Disfluent whole-word repetitions across the lifespan: Durational patterns and functions

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Abstract

Frequency of disfluencies in speech is often analysed in different age groups, but functions of certain types of disfluencies are rarely examined. The aim of this study is to analyse durational patterns and functions of the repeated words in diverse age groups (from preschool children to elderly speakers). Functions of repetitions are well determinable from their durational patterns and pauses around the first and second instances of the repeated words. Results show that disfluent word-repetitions are good predictors for detecting some age-dependent changes in speech production process.

Keywords: whole-word repetition, durational patterns, function, age

1. Introduction

During spontaneous speech, speakers often produce disfluencies. They can occur for several reasons, and they are of various types. They reflect the speakers' speech planning process, as well (Levelt, 1989). The occurrence of disfluencies is influenced by numerous factors such as age (de Andrade & de Oliveira Martins, 2007, 2010). Across the lifespan, cognitive processes change which also affects language abilities of a person (Craik & Bialystok, 2006). During first language acquisition, the vocabulary of children is constantly growing, and more complex grammatical structures are acquired. As spontaneous speech becomes more complex, children learn to hesitate by copying disfluencies of adults (Haynes & Hood, 1977; Ratner & Sih, 1987). This means that they learn how to fill in the time resolving the speech planning problems. In the speech of young children, long silent pauses and multiple whole-word repetitions are typ-

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ical (Kowal et al., 1975; DeJoy & Gregory, 1985; Horváth, 2006). After young adulthood, more cognitive changes take place. During aging, lexical retrieval abilities deteriorate because of the slowing cognitive processes and the change of the capacity of the memory (Burke et al., 1991). These might also influence the occurrence of speech errors and disfluencies. However, there are contradictory findings regarding significant differences in the frequency of disfluencies when comparing young and elderly speakers. Some authors didn't find any differences while others found that the elderly typically produce more disfluencies (Duchin & Mysak, 1987; Leeper & Culatta, 1995; Yairi & Clifton, 1972).

It is our assumption that not only frequency and/or types of disfluencies can vary in different ages, but their functions differ as well. For the analysis of this question, disfluent whole-word repetition will be examined as it is one of the most frequent disfluencies in speech (Shriberg, 1995; Branigan et al., 1999). Repetitions can occur at different levels of the speech planning process. For example, they can indicate word-finding problem, difficulty in conceptual planning, or covert self-monitoring (Plauché & Shriberg, 1999; Gyarmathy, 2009). In addition, their function could be various which is well determinable from their durational patterns and pauses around the first and second instances of the repeated words.

Whole-word repetitions could be single and multiple repetitions. In case of single repetitions, the repeated word occurs twice. In case of multiple repetitions, it can occur three or four, or occasionally more times. In the latter case, the speaker has more serious difficulties with speech planning. In Example (1) (Bóna, 2013), the speaker tried to remember a heard text, but she didn't succeed (FIL = filled pause, double letters indicate prolongation). Multiple repetitions might occur when at the beginning of the interview the speaker is thinking about what to say (Example 2) (Bóna, 2013). In the examples, disfluencies are bold.

(1) valami ilyesmiről volt szó **SIL** és akkor ez mit hozott ki mi lett belőle SIL **FIL** SIL érdeke**sss** kutatási dolog d**ee** SIL **ez** ezt **úgy úgy** SIL **úgy** nem tudom

'the topic was something like that SIL and than how this ended what this resulted in SIL FIL SIL interestinggg research topic buuut SIL I don't quite quite SIL quite know i it'

(2) **FIL** akkor eddig SIL **FIL hát én én én** ugye ezerkilencszáz-harminchétben születtem tehát hetvenegy éves vagyok

'FIL until now SIL FIL well I I I you know was born in 1937 so I am 71'

The main parts of the repetitions are the following: the original utterance, the first instance of the repeated word, the second instance of the repeated word and the continuation of the utterance (Plauché & Shriberg, 1999). Optional pauses may also occur next to the main parts (Plauché & Shriberg, 1999). Example (3) shows the main parts of a disfluent whole-word repetition (SIL = silent pause, P = pause, R1 = first instance of the repeated word, R2 = second instance of the repeated word):

