NOUN DURATIONS WITH AND WITHOUT SUFFIXES ACROSS AGES

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Abstract

Temporal properties of words are defined by several physiological, psychical, and language-specific factors that interact with each other in spontaneous speech. Storage of lexical representations either in a morphologically decomposed form or in a conceptually non-decomposed form is supposed to influence word durations, particularly during language acquisition. To access the appropriate suffix and combination of stem and suffix requires greater mental effort from children than from adults. The process is assumed to result in longer word durations. The goal of the present study is to analyse the possible changes in word durations depending on the morphological structure of words across ages. We assumed that the duration of words with and without suffixes would show age-specific differences.

Hungarian nouns with various lengths (containing 2, 3 and 4 syllables with and without suffixes) produced by 30 children (ages of 5, 7 and 9) and 10 young adults in spontaneous utterances were measured. Word durations revealed significant differences depending on age and on the words' morphological structures. Monomorphemic nouns were shorter than multimorphemic nouns of the same length in all experimental groups. Durational differences between monomorphemic and multimorphemic nouns, however, showed gradual changes according to age, being larger in younger children and smaller in older children and adults.

Our interpretation is that the longer route of lexical access for multimorphemic words in young children can be explained by their developing routine for accessing the suffixes fast and for combining stems and suffixes.

Keywords: monomorphemic and multimorphemic nouns, temporal patterns, children's word production, lexical route

1. Introduction

A great number of studies have discussed how diverse factors influence the temporal patterns of speech both in children and adults (Smith 1992; Bell et al. 2009; Guitar–Marchinkoski 2001; Kuperman–Bresnan 2012; etc.). In spontaneous speech, speakers regularly speed up and slow down their articulation depending on various physiological, language-specific, and individual factors. During language acquisition, temporal patterns of word articulation reflect the children's motor skills, morphological knowledge, grammatical awareness, routes of lexical access, memory capacity, and temporal control (e.g. Berko Gleason and Bernstein Ratner 1988; Pinker 1999; Tomasello 2003; Redford 2015).

Temporal characteristics of words (their durations and the variability therein) are decisive for both speech rate and fluency impression although several other factors influence the dura-

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tions of the words. Words and their lexical representations change during language acquisition across ages from the 'frozen' lexical units (Handl–Graf 2010; Berko Gleason and Bernstein Ratner 1993) up to the production of morphologically complex words. The increase of the children's vocabulary and the organization of their mental lexicon define the route of their lexical access together with their developing motor skills and the underlying acoustically linked articulatory schema (Redford 2015). Not only the length of the words but also their morphological structure influence durations (Gósy 2005). In this study, we provide experimental data on temporal properties of nouns produced by Hungarian-speaking monolingual children and young adults.

Before discussing the theoretical background of the topic, we summarize a few relevant facts on the language. Hungarian is an agglutinating language that belongs to the Finno-Ugric language family. It has an extremely rich morphology and an extensive system of affixation and postpositions (rather than prepositions). The syntactic and semantic functions of noun phrases are primarily expressed via suffixes and postpositions. Case markings are used extensively with Hungarian nouns. There are certain phonological rules to be performed at morpheme boundaries (e.g., voicing assimilation). Word order is relatively flexible but not completely free. The average number of syllables per word in spontaneous Hungarian is 3.5 (adult speech). Word stress invariably falls on the initial syllable although in connected speech not all words are stressed (Siptár–Törkenczy 2000).

To interpret our findings, we specify a few related points about the language acquisition of Hungarian-speaking children. In the second year of life, typically developing children begin to show increased use of suffixation. Inflected forms of nouns begin to give evidence of conscious segmentation and systematic linking of suffixes to stems. Rapid morphological development of affixation takes place between the ages of 2 and 3 (Gósy 2005; Bunta et al. 2016). A similarly rich morphological system is reported to be used relatively error-free by the age of 2 for example in Spanish and Persian, somewhat earlier than in the case of languages with less rich morphology (Samadi–Perkins 1998; Aguado-Orea–Pine 2015; Fletcher et al. (eds.) 2016). After the age of 3, children use more and more varied suffixes consciously linked to nouns in their spontaneous utterances. By the age of five, Hungarian-speaking children acquire all productive suffixes of nouns including accusative case markings, plural markers, diminutive markers, the use of marking possession on the noun (both genitive marker and possessive suffixation) and the markers of various temporal, spatial, positional or other relationships as well. Cases where the suffixation of Hungarian words requires mastering of various phonological rules are unambiguously acquired by the age of 5. When speaking fluently, children combine stems and suffixes according to morphological rules followed by a phonological and an articulatory plan to produce the target word. It is widely assumed that children's mental lexicon is continuously reorganized, particularly semantically, as new words are acquired across ages (e.g. Clahsen 2007; Penke 2006). Since 5-year-old children are able to identify stems and suffixes of the words, this offers insights into how their mental lexicon might be organized (Clark 2017).

