)	111 (43.5)
Sentence-medial	40 (36.4)	46 (51.7)	96 (51.4)	134 (52.6)
Sentence-final	4 (3.6)	2 (2.2)	1 (0.5)	10 (3.9)
Total	110	89	187	255
Slips of the tongue				
Sound	57 (98.3)	17 (81.0)	60 (95.2)	77 (95.1)
Word	1 (1.7)	4 (19.0)	3 (4.8)	4 (4.9)
Word group	–	–	–	–
Total	56	21	63	81
Repetitions				
Sound	4 (6.2)	–	1 (3.0)	9 (13.6)
Word	56 (86.1)	8 (80.0)	28 (84.9)	47 (71.2)
Word Group	5 (7.7)	2 (20.0)	4 (12.1)	10 (15.2)
Total	65	10	33	66
Prolongations				
Initial syllable	279 (18.5)	22 (4.9)	45 (5.5)	131 (4.3)
Medial syllable	79 (5.2)	3 (0.7)	16 (1.9)	38 (1.2)
Final syllable	853 (56.5)	332 (73.9)	570 (69.2)	2240 (73.4)
One-syllable words				
Vowel	243 (16.1)	42 (16.0)	149 (18.1)	515 (16.9)
Consonant	56 (3.7)	20 (4.5)	44 (5.3)	128 (4.2)
Total	1510	449	824	3052

For unprepared speech situations, we observed some differences from prepared speech situations for some disfluency types. Table 10 presents the findings for unprepared speech situations.

As shown in Table 10, in unprepared speech situations, filled gaps were more common in the sentence-medial position for 18–23, 33–50 and over 50-year-olds as they were in the prepared speech situations; however, the percentage of sentence-initial filled gaps were more

than that of sentence-medial filled gaps in 4–8-year-old participants' unprepared speech. Hesitations were more common in the sentence-medial position than the sentence-initial position for all age groups (4–8, 18–23, 33–50 and over-50-year-olds); however, the percentage of sentence-initial hesitations for 4–8-year-olds was significantly more than the percentages of sentence-initial hesitations for the other three age groups (18–23, 33–50 and over 50-year-olds). As for false starts, similar to filled gaps, sentence-medial false starts were more common than sentence-initial false starts in 18–23, 33–50, and over 50-year-old participants' unprepared speeches, but that was not the case for 4–8-year-old participants. The percentage of sentence-initial false starts was higher than sentence-medial false starts for them. Regarding slips of the tongue, a great majority of slips of the tongue were between sounds in all age groups, but the percentage of slips of the tongue that occurred at the lexical level for 18–23-year-olds was significantly more than those for the other three age groups (4–8, 33–50 and over 50-year-olds). So, slips of the tongue mostly occurred at the phonological level in unprepared speech as in prepared speech. In terms of repetitions, repetitions at the word level were significantly more common than those at the sound and word group level in all four age groups; however, repeated sounds were significantly more common in over 50-year-old participants' unprepared speeches than the repeated sounds in the unprepared speeches of the 4–8, 18–23 and 33–50-year-olds. Concerning prolongations, the final syllable was the most prolonged syllable in multisyllable words by all participants; however, 4–8-year-old children prolonged the initial syllable of multisyllable words significantly more than the other participants in our study. For one-syllable words, the prolongation of vowels was more common than the prolongation of consonants as in prepared speech.

Discussion

Our findings provided us some valuable insights on speech disfluency production in Turkish speech in terms of the age variable.

First, native speakers of Turkish from four different age groups (4–8, 18–23, 33–50 and over 50) produced different types of disfluencies (filled gaps, hesitations, prolongations, false starts, slips of the tongue, repetitions). Among these disfluencies, prolongations, filled gaps and hesitations were more common, both in prepared and unprepared speech situations in Turkish speech. Prolongations being the most common type of speech disfluency in Turkish speech is quite a different observation from the previous studies on other languages. Most research findings show that silent gaps and filled gaps outnumber prolongations in different languages (Eklund 2000; Eklund and Shriberg 1998; Gósy 2001). Our finding reveals that the prevalence of a certain type of disfluency could be language-specific. In our case, it is highly probable that the widespread occurrence of prolongations instead of filled gaps (silent gaps were beyond the scope of the current study) in Turkish speech is simply a strategic choice of Turkish speakers to gain some time for planning the next step of their speech. As it is going to be mentioned later, the common appearance of prolongations at the word-final position in the current study supports this idea. However, whether there are some other underlying phonological and morphological factors, specific to Turkish language, for higher prolongation rates could be an interesting research area for future studies.