(3) *There is a book SIL **on** SIL **on** SIL the table.*
Original utterance P1 R1 P2 R2 P3 Continuation

The duration of the first and second instances of the repeated words and the occurrence of pauses are related to the function of the repetitions. Heike (1981) suggested two types of repetitions – bridging a gap and hesitating. In the first case, the repeated word provides a bridge to the continuation of the utterance after hesitating (retrospective repeat). In the second case, the repeated word is the hesitation itself (prospective repeat). This means that it fills the gap between the original utterance and the continuation. The occurrence of these two functions are indicated by pauses which appear next to the repeated items. In retrospective repeats, there is a pause before the repeated word, but there

isn't one after it. In prospective repeats, there is a pause after the repeated word.

Plauché & Shriberg (1999) suggested more other functions according to the phonetic features of the repetitions. They analysed the durational patterns, f0-variation and glottalization, and on the basis of these results they found three main types of functions: canonical repetition, covert self-repair, and stalling repetition (Table 1).

In canonical repetitions (Plauché & Shriberg, 1999), the duration of R1 is much longer than in the utterance of the same word in fluent speech. The duration of R2 is similar to the fluent word. There might be a pause before R1, there is a long pause between R1 and R2, and there is no pause after R2. Both R1 and R2 are characterized by falling intonation, and R1 is often characterized by creak-like voicing modality (similar to filled pause). In this case the speaker has difficulties in speech, stops during the pronunciation of the word (R1), lengthens it, and after having solved the problem they continue speaking with repeating the last lengthened word. This type corresponds to Heike's *retrospective repeat* (1981).

In covert self-repairs (Plauché & Shriberg, 1999), P1 often occurs, but P2 and P3 don't occur. R1 and R2 are slightly long, they are slightly longer than they are in fluent speech, and their duration is similar to each other. R1 and R2 are both characterized by rising pitch. R1 is pronounced sometimes with glottalization. In this case the speaker detects a problem during the pronunciation of R1, this is shown by a possible preceding pause and glottalization. The speaker makes an effort to correct it, and "R2 usually marks the beginning of a new utterance or a corrected version of the previous one" (Plauché & Shriberg, 1999, 1516.).

In stalling repetitions (Plauché & Shriberg, 1999), there is no pause before R1, but P2 and P3 might occur. The duration of R1 is slightly longer than in fluent speech, and the duration of R2 is much longer. R1 is characterized by dropping in pitch. The speech is fluent during the pronunciation of R1, the speaker has a problem during and/or after the production of R2. This is usually

marked by P3 or other possible disfluencies after R2. This type looks as if it was the inverse of canonical repetitions, and corresponds to Heike's *prospective repeat* (1981).

Table 1: The structures of the three types of word-repetitions (examples with 'the') '+' = a longer than fluent duration. ' - ' = no pause. (Based on Plauché & Shriberg (1999))

Type	**Structure**
Canonical repetition	(Original Utterance) (Possible Pause) **the**+++ (Long Pause) **the** (-) (Continuation)
Covert self-repair	(Original Utterance) (Often Pause) **the**+ (-) **the**+ (-) (Continuation)
Stalling repetition	(Original Utterance) (-) **the**+ (Possible Pause) **the**+++ (Possible Pause) (Continuation)

Our starting point was that the characteristics of repetitions (like other disfluencies) are influenced by speakers' age. In the case of young children, the numerous and multiple repetitions refer to problems of lexical retrieval and grammatical formulation (Horváth, 2017a). The function of the repeated instance is mainly stalling and hesitation. Young adults speak more fluently, they have significantly less problems with speech planning, and they need less time to resolve them. In their case, the function of the repeated instance is bridging the gap between the original utterance and the continuation, or self-monitoring. In case of elderly, word retrieval becomes difficult again (Burke et al., 1991; Burke & Shafto, 2004). They repeat words for gaining time to solve the problem.

