CHARACTERISTICS OF SILENT PAUSES IN THE SPONTANEOUS SPEECH OF KINDERGARTEN AND PRIMARY SCHOOL CHILDREN

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1. Introduction

Silent pauses are classified in various ways based on their function. Pauses were first mentioned in the phonetic literature by Sweet (1890), who linked them to breathing and used the term "breath-group" for speech units created with a single exhalation. Early research differentiated between silent pauses caused by difficulties in speech planning, and the junctures created at syntactic boundaries (Boomer 1965, Lounsbury 1965). Another basis for early differentiation was whether there were articulatory reasons or speech planning problems in the background (Goldman-Eisler, 1968). Pauses can also be classified based on their grammatical versus non-grammatical role in speech. The basis of differentiation in this case is whether it is a content word or a function word that precedes or follows the pause (Gee&Grosjean, 1983). Pauses between a content word and a function word usually have a grammatical function, marking a syntactic or prosodic boundary. On the other hand, pauses following a function word and preceding a content word materialise within a syntactic/prosodic unit, and are non-grammatical. The professional literature mentions several types of silence in spontaneous speech and conversations. "Pause" is defined as a signal break within a speech turn; a "gap" is silence between conversational units that provides an opportunity to take turns; a "lapse" can also indicate the end of the conversation (Sacks et.al., 1974; Levelt, 1989). Furthermore, conversations can have pauses for thinking or for dramatic effect, the speaker can use them to highlight new information, and they can also be used to structure the discourse (Esposito et al., 2007).

Differentiating between the functions of pauses depends (among other factors) on the paradigm used by the researchers. Bruneu (1973) identified three types of silence from a communication viewpoint: psychological, interactive and sociocultural. Psychological silence is usually very short, presenting itself in the form of hesitation or decelerating rate of speech, and its purpose is to allow time for the listener to process what has been said. Interactive pauses are usually longer, and they support the interaction between the persons involved in the discourse, for example by enabling them to take turns. Sociocultural pauses combine the characteristics of the previous two types. Zellner (1994) distinguished two classification systems of pauses: 1. Physical and linguistic classification, and 2. Psychological and psycholinguistic classification. According to the first classification system, a pause can be intra-segmental or inter-lexical; while the second classification distinguishes between silent and filled pauses. Kurzon (2007) uses a pragmatical perspective in his analysis, distinguishing four types of silence: the first three are conversational silence; thematic silence (the speaker is not willing to talk about a certain subject, e.g. in a political interview); and silence that occurs in a conversational situation when one or more participants silently read a text: for example during a lesson, when the pupils read a chapter from the textbook. The fourth type is situational silence, for example listening to a concert together or taking part in a joint commemoration. Zellner (1994) defines silent pauses from different aspects: from a speech technology aspect, pause is a zero-amplitude unit, which is a physical phenomenon; it can be part of a speech sound (for example the silent phase of voiceless plosives), or it can appear between words. Psycholinguistically, silent pauses can go together with exhalation, swallowing or audible inhalation.

According to research, there is a link between the speech situation and the function, frequency and duration of pauses. The more complex a speech task is – the greater cognitive effort it requires – the longer and more frequent the pauses become (Goldman-Eisler, 1968; Kowal et al., 1975). Silent pauses were longer and more frequent in political speech, the longest pauses having a stylistic function. Filled pauses were not characteristic for this type of speech, whereas they were decidedly frequent in interview situations (Duez 1982). Among English speakers, a connection was found between the position and the duration of pauses, for example in the case of 'to+infinitive' grammatical structures. When reading aloud, there were significantly longer pauses before 'to' than after it; whereas the opposite was found in spontaneous speech, probably due to speech planning characteristics (Bada&Genç, 2008).

As for the realisation and functions of pauses in spontaneous speech, less research was conducted among children than among adults. International studies with a psycholinguistic focus mainly analyse the realisation of pauses depending on the child's age and the type of speech. A significant decrease was observed in the length of silent pauses from age 4 to 8 (Singh et al., 2007). The length, however, is not only influenced by the speaker's age, but also by the type of speech and the task. Preschool to primary school-aged children used pauses at a significantly higher percentage when telling a story based on a picture than during a conversation (Deputy et al., 1982). According to another study, primary school pupils used significantly longer pauses when having to recite a story word-for-word than when they only had to summarise the essence of it (Schönpflug, 2008).

Research was conducted among Italian primary school pupils, analysing silent pauses from a pragmatical viewpoint in a 15-hour material. The study analysed the functions of pauses in classroom communication, one example being 'wait time' – when the teacher asks a question and gives pupils some time to think about it (Maroni, 2011). An analysis of primary school classroom communication among English speakers revealed that pausing and taking turns worked similarly to other speech situations, but silence due to 'wait time' was longer (Ingram-Elliott, 2014).

Analysing pauses has a long tradition in Hungarian speech research as well. József Balassa discussed the phenomenon – from a primarily physiological perspective – as early as the 19th Century (1886). Lajos Hegedűs (1953) also emphasised the importance of pauses in communication, however, he considered breathing to be determined by cognitive rather than physiological processes during speech. Pauses have been defined and classified in various ways in 20th Century Hungarian literature on phonetics, including both production and perception aspects (Fónagy, 1967; Szende, 1979; Váradi, 1988). Sallai and Szende (1995) discussed the pauses in spontaneous speech, distinguishing silent and filled pauses, zero-duration pause, and "pause compensation" (e.g. longer pronunciation of vowels before a silent pause). In their wider theoretical framework, pause is considered to be a break in the sequence – that is, the serial structure – which creates or carries information. At the same time, signal breaks can occur in speech as a part of sound construction (e.g. the stop gap of voiceless plosives and affricates), and these cannot be considered pauses (cf. Gósy, 2004).