Second, age was an effective variable in the production of some types of disfluencies in our study. In prepared speech situations (excluding 4–8-year-old participants), the over 50-year-old age group produced more hesitations and prolongations than the other participants (18–23 and 33–50-year-olds). In unprepared speech situations, the age variable did not affect

filled gap production rates; however, hesitations and prolongations were more common in the 4–8 and over 50-year-old participants' speeches than those of other age group participants (18–23 and 33–50). Slips of the tongue, false starts and repetitions were produced more by children than all the other age groups.

It is clear from our findings that children produce most disfluency types more than the other age groups. Considering the literature, it could be said that disfluencies are more common in child speech as a result of the continuing language acquisition process (Ambrose and Yairi 1999; Gordon and Luper 1989; Yairi 1982). Levelt (1989: 28) states that message generation and monitoring stages of speech production are controlled activities requiring the speaker's continuing attention, but grammatical encoding, form encoding, and articulating phases are automatic to a large degree. According to this, although conceptualizing and grammatical encoding are interacting for the language-acquiring child, the mature speaker has learned what to encode when preparing a message for expression (Levelt 1989: 105). In line with this hypothesis, it won't be wrong to say that since children lack this automatic experience, they could have more disfluencies than adults. And the findings of our study support the idea that children's language production mechanisms are still in construction due to their continuing language development processes and their lack of experience in speech production leads to more disfluencies in Turkish language as it is the case with children speaking other languages. Regarding the disfluency types produced by children, it is significant that the only type of disfluency which was not produced more by children than the other age groups was filled gaps. Consistent with filled gap studies that find filled gaps are used intentionally by the speaker to sustain speaking turn (Bortfeld et al. 2001; Maclay and Osgood 1959; Shriberg 1996), this kind of strategic use of filled gaps may not have been acquired completely by the children whose language acquisition process is still under construction.

As mentioned above, another observation related to the age variable was that the over 50-year-old participants produced more hesitation and prolongation type of disfluencies than the 18–23 and 33–50-year-old participants. So, with aging, disfluency production increased in older speakers' speech and they produced more disfluencies than young speakers and adults, though that was not the case for children. When children's disfluency production rates in this study were evaluated, it was seen that children produced more hesitations, prolongations, false starts, and slips of the tongue than 18–23 and 33–50-year-old participants; however, this significant difference was not seen when the children's and over 50-year-olds' disfluency production rates were compared. Therefore, it is possible to state that there are some factors that make the over 50-year-olds' speech production different from the 18–23 and 33–50-year-olds. With aging, the disfluency production rates of over 50-year-old speakers come closer to those of children and over 50-year-olds produce more disfluencies than 18–23 and 33–50-year-olds. It seems that though elderly speakers have more experience and practice in speech production, aging leads to some changes in speech production and these changes cause some deficits in the speeches of elderly speakers, resulting in speech disfluencies.

As mentioned before, elderly speakers produced more hesitations than the 18–23 and 33–50-year-old participants in our study, and hesitations are known to be produced more by aging due to word selection problems (Cooper 1990; Kemper 1992). In an adaptation of Levelt's (1999) speech production model, Menyhárt (2003: 45) states that hesitations are an indication of problems in the conceptualisation and grammatical planning stages of speech production, and prolongations are the reflections of problems in the articulation planning stage of speech production. So, concerning our findings, we assume that since it gets more difficult to formulate what to say and how to say it, in terms of linguistic forms, due to the declines in some cognitive functions as the speakers get older, hesitations are more common in over 50-year-old speakers' speeches. The planning burden becomes greater, which causes

more hesitations in the speeches of the elderly. Prolongations were also more common in older people's speech in our study probably because of some physiological changes resulting from aging. Even the transformations in the respiratory system and the decline in voice quality (weakened, wavery, and/or thin voice) may have an influence on the hesitation and prolongation production rates of the elderly speakers.

