CZECK-REP: INTRODUCING A NONWORD REPETITION TASK FOR CZECH

1. INTRODUCTION

Typically developing (TD) children develop the ability to imitate new words (Snow 1981, Speidel 1989) and accurately repeat nonwords as early as two years of age (Gathercole and Adams 1993, Carey 1978, Rice 1990). Conversely, it is well attested that children with language impairment (LI) find it difficult to accurately repeat nonwords throughout childhood (Kamhi and Catts 1986, Kamhi et al. 1988, Taylor, Lean and Schwartz 1989, Gathercole and Baddeley 1990, Baddeley and Wilson 1993, Montgomery 1995, Bishop et al. 1996, Dollaghan and Campbell 1998, Edwards and Lahey 1998, Weismer et al. 2000, Norbury et al. 2001, Cont i-Ramsden and Kesketh 2003, Gray 2003, Estes et al. 2007, Archibald and Gathercole 2007).

Relative accuracy in nonword repetition (in both TD and LI) depends on a variety of factors, the most important being: nonword length (Gathercole et al. 1991, Gathercole and Baddeley 1996), phonological complexity (Archibald and Gathercole 2006, Cilibrasi et al. 2015), and morphological complexity (Miceli & Caramazza, 1988). Given the role of these factors, nonword repetition is a powerful tool to, first, assess language impairment, and second, assess linguistic parameters that play a significant role in first language acquisition (Gathercole et al. 1994). While some languages have a long list of nonword repetition tests available (for example, English), others have very few of these tests (for example, Czech). This paper presents a new nonword repetition task for Czech. The test is novel in that the items are created controlling for nonword length, phonological complexity, and morphological complexity.

2. ATTESTED CONSTRAINTS ON CHILDREN'S REPETITIONS OF NONWORDS

There are three main linguistic constraints evidenced, so far, to affect children's repetitions of nonwords: nonword length, phonological complexity, and morphological complexity. This section will present the three of them separately.

NONWORD LENGTH

As Gathercole et al. 1991 point out, TD children repeat shorter nonwords more accurately than longer nonwords. This phenomenon is reported with different strength in children with and without a language impairment: While both children with and without an impairment find long nonwords more difficult, children with language impairment find long nonword repetitions more difficult than TDs (Gathercole and Baddeley 1996, Weismer et al. 2000). This finding is usually interpreted as a limitation in working memory resources. Baddeley (1992:556) defines working memory as "a brain system that provides temporary storage and manipulation of the information necessary for such complex cognitive tasks as language comprehension, learning, and reasoning". Within Baddeley's (1992, 2003) model, working memory consists of one central and two subsidiary components. The executive core takes into

account contextually relevant stimuli, while the visuospatial component handles visual images and the phonological loop processes speech sounds. Within Baddeley's framework, the phonological loop temporarily holds sound patterns in the relevant language's phonological code and is responsible, as a result, for accurate (and/or inaccurate) nonword repetitions. Thus, due to the architecture of the phonological loop, shorter nonwords are repeated more accurately than longer nonwords, and due to disruptions in the phonological loop, this contrast is more pronounced in children with language impairment.

PHONOLOGICAL COMPLEXITY

Inaccurate repetitions of nonwords cannot be exclusively put down to working memory effects and, in order to make adequate assessments, "richer measures" of linguistic structure, to follow Snowling et al.'s (1991:373) terminology, are to be taken (and tested). In this influential work the authors hypothesise that difficulties in nonword repetition might derive from a list of factors that include children's perceptual problems, phoneme segmentation, prosodic and even articulatory constraints.