In the past few years, a greater quantity of recordings and databases has become available in Hungarian, which has made it possible to research silent pauses in spontaneous speech from a variety of perspectives. Research has found that the frequency and duration of pauses depends on the speaker (age, gender), the speech situation, and the speech type (cf. e.g. Gósy, 2000; Gocsál, 2001; Menyhárt, 2003; Imre, 2005; Markó, 2005; Olaszy, 2005; Laczkó, 2009; Váradi, 2010; Bóna, 2013; Neuberger, 2014).

The analysis of spontaneous speech has revealed that silent pauses often accompany disfluency phenomena, especially when the speaker makes changes or corrections. Pauses however do not influence the perception of disfluencies: the listener's ability to detect disharmony depends more on the type of disfluency (Bóna, 2006). Pausing within a word is a sign of speech planning problems. Speech production most frequently comes to a halt before a suffix, which indicates difficulties in grammatical planning and lexical recall. Silent pauses during restart were longer than the ones within the words (Gósy, 2010, 2012). Pauses in the first half of the speech segment were longer than the ones in the second half (Gósy&Krepsz 2017). Based on data from a large amount of spontaneous speech, a study on the connection of silent and filled pauses revealed that most silent pauses occur after hesitation. A silent pause both before and after a filled pause occured the least often. Silent pauses before hesitation were longer than after a filled pause (Horváth, 2014).

In addition to examining the functions of pauses in speech production, Gósy (2000) was among the first Hungarian researchers to highlight the role of pauses in speech perception. Her results showed that listeners perceive about two thirds of pauses, and that there is a strong connection between the duration of a pause and its perception.

Extensive research on pauses in the speech of Hungarian kindergarten and primary school pupils has only begun in recent years. Examining the spontaneous speech of 6-13-year-old children, Neuberger (2014) found that age did not have a significant influence on the per minute occurrence of silent pauses. The average number of silent pauses was 22.5 for kindergarteners and 9-year-old children; 19.8 for age 7, 22.9 for age 11, and 21.4 for age 13. The average time proportion of silent pauses was 30-35% in all age groups, individual values ranging from 15 to 46%. The length of silent pauses showed significant differences by age group: pauses were the shortest among 13-year-old children and the longest among 7-year-olds. In every age group, girls used shorter pauses than boys.

A temporal analysis of speech among 5, 7 and 9-year-old children found that the proportion of speaking (71-77%) versus pausing (23-29%) was very similar for all of them. There were great individual differences in the frequency of pausing: 11.1-28.9 pauses per minute for age 5; 5.1-27.2 for age 7; and 8.9-36.2 for age 9 (Vakula&Krepsz, 2017).

Examining primary school children with dyslexia, the proportion of silent pauses was the same as in the control group (36% of total speaking time), but the pauses were longer than among typically developing children (Vakula, 2012).

For Hungarian speaking children, only a small amount of research is available on the connections between disfluency phenomena and silent pauses. Mészáros (2012) analysed silent pauses related to disfluency phenomena in conversations of school-age children as well as adults. The researcher defined two basic types of pauses depending on their role in conversation: 1. pauses within a turn, and 2. pauses related to taking turns. Pauses within a turn were divided into two categories: pauses with a syntactical function and pauses related to disfluency phenomena. According to the system created by Mészáros, the second category includes not only the silent pauses that are strictly related to editing phases, but any signal break before or after a disfluency phenomenon. Silent pauses with a syntactical function only include the ones before or after conjunctions or at clause boundaries. Research was conducted among preschool/kindergarten children, analysing the relationship between silent and filled pauses (Horváth, 2014). Similarly to adults, the children used silent pauses most often after filled pauses. A filled pause without a silent pause before or after it was an extremely rare phenomenon. On average, silent pauses preceding a filled pause were shorter.

The aim of the present study is the classification and temporal analysis of silent pauses in spontaneous narratives of Hungarian kindergarten and primary school pupils. The hypotheses are the following: i) the duration of silent pauses depends on their position, and ii) different temporal patterns of pauses will be observed depending on the children's age.

2. Research subjects, method and material

Narratives of 6-,7-,8- and 9-year-old children (5 girls and 5 boys in each age group) were recorded for the research. The 6-year-old children were in kindergarten, the 7-year-olds in first grade, the 8-year-olds in second grade and the 9-year-olds in third grade. All the children were from Budapest, all were monolingual and of typical speech development, and none of them had hearing problems or a speech disorder. The recording protocol and the interviewer was the same every time. The children were asked to talk about their family, their activities in school, what they like to play, etc. The interviewer then silently listened and only asked further questions when it was necessary to help the child continue speaking. The interviews took place in the same familiar school environment. The narratives were recorded using a Sony ICD-SX700 device.

The research material consists of 40 narratives, the length of the whole corpus is 112 minutes. The recordings were annotated at the lexical and speech segment level, using the Praat 5.3 software (Boersma–Weenink, 2013). Silent pauses were manually extracted under continuous visual and auditory supervision, labeling signal breaks lasting from the cessation of the last sound of a lexeme to the first sound of the next lexeme.

