

2nd Workshop on Speech Perception  
and Production across the Lifespan  
vSPPL, 2020

**Durations of  
words with various  
numbers of  
syllables across  
childhood**



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## Introduction

physiological factors, age, phonemic differences, emotion, frequency, speaker-related behavior...

In spontaneous speech, speakers regularly speed up and slow down their articulation depending on various factors, particularly the speaker's age.

Temporal properties of words are influenced by universal, language-specific, and individual characteristics.

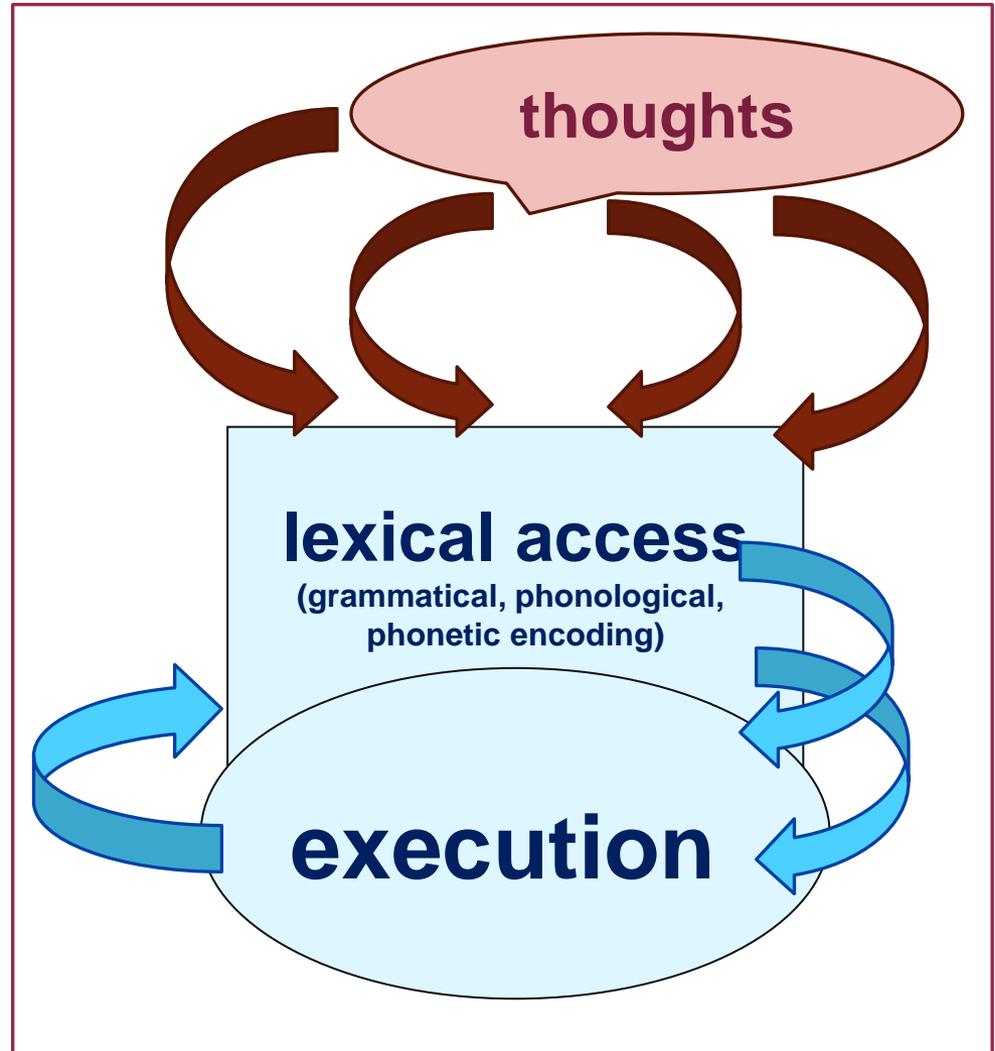
A large number of studies discussed those factors that influence the duration of a word and the variability therein both in children and adults (Smith 1992; Bell et al. 2009).