There is a debate in the literature concerning storage in the mental lexicon and the routes of lexical access (both in children's and adults' language). Over the past thirty years, the literature has provided a large body of empirical evidence for the dual-route (word stems and suffixes are the basic building blocks in the mental lexicon) and one-route models of the mental lexicon (dissociation in terms of frequency factor, phonological and/or semantic similarity) (e.g. Rueckl–Raveh 1999; Pinker–Ullman 2002). The theory of decomposed storage and the decompositional route of lexical access assumes that morphological units are represented separately in the mental lexicon. The speaker would access the word stem and the suffix(es) at

different places in the mental lexicon. By contrast, under the assumption of conceptually non-decomposed storage, suffixed words are stored and activated holistically. The theories of morphologically decomposed vs. conceptually non-decomposed forms of storage in the mental lexicon failed to provide conclusive support for either account (e.g. Caramazza et al. 1988; Roelofs 1993; Pinker 1999; Ferro et al. 2010).

There are data from diverse languages (e.g., English, German, Chinese, French) that provide experimental evidence for the storage of lexical representations in morphologically decomposed forms and the existence of a decompositional route for inflected word forms in speech production (Zhang–Peng 1992; Marslen-Wilson et al. 1994; Kazanina et al. 2008; Ferro et al. 2010; Gor–Jackson 2013; Estivalet–Meunier 2015). Storage and activation of morphologically complex forms of words is not restricted to irregular words (Ferro et al. 2010). In a paper on adults' speech, we assumed that the duration of Hungarian nouns with and without suffixes would indicate the route of their lexical access which is in close connection with the storage of stems and suffixes (Gósy–Gocsál 2019). Durations of monomorphemic nouns were significantly shorter than those of multimorphemic nouns. This finding seems to support the existence of morphologically decomposed forms of nouns in Hungarian.

The question arises whether nouns have their lexical representations separated into stems and suffixes in the children's mental lexicon. Researchers agree that during the early phases of language acquisition, when children use both regular and irregular word forms the same way (as a kind of overgeneralization), their mental lexicon contains both forms (e.g., **bringed* vs. *brought* in English) that can be accessed similarly (Maratsos 2000). Empirical results have confirmed that inflected word forms that consist of regular suffixes have decomposed representations in German-speaking children's mental lexicon between the ages of 1;1 and 3;8 years (Clahsen et al. 2001). According to Saxton (2010), regular past tense forms of English verbs are generated by a rule while irregular verbs are stored as whole units like in the 'words-and-rules model' proposed by Pinker (1999). The model for storage in the mental lexicon described by Ferro and his colleagues (2010) assumes a 'temporal connection' affecting short-term node activation. We think that this temporal connection is an important factor in language acquisition that controls the linking of stems and suffix(es) during word production. The durations of words may carry information about the route of lexical access, which is assumed to be shorter if accessed from a single place and longer if accessed from different places.

Various studies confirmed that young children's spoken words tend to be longer and more variable than those of older children and adults (e.g. Smith 1992; Lee et al. 1999; Flipsen 2002; Tomasello 2003). In line with Hay and Baayen (2005), our theory is that stems and suffixes may develop their own lexical representations. It follows that multimorphemic words are assumed to be accessed decompositionally in children's spontaneous utterances. Separate storage of stems and suffixes in children's mental lexicon requires the full capacity of retaining temporal sequences of items when speaking. This process is characterized (among others) by age-specific memory span (Henry 2012), age-specific vocabulary and appropriate phonological awareness (Gathercole–Baddeley 1989).

The goal of the present research is to analyse the durations of monomorphemic and multimorphemic nouns in children's speech from 5 to 9 years of age. We intend to compare the children's data with those of young adults. Our findings might reveal new information concerning the storage of nouns in the mental lexicon and lexical access in children.

Three hypotheses were defined. We expected that (i) the durations of the analysed nouns would be shorter as the participants' age increases, (ii) durations of the analysed nouns would show reductions across the lengths of the nouns only in adults, (iii) nouns with suffixes would

show longer durations than those without suffixes, (iv) there would be differences in noun durations depending on the number of suffixes that multimorphemic words contain.