The total duration of the 2596 silent pauses detected in the corpus was around 35 minutes. On average, a child talked for 2.8 minutes and used 65 silent pauses. As Table 1 also illustrates, the data collected in different age groups showed only minimal differences. A significant increase could only be observed in the speaking time of 9-year-old children, but the total pausing time was also longer in that age group.

Table 1: *Speaking times and total duration of silent pauses by age and gender*

Age	**Gender**	**Total speaking time per group (minutes)**	**Average speaking time per child (minutes)**	**Total pausing time per group (minutes)**	**Average pausing time per child (minutes)**
6 years	boy girl	11.5 12.7	2.3 2.5	3.1 3.5	0.62 0.70
7 years	boy girl	11.8 12.3	2.4 2.5	3.7 2.7	0.74 0.54
8 years	boy girl	13.2 12.8	2.6 2.6	3.8 5.4	0.76 1.08
9 years	boy girl	17.2 20.8	3.4 4.2	6.8 6.1	1.36 1.22
SUM	boy girl	53.7 58.6	2.7 2.9	17.4 17.7	0.87 0.89

We categorised pauses based on the system developed by Gyarmathy (2017), which was originally designed to analyse the narratives of adult speakers. The first distinction was whether the pause was related to disfluency (in these cases, the time span between the interruption of articulation and the beginning of correction was taken into account, as part of the editing phase), or it had a syntactical function (Figure 1). Pauses occurring as part of the editing phase were marked with "E", and pauses with a syntactical function were marked with "S". In both main categories, further subcategories were identified. Pauses with editing function (E) were further categorised based on whether the disfluency phenomena were due to the speaker's uncertainty or errors. We identified the following subcategories: a) **E_uncertainty** (**E_unc**; *with whom I like* E_unc *with whom I like to play*; *ex* E_unc *extra art lessons*), b) **E_error** (**E_error**; *I met three* E_error *four new friends*; *our house has three bathrooms* [bedrooms]). Silent pauses with a syntactical function (S) were distinguished based on their position. **Utterance onset pauses (S_Uo)** occur when a speaker claims the turn; here the pause may only be preceded by a filler word or a discourse marker: Interviewer: *Tell me about your family.* Responder: *Well* S_Uo *I have two siblings.* **Silent pauses at phrase boundaries (S_PhrB)** are found between clauses of virtual sentences, often before or after a conjunction: *in the summer we went to Transylvania* S_PhrB *and we slept there.* **Within phrase pauses (S_PhrW)** are found within a grammatical unit ("phrase"): *this is a very* S_PhrW *scary game.* **End of phrase pauses (S_PhrE)** are silent pauses at the end of a virtual sentence, after which the speaker starts another virtual sentence that often represents a new thought unit: *and then I will get a puppy* S_PhrE *I also go swimming…* The difference between pauses at phrase boundaries and phrase-final pauses is not always obvious in spontaneous speech. Therefore, pauses were only considered to be phrase-final ones if the virtual sentence following them did not start with a conjunction and/or represented a completely new thought unit. In uncertain cases the sample was left out from the analysis.

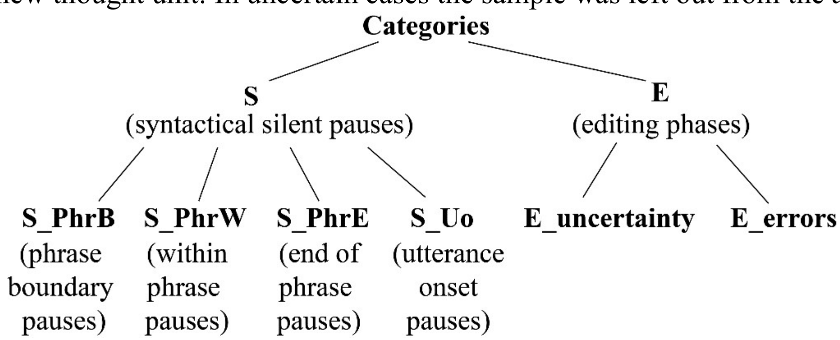

Figure 1: *Categories used in the research*

The statistical analysis was carried out using SPSS version 20. A generalised linear mixed model (GLMM) was built. The independent variables were the types of pauses, gender and age; pause duration was the dependent variable; and the speakers were considered as a random factor. Binomial nonparametric and Chi-square goodness-of-fit tests were used to examine the distribution of the data, and the Kolmogorov-Smirnov test was used for preliminary normality testing. Pause durations were not normally distributed, therefore a logarithmic transformation was performed, and the statistical model was built on the normally distributed data obtained by this process.

3. Results

2596 pauses were detected in the whole corpus: 527 silent pauses occurred in the group of 6-year-old children, 534 in the group of 7-year-olds, 588 among 8-year-olds and 947 among 9-year-olds. The per minute occurrence of pauses was very similar in the first three age groups

(Table 2). As the statistical analysis revealed, children's age and gender did not have a significant influence on the number of pauses per minute.

Table 2: *Occurrence of silent pauses in the corpus*

	Total number of pauses		**Number of pauses per minute**		**Number of pauses per 100 words**	
	Mean	SD	Mean	SD	Mean	SD
Age 6	53	28-88	21.7	16-29	29.1	22-48
Age 7	53	30-85	21.8	14-34	27.2	20-35
Age 8	59	20-131	21.6	11-29	38.3	23-61
Age 9	95	49-137	25	14-33	36.1	24-53

The number of pauses per 100 words is also included in the table. This indicator was very similar for age 6 and 7; and for age 8 and 9 (Table 2 and Figure 2). Older children paused more frequently, but the difference did not prove to be statistically significant.