Third, in terms of the analyses, comparing the medians of different disfluency types of the same participant, and aiming to reveal between which disfluency types the difference occurred, we observed that there is a correspondence between the prepared and unprepared speeches of the participants for each age group. For instance, in 18–23-year-old participants' speech samples, the differences between the filled gap-hesitation, and filled gap-prolongation disfluencies were not statistically significant both in prepared and unprepared speech situations. For 33–50-year-old participants, no statistically significant difference was found between the filled gap-prolongation, hesitation-prolongation, and slip of the tongue-repetition disfluencies. And in over 50-year-old participants' prepared and unprepared speeches, the differences between the filled gap-hesitation, and slip of the tongue-repetition disfluencies were not statistically significant. Shriberg (1994) asserts that disfluencies show remarkably regular trends in a number of dimensions though they have traditionally been viewed as irregular events. Our findings clearly demonstrate that there are definitely some regularities and consistencies in disfluency production. Regarding our further analyses on disfluency types, children's speech shows differences from adult speech concerning disfluency rates. There is no statistically significant difference between filled gap-hesitation, filled gap-false start, filled gap-slip of the tongue, filled gap-repetition, false start-slip of the tongue, false start-repetition, and slip of the tongue-repetition disfluencies. We assume that children's speech has some specific features that make it distinct from adult speech, and filled gap type of disfluency production in children's speech displays some irregularities as mentioned before. This idea was also supported by our further analyses conducted with the Kruskal–Wallis and Mann-Whitney Tests on disfluency types.

Finally, as for the position of disfluencies in an utterance, our analyses at the sentence-level revealed that disfluencies (filled gaps, hesitations, and false starts) generally occurred in the sentence-medial position both in prepared and unprepared speech for most of the participants in our study, except in 4–8-year-olds. And the sentence-initial false-start percentage of over 50-year-olds in the prepared speech was more than the percentage of the sentence-medial false starts. These findings illustrate that the 4–8-year-old and over-50-year-old participants' speeches display some irregularities in terms of the position of disfluencies, as in the disfluency production rates. These findings again support the assumption that there may be different underlying mechanisms related to speech disfluency production for children and elderly speakers. Children's continuing language acquisition process and lack of practice/experience in speech production, and elderly people's decreasing cognitive functions with aging could be effective for the occurrence of these irregularities.

Chomsky (1965: 4) states that a record of natural speech will show numerous false starts, deviations from rules, changes of plan in mid-course, and so on. The prevalence of sentence-medial disfluencies could point to uncertainties and problems in the planning stage of speech production. They could be the reflections of changes of speech plan in the middle of an utterance.

For the position of prolongations in a multisyllable word, the prolongation of the final syllable was more common both in prepared and unprepared speeches of all participants. A lot of studies analyzing different languages showed that a great percentage of prolongations occurred in final word position (Den 2003; Eklund and Shriberg 1998; Lee et al. 2004). Eklund (2001) states that some phones, like continuants, are simply easier to prolong. In

our study, we analyzed the type of the phones that are prolonged for one-syllable words only and found that the prolongation of vowels was more common than the prolongation of consonants, both in prepared and unprepared speeches of all participants. Thus, in our study on Turkish language, vowels were more prone to prolongation than consonants.

In terms of analysis we made related to the linguistic units involved in disfluency production, it was seen that slips of the tongue occurred mostly at the phonological levels and repetitions occurred at word level both in prepared and unprepared speeches of all participants. For slips of the tongue, our findings comply with Erişen (2010) who analyzed slips of the tongue in the Turkish language. He mentions that 54.27% of the slips of the tongue in his study are phonological, and Turkish having more phonological errors might be related to a higher demand on working memory because of the head-final SOV sentence structure.

Conclusions

In sum, the findings of this study reveal that the age variable influences disfluency production of native speakers of Turkish in various dimensions.

According to the statistical analyses of different types of disfluency data in terms of *age variable*;

In *prepared speech situations* (excluding 4–8-year-old participants),

- Age is not an effective variable for the filled gap, false start, slip of the tongue, and repetition types of disfluency production rates of the participants.
- Over 50-year-old participants produce more hesitations, and prolongations than 18–23 and 33–50-year-old participants.