2. Methodology

Thirty children were selected to form three groups: 5-year-olds (4;11–5;2), 7-year-olds (6;9–7;2), and 9-year-olds (8;10–9;3), while ten young adults (aged between 22 and 30 years) formed the fourth group (half of the participants were females in each group). 5-year-olds were preschool children, 7-year-olds were first graders while 9-year-olds were fourth graders. Children were randomly selected from the GABI Hungarian children's database (Bóna et al. 2014) while adult speakers were randomly selected from the BEA Hungarian speech database (Gósy 2012). None of the participants had any hearing or speech disorders. No known history of delayed onset of language acquisition were reported in child speakers. All children attended kindergartens and schools in Budapest. All of them had similar social and cultural backgrounds. Young adults were university students or had a university degree and also came from Budapest. All subjects were native monolingual speakers of Hungarian. The 9-year-olds and young adults were taught a foreign language (or languages in the latter case) at school.

Subjects were asked to speak about their family, life, hobby according to the protocol of both databases. Close to 9 hours of Hungarian spontaneous speech was analysed. The average length of the speech material of 5-year-old children was around 12 minutes, in the case of schoolchildren it was around 18 minutes, and in the case of young adults it was around 25 minutes per speaker.

Both monomorphemic and multimorphemic nouns (with 1 or 2 suffixes) were selected for analysis. Those nouns were considered that contained 2, 3 or 4 syllables. In order to diminish the possible effects of other factors on the durations of the words, the following criteria were defined (apart from the number of syllables and suffixes). (i) Undirected spontaneous utterances were produced both by children and adults on the same topic. We expected that the participants would use their accustomed nouns that were frequent in their verbal communication when speaking about their everyday life. (ii) The effects of noun frequency, suffix frequency, (local) variations of speech rate, and various syntactic positions on word durations could be compensated by the relatively large amount of speech samples. (iii) A great number of nouns were used to neutralize the temporal effects of the various speech sounds the nouns consisted of. Efforts were made to control the effects of diverse phonological and phonetical constructions of words on their durations. (iv) In suffixed nouns, we considered all suffixes indicating accusative case markings, plural markers, diminutive markers, possession on the noun and suffixes of various temporal, spatial, positional or other relationships. However, suffixed nouns in which the stem belonged to another part of speech were excluded (such as *szabadság* 'freedom', where the stem is the adjective *szabad* 'free' and *-ság* is a nominal suffix). No distinctions were made according to the suffix types in this study. (v) Compounds were not considered. (vi) We controlled the data against phrase-final lengthening. Therefore, no nouns produced in the vicinity of pauses were selected. (vii) Nouns that had lengthened segment(s) were excluded from analysis.

Examples from children's utterances (suffixes are marked in bold): *ebéd* 'lunch', *farkas* 'wolf', *mesé**t*** 'story + ACC', *keksz**ből*** 'cookie + from', *bicikli* 'bicycle', *boszorkány* 'witch', *lépcső**nél*** 'stairway + at', *ovi**ban*** 'kindergarten + in', *veszedelem* 'evil', *helikopter* 'helicopter', *pillangó**val*** 'butterfly + with', *irodalma**t*** 'literature + ACC'. Examples from young adults' utterances: *gyerek* 'child', *busz**on*** 'bus + on', *telefon* 'telephone', *csoport**ba*** 'group +

into', *gimnázium* 'highschool', *készülékek* 'device + PLURAL'. Examples where a stem is followed by two suffixes (suffixes are marked in bold): *ruhákkal* 'clothes + PLURAL + with', *dolgokról* 'thing + PLURAL + about', *fejükre* 'head + their + on', *versenyemen* 'competition + my + on', *gyerekekben* 'child + PLURAL + in', *nyelveket* 'language + PLURAL + ACC'.

A total of 2,437 nouns were analysed. 5-year-olds produced 511 nouns, 7-year-olds 613 nouns, 9-year-olds 633 while young adults 680 nouns. There were 947 disyllabic, 953 trisyllabic and 537 four-syllabic nouns. 869 of all nouns were stems, 1309 had one suffix while 259 had two suffixes. The speech material was carefully hand-labeled in Praat (Boersma–Weenink 2014). All nouns were segmented and measured. The word boundaries were identified in the waveform signal and spectrogram display via continuous listening to the words. Markers were inserted at the onset and offset of acoustic features characteristic of a given segment, voicing, and second formant information was also considered following standard acoustic-phonetic criteria. A specific script was written to obtain the values automatically.

To test statistical significance, we performed mixed analysis of variance (ANOVAs) to examine between-group differences of noun durations by morphological structure, and a Tukey post hoc test was applied (SPSS 20.0 version). The confidence level was set at the conventional 95%.