The retrieval of a word requires the selection of a syntactically, semantically and phonologically appropriate word with the corresponding articulatory gestures.

## Lexical retrieval

from thoughts to  
articulation

(Levelt 1989, and many  
others)



**Schema of word production in spontaneous speech**

# Language acquisition

grammar  
pronunciation  
motor skill develop-  
ment  
cognitive capacities

**Hungarian**  
language

- Grammatical knowledge & mastering of articulation are particularly responsible for word duration during language acquisition (Hulme et al. 1984).
- The acquisition of the morphology of words in an **agglutinating language**, shows a relatively rapid process as children's linguistic and cognitive capacities grow (Bunta et al. 2016).
- The acquisition of temporal patterns reflects motor skill development where some patterns are stored as acoustically linked articulatory schema while others emerge during fluent speech practice (Redford 2015).

**Stress** invariably falls on the first syllable of the words in Hungarian.

## Words

complex  
morphology  
increasing mental  
lexicon

## Research question



**How** do complex morphology of words, growing articulation skills of children and skilled access to the mental lexicon contribute to word durations and variance across **ages 4 to 8?**

- Children acquiring **Hungarian**, which has a rich morphology, are able to use suffixes of nouns, verbs and adjectives by the age of three (Gósy 2005).
- A number of studies confirmed that young children's spoken words tend to be longer and more variable than those of older children and adults (Smith 1992; Lee et al. 1999; Flipsen 2002; Tomasello 2003).
- Investigations revealed that verbs were articulated faster than nouns (Hirsh-Pasek & Michnick Golinkoff 2006).

- **Examples:** *ló* 'hoarse', *volt* 'was', *kis* 'little', *fiúk* 'boys', *kapott* 'I/s/he got', *Húsvét* 'Easter', *édes* 'sweet'.

## Goal, hypotheses

What is the nature of the changes?

Do word durations show a constant increase?

Word length effects on durations across ages.

- **Examples:** *lánycat* 'girls+Acc.', *sütöttem* 'I/II baked', *féltékeny* 'jealous', *iskolába* 'to school', *eljutottam* 'I/II reached', *egérszürke* 'mousy'.

- The goal of the present (cross-sectional) research was to show the changes of word durations in spontaneous speech of fifty monolingual Hungarian-speaking children aged between 4 and 8 years.

We hypothesized that

- (i) the duration of words would be shorter as age increases,
- (ii) nouns would be longer than verbs and adjectives with the same number of syllables, and
- (iii) the durations of words would show a relatively constant increase with the increasing number of syllables irrespective of age.

## PARTICIPANTS

# Methodology

A total of 5,460 words were measured. Words/age:

4-year-olds: 760

5-year-olds: 1070

6-year-olds: 1080

7-year-olds: 1160

8-year-olds: 1390

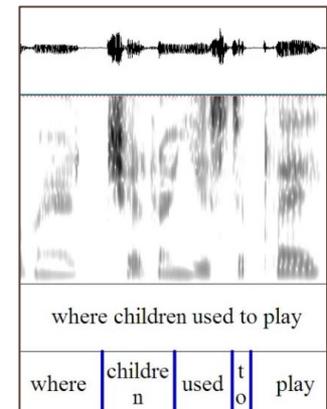
- The **word boundaries** were identified in the waveform signal and spectrogram display via continuous listening to the words (closure, release, voicing, F2). Specific script. Statistics: ANOVA (SPSS 20.0).

- 50 Hungarian-speaking children (ages between 4 and 8 years), 10 children in each age group (half of them girls)
- Normal hearing, no speech defects, no known history of delayed onset of language acquisition. 6-year-olds started their schooling while 7-year-olds completed their first year of education

## MATERIAL, MEASUREMENTS



- Narratives of children's life, family, and hobbies of about 20 minutes each were randomly selected from the GABI children's speech database (Bóna et al. 2019).
- Manual annotations: (i) part of speech (nouns, verbs and adjectives), (ii) number of syllables (from 1 to 4), (iii) durations of words using Praat (Boersma and Weenink 2014).
- No words were considered that were pronounced in the vicinity of a pause.



