

## Construction and Psychometric Properties of Sentence Repetition Test (SRT) for Latvian Primary School Children

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Doi:10.5901/jesr.2014.v4n4p104

### Abstract

*This study was conducted to determine psychometric properties of newly developed Sentence Repetition Test (SRT). The test evaluates ability to recall orally presented sentences in Latvian language, and it was constructed specifically for junior primary school children. The sample consisted of 136 first and second graders aged 7 to 9 years (52% girls). Final version of Sentence Repetition Test is composed of 12 items in increasing level of difficulty. Spearman-Brown split-half reliability coefficient of the test is sufficiently high to recognize SRT as reliable. Convergent and concurrent validities of the test were determined in smaller sub-sample of 64 children, using measurements of Digit Span sub-test from Latvian edition of Wechsler Intelligence Scale for Children-IV (Wechsler, 2003) and Phoneme Segmentation Fluency from Latvian edition of Dynamic Indicators of Basic Early Literacy Skills (DIBELS Next) (Good & Kaminski et al., 2011; Rascevska et al., 2013a). Sentence Repetition Test has medium strong statistically significant correlations with both tests. The study affirms sufficient reliability and validity of the new test.*

**Keywords:** Sentence Repetition Test, sentence recall, verbal short-term memory, reliability, validity

### 1. Introduction

Memory in general plays a very important role in learning process, literacy and knowledge acquisition. Studies along with verbal short-term and verbal working memory especially distinguish sentence memory which predicts learning difficulties (Alloway & Gathercole, 2005a). Sentence memory simultaneously involves both – short-term and long-term memory. Simultaneously to sequential memorizing process of sounds and words, activation of semantic system is ongoing, thus, allowing to retrieve meaning from words and sentences. Baddeley's model of working memory explains the unique contribution of short-term and long-term memories illuminating sentence memory (Baddeley, 2000). In this model, central executive is a flexible system, which provides control and regulation of cognitive processes including temporary long-term memory activation (Baddeley, 1998), coordination of several simultaneously performed tasks, shifting from one task to another or from one strategy of retrieval to another and selective attention and inhibition (Baddeley, Emslie, Kolodny, & Duncan, 1998). Central executive is directly related to its three sub-systems. Every sub-system holds a responsibility for its own domain, specifically, episodic buffer is responsible for information from working and long-term memory to be integrated in a single episodic representation. According to Baddeley's model of working memory, sentence memory measures the capacity of episodic buffer. Furthermore, it forms separate construct not being related to phonological loop or visual-spatial sketchpad (Alloway, Gathercole, Willis, & Adams, 2004). Sentence memory is highly related to phonological memory which, in turn, is related to phonological ability (Alloway & Gathercole, 2005b).

In English speaking countries numerous of tests are used for sentence memory assessment. For instance, modified version of Test for Reception of Grammar (TROG; Bishop, 1989), Sentence memory from Wide Range Assessment of Memory and Learning (WRAML, Sheslow & Adams, 1990), as well as sentence memory tests specifically developed for each particular study needs and corresponding age group (Alloway & Gathercole, 2005b; Roselli, Matute, Pinto, & Ardila, 2006). To our knowledge, in Latvian language there are no specific tests assessing sentence memory, so we decided to develop a test taking some principles of Sentence Memory from Wide Range Assessment of Memory and Learning (WRAML; Sheslow & Adams, 1990), and adding specifics of Latvian syntax and semantics. Sentence Repetition Test is aimed to be used for assessment of verbal short-term memory.

Studies prove that it is easier to memorize sentences than unrelated words, because in the process of sentence memorizing semantic information is integrated with phonological and lexical information (Alloway, 2007). Accuracy of sentence memory is related not only to short-term memory span (Alloway & Gathercole, 2005a), but also to verbal working memory span (Alloway, Gathercole, Willis, & Adams, 2004; Rohl & Pratt, 1995). Another aspect, which plays an important role in sentence memory, is word length and word count per sentence. Many studies report that increase of

word length and word count per sentence affects the ability to repeat sentences (Gathercole, 2001; Engelkamp & Rummer, 2002; Rummer, Engelkamp, & Konieczny, 2003). Taking into account this theoretical knowledge, Sentence Repetition Test was developed with increasing word length and increasing word count per sentence in order to increase difficulty level of the test and, thus, differentiate children with high and low ability to memorize sentences.