3. Results

As expected, the durations of the nouns decreased as the **speakers' age** increased (Fig. 1). However, no difference was found between the two youngest age groups. The mean duration of all words produced by 5-year-olds was 702 ms (SD = 231.1), by 7-year-olds it was 714 ms (SD = 218.5), by 9-year-olds 608 ms (SD = 185.9) and by young adults 500 ms (SD = 159.8). Statistical analyses confirmed significant differences in noun durations depending on age ($F(3, 2436) = 302.109$, $p = 0.001$, $\eta^2 = 0.274$). Tukey post hoc tests revealed, however, that there was no statistically significant difference in noun durations between those produced by 5-year-olds and 7-year-olds ($p = 0.305$).

The **word lengths** obviously influenced the durations of the analysed nouns. The longer the words the longer their durations are. This tendency could be shown in all age groups (Fig. 1). The mean values of disyllabic, trisyllabic and four-syllable nouns were 461 ms (SD = 143.6), 655 ms (SD = 172.0) and 830 ms (SD = 185.3), respectively. The differences in noun durations depending on word length varied with age. The two youngest groups showed similar patterns, the mean difference between the disyllabic and trisyllabic nouns was 220 ms in their cases. The difference between the trisyllabic and four-syllable nouns was 190 ms in 5-year-olds and 200 ms in 7-year-olds. Mean durations of nouns produced by 9-year-olds showed a 130 ms difference between their disyllabic and trisyllabic nouns, and 190 ms difference between their trisyllabic and four-syllable nouns. Young adults' within-group durational differences were 160 ms and 106 ms, respectively.

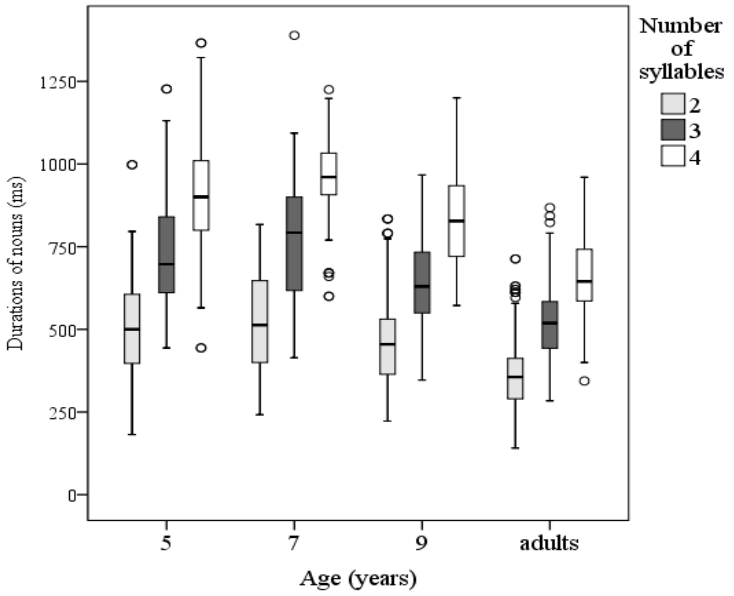

Figure 1. The durations of nouns according to word length and the speakers' age (medians and interquartile ranges)

Although the longest nouns were expected to be produced by the 5-year-old children, data showed that a great many of the 7-year-olds' nouns were even longer (the difference of the mean values turned out to be larger by 28 ms in the cases both of disyllabic and trisyllabic nouns while it was larger by 41 ms in the case of the four-syllable nouns produced by the older children). Nouns of a higher number of syllables produced by 9-year-olds were shorter than those of the 5-year-olds (the differences were 49 ms, 92 ms, 90 ms, respectively). Young adults articulated the shortest nouns, on average (the difference of the mean values in noun durations between 9-year-olds and adults turned out to be 149 ms in the case of disyllabic nouns, 116 ms in the case of trisyllabic nouns and 200 ms in the case of four-syllable nouns). The mean value of the longest nouns was 917 ms in the 5-year-olds (four-syllabic words).

Statistical analysis revealed significant differences in noun durations depending on the number of syllables ($F(2, 2436) = 925.288$, $p = 0.001$, $\eta^2 = 0.435$). The post-hoc Tukey tests confirmed significant differences for all noun lengths ($p = 0.001$, in all cases). The interaction between age and noun length was also significant ($F(6, 2436) = 7.615$, $p = 0.019$).