Durational patterns of word-repetitions have been analysed mainly in the speech of young adults (e.g. Shriberg, 1995; Benkenstein & Simpson, 2003; Gyarmathy, 2009), few similar measurements are known at different ages (Bóna, 2015; Horváth, 2017b; Bóna & Vakula, 2018). Horváth (2017b) analysed the durational patterns of word-repetitions in the speech of 6-9-year-old children. She found that age didn't affect the duration of editing phases, but there are big individual differences in the durations in each age group. In another study (Bóna

& Vakula, 2018), durational patterns and functions of repetitions were compared in four age groups and two speech tasks. The age groups were the following: schoolchildren (9-year-olds), adolescents (13-14-year-olds), young adults (20-25-year-olds), and old speakers (75+). The two speech tasks were spontaneous narratives about the own lives and narrative recalls of heard texts. Results show that speech tasks didn't influence the characteristics of repetitions (the ratio of the repeated words and the duration of editing phases were similar in both speech tasks) while the age of speakers did. There were differences in the durational patterns (duration of the repeated words and pauses) and functions between the age groups in both speech tasks.

The above mentioned paper (Bóna & Vakula, 2018) analysed four age groups whose speech planning processes were examined by several papers. However, our knowledge is scarce about the disfluencies of preschool children, middle-aged, and young-old speakers. In this paper therefore we try to examine their speech, as well. The aim of this study is to analyse durational patterns, functions and linguistic characteristics (function or content word) of the repeated words in diverse age groups – from preschool children to elderly speakers.

Our hypotheses are that (i) all speakers mostly repeat function words, but (due to their slower or more difficult word-retrieval processes) the ratio of the repetitions of content words is higher in the speech of children and senior speakers than in that of young adults. (ii) Across the lifespan, the durational patterns of repetitions change: a) the pauses between the two instances of the repeated words and b) the ratio of the duration of the two repeated instances. The children and the elderly will have longer editing phases, and the difference between the duration of the two instances will be smaller. (iii) The ratio of the diverse functions differs between the age groups. The children and the elderly will have a higher rate of stalling function than young adults.

2. Procedure

2.1. Material

Speech samples were selected from the GABI Hungarian Children Speech Database and Information Repository (Bóna et al., 2014) and BEA Hungarian Speech Database (Gósy, 2012). Participants were asked to speak about their own lives, hobbies and families. Their speech was rarely interrupted, only when they were having difficulties in continuing, so spontaneous narrative could be recorded. Altogether 380 min of recordings were analysed.

2.2. Participants

Speech samples were selected from 140 speakers altogether. They were from seven age groups: pre-schoolers (4-5-year-olds), school children (9-year-olds), adolescents (13-14-year-olds), young adults (20-25-year-olds), middle-aged adults (45-53-year-old), senior adults (60-65-year-olds), and elderly adults (75+-year-olds). In every age group there were 20 speakers – 10 women and 10 men. They were native Hungarian speakers with normal hearing and without any known mental or speech disorders. Even senior adults didn't show any mental disorders. The adults were all of similar educational background. They all completed at least 12 years of education.

2.3. Method

Disfluent whole-word repetitions were annotated in speech samples by Praat (Boersma & Weenink, 2008). Duration of the first instance of the repeated word (R1), the second instance of the repeated word (R2), the pause between R1 and R2 (P2), and the pause between R2 and the continuation (P3) were measured as well. The durations of the repeated instances were measured from the beginning of the word to the end of the word.

Functions and the types of repeated words (function word or content word) were classified. Functions were defined on the basis of Plauché & Shriberg (1999). Since they found that phonetic parameters (durational patterns, pausing, f0-variation) show connection with functions, we based our analysis on these

factors. Those phenomena in which R1 was significantly longer than R2, and there was a pause between them, but there was no pause after R2, and thus were classified as canonical repetition. Those phenomena in which the duration of R1 and R2 was similar, in which there was no pause between R1 and R2 and after R2, were classified as covert-self repair. Those phenomena in which R2 was longer than R1, were classified as stalling repetition. In these cases, often, but not necessarily, there was a pause between R2 and the continuation. Those phenomena which could not be classified into these main categories, were considered as "Others".