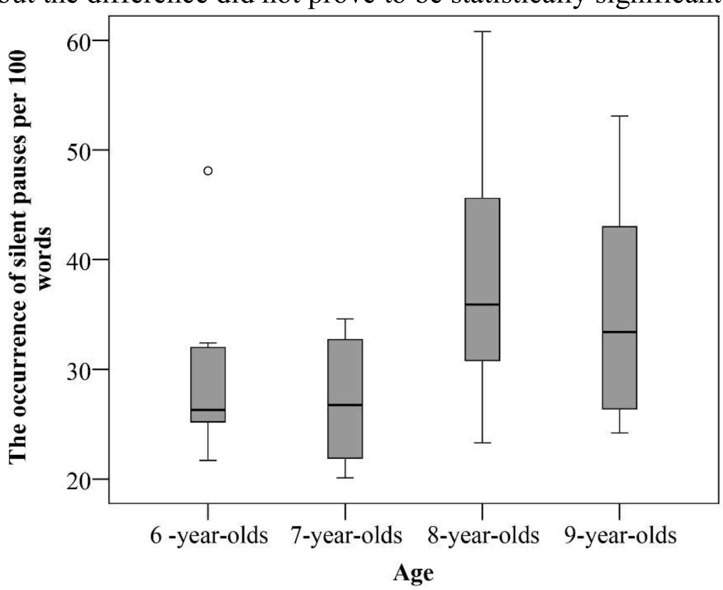

Figure 2: *Number of silent pauses per 100 words*

First we analysed the two main categories: silent pauses having a syntactical function (S), and silent pauses occurring as part of the editing phase (E). 81.5 % of all silent pauses belonged in the "S" category and 18.5 % belonged in the "E" category. The binomial nonparametric test verified that the distribution of the two categories was not random ($p < 0.001$). Silent pauses in a syntactical position made up 27.1% of the total speaking time (18.8 pauses per minute), whereas editing phases made up only 4.3% (4.3 pauses per minute). Percentages by age group were the following: Among 6-year-old children, 78% of silent pauses were in a syntactical position (17/minute) and 22% were editing phases (4.8/minute), the former taking up 22.7 % of the total speaking time, the latter 5%. The results were similar for 7-year-olds: the percentages were 73.6% for pauses having a syntactical function (16.3/minute) and 26.4% for editing phases (5.9/minute), the former taking up 20 % of the total speaking time, the latter

6.4%. Proportions changed in the group of 8 and 9-year-old children, their results were closer to those observed in the speech of adults. Among 8-year-olds, the percentages were 84.9% for pauses having a syntactical function (19.2/minute) and 15.1% for editing phases (3.4/minute); in the group of 9-year-olds the percentages were 85.7% (21.4/minute) and 14.3% (3.6/minute) respectively. Among 8-year-old children, pauses in a syntactical position made up 31.1% of the total speaking time, editing phases made up 4.3%; these percentages were 31.8% and 2.4% among 9-year-olds. Binomial nonparametric tests verified for each age group that the distribution of the main categories was not random ($p < 0.001$).
We also analysed the distribution of the different types of pauses (Figure 3). In the group of 6-year-old children, the great majority of pauses were found at phrase boundaries. There were only half as many pauses within phrases. Editing phase-type pauses were more often due to uncertainty than due to errors. The distribution of the pause types was significantly different from random distribution (χ^2 goodness-of-fit test: $\chi^2(5) = 361.125$; $p < 0.001$) The data collected in the group of 7-year-olds showed very similar patterns as in the previous group. Again, the distribution of pause types was significantly different from random distribution (χ^2 goodness-of-fit test: $\chi^2(5) = 191.461$; $p < 0.001$). Pauses at phrase boundaries were in majority in the group of 8-year-old children as well, but they used a higher percentage of phrase-final pauses than their younger peers. The distribution of pause types was not random for this age group, either (χ^2 goodness-of-fit test: $\chi^2(5) = 291.571$; $p < 0.001$). Among 9-year-old children, intra-phrase pauses were the most frequent, the distribution of pause types was again significantly different from random distribution (χ^2 goodness-of-fit test: $\chi^2(5) = 652.141$; $p < 0.001$).

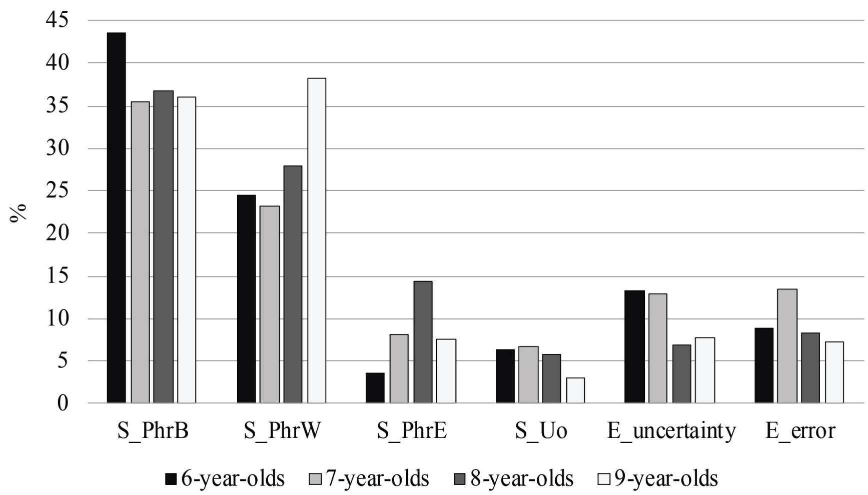

Figure 3: *The ratio of silent pauses by their function in the different age groups*