The **presence** of a **suffix** or suffixes altered noun duration. The mean values of noun stems were 576 ms, 477 ms, 506 ms and 391 ms in consecutive age groups. The age-specific mean durations of the suffixed nouns were 785 ms, 807 ms, 629 ms and 567 ms, respectively. Data showed that all suffixed words were longer than the monomorphemic nouns (of the same lengths) irrespective of age. Figure 2 shows various differences in noun durations depending on the presence (or absence) of a suffix (or suffixes) according to increasing age (considering all data the durational differences were 209 ms, 330 ms, 123 ms, 176 ms, respectively). Boxplots demonstrate also the overlaps of values between monomorphemic and multimorphemic nouns in each age group. Statistical analysis revealed significant differences in noun durations between the monomorphemic and multimorphemic nouns ($F(2, 2436) = 178.735$, $p = 0.001$, $\eta^2 = 0.129$).

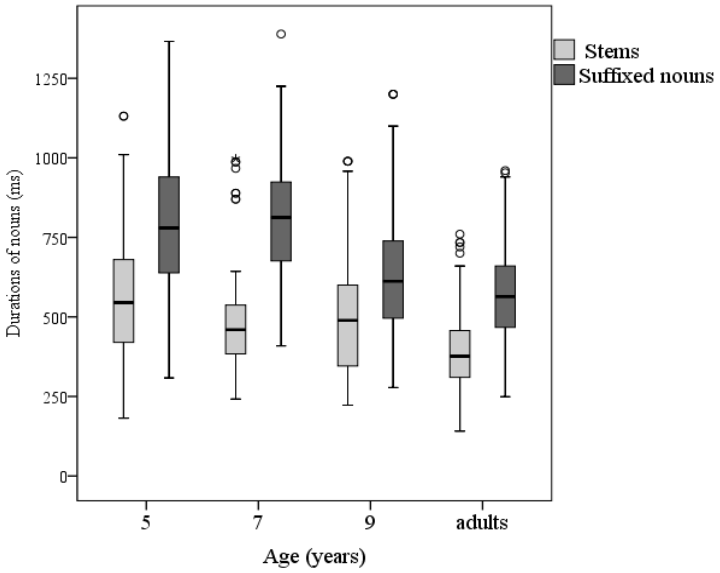

Figure 2. The durations of nouns according to suffixation and the speakers' age (medians and interquartile ranges)

The durations of the nouns were further analysed in terms of the **factors** of length and suffixation (shown in Fig. 3) as well as length, suffixation and age (summarized in Table 1). As expected, suffixed nouns were significantly longer than stems with the same number of syllables ($F(1, 2436) = 274.085$, $p = 0.001$). The differences were significant in all age groups ($p = 0.001$ in all cases). The interactions between the number of syllables, the number of suffixes and age were also significant ($F(9, 2436) = 4.352$, $p = 0.001$). The ranges of noun durations increased according to the increasing length of the nouns, they were larger with suffixed nouns than with stems, and decreased as the speakers' age increased.

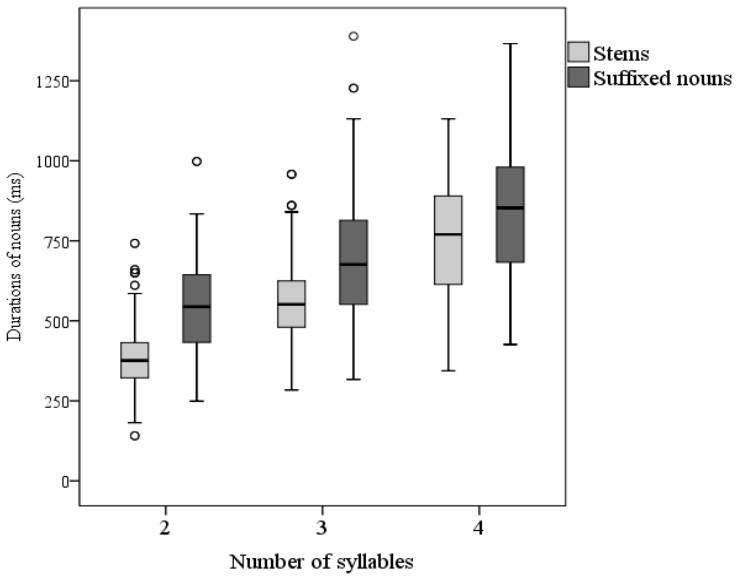

Figure 3. The durations of nouns according to suffixation and the number of syllables of the words (medians and interquartile ranges)

Table 1. Durations of nouns depending on noun length and number of suffixes across ages (SD = standard deviations)

Age groups	Durations of nouns (ms)					
	Number of syllables nouns contain					
	2		3		4	
	stem/SD	suffixed noun/SD	stem/SD	suffixed noun/SD	stem/SD	suffixed noun/SD
5-year-olds	440/111.1	594/134.7	651/143.5	773/172.0	881/104.6	927/187.9
7-year-olds	406/59.2	641/108.5	532/61.7	823/138.8	866/148.8	967/98.0
9-year-olds	396/96.4	509/115.7	512/129.6	628/122.9	751/134.4	850/153.7
Young adults	323/74.2	429/110.7	466/83.5	545/101.9	579/112.2	677/124.9