Next, durational patterns of the certain types were analysed in the age groups. The duration of the components of repetitions (pauses and first and second instances of repeated words) were measured by Praat (Boersma & Weenink, 2008). The time interval between two words was considered as pause irrespective of its duration, and whether it was silent or filled with sound (not words) (Fletcher, 2010).

The ratio of R2 and R1 was calculated in each repetition. Calculating the ratio was necessary for the analysis to disclose whether there were significant differences between the age groups in the duration of R1 and R2 and their relations to each other. If purely their duration had been compared, it would not have resulted in relevant data. On the one hand, tempo differences between the age groups would have caused differences in durational patterns. On the other hand, alternatively to Shriberg (1999) and Plauché & Shriberg (1999), not only the repetitions of the words *I* and *the* were analysed. This wouldn't have been possible in Hungarian, since Hungarian is an agglutinative language and as such it doesn't require to use the personal pronoun with verbs. Each occurrence of any kind of word-repetition was analysed, this is why the raw data of the different groups could not be compared. Speakers of different groups repeated different words, so differences were caused by the divergent length and phonetic characteristics of words. For example, if young speakers had repeated multisyllabic words in faster speech rate and elderly speakers repeated monosyllabic words in slower speech rate, the comparison of the raw duration of R1 and R2

would have resulted in false results. The ratio resolved these problems, and it could be compared between the age groups. The ratio of the second instance of the repeated word and the first instance of the repeated word and the pauses (before) between and after them were analysed.

Statistical analysis was carried out by SPSS on 95% confidence level.

2.4. Reliability

The annotation of repetitions, the coding of types of words and the definition of functions were carried out by the two authors individually. The results were compared with 94% agreement. In cases where there was not agreement, a third party was involved in the decision making.

3. Results

There were 566 disfluent whole-word repetitions in the analysed speech samples. There were far fewer repetitions in the speech of children and adolescents than in the speech of adults (perhaps due to their speech consisting of shorter connected sections). The number of occurrences of word-repetitions was 45 in 4-5-year-olds, 32 in 9-year-olds, 21 in 13-year-olds, 160 in 20-30-year-olds, 102 in 45-53-year-olds, 112 in 60-65-year-olds, and 94 in 75+-year-olds. The frequency cannot be inferred from the numbers as they are of speech samples of different lengths and from speakers with various speech- and articulation rate. Children, adolescents and young-old speakers repeated content words in higher ratio than young, middle-aged and old-old adults (Table 2). Example (6), (7), (8) contain repetitions of function words. Example (9), (10), (11) contain repetitions of content words.

(4) van egy hely és SIL és FIL és ott mindent lehet játszani (5-year-old boy)
'there is a place and SIL and FIL and there you can play anything you want'

(5) pedig fizetnek azért amit 1082 amit hallgatnának (20-year-old man)
'but they pay for what SIL what they study'

(6) alkalom a SIL FIL SIL a SIL egyetemi tanulmányaim folytatására (75+-year-old woman)
'there was no chance to continue the SIL FIL SIL the SIL university studies'

(7) szoktam játszani játszani a barátokkal (5-year-old girl)
'I usually play play with friends'

(8) találkozott egy kiskacsa kiskacsa a másik kiskacsával (9-year-old boy)
a duckling duckling met another duckling'

(9) mondjuk kedvenc SIL kedvenc országom Olaszország és Franciaország (75+-year-old woman)
'let's say my favourite SIL favourite countries are Italy and France'

Table 2: Types of the repeated words

Age-group	**Content word**	**Function word**
4-5-year-olds	11.1%	88.9%
9-year-olds	28.1%	71.9%
13-year-olds	23.8%	76.2%
20-30-year-olds	3.8%	96.3%
45-53-year-old	2.0%	98.0%
60-65-year-olds	11.6%	88.4%
75+-year-olds	6.4%	93.6%

Duration of R1 and R2 was analysed in all repetitions (Table 3). There was no significant difference between R1 and R2 in the speech of 4-5-year-old, 9-year-old, and 75+-year-old speakers. There were significant differences between

the durations of R1 and R2 in the speech of 13-year-old [repeated measures ANOVA: $F(1, 20) = 28.755$; $p < 0.001$; $\eta^2 = 0.590$], 20-30-year-old [repeated measures ANOVA: $F(1, 159) = 91.871$; $p < 0.001$; $\eta^2 = 0.366$], 45-53-year-old [repeated measures ANOVA: $F(1, 101) = 16.190$; $p < 0.001$; $\eta^2 = 0.138$], and 60-65-year-old (Wilcoxon Signed Ranks Test: $Z = -3.120$; $p = 0.002$) speakers.