In*unprepared speech situations*,

- Age is not an effective variable for the filled gap type of disfluency production rates of the participants.
- 4–8-year-old and over 50-year-old participants produce more hesitations, and prolongations than 18–23 and 33–50-year-old participants.
- 4–8-year-old participants produce more slips of the tongue, false starts, and repetitions than the other age groups (18–23, 33–50, and over 50).

According to our further analyses on disfluency types;

In *prepared speech situations* (excluding 4–8-year-old participants),

- No statistically significant difference was found between filled gap-hesitation, filled gap-prolongation, and slip of the tongue-repetition disfluencies for 18–23-year-old participants. The differences were statistically significant for all the other disfluencies.
- For 33–50-year-old participants, the differences between filled gap-hesitation, filled gap-prolongation, hesitation-prolongation, and slip of the tongue-repetition disfluencies were not statistically meaningful. Other than these disfluencies, statistically meaningful differences were observed.
- For over 50-year-olds, the differences between different disfluency types were statistically significant except for filled gap-hesitation, and slip of the tongue-repetition disfluencies.

In *unprepared speech situations*,

- For 4–8-year-old participants, there were no statistically significant differences between filled gap-hesitation, filled gap-false start, filled gap-slip of the tongue, filled gap-

repetition, false start-slip of the tongue, false start-repetition, and slip of the tongue-repetition disfluencies. The differences between the other disfluencies were statistically significant.

- For 18–23-year-olds, the differences between different disfluency types were statistically significant except for filled gap-hesitation, filled gap-prolongation, hesitation-prolongation, and slip of the tongue-repetition disfluencies.
- For 33–50-year-olds, there were no statistically significant differences between filled gap-prolongation, hesitation-prolongation, and slip of the tongue-repetition disfluencies.
- For over 50-year-olds, the differences between different disfluencies were meaningful except for filled gap-hesitation, and slip of the tongue-repetition disfluencies.

According to the statistical analyses for comparing the disfluencies of different participants;

In *prepared speech situations*,

- There is no statistically significant difference between different age groups (18–23, 33–50, and over 50) for filled gaps, false starts, slips of the tongue and repetitions.
- There is a statistically significant difference between "the 33–50-year-olds and the over 50-year-olds" for hesitations.
- For prolongations, there is a significant difference between "the 33–50-year-olds and the over 50-year-olds," and "the 18–23-year-olds and the over 50-year-olds."

In *unprepared speech situations*,

- There is no statistically significant difference between different age groups (4–8, 18–23, 33–50, and over 50) for filled gaps.
- There is a statistically significant difference between "the 4–8-year-olds and the 18–23-year-olds," and "the 4–8-year-olds and the 33–50-year-olds" for hesitations.
- For prolongations, there is a significant difference between "the 4–8-year-olds and the 18–23-year-olds," "the 4–8-year-olds and the 33–50-year-olds," "the 18–23-year-olds and the over 50-year-olds," and "the 33–50-year-olds and the over 50-year-olds."
- For false starts, the significant difference is between "4–8 and 33–50-year-olds."
- For slips of the tongue, there is a statistically significant difference between "the 4–8-year-olds and the 18–23-year-olds," "the 4–8-year-olds and the 33–50-year-olds."
- For repetitions, the significant differences are between "the 4–8-year-olds and the 18–23-year-olds," "the 4–8-year-olds and the 33–50-year-olds," and "the 4–8-year-olds and the over 50-year-olds."

According to the statistical analysis concerning the position of disfluencies in an utterance and the linguistic units involved in disfluency production;

In *prepared speech situations* (excluding 4–8-year-old participants),

- Filled gaps and hesitations were more common in the sentence-medial position for all participants in our study.
- False starts were more common in the sentence-medial position for the 18–23 and 33–50-year-old participants, but the over 50-year-old participants produced more sentence-initial false starts than the sentence-medial false starts.
- A great number of slips of the tongue were between sounds for all age groups.
- Repetitions at the lexical level were significantly more common than repetitions at the phonological and lexical level in all three age groups.
- All participants prolonged the final syllables more than initial or medial syllables of multisyllable words. For one-syllable words, the prolongation of vowels was more common than the prolongation of consonants.