Multimorphemic nouns of 3 and 4 syllables were analysed in terms of the **number of suffixes** they contained (we did not separate nouns by their lengths in this case due to the limited amount of measured data). The values showed that nouns with two suffixes were significantly longer than those containing one suffix ($F(1, 1118) = 137.326$, $p = 0.001$). The differences were larger than 150 ms in the children's groups while it was only 80 ms in young adults. The Tukey post hoc tests confirmed significant differences in noun durations depending on the number of suffixes the nouns contained in all groups (p-value was 0.001 in all cases). The interaction between the number of suffixes and age was significant ($F(2, 1118) = 9.452$, $p = 0.001$).

4. Conclusions

The aim of the paper was to analyse and compare the durations of monomorphemic and multimorphemic nouns in Hungarian-speaking children's and young adults' speech. Our findings provided exact temporal values of the spoken nouns with diverse numbers of syllables (from 2 to 4), and we were able to confirm the expected effects of suffixation on word durations. The findings may shed light on the storage of nouns in the mental lexicon and lexical access.

The older our subjects were, the faster they produced the nouns, which is an obvious outcome of language development in children and of more practice and steady language knowledge in young adults (see also Lee et al. 1999). The mean durational difference of nouns between 5-year-olds and young adults was around 200 ms. The 9-year-olds' noun durations were significantly shorter than those of 5-year-olds by around 100 ms, on average. There is, however, one exception: Suffixed nouns were relatively slowly articulated by the 7-year-olds. The durations of their suffixed nouns did not differ significantly from those produced by the 5-year-olds. Thus, our first hypothesis was partly confirmed. This finding can be explained by the beginning of literacy acquisition at the age of 7, with children starting to learn to read and write, acquiring various pieces of new information at school with the corresponding new words. Examples for possibly "new" or earlier rarely used nouns from their utterances include *szakkör* 'study class', *matek* 'math', *technika* 'technology', *házasság* 'marriage', *trambulin* 'springboard', *követelmény* 'requirement', etc. The suffixes are linked to both the "old" and "newly acquired" nouns in children's speech. 7-year-olds use many suffixes frequently that they rarely used before due to the morphologically and syntactically complex utterances they produce (see Gósy 2005). All these processes (noun and suffix selection, lexical access, linking of stems and suffixes, underlying phonological and articulation planning) are assumed to slow down the suffixed noun production of 7-year-olds.

The durations of the analysed nouns show a linear increase as a function of the number of syllables but there is no constant change according to noun lengths. Syllable reductions could

be observed with young adults and slightly with the oldest children (see Köhler et al. 2005). Our hypothesis that the durations of the analysed nouns would show reductions across the lengths of the nouns only in adults was again partly confirmed. The effectiveness of temporal control over noun durations in the spontaneous utterances of younger children is a developmental factor that does not seem to work properly until the age of 9.

Our data confirmed that monomorphemic nouns were significantly shorter than multimorphemic nouns in all age groups and with various lengths of nouns. Thus, our hypothesis was confirmed. These results support the assumption that nouns and suffixes may be stored at different places in the mental lexicon of Hungarian-speaking subjects. In noun production, the different morphemes are linked during lexical access in spontaneous speech (Leminen et al. 2016). On the basis of these temporal patterns, morphologically decomposed storage seems to be supported by evidence, at least for nouns, underlying dual-route lexical access irrespective of age (e.g. Pinker 1999; Ferro et al. 2010). Children need more time for (i) linking stems and suffixes and (ii) performing Hungarian phonological rules at the same time. The need for extra time to execute appropriate suffixed nouns can be observed in durational differences between monomorphemic and multimorphemic nouns particularly in the two youngest groups of children. The temporal differences across ages can be explained by diverse cognitive abilities, memory, attention span, grammatical, phonological knowledge, individual vocabulary, and age-specific articulation skills of the speakers, among others (Redford 2015; Fletcher et al. 2016).

Our last hypothesis was that there would be significant differences in word durations depending on the number of suffixes multimorphemic words contain. The results confirmed this assumption. Two suffixes seemed to require more complex execution of lexical access and more mental effort than one suffix. The linking procedure of the two suffixes following the stem needs higher-level grammatical knowledge including complex phonological execution as opposed to the construction of a stem and a suffix. Our interpretation of the findings based on the measured data is that the increased duration of nouns with two suffixes as opposed to those with one suffix reflects the longer route of lexical access in the former cases (Caramazza et al. 1988; Baayen 2007; Ferro et al. 2010). We think that our assumption was confirmed.