Table 3: Duration of R1 and R2 depending on age (ms) (Mean and Standard Deviation)

	Spontaneous narratives	
	R1	**R2**
4-5-year-olds	716 (408)	647 (350)
9-year-olds	430 (199)	378 (212)
13-year-olds	448 (179)	255 (113)
20-30-year-olds	344 (144)	232 (109)
45-53-year-olds	320 (133)	264 (118)
60-65-year-olds	364 (212)	322 (167)
75+-year-olds	362 (237)	334 (181)

To be able to compare how the duration of R1 and R2 relate to each other in different age groups and speech tasks, the ratio of R2 and R1 was calculated (Figure 1). If the ratio was less than 100%, R1 was longer than R2. If the ratio was more than 100%, than R2 was longer than R1. The average ratio of R2 and R1 was 93% (SD: 35.2) in 4-5-year-olds, 92% (SD: 9.1) in 9-year-olds, 63% (SD: 6.5) in 13-year-olds, 75% (SD: 3.2) in 20-30-year-olds, 91% (SD: 43.6) in 45-53-year-olds, 98% (SD: 44.2) in 60-65-year-olds, and 107% (SD: 6.3) in 75+-year-old speakers. This means that the lowest mean values were calculated in 13-year-olds and 20-30-year-olds, while the highest values were calculated in 75+-year-olds. Table 4 shows the significant differences as results of the statistical analysis. There were no significant differences between the age groups in any other cases.

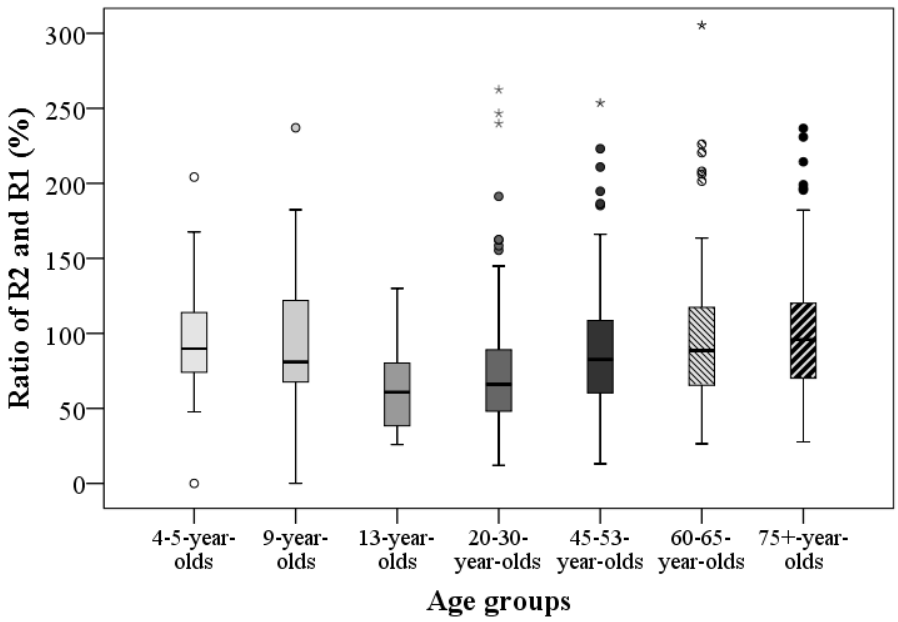

Figure 1: Ratio of the durations of R2 and R1 (R2 = duration of the second instance of the repeated word, R1 = duration of the first instance of the repeated word)