The standard deviation of the duration of silent pauses was substantial: some being only 50 ms long, while others being as long as 10 s (e.g. at the end of a phrase; or at the beginning of an utterance when a child was pondering what to answer to the interviewer's question, or what grammatical structure to use). In the group of 6-year-old children, the shortest silent pause was 45 ms and the longest was 9525 ms. Among 7-year-olds, pause durations ranged from 35 ms to 11633 ms. Among 8-year-olds, the extreme values were 69 ms and 8870 ms; and among 9-year-olds, the shortest pause was 31 ms and the longest 14513 ms.
We also analysed the extreme values of pause duration for the different types of silent pauses (Table 3). Most of the extremely long silent pauses were found at the end of a phrase or at the beginning of an utterance, irrespectively of the children's age. The highest number of the

shortest pauses was also found in these two positions. The lowest incidence of extremely long duration was observed in the "editing phase" category.

Table 3: *Range values of pause durations (ms) by pause type in the different age groups*

		age 6	age 7	age 8	Age 9
S_PhrB	Minimum Maximum	45 4223	52 7853	66 5424	52 10998
S_PhrW	Minimum Maximum	61 3179	42 4565	69 8870	58 4034
S_PhrE	Minimum Maximum	194 9525	128 4407	135 6129	239 11795
S_Uo	Minimum Maximum	144 6372	154 11633	121 4953	179 14513
E_unc	Minimum Maximum	54 3403	35 6270	78 2082	31 2120
E_error	Minimum Maximum	65 1481	51 5757	71 6760	65 706

Pause durations showed substantial standard deviation not only depending on their type: there were also great individual differences. For example, for one of the 6-year-old children, 90% of pre-utterance pauses were more than 2 seconds long; while for another child, only one pause of this type was observed.

Outliers (representing 9.2% of the cases) were ignored in the statistical analysis, as well as instances when a certain type of pause occurred only once during the whole interview with a child. Preliminary normality testing confirmed that the data was not normal, therefore a logarithmic transformation was performed before the analysis. Investigating the average pause durations in the two main categories, it can be stated that having a syntactical or editing function significantly influences the duration of silent pauses, which has been confirmed by statistical analysis: F (1, 214) = 37.864; $p < 0.001$. The duration of pauses is also influenced by the combined effect of age and gender ($F(3, 214) = 5.106$; $p = 0.002$) and the combined effect of pause type and gender ($F(3, 214) = 4.807$; $p = 0.003$). From the two main types, syntactical pauses were longer in all of the age groups (Figure 4). The mean duration of syntactical pauses was 663 ms (SD: 562 ms) in the group of 6-year-old children, 529 ms (SD: 454 ms) among 7-year-olds, 689 ms (SD: 530 ms) among 8-year-olds, and 638 ms (SD: 593 ms) among 9-year-olds. The average length of editing phases was 541 ms (SD: 602 ms) in the group of 6-year-old children, 477 ms (SD: 414 ms) among 7-year-old children, 501 ms (SD: 407 ms) among 8-year-olds and 386 ms (SD: 398 ms) for 9-year-olds. Statistical analysis confirmed significant difference between the two main categories only in the two upper age groups (8-year-olds: $F(1, 214) = 10.616$, $p = 0.001$; 9-year-olds: $F(1, 214) = 37.762$, $p < 0.001$).

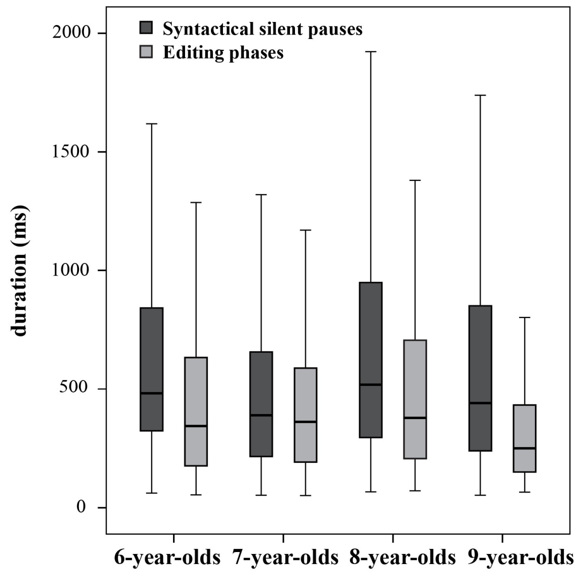

Figure 4: *Duration of syntactical pauses (N) and editing phase-type pauses (S) in the different age groups*

Age in itself did not influence pause duration in the two main categories. The proportion between the duration times of syntactical pauses and editing phases can be considered constant: it does not change with age, syntactical pauses being the longer type in every age group. On the other hand, looking at the duration of each pause type separately in each age group, we can see that both syntactical pauses ($F(3, 214) = 4.027$; $p = 0.008$) and editing phases ($F(3, 214) = 2.873$; $p = 0.037$) are influenced by the speaker's age. The durations of editing phases show a decreasing trend with increasing age. Pairwise comparison results for syntactical phases were statistically different comparing 6- and 8-year-olds ($t = 2.043$, $p = 0.042$), 6- and 9-year-olds ($t = 2.042$; $p = 0.042$); 7- and 8-year-olds ($t = 2.798$; $p = 0.006$), 7- and 9-year-olds ($t = 2.756$; $p = 0.006$). Compared to 6-year-old children (663 ms), pause durations were longer among 8-year-olds (689 ms) and shorter among 9-year-olds (638 ms). Compared to 7-year-olds (529 ms), both 8- and 9-year-olds used longer syntactical pauses. 8-year-old children used the longest syntactical pauses among the four age groups.