## Statistics

- Age: ( $F(4, 5458) = 72.7, p = 0.001, \eta^2 = 0.270$ )

## Results 1.

Duration of words.  
Age-specific durations.

- The mean duration of all words was **656 ms**.
- The age-specific values decreased from the age of 4 up to the age of 8 with the only exception of those produced by 7-year-olds.

Values of

- nouns:**

667 ms (SD = 258),

- verbs:**

621 ms (SD = 326),

- adjectives:**

581 ms (SD = 318).

- No significant differences were found in verb and adjective durations across ages.

Age (years)	Duration of words (ms)	
	mean	SD
4	918	393
5	623	258
6	585	243
7	<b>646</b>	278
8	508	211

## Statistics

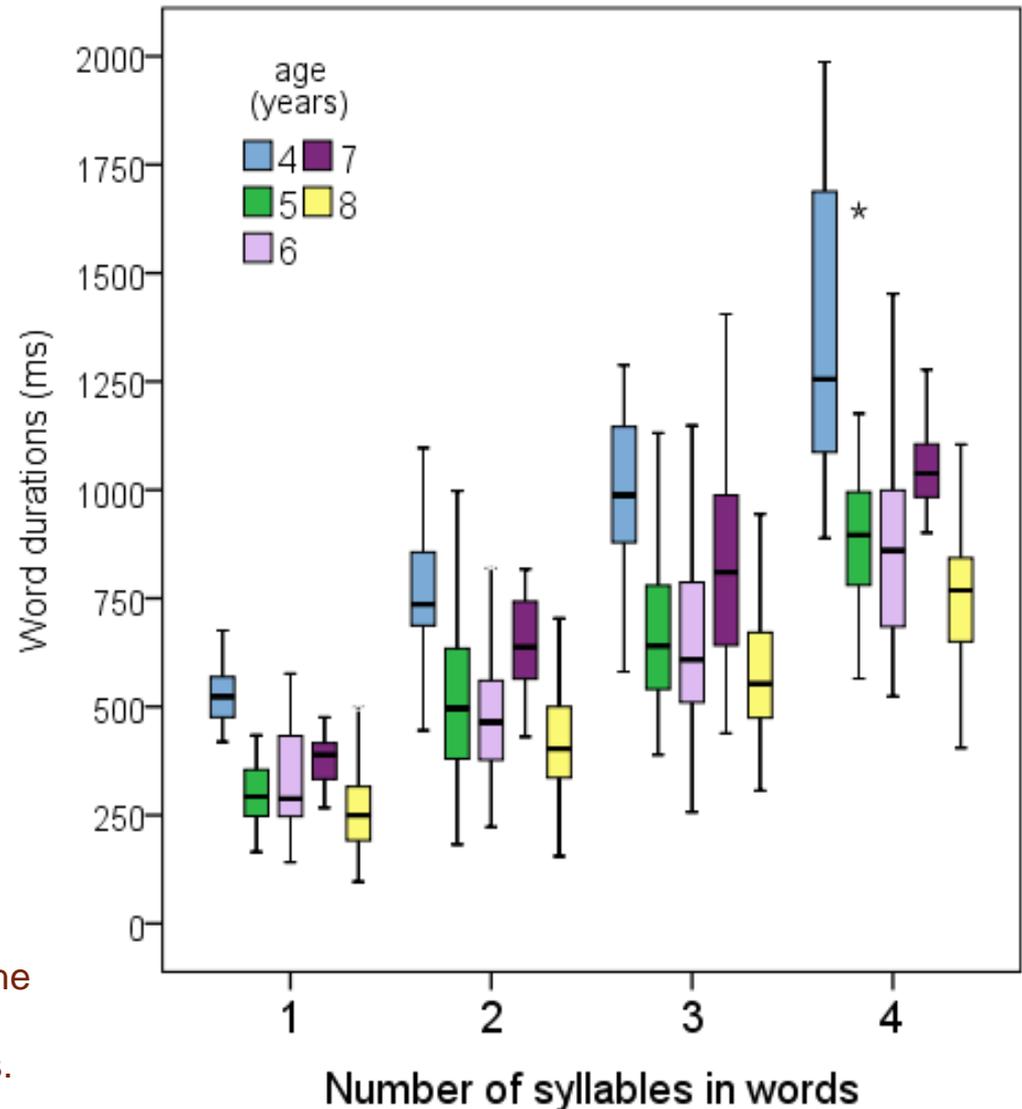
- Number of syllables: ( $F(3, 5458) = 399.07, p = 0.001, \eta^2 = 0.495$ )
- Interaction of age and number of syllables: ( $F(8, 5458) = 281.71, p = 0.001, \eta^2 = 0.146$ )