Short-term memory span can be characterized with item count successfully retained in the memory (Baddeley, 2005). Information in short-term memory is maintained only for a short period of time (1.5 to 2 seconds). From preschool to primary school age short-term memory span is still developing. For instance, four years old child can maintain 2 to 3 items in memory, but 12 years old child – approximately 6 items. In turn, sentence memory span is almost twice larger than separate word memory span (Alloway & Gathercole, 2005b). Since the test was performed by junior primary school children with perhaps different short-term memory span, then the easiest item was a three word sentence, but the hardest consisted of nine words. The content of sentences is made appropriate to experience of according age group. Sentences consist of words that are very likely to be in vocabulary of junior primary school children and, thus, might be grasped quite easily.

The first version of Sentence Repetition Test for Latvian children had 20 items, but the final version after the analyses based on Item Response Theory (Hambleton & Swaminathan, 1985), and analyses of difficulty and discrimination indices (Standards of Educational and Psychological Testing, 1999) is composed of 12 items. Reliability of the test was examined with Spearman-Brown split half reliability coefficient (Kline, 2000).

Convergent validation has to be made with test measuring similar construct (Kline, 2000). The best options for convergent validation would have been parallel measurements with other tests of immediate sentence or word memory. In our study convergent validity of Sentence Repetition Test was examined using sub-test of Digit Span from WISC-IV (Wechsler, 2003, Latvian edition). Digit Span assessment procedure states that in one task a sequence of numbers is presented orally and immediate repetition of numbers is required. This demands verbal short-term memory involvement, but specifically for partly verbal and partly symbolic content. Another Digit Span task asks to repeat numbers in the reverse order, thus, memorizing and simultaneously manipulating with information is taking place as working memory. We used measurement of Digit Span for convergent validity, because this was the closest and most reliable recently adapted instrument in Latvia, that in one task measures verbal short-term memory. However, the content of the test is partly symbolic and differs from content of our developed test. We presumed that Sentence Repetition Test will show moderately strong correlations with Digit Span sub-test because previous studies in other language populations show correlation of  $r = .60$  between sentence memory with verbal-short term memory measured by number sequence recall (Sheslow & Adams, 1990; Alloway & Gathercole, 2005b).

Concurrent validity examination requires measurements representing similar external criteria that is involved during memorizing process of sentences (Kline, 2000). Concurrent validity of Sentence Repetition Test was verified with Phoneme Segmentation Fluency from Dynamic Indicators of Basic Early Literacy Skills (DIBELS Next) (Good & Kaminski et al., 2011; Rascevska et al., 2013a). A procedure of Phoneme Segmentation Fluency is following: A word is orally presented to a child and a he or she has immediately respond naming sequence of phonemes of a word. A part from the task, when a child has to keep into his or her mind a word, involves short-term memory of verbal content. The operation of chunking word into phonemes is an extra demand to short-term memory activation and this defines that whole working memory is activated. Although Phoneme Segmentation Fluency involves more than just verbal short-term memory and generally is representing phonological ability, we chose this measurement as the most appropriate tool for concurrent validity, because it is one of rare instruments that has been adapted in Latvia and can be accounted as reliable. Within PsychARTICLES data base did not come across studies reporting correlations between sentence memory and phoneme segmentation, but we presumed that correlation between Sentence Repetition Test and Phoneme Segmentation fluency would be moderate.

This study examined the extent to which psychometric properties of constructed Sentence Repetition Test meet standards of the reliability and validity requirements (Hambleton & Swaminathan, 1985; Standards of Educational and Psychological Testing, 1999; Kline, 2000).

## 2. Method

### 2.1 Participants

The sample consisted of 136 children aged 7 to 9 years (average age in month=96.82, SD=6.85, 52 % girls). Participants were 1st and 2nd graders from seven mainstream schools of Riga and two schools of region of Riga. Latvian was the first, native language for all children. Children were selected by availability principle. Parents of children had given written

permission for child's participation in the study.

For convergent and concurrent validity examination with Digit Span sub-test from WISC-IV and Phoneme Segmentation Fluency from DIBELS Next was done in a smaller sub-sample of 64 children aged 7 to 9 years (average age in month=98.05, SD =6.65, 58 % boys), 1st and 2nd graders from mainstream schools of Riga and region of Riga, they had Latvian as their first, native language.