In *unprepared speech situations*,

- Filled gaps and false starts were more common in the sentence-medial position for the 18–23, 33–50 and over 50-year-olds, but the percentages of sentence-initial filled gaps and false starts were more than those of sentence-medial filled gaps and false starts in the 4–8-year-old participants' unprepared speech.
- Hesitations in the sentence-medial position were more common for all participants in our study.
- Slips of the tongue mostly occurred at the phonological level between sounds in all age groups.
- Repetitions at the lexical level were significantly more common than repetitions at the phonological and syntactic level in all four age groups.
- The final syllable was the most prolonged syllable in multisyllable words by all participants. For one-syllable words, the prolongation of vowels was more common than the prolongation of consonants.

As mentioned before, there are many studies analyzing speech disfluencies in the literature. Most of these studies have focused on the speech disfluencies of native speakers of English. Our study analyzing the speech disfluency production in Turkish language, which has very different features from English language by nature, will enrich our knowledge about the mechanisms underlying speech disfluencies. Furthermore, while most studies have been concerned with spontaneous speech, our research will give an insight into different processes especially the planning phase in speech production by comparing disfluency production of the same speaker both in prepared and unprepared speech situations.

Considering the results of our study in relation to daily life needs, it is seen that effective communication among people is possible with a clear, fluent and smooth speech. Without fluency in speech, human interaction is negatively influenced and many communication problems occur. The results of this study may help to pave the way for future studies on determining the frequency of disfluencies in speech and understanding the causes underlying disfluency production, and preventing disfluency production for more effective communication.

Compliance with ethical standards

Conflicts of interest The authors declare that they have no conflict of interest.

References

Akgün, Ö. (2005). *Türkçe Konuşan 3-6 Yaş Grubundaki Kekemeliği Olan ve Olmayan Çocukların Konuşma Akıcısızlıklarının İncelenmesi*. (Unpublished Master's Thesis). Eskişehir: Anadolu University the Institute of Health Sciences.

Ambrose, N. G., & Yairi, E. (1999). Normative disfluency data for early childhood stuttering. *Journal of Speech, Language, and Hearing Research.*, *42*, 895–909.

Bard, E. G., Lickley, R. J., & Aylett, M. P. (2001). Is disfluency just difficulty? In *Proceedings of disfluency in spontaneous speech (DiSS'01)*, *ISCA tutorial and research workshop (ITRW) on disfluency in spontaneous speech* (pp. 97–100). Edinburgh, Scotland, UK. 29–31 August 2001.

Bortfeld, H., Leon, S. D., Bloom, J. E., Schober, M. F., & Brennan, S. E. (2001). Disfluency rates in conversation: Effects of age, relationship, topic, role, and gender. *Language and Speech*, *44*(2), 123–147.

Burke, D. M., MacKay, D. G., & James, L. E. (2000). Theoretical approaches to language and aging. In Timothy J. Perfect & Elizabeth A. Maylor (Eds.), *Models of cognitive aging* (pp. 204–246). Oxford: Oxford University Press.

Carroll, D. W. (2008). *Psychology of language*. Melbourne: Thomson/Wadsworth.

Chomsky, N. (1965). *Aspects of the theory of syntax*. Cambridge, MA: The MIT Press.

Clark, H. H., & Wasow, T. (1998). Repeating words in spontaneous speech. *Cognitive Psychology*, *37*, 201–242.

Cooper, P. V. (1990). Discourse production and normal aging: Performance on oral picture description tasks. *Journal of Gerontology: Psychological Sciences*, *45*, 210–214.

Den, Y. (2003). Some strategies in prolonging speech segments in spontaneous Japanese. In *Proceedings of DiSS'03, disfluency in spontaneous speech workshop* (pp. 87–90). Editor Robert Eklund. Gothenburg University. Sweden. 5–8 September 2003.

Doğan, Ö. (2001). *Okulöncesi Dönem Çocuklarının Konuşmalarının Akıcılık Özelliklerinin İncelenmesi* (Unpublished Master's Thesis). Ankara: Hacettepe University the Institute of Health Sciences.