The durations of editing phases were significantly different comparing 6 and 9-year-old children ($t = 2.306$, $p = 0.022$), 7 and 9-year-old children ($t = 2.273$, $p = 0.024$, and also 8 and 9-year old children ($t = 2.542$, $p = 0.012$). The results of 9-year-olds were different from every other age group, their editing phases being the shortest on average (386 ms). Dealing with disharmonies took the longest time for 6-year-olds (541 ms), the second longest for 8-year-olds (501 ms), and the third longest for 7-year-olds (477 ms).

Dividing each age group by gender (see Figure 5), pause durations were significantly different for boys and girls in the age group of 6-year olds ($F(1, 214) = 5.114$; $p = 0.025$), 7-year-olds ($F(1, 214) = 5.710$; $p = 0.018$) and 8-year-olds ($F(1, 214) = 5.546$; $p = 0.019$). Looking at all silent pause types, girls used longer pauses among 6-year-old children (boys: 619 ms; girls: 654 ms) and among 8-year-olds (boys: 579 ms, girls: 756 ms). 7-year-old boys used longer pauses (612 ms) than girls in the same age group (438 ms). Differences were minimal in the group of 9-year-olds (boys: 615 ms, girls: 585 ms). Syntactical pauses were longer for boys in the group of 6-year-olds (boys: 699 ms; girls: 622 ms) and the group of 7-year-olds (boys: 630 ms; girls: 440 ms), longer for girls among 8-year olds (boys: 598 ms; girls: 806 ms), and there were minimal differences in the group of 9-year-olds (boys: 653 ms; girls: 623 ms). Editing phases were longer for girls among 6-year-olds (boys: 385 ms; girls: 785 ms) and

8-year-olds (boys: 459 ms; girls: 548 ms), and longer for boys among 7-year olds (boys: 553 ms; girls: 431 ms) and 9-year-olds (boys: 440 ms; girls: 292 ms). Pairwise comparison verified that the durations of syntactical pauses were significantly different for boys and girls in the group of 7(t = 2.376, p = 0.018) and 8-year-olds (t = 2.311, p = 0.022).

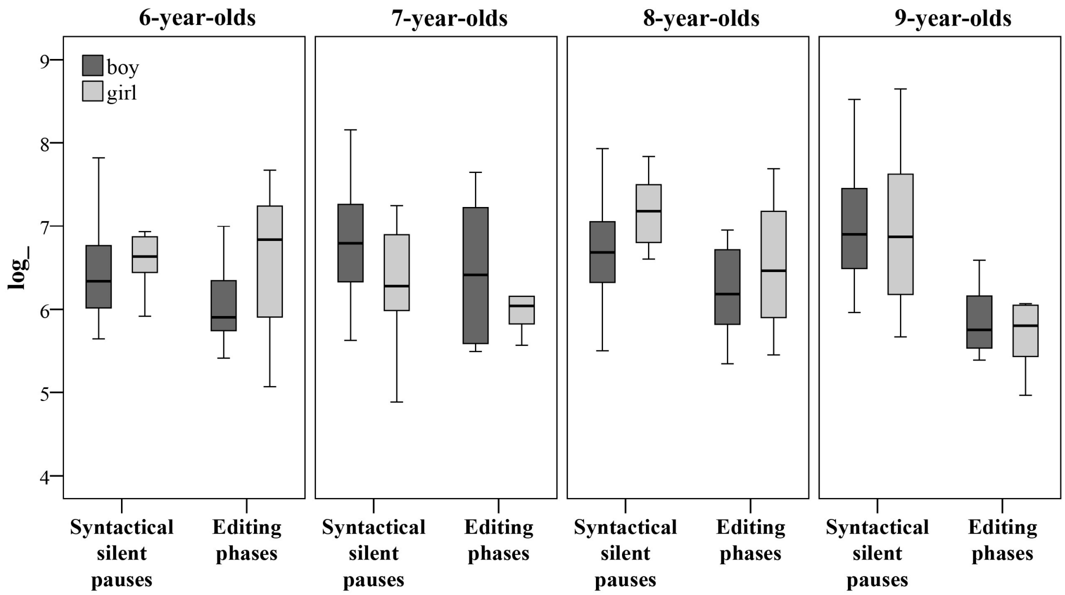

Figure 5: *Syntactical pauses and editing phases by gender and age group*

Extending the analysis to the subcategories of silent pauses, the longest mean durations were measured for phrase-final pauses (1219 ms, SD: 734 ms) and utterance onset pauses (967 ms, SD: 992 ms). These two types were also the ones that occurred the least often. The mean duration was 657 ms (SD: 489 ms) for silent pauses at phrase boundaries, 423 ms (SD: 314 ms) for within-phrase pauses causing a break in the grammatical structure, 605 ms (SD: 575 ms) for editing phases due to uncertainty, and only 327 ms (SD: 233 ms) for editing phases due to errors. Pause durations were different in the four age groups, but similar tendencies could be observed. Utterance onset pauses and pauses at end of phrase were the longest in all four age-groups; utterance onset pauses being longer in the speech of 6- and 7-year-olds, and pauses at the end of a phrase being longer in the group of 8- and 9-year-olds (Table 4).