## 2.2 Measures

*Sentence Repetition Test (SRT)* consists of items with increasing level of difficulty. It was developed specifically for first and second graders to assess their ability to remember orally presented sentences. Items are made from 5 syllable and 3 word to 22 syllable and 9 word sentences. Example of easiest item (Item 1) is: "Es redzu sauli" (translation in English: "I see the sun"). Example of medium difficult item (Item 6): "Vakar notika kaut kas pavisam īpašs" (in English: "Yesterday happened something very special"). Example of most difficult item (Item 12): "Meitenes vecais ritenis, nokrāsots sarkans, izskatās ne pārāk lieliski" (in English: "Girl's old painted red bicycle does not look very great"). At the time of assessment the sentence is presented to a child and he or she has to repeat it immediately after presentation. The identical response is scored with 2 points, if the child makes one mistake (for example, omits word, adds extra word, uses changed form of the word), then this is scored with 1 point. If two or more mistakes are made - score is 0 points. At the end total score is calculated.

*Digit Span sub-test* from Wechsler Intelligence Scale for Children Forth Edition (WISC-IV) (Wechsler, 2003, Latvian Edition) includes Digit Span Forward and Digit Span Backward tasks. Digit Span Forward measures verbal short-term memory while Digit Span Backward assesses verbal working memory. During administration of Digit Span Forward the child listens to and repeats a sequence of numbers just said. In Digit Span Backward, the child listens to a sequence of numbers and repeats them in reverse order. In both tasks, the length of each sequence of numbers increases as the child correctly responds. Each correct response receives 1 point, if one or more mistakes are made, the response is scored with 0 points. At the end total score is obtained for each of tasks and Digit Span Total is calculated as sum of both tasks. Spearman-Brown reliability coefficient for Latvian version of Digit Span sub-test in sample of children aged 6 to 16 years is  $r_{sb} = .82$  (Rascevska, Sebre, & Ozola, 2013).

*Phoneme Segmentation Fluency (PSF)* from Dynamic Indicators of Basic Early Literacy Skills (DIBELS Next) (Good & Kaminski et al., 2011; Latvian edition: Rascevska et al., 2013a) is a measurement of phoneme awareness. All children participating in the study regardless to their age and grade were assessed with Benchmark Assessment for the first grade in the beginning of the school year. In PSF task child listens to words of three to four phonemes, and then verbally produces the individual phonemes in each word. One point is given for each correctly produced separate phoneme or each phoneme blending. Phonemes produced correctly in one minute determines the total score. The reliability Latvian version of PSF task is characterized by correlations between repeated measures (period of time between two measures was 2 to 3 month). A correlation between the end of pre-school and beginning of the first grade period on PSF is  $r = .52$ ,  $p < .01$  (Rascevska et al., 2013b).

## 2.3 Procedure

Individual testing was done with each child at school. Most part of children had only been assessed with Sentence Repetition Test, which procedure is around 5 minutes long. A part of children had been assessed first with Digit Span task, then Phoneme Segmentation Fluency and only after they had been given Sentence Repetition Test.

## 3. Results

### 3.1 Item analysis of the test

Item analysis was made according to Item Response Theory principles. In general the idea of Item Response Theory was supported for all items, and each of 12 items, appeared suitable to discriminate children along the ability scope. Additionally to Item Response Theory analysis, difficulty and discrimination indices were examined. Difficulty indices of the test are presented in sequence starting with the easiest and going up to the hardest item, and together with SD and discrimination indices they are displayed in Table 1.

**Table 1:** Difficulty and discrimination indices of Sentence Repetition Test

Serial number of item	Difficulty index/ M	SD	Discrimination index*
Item 1	1.99	0.12	.40
Item 2	1.97	0.17	.30
Item 3	1.96	0.24	.37
Item 4	1.82	0.47	.40
Item 5	1.65	0.68	.49
Item 6	1.61	0.63	.53
Item 7	1.45	0.80	.53
Item 8	1.30	0.76	.52
Item 9	1.07	0.76	.60
Item 10	0.60	0.77	.57
Item 11	0.46	0.76	.45
Item 12	0.29	0.63	.42
<i>Item mean</i>	<i>1.35</i>	<i>0.57</i>	<i>.47</i>
<i>Total scale</i>	<i>16.17</i>	<i>4.11</i>	<i>-</i>

n=136 *Note.* \*Corrected item total correlation was used as discrimination index.