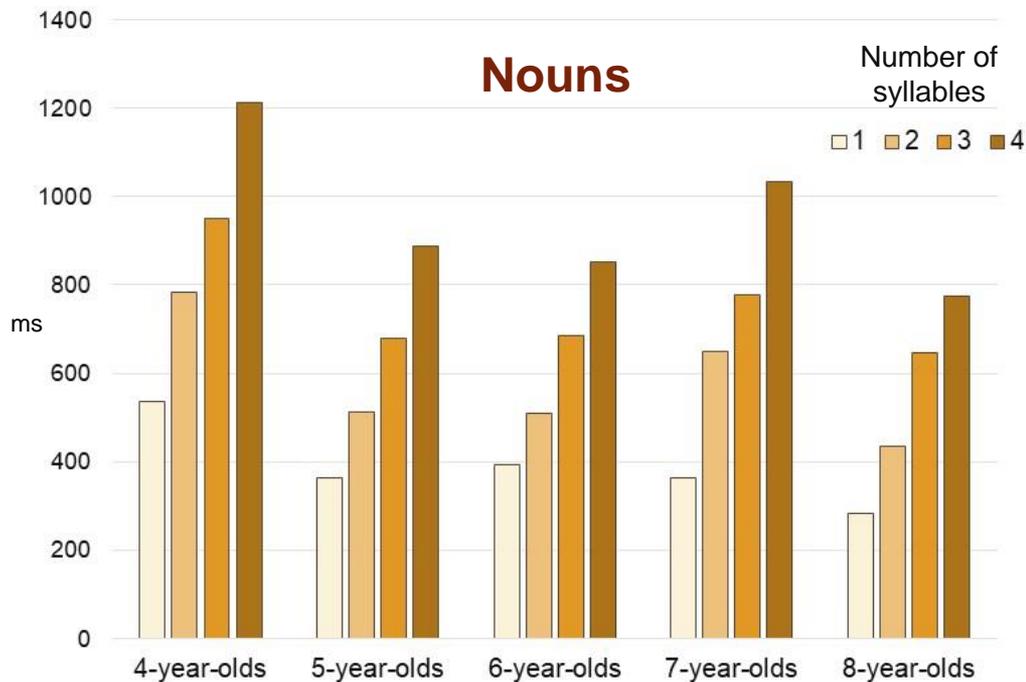
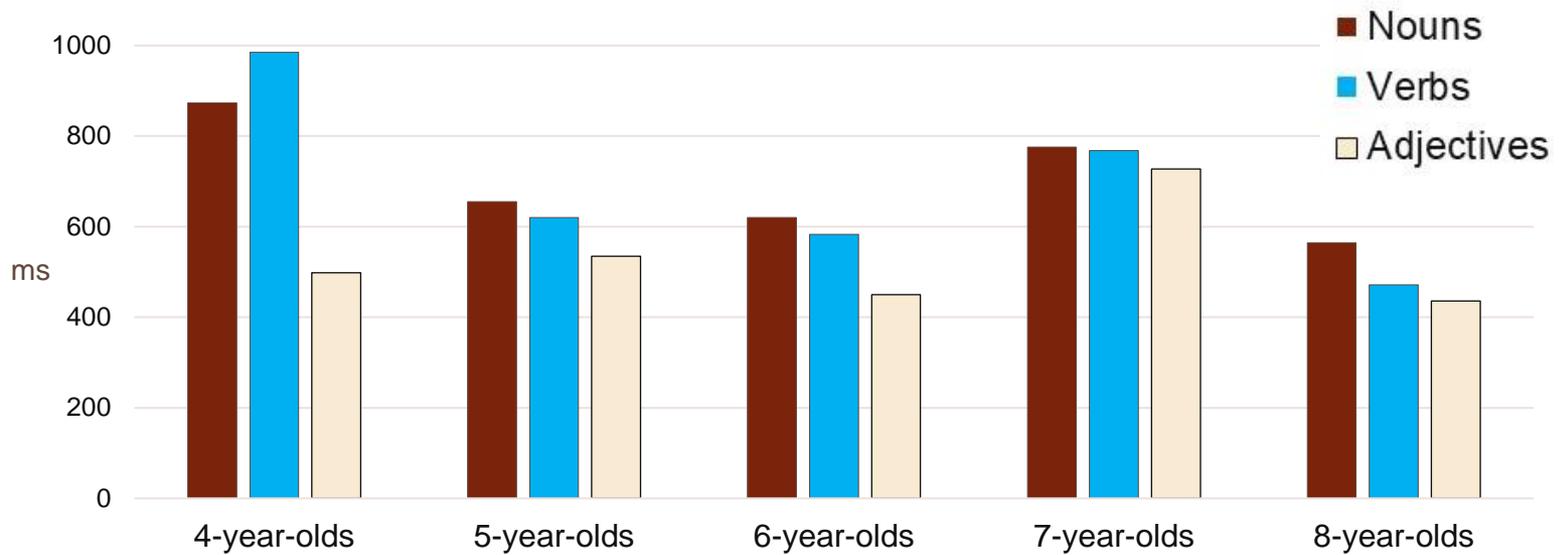
## Results 2.