A clear separation in the measurement of working memory effects from segmentation effects is difficult to achieve. As Gathercole et al.'s (1994) explain, it is not feasible to design working memory tasks that do not involve, at the same time, segmentation of incoming speech. Prosodic effects can instead be measured separately. Chiat (1989) showed, for example, that children repeated nonwords more accurately before unstressed than before stressed vowels, while Marshall and van Der Lely (2008) and Cilibrasi et al. (2015) found that TD children repeat stressed syllables more accurately than unstressed syllables. Archibald and Gathercole (2006) showed that LI children find it more difficult to repeat phonologically complex nonwords, particularly when these contain phonological clusters. Even effects normally considered as arising from memory may in some cases depend on phonology. For example, Cilibrasi et al. (2018) showed that nonword repetitions by TD children and children with LI is affected by the interaction of nonword length and phonological complexity: long nonwords are more difficult than short nonwords, but within the subset of long nonwords those with noninitial consonant clusters are repeated less accurately, thus suggesting that phonological complexity operates in conjunction with the working memory limitations triggered by nonword length.

MORPHOLOGICAL COMPLEXITY

Finally, a number of studies focussed on the role of morphological complexity in nonword repetition and, more often, perception (arguably, nonword repetition requires perception and then recollection from the phonological loop. Many tasks assessing morphology focused on the first step of this process). One effective way of assessing this phenomenon was revealed in the creation of nonwords that contain inflectional morphemes. A consistent finding is that the processing of verb-like nonwords is more challenging than the processing of noun-like nonwords. In their seminal work, Caramazza et al. (1998) asked their Italian speaking participants to de-

cide whether the target items presented were words or nonwords. The target items started with (or without) an Italian verb stem and finished with an existent (or non-existent) Italian inflectional morpheme. In the study, participants took significantly longer to discriminate nonword items ending with possible (existing) inflections, which suggests that recognisable morphological structures were decomposed whenever they were encountered and that verb-like nonwords require more time to be processed.

Post et al. (2008) developed this idea by focussing on English and better assessing the relation between phonology and morphology. In the presence of morpho-phonological and phonological items that respect the past tense rules of English (i.e. verb-like nonwords), participants required a long (*i.e.* longer) time to complete the task. In a minimal pair discrimination task, they evidenced that morpho-phonological factors (*i.e.* voice agreement between stem and affix) as well as purely phonological variables (*i.e.* syllabicity and voicing) played a role in the processing of English verbal inflections. First, syllabic past tense morphemes (as opposed to single segment morphemes) were found to lead to faster same/different judgements (*e.g. melted — melt / plied — ply*), in both real words and nonwords. Second, voicing agreement between final coronal consonants and their preceding segments (*e.g. steed — stee)* was shown to require a larger amount of time to be processed (in comparison to *steet — stee*), suggesting stem/affix segmentation. Along the same line, Cilibrasi et al. (2019) assessed nonword recognition with a same/different task with verb-like and noun-like nonwords. In this task, participants encountered nonwords ending in /ld/ and /lz/, on the one hand, and in /lt/ and /ls/, on the other. These items were chosen because /d/ and /z/ mark the past inflection in English when following /l/, while /t/ and /s/ do not mark morphological inflection when they are used after /l/ (but they do in different phonological contexts). The results were consistent with those of Caramazza et al. (1988) and Post et al. (2008): Participants took longer to discriminate verb-like nonwords (potentially inflected nonwords) than to discriminate noun-like nonwords.

3. THE PROPOSED TASK

Since all the three variables at hand (*i.e.* nonword length, phonological complexity and morphological complexity) affect children's nonword repetition, the task that we present here was developed so as to account for them. Given each variable, there is an equal number of nonwords for each value of the variable, allowing for direct comparisons between conditions. The division goes as follows: The task is composed of a total of 24 nonwords. There are three possible nonword lengths (2, 3 and 4 syllables), with 8 nonwords for each value of the variable. Nonwords may or may not contain a non-initial cluster, with 12 words containing a cluster and 12 without a cluster. Finally, nonwords are inflected so as to resemble either verbs or nouns, and there are 12 nonwords that resemble verbs, and 12 nonwords that resemble nouns.