Analysis of item difficulty indices suggest that all indices are almost within permissible boundaries from 0.40 to 1.80 (which indicates an optimal level of difficulty for items of 0 to 2 points) (see Table 1). The first three items are relatively easy, but they were maintained because are beginning items. The last item is the most difficult and its difficulty index is <0.40, however, perhaps in other sample this item might achieve higher average score.

The maximum score that could be reached was 24.00, the average score is 16.17. As the results for sample differed from normal distribution, more informative was median, which is 16.00. Spearman-Brown split-half reliability coefficient of test is sufficiently high  $r_{sb}=.85$  to recognize test as a reliable.

### 3.2 Convergent and concurrent validity

Correlation analysis between the results in Sentence Repetition Test and Digit Span sub-test from WISC-IV and Phoneme Segmentation Fluency from DIBELS Next was made in 7 to 9 years old children group. Correlation matrix is displayed in Table 2.

**Table 2:** Spearman rank correlation matrix of Sentence Repetition Test with Digit Span Forward, Digit Span Backward, Digit Span Total score and Phoneme Segmentation Fluency

	Sentence Repetition Test
Digit Span Forward	.40**
Digit Span Backward	.32**
Digit Span Total	.43**
DIBELS Next PSF	.47**

n=64; \*\*p<0,01 *Note.* PSF – Phoneme Segmentation Fluency.

Sentence Repetition Test has positive, moderately strong statistically significant correlations with the results of Digit Span Forward, Digit Span Backward, Digit Span Total score and DIBELS Next Phoneme Segmentation Fluency.

## 4. Discussion

The examination of some psychometric properties for newly constructed Sentence Repetition Test showed that in general our developed test for verbal short-term sentence memory assessment meet standards of test reliability and validity (Standards of Educational and Psychological Testing, 1999; Kline, 2000).

Item analysis was supported by principles of Item Response Theory (Hambleton & Swaminathan, 1985). Each of items appeared suitable to discriminate respondents along the ability scope. Additional examination of item difficulty and discrimination indices of Sentence Repetition Test showed that items meet standards of psychometric criteria (Standards of Educational and Psychological Testing, 1999; Kline, 2000). The final version of Sentence Repetition Test for 7 to 9 years old Latvian children consists of twelve items.

Spearman-Brown reliability coefficient shows sufficiently high reliability of Sentence Repetition Test (Kline, 2000), it is very close to coefficient reported for Sentence memory from Wide Range Assessment of Memory and Learning (Sheslow & Adams, 1990).

Content validity of the test is confirmed in introduction when theoretical aspects are discussed. The sample of children participating in the study is quite large.

For confirmation of convergent and concurrent validity Digit Span sub-test from WISC- IV and DIBELS Next Phoneme Segmentation Fluency tasks were used. Sentence Repetition Test has moderately strong, positive, statistically significant correlations with the other two tests. The correlation between sentence memory and part of Digit Span sub-test, measuring number sequence recall, in our study a bit weaker than observed in studies before (Sheslow & Adams, 1990; Alloway & Gathercole, 2005b). This can be due to age range of participants, which was broader in the other two studies, and that is, probably, why showed larger variation in test scores that resulted in stronger correlation. In general convergent and concurrent validities were confirmed.

## 5. Limitations

We have to admit several limitation of our study. One of limitations is that sample consisted only of children from schools of Riga and region of Riga and is not representing whole population of Latvia. The other – children were not selected for the study using random selection. Thus, it might be essential to supplement sample with data from rural areas increasing representativeness of the sample. Also the population of Latvia consists of bilingual children which were not included in this study, but they might be included in future.

So far, our Sentence Repetition Test is made for a narrow age group, and in future age limits may be extended to both directions – preschool children and older primary school children. It is suggested to make test-retest reliability examination and validate test with the other test representing closer construct, particularly, measuring immediate verbally presented sentence or word recall.

## 6. Acknowledgements

This work has been supported by the European Social Fund within the project “Support for Doctoral Studies at University of Latvia”.

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