Table 4: Significant differences between the age groups in the ratio of R2 and R1 (Results of the Mann–Whitney-test)

	4-5-year-olds	**9-year-olds**	**13-year-olds**	**20-30-year-olds**	**45-53-year-olds**	**60-65-year-olds**	**75+-year-olds**
4-5-year-olds	_	_	$Z = -6.505$; $p < 0.001$	$Z = -3.840$; $p < 0.001$	_	_	_
9-year-olds	_	_	$Z = -2.237$; $p = 0.025$	$Z = -2.805$; $p = 0.005$	_	_	$Z = -2.365$; $p = 0.018$
13-year-olds	$Z = -6.505$; $p < 0.001$	$Z = -2.237$; $p = 0.025$	_	$Z = -7.438$; $p < 0.001$	$Z = -7.199$; $p < 0.001$	$Z = -7.250$; $p < 0.001$	$Z = -3.866$; $p < 0.001$
20-30-year-olds	$Z = -3.840$; $p < 0.001$	$Z = -2.805$; $p = 0.005$	$Z = -7.438$; $p < 0.001$	_	$Z = -3.501$; $p < 0.001$	$Z = -5.197$; $p < 0.001$	$Z = -5.437$; $p < 0.001$
45-53-year-olds	_	_	$Z = -7.199$; $p < 0.001$	$Z = -3.501$; $p < 0.001$	_		$Z = -2.047$; $p = 0.041$
60-65-year-olds	_	_	$Z = -7.250$; $p < 0.001$	$Z = -5.197$; $p < 0.001$	_	_	_
75+-year-olds	_	$Z = -2.365$; $p = 0.018$	$Z = -3.866$; $p < 0.001$	$Z = -5.437$; $p < 0.001$	$Z = -2.047$; $p = 0.041$	_	_

Editing phases (p2) of all repetitions were also analysed (Figure 2). The longest editing phases were produced by 9-year-olds. According to the statistical analysis, there were significant differences between 9-year-olds and 20-30-year-olds (Mann–Whitney-test: $Z = -2.805$; $p = 0.005$), between 9-year-olds and 45-53-year-olds (Mann–Whitney-test: $Z = -3.176$; $p = 0.001$), between 9-year-olds and 60-65-year-olds (Mann–Whitney-test: $Z = -2.383$; $p = 0.017$), and between 9-year-olds and 75+-year-olds (Mann–Whitney-test: $Z = -2.365$; $p = 0.018$) in the durations of editing phases. There were no significant differences between the other age groups.

The majority of editing phases was realized as silent pause in each age group. In 20-30-year-olds and 75+-year-olds, the ratio of silent editing phases was higher than in the other age groups (Figure 3). There were some cases in each group where editing phase also contained filled pauses. Due to the rare occurrence of these cases, Figure 5 shows in one category the cases in which the editing phase was only a filled pause and the cases in which filled pause and silent pause occurred together (one after the other).

Functions of repetitions varied among the age groups. Adolescents, young and middle-aged adults produced canonical repetitions in higher ratio than the other groups. Children, middle-aged adults and elderly (both 60-65 and 75+) speakers produced more stalling repetitions than adolescents and young adults. Other types of repetitions (which could not be categorized into the three main types) occurred in higher ratio in pre-schoolers and elderly speakers (Table 5).

Durational patterns of the three main types of repetitions were analysed (Table 6). In case of *canonical repetitions*, editing phases (p2) were significantly longer in the speech of children than in the speech of other speakers (Table 7). There were no significant differences between the age groups above the age of 13 (the only exception was the significant difference shown between 20-30-year-olds and 45-53-year-olds). In the ratio of R2 and R1, there were significant differences only between 20-year-olds and 4-5-year-olds [UNIANOVA showed significant differences between the groups: $F(6, 237) = 5.477$; $p < 0.001$, according to the Tukey post hoc test between 20- and 4-5-year-olds: $p = 0.001$], between 20-