Eklund, R. (2000). Crosslinguistic disfluency modeling: A comparative analysis of Swedish and Tok Pisin Human–Human ATIS Dialogues. In *Proceedings of the international conference on spoken language processing (ICSLP) 2000* (pp. 991–994). 16–20 October 2000, Beijing, China.

Eklund, R. (2001). Prolongations: A dark horse in the disfluency stable. In *Proceedings of DiSS '01 disfluency in spontaneous speech* (pp. 5–8). University of Edinburgh, Scotland. 29–31 August 2001.

Eklund, R., & Shriberg, E. (1998). Crosslinguistic disfluency modeling: A comparative analysis of Swedish and American English Human–Human and Human–Machine Dialogs. In *Proceedings of the international conference on spoken language processing (ICSLP)* (pp. 2631–2634). Sydney, Australia. 30 November–5 December 1998.

Erişen, İ. Ö. (2010). *Language production in a typological perspective: A corpus study of Turkish slips of the tongue* (Unpublished Master's Thesis). Ankara: The Graduate School of Informatics of the Middle East Technical University.

Gordon, P. A., & Luper, H. L. (1989). Speech disfluencies in nonstutterers: Syntactic complexity and production task effects. *Journal of Fluency Disorders*, *14*, 429–445.

Gósy, M. (2001). The double function of disfluency phenomena in spontaneous speech. In *Proceedings of disfluency in spontaneous speech (DiSS'01)*, *ISCA tutorial and research workshop (ITRW)* (pp. 57–60). Edinburgh, Scotland, UK. 29–31 August 2001.

Kemper, S. (1992). Adults' sentence fragments: Who, what, when, where, and why. *Communication Research*, *19*, 444–458.

Lee, T. L., He, Y. F., Huang, Y. J., Tseng, S. C., & Eklund, R. (2004). Prolongation in spontaneous mandarin. In *Proceedings of interspeech (ICSLP)* (pp. 2181–2184). Jeju Island. Korea. 4–8 October 2004.

Levelt, W. J. M. (1989). *Speaking: From intention to articulation*. Cambridge, MA: The MIT Press.

Levelt, W. J. M. (1999). Producing spoken language: A blueprint of the speaker. In Colin M. Brown & Peter Hagoort (Eds.), *The neurocognition of language* (p. 122). Oxford: Oxford University Press.

Lovelace, E. A., & Twohig, P. T. (1990). Healthy older adults' perceptions of their memory functioning and use of mnemonics. *Bulletin of the Psychonomic Society*, *28*(2), 115–118.

MacKay, D. G., & James, L. E. (2004). Sequencing, speech production, and selective effects of aging on phonological and morphological speech errors. *Psychology and Aging*, *19*(1), 93–107.

Maclay, H., & Osgood, C. E. (1959). Hesitation phenomena in spontaneous English speech. *Word*, *15*, 19–44.

Menyhárt, K. (2003). Age-dependent types and frequency of disfluencies. In *Proceedings of DiSS'03* (pp. 45–48). Editor Robert Eklund. Gothenburg University. Sweden. 5–8 September 2003.

Obler, L., & Albert, M. L. (1984). Language in aging. In M. L. Albert (Ed.), *Clinical neurology of aging* (pp. 245–253). New York, NY: Oxford University Press.

Shriberg, E. E. (1994). *Preliminaries to a theory of speech disfluencies* (Unpublished Doctoral Dissertation). Berkeley: The Graduate Division of Psychology of the University of California.

Smith, B. L. (1990). Elicitation of slips of the tongue from young children: A new method and preliminary observations. *Applied Psycholinguistics*, *11*, 131–144.

Tottie, G. (2011). Uh and Um as Sociolinguistic markers in British English. *International Journal of Corpus Linguistics*, *16*, 173–197.

Wijnen, F. (1992). Incidental word and sound errors in young speakers. *Journal of Memory and Language*, *31*, 734–755.

Yairi, E. (1982). Longitudinal studies of disfluencies in two-year-old children. *Journal of Speech and Hearing Research*, *25*, 155–160.