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Do nonword repetition errors in children with specific language impairment reflect a weakness in an unidentified skill specific to nonword repetition or a deficit in simultaneous processing?

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This Commentary supports Gathercole's (2006) proposal on a double deficit in children with specific language impairment (SLI). The author suggests that these children have a limited phonological storage combined with a particular problem of processing novel speech, stimuli. According to Gathercole, there are three areas of skill contributing to memory for nonwords: general cognitive abilities, phonological storage, and an unidentified skill specific to nonword repetition. The focus of this Commentary is to examine whether these children's nonword repetition performance is influenced by an unidentified skill or some other processes. An alternative hypothesis is that the nonword repetition errors observed in children with SLI are related to one of their main weaknesses, to their difficulties in simultaneous processing of information. Evidence for this argument comes from our recent studies: from error analyses data and from findings on nonword repetition with stimuli that included meaningful parts (monosyllabic real words).

Our earlier findings showed a deficit in simultaneous processing across verbal and nonverbal working memory tasks in children with SLI (linguistic span task, list recall, space visualization, etc.; Marton & Schwartz, 2003; Marton, Schwartz, Farkas, & Katsnelson, in press; Marton, Schwartz, Phinkasova, Roth, & Kelmenson, 2006). These children showed diminished primacy and recency effects in list recall tasks; they were not able to process the new incoming stimuli and rehearse the old information simultaneously. In the linguistic span task, children with SLI either repeated the sentence-final words/nonwords or answered the questions that targeted the sentence content. Again, they were not able to perform both operations concurrently. Their difficulties were not simply related to limitations in storage. Although these children remembered relatively few of the sentence-final words during testing, if testing was stopped and they were asked whether they could repeat the stimuli they were presented with, most children repeated entire sentences correctly. Thus, their difficulty was not in remembering long stimuli, but performing various tasks concurrently.

In this Commentary, I suggest that nonword repetition is a task that requires simultaneous processing, a skill with which children with SLI have difficulty. The following findings from our studies are of relevance to this argument. According to a theory of phonological encoding in word retrieval, the phonemes of a word and the word's metrical frame are processed separately. The "segment-to-frame association" theory (Biran & Friedmann, 2004; Levelt, 1992) suggests that segments/phonemes are inserted into the metrical frame of a word during phonological encoding. The metrical frame includes the number of syllables and information on the words' stress pattern; the segmental part consists of information on the phonemes (consonants, vowels, clusters). In word retrieval, these two types of information are integrated by the mechanism of segment-to-frame association. Evidence comes from various speech errors in different populations, for example, stress exchange, anticipatory and perseveratory phoneme substitutions, and changes in syllabification (Biran & Friedmann, 2004; Meyer, 1992).

Detailed analyses of nonword repetition errors of children with SLI and their typically developing (TLD) peers indicate that the majority of their errors are segment substitutions with notable assimilation errors (when the production of one part of the nonword influences the production of another part of the same nonword) in the former group. In contrast to the many segmental errors, the metrical frames of these nonwords are produced correctly; the number of syllables and the stress patterns are correct. In one of our earlier studies (Marton & Schwartz, 2003), we found that about 80% of all errors produced by the children with SLI were segmental errors: vowel and consonant substitutions with no syllable structure changes. These children repeated nonwords that consisted of the same number of syllables and stress patterns than the target stimuli. In our recent study (Marton et al., 2006), the percentage of nonwords produced with segment substitutions and segment order errors was 90% for the children with SLI and 92% for the children with TLD. Thus, the majority of the error nonwords resembled the metrical frame of the original stimulus.

An increase in word length influenced nonword repetition in all groups; all children made more errors in repeating four-syllable nonwords than in repeating three-syllable nonwords (this result is in agreement with previous findings; e.g., Gathercole, Willis, & Baddeley, 1991; Montgomery, 1995). In addition to a group effect (children with SLI made significantly more errors than the children with TLD), the children also differed in the proportion of single versus multiple errors per nonword. If a child produced only one segmental error in a nonword, that was considered as a single error. If they produced several errors within the same nonword, those errors were categorized as multiple errors. Children with SLI not only produced more multiple errors than their age-matched and language-matched peers, but the proportion of multiple errors compared to the total number of errors increased with the increase in the number of syllables. The proportion of single versus multiple errors did not change with an increase in word length for the children with TLD (see Figure 1). Both control groups produced more single than multiple errors at each word length. Thus, children with SLI showed a different performance pattern in nonword repetition than the typically developing children as the amount of information that had to be processed concurrently increased.

However, even with this decline in performance accuracy in the children with SLI, the distribution of error types remained the same. Children with SLI produced many multiple errors that consisted of segment substitutions, assimilations, and of a change in the original phonemic order. The number of syllables was in most cases the same as that in the target stimulus. The percentage of changes in the stress pattern was below 1% of all errors. Thus, the repetition of nonwords showed that the children with SLI were able to produce the correct metrical frame, but experienced difficulty when they had to integrate the segments with the frame. These data support the idea that metrical and segmental information are represented separately and accessed in parallel (Levelt, Roelofs, & Meyer, 1999).

The following part of this Commentary provides further evidence to the argument that nonword repetition requires simultaneous processing, and therefore, it is highly demanding on language-impaired children's working memory. In our recent study (Marton et al, 2006), we compared nonword repetition accuracy of stimuli with no meaningful syllables to nonwords that consisted of one monosyllabic real word and two to three syllables that had no meaning. Previous research showed that children's nonword repetition accuracy improves if the nonwords include meaningful syllables (Dollaghan, Biber, & Campbell, 1995). Our results showed a similar pattern for the age-matched and the language-matched groups. The children with SLI, however, did not show a difference in performance accuracy across the nonword lists (see Figure 2). Their performance did not improve, even when we ensured that they knew the words that were inserted in the nonwords. The children with TLD did benefit from their permanent knowledge, whereas the children with SLI did not take advantage of their long-term knowledge.

One explanation for these findings is that the simultaneous processing of different phonological structures (metrical frame and segments) was so demanding for the children with SLI that they were not able to process the semantic information of the inserted monosyllabic words. There may be alternative interpretations of these data that focus on the access of long-term knowledge during working memory performance in children with SLI, but the current findings strongly support the idea that these children have extreme difficulty in tasks that require concurrent processing of information. In these situations, children with SLI are often not able to use even their existing knowledge to support their working memory performance. The results have further theoretical implications regarding the relations between working memory and the long-term lexicon; however, that discussion is outside the scope of the present paper. There are various functions that influence the simultaneous processing of information; one candidate for the difficulties observed in children with SLI is a weakness in attention switching. Complex tasks that involve the concurrent processing of information require continuous attention switching. Further research is needed to decide whether a deficit in this function influences these children's performance in working memory tasks.

In summary, this commentary provides an alternative explanation to the role of an unidentified skill for language-impaired children's difficulty in nonword repetition. I argue that nonword repetition is a task that requires simultaneous processing of information, and that children with SLI show poor performance in situations where they have to perform concurrent tasks. In these tasks, they cannot even use their existing knowledge efficiently to support their working memory performance. Evidence comes from a number of studies and the pattern of performance is consistent across various experiments.

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Figure 1.
The proportion of single and multiple errors in nonword repetition.

Figure 2.
Nonword repetition across lists