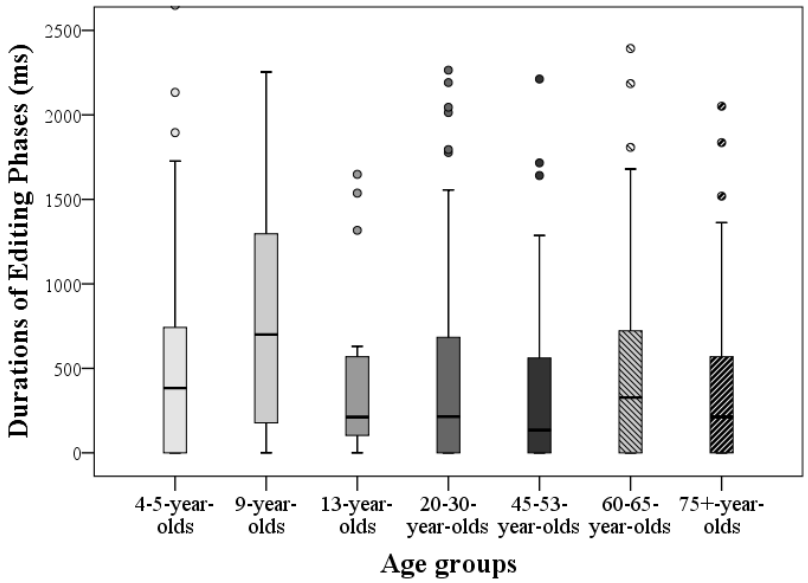

Figure 2: Durations of editing phases of every repetitions (ms)

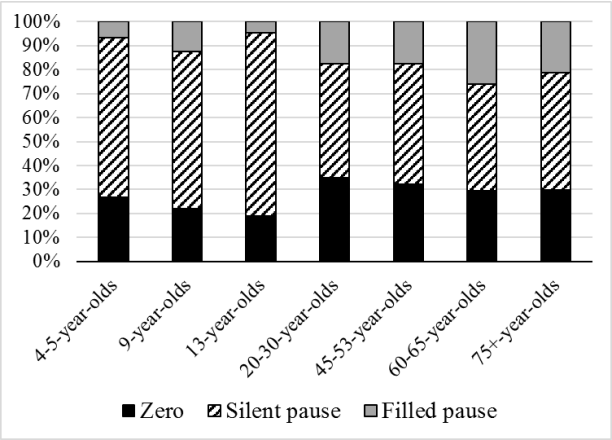

Figure 3: Types of editing phases (p2)

Table 5: Functions of repetitions

Age-group	Canonical repetitions	Covert self-repairs	Stalling repetitions	Others
4-5-year-olds	35.6%	17.8%	26.7%	20.0%
9-year-olds	46.9%	18.8%	31.3%	3.1%
13-year-olds	61.9%	19.0%	19.0%	0.0%
20-30-year-olds	50.0%	27.5%	16.3%	6.3%
45-53-year-old	48.0%	18.6%	32.4%	1.0%
60-65-year-olds	35.7%	16.1%	39.3%	8.9%
75+-year-olds	31.9%	16.0%	39.4%	12.8%

year-olds and 60-65-year-olds ($p = 0.006$), and between 20-year-olds and 75+-year-olds ($p = 0.005$). In case of *covert-self monitoring*, editing phases were 0 ms. There were no significant differences between the age groups in the ratio of R2 and R1. In case of *stalling repetitions*, there were no significant differences between the age groups in editing phases. As regards the ratio of R2 and R1, there was significant difference only between 20-30-year-olds and 75+-year-olds ($Z = -2.011$; $p = 0.044$).

4. Discussion

In the analysis, disfluent whole-word repetitions were analysed in different age groups. Our question was whether functions of whole-word repetitions are different in diverse age groups and whether this occurs in the durational patterns of repetitions.