There are limitations to this study. We focused only on nouns while analysing the assumed different durations depending on suffixation. Verbs and some other parts of speech can be considered in the future. Young children use fewer nouns with four syllables than young adults which is the normal case in age-specific spontaneous utterances. Efforts were made, however, to compensate differences in the number of occurrences by using large speech materials.

The development of children's grammatical, phonological, articulatory abilities, memory, attention span, and cognitive abilities during first language acquisition makes it possible for them to use the rich morphology of the language, increasing the number of morphemes and syllables in Hungarian nouns. The durations of stems and suffixed nouns provide an opportunity to learn more about lexical access in spontaneous speech underlying age-specific language awareness. More research is needed to analyse further the temporal consequences of lexical access in spontaneous utterances across the lifespan (e.g., the phonological requirements of the stem and suffix combinations).

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References

Aguado-Orea, Javier – Pine, Julian M. 2015. Comparing different models of the development of verb inflection in early child Spanish. *PLoS One* 10(3): 119–613.

Baayen, Harald 2007. Storage and computation in the mental lexicon. In: G. Jarema, Gonia – Libben, Gery (eds.): The mental lexicon: Core perspectives. Amsterdam: Elsevier. 81–104.

Bell, Alan – Brenier, Jason M. – Gregory, Michelle L. – Girand, Cynthia – Jurafsky, Dan 2009. Predictability effects on durations of content and function words in conversational English. *Journal of Memory and Language* 60: 92–111.

Berko Gleason, Jean – Bernstein Ratner, Nan (eds.) 1998. *Psycholinguistics*. Orlando: Harcourt Brace College Publishers.

Boersma, Paul – Weenink, David 2014. *Praat: Doing phonetics by computer*. Version 5.4.1. http://www.praat.org (Accessed: May. 14. 2014.)

Bóna, Judit – Vakula, Tímea – Váradi, Viola 2019. GABI – Hungarian child language and speech database and information repository. *The Phonetician* 116: 41–52.

Bunta, Ferenc – Bóna, Judit – Gósy, Mária 2016. HU-LARSP: Assessing children's language skills in Hungarian. In: Fletcher, Paul – Ball, Martin J. – Crystal, David (eds.): *Profiling grammar. More languages of LARSP*. Bristol–Buffalo–Toronto: Multilingual Matters. 80–98.

Caramazza, Alfonso – Laudanna, Alessandro – Romani, Cristina 1988. Lexical access and inflectional morphology. *Cognition* 28(3): 297–332.

Clahsen, Harald 2007. Psycholinguistic perspectives on grammatical representation. In: Featherston, Sam – Sternefeld, Wolfgang (eds.): *Roots: Linguistics in search of its evidential base*. Berlin: Mouton de Gruyter. 97–131.

Clahsen, Harald – Prüfert, Peter – Eisenbeiss, Sonja – Cholin, Joana 2001. Strong stems in the German mental lexicon: Evidence from child language acquisition and adult processing. In: Kaufmann, Ingrid – Stiebels, Barbara (eds.): *More than words. A Festschrift for Dieter Wunderlich*. Berlin: Akademie Verlag. 91–112.

Clark, Eve V. 2017. Lexical acquisition and the structure of the mental lexicon. In: Aronoff, Mark (ed.): *Oxford research encyclopedia of linguistics*. Oxford: Oxford University Press.

Estivalet, Gustavo L. – Meunier, E. Fanny 2015. Decomposability and mental representation of French verbs. *Frontiers in Human Neuroscience* 8: 91–100.

Ferro, Marcello – Pezzulo, Giovanni – Pirrelli, Vito 2010. Morphology, memory and the mental lexicon. *Lingue e Linguaggio* IX/2: 199–238.

Fletcher, Paul – Ball, Martin J. – Crystal, David (eds.) 2016. *Profiling grammar. More languages of LARSP*. Bristol–Buffalo–Toronto: Multilingual Matters.

Flipsen, Peter 2002. Articulation rate and speech-sound normalization failure. *Journal of Speech, Language, and Hearing Research* 46: 724–737.

Gathercole, Susan E. – Baddeley, Alan D. 1989. Evaluation of the role of phonological STM in the development of vocabulary in children: A longitudinal study. *Journal of Memory and Language* 28: 200–213.

Gor, Kira – Baddeley, Alan D. – Jackson, Scott 2013. Morphological decomposition and lexical access in a native and second language: A nesting doll effect. *Language and Cognitive Processes* 28: 1065–1091.