Table 4: *Pause durations by type and age group*

	age 6		age 7		age 8		age 9	
	Mean (ms)	SD (ms)	Mean (ms)	SD (ms)	Mean (ms)	SD (ms)	Mean (ms)	SD (ms)
S_PhrB	677	469	520	386	722	538	680	508
S_PhrW	489	345	390	290	442	443	403	325

S_PhrE	985	471	948	736	1027	552	1660	791
S_Uo	1225	1300	693	653	916	798	1111	1143
E_unc	702	706	623	505	504	504	520	518
E_error	290	225	338	231	463	297	258	150

Statistical analysis of the data has revealed that pause durations mainly depend on the pause type ($F(5, 182) = 23.555$; $p < 0.001$), but they are also not independent from age ($F(3, 182) = 2.883$; $p = 0.032$). Pause durations are also influenced by the combined effect of age and gender ($F(3, 182) = 6.708$; $p < 0.001$), and the combined effect of age and pause type ($F(15, 182) = 2.539$; $p = 0.002$). Analysing the durations of different pause types by age group, significant differences were found for error-related editing phases ($F(3, 182) = 7.589$; $p \leq 0.001$) end of phrase pauses ($F(3, 182) = 3.360$; $p = 0.020$), and within-phrase pauses ($F(3, 182) = 4.762$; $p = 0.003$). The duration values of these three pause types were mathematically different by age group (see Table 4). Pairwise comparison revealed significant differences in one case both for uncertainty-related editing phases and for pauses at phrase boundaries, in two cases for error-related pauses, and in three cases both for within-phrase and phrase-final pauses (Table 5).

Table 5: *Pairwise comparison of pause types by age group – statistical results*

Pause type	Pairwise comparison	*t*-value	*p*-value
S_PhrB	age 6 – age 8	2.165	0.032
S_PhrW	age 6 – age 8 age 7 – age 8 age 8 – age 9	2.452 2.427 2.979	0.015 0.016 0.003
S_PhrE	age 6 – age 9 age 7 – age 8 age 7 – age 9	2.147 2.175 2.897	0.033 0.031 0.004
E_unc	age 6 – age 9	2.449	0.015
E_error	age 7 – age 9 age 8 – age 9	2.491 4.232	0.014 0.000

Although the speakers' gender in itself did not influence pause durations, the combined effect of age, gender and pause type proved to be significant: $F(38, 182) = 2.191$; $p < 0.001$. In the group of 6-year-old children, pairwise comparison revealed a significant difference between pause durations of boys and girls for silent pauses at phrase boundaries ($t = 2.016$, $p = 0.045$).

In the group of 8-year-old children, gender differences were significant for pauses at phrase boundaries (t = 2.484, p = 0.014) and for pauses in an within-phrase position (t = 2.581, p = 0.011). Gender differences in pause duration were also significant for within-phrase pauses in the group of 9-year-olds (t = 2.194, p = 0.030). Comparing data obtained from boys and girls, it can be stated in general that girls used longer pauses in most cases (Figure 6), with the exception of 7-year-olds, where boys' pauses were longer.

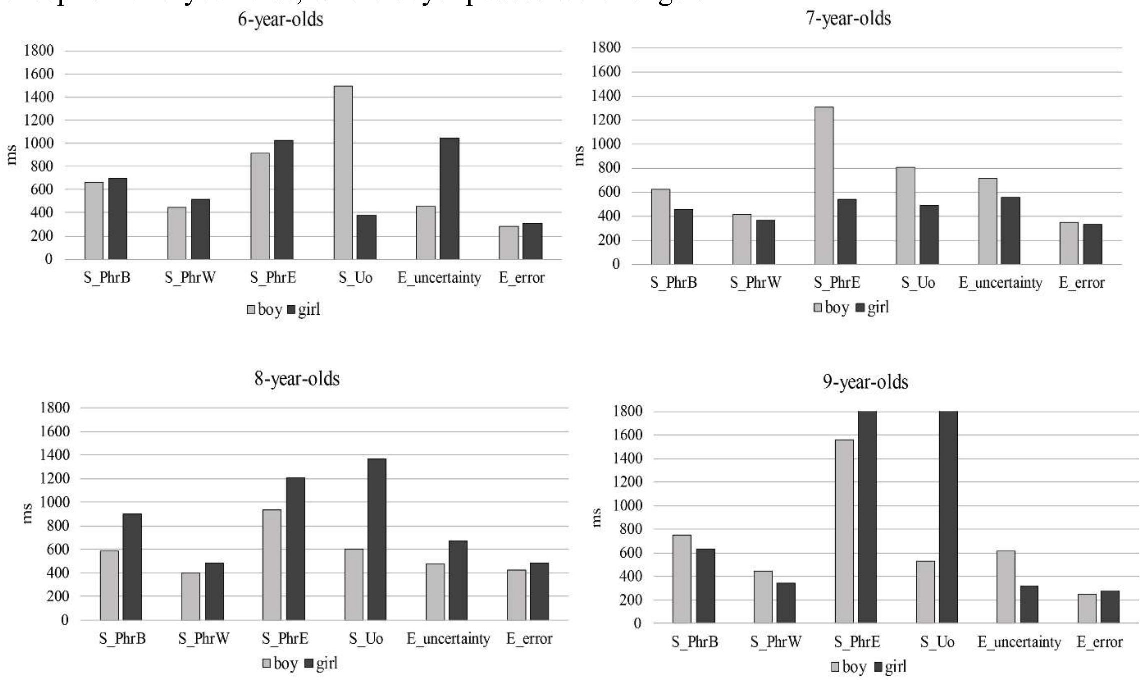

Figure 6: *Pause durations by gender and age group*

4. Conclusions

Our study analysed silent pauses in the spontaneous narratives of kindergarten and primary school pupils. The main question of the research was how the children's age and gender, and the pauses' syntactical position influence the temporal patterns of silent pauses.