The first hypothesis was confirms as results show that although repetition of function words occurred in the highest ratio in each age group, children, adolescents and elderly speakers repeated content words in much higher ratio than young and middle-aged adults. According to the literature (e.g. Burke et al., 1991; McGregor, 1997; Barresi et al., 2000), the former age groups have more difficulties with lexical access than the latter age groups. Thus, the ratio of

Table 6: Duration of editing phases and ratio of R2 and R1

	p2 (Editing phase) (ms)	Ratio of R2 and R1 (%)
Canonical repetitions		
4-5-year-olds	943 (218)	76 (4)
9-year-olds	1421 (313)	62 (8)
13-year-olds	630 (148)	53 (6)
20-30-year-olds	636 (60)	53 (2)
45-53-year-old	454 (65)	63 (3)
60-65-year-olds	508 (73)	68 (3)
75+-year-olds	607 (158)	69 (4)
Covert self-repairs		
4-5-year-olds	–	75 (6)
9-year-olds	–	82 (5)
13-year-olds	–	59 (7)
20-30-year-olds	–	77 (4)
45-53-year-old	–	86 (5)
60-65-year-olds	–	77 (5)
75+-year-olds	–	75 (6)
Stalling repetitions		
4-5-year-olds	464 (170)	107 (15)
9-year-olds	744 (209)	146 (14)
13-year-olds	195 (67)	219 (105)
20-30-year-olds	441 (96)	119 (9)
45-53-year-old	360 (77)	135 (8)
60-65-year-olds	585 (83)	127 (7)
75+-year-olds	441 (80)	150 (12)

Table 7: Significant differences between the age groups in the duration of editing phases

	4-5-year-olds	**9-year-olds**	**20-30-year-olds**
13-year-olds		$Z = -2.326$; $p = 0.020$	
20-30-year-olds		$Z = -3.041$; $p = 0.002$	
45-53-year-olds	$Z = -2.635$; $p = 0.008$	$Z = -3.875$; $p < 0.001$	$Z = -2.104$; $p = 0.035$
60-65-year-olds	$Z = -2.086$; $p = 0.037$	$Z = -3.383$; $p = 0.001$	
75+-year-olds		$Z = -3.226$; $p = 0.001$	

the repeated content words can refer to word finding problems. With repeating content words, children and elderly probably monitor if they said the appropriate word or they solve a greater difficulty in speech planning than young and middle-aged adults.

The second hypothesis was that the durational patterns of repetitions change across the lifespan. This was analysed together with the functions of repetitions—the third hypothesis. The differences of durational patterns reflect the differences of functions between the age groups. The fact that adolescents, young- and middle-aged adults produced more canonical repetitions than the other age groups, shows that they can monitor speech planning problems earlier, and the duration of R1 and p2 is enough for solving them.

Children and speakers over age 45 produced stalling repetitions more frequently than adolescents and young adults. This type refers to the assumption that they try to solve the speech planning problems later, during the pronunciation of R2. Often the duration of R2 is not enough for the solution. particular results were shown by the middle-aged group. Their results show that they make a transition between young adults and elderly speakers.

The analysis of durational patterns dependent on function shows that there are only slight differences between the age groups. Covert self-repair is similar in each age group. In case of canonical repetitions, the longer pauses in the speech of preschool children might be caused by slower speech rate. However, pauses are not different in the other groups despite the different speech and articulation rates. On the other hand, pauses might show that preschool children need more time to solve the speech planning problems. The differences in the ratio of R2 and R1 between the groups refer to the fact that R1 is much longer than R2 in the speech of young adults, and R1 is less long than R2 in the speech of pre-schoolers and elderly speakers. It seems that the function of R2 is not only a bridge between the original utterance (and R1) and the continuation, but also it gives time for further planning.

In case of stalling repetitions, there are no differences between the age groups in the duration of p2. This means that speakers do not intend to keep a long pause during solving the problem, so they repeat the last item of the original utterance (R1, the repetition is R2) to fill the gap. The ratio of R2 and R1 is significantly higher in elderly speech than in that of young adults. This correctly indicates the assumption that the elderly need more time for solving the speech planning or monitoring problems.

5. Conclusions

Our findings lead to the conclusions that (i) disfluent word-repetitions are good predictors for detecting some age-dependent changes in speech production process reflected by repetitions, (ii) children's use of repetitions differ from the adults' ones in a number of properties demonstrating a developing speech planning mechanism, (iii) elderly speakers' repetitions differ from young speakers' ones in function which shows their cognitive changes and different speech planning processes.

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