Gósy, Mária 2005. *Pszicholingvisztika* [Psycholinguistics]. Budapest: Osiris Kiadó.

Gósy, Mária 2012. BEA – A multifunctional Hungarian spoken language database. *The Phonetician* 105/106: 50–61.

Gósy, Mária – Gocsál, Ákos 2019. Temporal patterns of words with and without suffixes in spontaneous Hungarian. *ESUKA/JEFUL* 10(1): 53–70.

Guitar, Barry – Marchinkoski, Lisa 2001. Influence of mother's slower speech on their children's speech rate. *Journal of Speech, Language, and Hearing Research* 44: 853–861.

Handl, Susanne – Graf, Eva-Maria 2010. Collocation, anchoring and the mental lexicon – an ontogenetic perspective. In Schmid, Hans-Jörg – Handl, Susanne (eds.): *Cognitive foundations of linguistic usage patterns: Empirical studies*. Berlin, New York: De Gruyter, Mouton. 119–150.

Hay, Jennifer B. – Baayen, Harald R. 2005. Shifting paradigms: gradient structure in morphology. *Trends in Cognitive Sciences* 9: 342–348.

Henry, Lucy 2012. *The development of working memory of children*. London: Sage Publications.

Kazanina, Nina – Dukova-Zheleva, Galina – Kharlamov, Viktor – Tonciulescu, Keren 2008. Decomposition into multiple morphemes during lexical access: A masked priming study of Russian nouns. *Journal of Language and Cognitive Processes* 23: 800–823.

Köhler, Reinhard – Altmann, Gabriel – Piotrowski, Rajmund G. (eds.) 2005. *Quantitative linguistics. An international handbook*. Berlin, New York: De Gruyter, Mouton.

Kuperman, Victor – Bresnan, Joan 2012. The effects of construction probability on word durations during spontaneous incremental sentence production. *Journal of Memory and Language* 66(4): 588–611.

Lee, Sungbok – Potamianos, Alexandros – Narayanan, Shrikanth 1999. Acoustics of children's speech: Developmental changes of temporal and spectral parameters. *Journal of the Acoustical Society of America* 105: 1455–1468.

Leminen, Alina – Clahsen, Harald – Lehtonen, Minna – Bozic, Mirjana (eds.) 2016. *Morphologically complex words in the mind/brain*. Frontiers in Human Neuroscience 10.

Maratsos, Michael 2000. More over-regularizations after all. *Journal of Child Language* 28: 32–54.

Penke, Martina 2006. The representation of inflectional morphology in the mental lexicon. An overview of psycho- and neurolinguistic methods and results. In: Wunderlich, Dieter (ed.): Advances in theory of the lexicon. Berlin: Mouton de Gruyter.

Pinker, Stephen 1999. *Words and rules*. New York, N.Y.: Basic Books.

Pinker, Stephen – Ullman, Michael T. 2002. The past and future of the past tense. *Trends in Cognitive Science* 6: 456–463.

Redford, Melissa A. 2015. The acquisition of temporal patterns. In: Redford, Melissa A. (ed.): *The handbook of speech production*. New Jersey: Wiley-Blackwell. 379–403.

Rodríguez-Aranda, Claudia – Jakobsen, Mona 2011. Differential contribution of cognitive and psychomotor functions to the age-related slowing of speech production. *Journal of the International Neuropsychological Society* 17(5): 1–15.

Roelofs, Ardi 1993. Testing a non-decompositional theory of lemma retrieval in speaking: retrieval of verbs. *Cognition* 47: 59–87.

Rueckl, Jay G. – Raveh, Michal 1999. The influence of morphological regularities on the dynamics of connectionist networks. *Brain and Language* 68: 110–117.

Samadi, Habibeh – Perkins, Michael R. 1998. P-LARSP: A developmental language profile for Persian. *Clinical Linguistics and Phonetics* 12: 83–103.

Saxton, Matthew 2010. *Child language: Acquisition and development*. Thousand Oaks CA.: Sage Publication.

Siptár, Péter – Törkenczy, Miklós 2000. *The phonology of Hungarian*. Oxford: Oxford University Press.

Smith, Bruce L. 1992. Relationships between duration and temporal variability in children's speech. *Journal of the Acoustical Society of America* 91(4): 2165–2174.

Tomasello, Michael 2003. *Constructing a language. A usage-based theory of language acquisition*. Cambridge: Harvard University Press.

Zhang, Biyin – Peng, Danling 1992. Decomposed storage in the Chinese lexicon. In: Chen, Hsuan Chih – Zheng, Ovid J. L. (eds.): *Language processing in Chinese*. Amsterdam: Elsevier. 131–149.