Silent pauses made up 31% of the children's total speaking time. Neuberger (2014) observed a similar percentage (30-35%) in the speech of kindergarten and primary school pupils. The proportion of silent pauses relative to total speaking time was smaller among adults, only 20% (cf. e.g. Gyarmathy, 2017). The difference is presumably due to the fact that transforming thoughts into language and harmonizing speech planning and execution is more difficult for children – because of their less developed cognitive skills, less speech experience and the nature of the interview situation.

The present research has not revealed significant differences between the age groups in the occurrence of silent pauses per minute. An earlier study conducted among children had similar findings: the frequency of silent pauses did not show significant difference by age (Neuberger, 2014). At the same time, individual differences were substantial, as other studies for similar age groups also revealed (Neuberger, 2014; Vakula&Krepsz, 2017). Looking at the number of pauses per 100 words, two groups could be identified: the numbers were very similar for 6- and 7-year-olds, as well as for 8- and 9-year-olds, older children using more pauses per 100 words. As grammatical complexity develops (Horváth, 2017), children create compound virtual sentences more often, which on one hand increases the number of syntactic

pauses. On the other hand, more complex utterances make speech planning more difficult, increasing the possibility for disharmonies – which often manifest themselves as silent pauses.
In the course of the analysis of pause positions, we differentiated between pauses with a syntactical function (S) and pauses occurring as part of the editing phase (E). In both main categories, further subcategories were identified. In the whole corpus, the percentage of syntactical pauses was 81.5 %, and 18.5 % of silent pauses were linked to some form of disfluency. The percentage of syntactical pauses was 78% in the group of 6-year-old children, and 73.6% for 7-year-olds, 84.9% among 8-year-olds, 85.7% among 9-year-olds, and 87.8% among adults (cf. Gyarmathy, 2017). The percentage of syntactical pauses among 8- and 9-year-old children is closer to what we can observe among adults, but it is true for all age groups that syntactical pauses occur much more often than pauses linked to disfluency phenomena.
Silent pauses with a syntactical function (S) were further divided into four subcategories. In the narratives of 6 to 8-year-old children, pauses at phrase boundaries were the most prevalent – similarly to adults (Gyarmathy, 2017); while among 9-year-olds, within-phrase pauses occurred most frequently. It can be verified for children as well as adults (Gyarmathy, 2017) that silent pauses appear more often in grammatically functional positions (S_PhrB, S_PhrE, S_Uo) – not creating a break in the unit of the meaning and interpretation of the utterance – than within a phrase. This indicates that in the course of speech planning, we not only plan the content and form of the utterance, but also the pauses (cf. Zellner, 1994; Ramanarayanan et al. 2009). Within-phrase pauses can be a sign of a major speech planning problem.
The data revealed that disfluency-related pauses were more often linked to the uncertainty of the speaker than to errors. This stems from the fact that regardless of the speaker's age, insecurity itself is more common in speech than errors are (cf. e.g. Gósy, 2003; Szabó, 2008; Bóna, 2010; Neuberger, 2014).
The analysis of silent pauses verified our hypothesis that pause durations depend significantly on whether they are in a syntactical position or are linked to disfluency phenomena. In children's speech – regardless of their age – syntactical pauses were longer.
Within the category of syntactical pauses, utterance-onset pauses and end of phrase pauses were the longest in all age groups. Utterance-onset pauses were also the longest in the narratives of adults (Gyarmathy, 2017). Both children and adults need more time to select thoughts and develop their linguistic structure. The explanation for longer pause durations in phrase-final position is that after finishing a line of thought, one has to start the speech planning process from the beginning. In all four age groups – as well as among adults (Gyarmathy, 2017) – within-phrase pauses were the shortest, which can be explained by the necessity of clarity and processability in communication.
In the groups studied during the present research, the durations of editing phase-type pauses showed a decreasing trend with increasing age. Confirming our hypothesis, pause durations proved to be significantly different in the narratives of 6-year-old kindergarteners compared to 9-year-old primary school pupils. This indicates that with language development, children also gradually learn self-correcting mechanisms, needing less and less time to resolve disharmonies. In addition to cognitive development, the school environment also provides more practice in creating different types of narratives (e.g. oral tests, short presentations, summary of reading assignments), and more experience has an effect on children's utterances.
Regarding silent pauses linked to editing phases, it can be generally stated that children need a lot more time to resolve disharmonies due to insecurity than due to errors. In the speech of adults, error-related editing phases were also shorter than insecurity-related pauses (Gyarmathy 2017).
The detailed analysis of the position and realisation of silent pauses revealed that kindergarten and primary school children already use similar pausing strategies in their narratives as adults.

Pause durations showed a decreasing trend with increasing age. The grammatical structure of the language presumably largely determines segmentation and pausing. Children learn this in the course of mother-tongue acquisition, and as their speech experience grows, their patterns become more and more similar to those in the speech of adults.

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