Number of syllables and word durations across ages.

The durations between the monosyllables and the disyllabic words as well as the disyllabic and tri-syllabic words were similar in 5- and 6-year-olds.

Significant differences were in durations between words of three and four syllables in all children.





## Results 3.

Parts of speech:  
duration, word  
length, age

- **Noun** durations showed significant differences both within and across ages ( $p < 0.05$ ).

Nouns can have more suffixes than verbs which means simpler lexical access in the case of verbs.

## Conclusions 1.

7-year-olds,  
different number of  
suffixes  
specific use of  
adjectives

The majority of adjectives children used are the same across ages, like (in English) *small, big, nice, red, brown, old, young, false, good, bad, dotted*, etc.

- Although the duration of words gradually decreased with age in four of the five age groups, the 7-year-olds' word articulation was exceptionally slow.
- **This can be explained by (i) their starting to learn reading and writing at school and (ii) presumably also the increasing number of newly acquired words at this age.**
- We assumed that nouns would be longer than verbs and adjectives with the same number of syllables, for which evidence has been found in the present study.
- **Adjectives were pronounced relatively shortly by children with the exception of 7-year-olds. This can be explained mainly by the many repeated adjectives in each age group.**

**Hypothesis1** could be verified, **hypothesis2** could partly be verified, **hypothesis3** could not be verified.

## Conclusions 2.

*Thank you for  
your interest!*

- The durations of words did not show a constant increase with the increasing number.
- **This finding seems to be mainly a developmental factor including, for example, cognitive abilities, memory, attention span, grammatical knowledge, increasing individual vocabulary, and articulation skills (Redford 2015; Fletcher et al. 2016).**
- All developmental factors influence the temporal control over word durations in spontaneous utterances in children. Measured values evidenced the age-specific changes with Hungarian-speaking children.

We suppose that our findings are in connection with the acquisition of both the diverse parts of words and the great variety of the corresponding suffixes.