Clinicians or linguists interested in using this task can thus not only obtain a measure of accuracy for each child, but they can also compare different conditions to

assess the origin of the difficulty (if any). For example, if a child struggles with long nonwords (independently of their phonology or of their morphological category), one can interpret it as a working memory deficit. By the same logic, if a child struggles with nonwords with clusters (independently of length or category) one can interpret it as a phonological deficit. If they struggle with verb-like nonwords (independently of length or phonology), it can be interpreted as a morphological deficit. In addition, all possible combinations of difficulties may be attested.

The list of nonwords is presented in table 1. In each cell, a description of the inflectional paradigm used is provided. In the Appendix we provide an answer sheet that can be used to collect data with this test and calculate the final result. One point should be counted for any correct repetition. The maximum number of points in the task is 24. A link to a recording of the nonwords can be found on our group website: http://csbc.ff.cuni.cz. If using this task, clinicians and researchers are invited to share their result on our platform, so that normative data can gradually be built.

		2 syllable	3 syllable	4 syllable
With a non-initial cluster	verb	**sítrám** — 1st p, sg, present, verbal paradigm 'dělat'	**zatránit** — infinitive, verbal paradigm 'čistit'	**puprovala** — 3rd p, sg, past, verbal paradigm 'kupovat'
		sítrál — 3rd p, sg, past, verbal paradigm 'dělat'	**zatrání** — 3rd p, sg, present, verbal paradigm 'čistit'	**puprovaly** — 3rd p, pl, feminine, past, verbal paradigm 'kupovat'
	noun	(bez) **lítřu** — masculine inanimate, paradigm 'hrad', genitive case	**háklění** — neuter, paradigm 'stavení', nominative case	(bez) **kobaplice** — feminine, paradigm 'růže', genitive case
		(s) **lítřem** — masculine inanimate, paradigm 'hrad', instrumental case	(s) **hákléním** — neuter, paradigm 'stavení', instrumentral case	(o) **kobaplici** — feminine, paradigm 'růže', locative case
Without cluster	verb	**pátáš** — 2nd p, sg, present, verbal paradigm 'dělat'	**votovat** — infinitive, verbal paradigm 'kupovat'	**nevylouřit** — infinitive, verbal paradigm 'prosit'
		pátat — infinitive, verbal paradigm 'dělat'	**votují** — 3rd p, pl, present, verbal paradigm 'kupovat'	**nevylouřil** — 3rd p, sg, past, verbal paradigm 'prosit'
	noun	(vidím) **poletu** — feminine, paradigm 'žena', accusative case	**šanice** — feminine, paradigm 'růže', nominative case	(bez) **šolotele** — masculine inanimate, paradigm 'stroj', genitive case
		poleta — feminine, paradigm 'žena', nominative case	(s) **šanicí** — feminine, paradigm 'růže', instrumental case	**šoloteli** — masculine inanimate, paradigm 'stroj', vocative case

TABLE 1: *List of nonwords in the Czech-Rep Task*

4. FINAL REMARKS

Evidence so far suggests that a plethora of variables affect TD's and LI's repetitions of nonwords. In this article, we propose a nonword repetition task for Czech to assess the interaction of nonword length, phonological complexity, and morphological complexity.

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APPENDIX

		SUM: 2 syllable	SUM: 3 syllable	SUM: 4 syllable		
SUM:	With a non-initial cluster	**sítrám**	**zatránit**	**puprovala**	verb-A:	VERB A+B. SUM:
		sítrál	**zatrání**	**puprovaly**		
		(bez) **lítřu**	**háklění**	(bez) **kobaplice**	noun-A:	
		(s) **lítřem**	(s) **hákléním**	(o) **kobaplici**		
SUM:	Without cluster	**pátáš**	**votovat**	**nevyloufit**	verb-B:	NOUN A+B. SUM:
		pátat	**votují**	**nevyloufil**		
		poletu	**šanice**	(bez) **šolotele**	noun-B:	
		poleta	(s) **šanicí**	**šoloteli**		

Answer sheet

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