The Promise of Nonword Repetition as a Clinical Tool

La répétition de non-mots comme outil clinique prometteur

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Abstract

Nonword repetition requires the immediate recall of novel word forms such as *woogalamic*. The task mimics the learning of the phonological form of a new word as one aspect of vocabulary acquisition. Individuals with language learning difficulties typically are poor at repeating nonwords. Children with Specific Language Impairment (SLI) show marked and pervasive deficits on nonword repetition tasks; this deficit is highly heritable and linked to chromosome 16. Even children with a history of SLI but who score in the average range on language measures continue to have difficulty recalling novel words accurately. Nonword repetition effectively discriminates children with SLI from typically developing monolingual groups, and children learning a second language. The nonword repetition task is a simple, practical tool that can be scored online and easily adapted to the clinic environment. It is likely that the SLI impairment in nonword repetition arises in part due to deficits in phonological knowledge and retention impairing the transfer of new phonological material to the lexicon. Intervention strategies may be aimed either at enhancing the encoding or retention of new phonological sequences.

Abrégé

Pour répéter des non-mots, il faut arriver à se rappeler instantanément d'un mot inventé qui n'a pas de sens, tel que *woogalamic*. Cette tâche imite l'apprentissage de la forme phonologique d'un mot nouveau, ce qui constitue un aspect de l'acquisition du vocabulaire. Les personnes ayant un trouble d'apprentissage du langage ont généralement de la difficulté à répéter des non-mots. Les enfants ayant un trouble spécifique du développement du langage (TSDL) montrent un déficit marqué et envahissant aux tâches de répétition de non-mots : ce déficit est hautement héréditaire et est lié au chromosome 16. Tous les enfants ayant des antécédents de TSDL, mais qui obtiennent un résultat dans la moyenne aux mesures du langage continuent à éprouver de la difficulté à se rappeler les mots nouveaux correctement. La répétition de non-mots distingue efficacement la distinction entre les enfants atteints d'un TSDL de ceux monolingues au développement typique et des enfants apprenant une langue seconde. La tâche de répétition de non-mots est un outil simple et pratique qui peut être notée en ligne et facilement adaptée au milieu clinique. Il est probable que le TSDL se manifeste lors d'une répétition de non-mots en raison des lacunes au plan des connaissances phonologiques et de la mémorisation, ce qui compromet le transfert de nouveau matériel phonologique à sa représentation mentale. Les stratégies d'intervention pourraient viser l'amélioration soit de l'encodage ou de la mémorisation de nouvelles séquences phonologiques.

Key words: specific language impairment, nonword repetition, phonological processing, short-term memory, assessment, intervention

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The term 'nonword repetition' refers to a task in which individuals are required to repeat novel phonological forms such as woogalamic or noitauf. Despite its apparent simplicity, the task mimics one of the most basic and important language-learning mechanisms: immediate repetition of unfamiliar words. Children spontaneously imitate new words thereby initiating the process by which that word may become a part of the mental lexicon (Tomasello, 2001). Repeated exposures to the word paired with rich contextual information result in the long-term learning of the new

item. This item becomes incorporated into the existing semantic and phonological network in the child's mental lexicon. Results of extensive research have confirmed the link between nonword repetition and language abilities in both proficient and impaired language users. Nonword repetition has been proposed as a clinical marker for children with Specific Language Impairment (SLI) (Bishop, North, & Donlan, 1996) and dyslexia (Brady, 1997). Findings related to nonword repetition have sparked much theoretical debate, summaries of which are provided elsewhere (e.g., Coady & Evans, in press). The purpose of this article is to provide a brief review of current research related to nonword repetition in Specific Language Impairment (SLI), and to consider the clinical utility of the measure. It should be noted that the present discussion does not represent an endorsement of the clinical use of nonword repetition. Indeed, there are many questions that are yet to be answered, as the present review will outline, but there are also several interesting, clinically relevant findings of interest to the practising clinician.

SLI is a relatively common communication impairment affecting approximately 7% of kindergarten children (Tomblin, Records, Buckwalter, Zhang, Smith, & O'Brien, 1997). Although SLI can be succinctly characterized as an unexplained difficulty acquiring language, its clinical presentation varies considerably. The heterogeneity in SLI has frustrated attempts to develop broadly applicable assessment instruments, and to understand the disorder more generally. Highly consistent findings, however, have been reported for groups of children with SLI on one measure, nonword repetition. In a recent systematic review of 23 studies, children with SLI exhibited significant impairments in nonword repetition, performing on average 1.27 standard deviations below children without SLI (Graf-Estes, Evans, & Else-Quest, 2007). The nonword repetition deficit characterizes children with SLI of all ages, from preschool (Gray, 2003) through to adolescence (Conti-Ramsden, Botting, & Faragher, 2001; Stothard, Snowling, Bishop, Chipchase, & Kaplan, 1998). Even children with a history of SLI whose oral language is no longer distinguishable from age peers continue to perform poorly on tests of nonword repetition (Bishop, North, & Donlan, 1996; Conti-Ramsden, et al., 2001).

Nonword repetition effectively discriminates children with SLI from typically developing groups. In one important study, no overlap in performance between children receiving language intervention and typically developing children was found on the Nonword Repetition Test (NRT) consisting of four nonwords each of 1, 2, 3, and 4 syllables and excluding late developing sounds, lax vowels, and consonant clusters (Dollaghan & Campbell, 1998). Poor NRT performance was 25 times more likely to occur in the SLI group, and the diagnostic accuracy of the NRT surpassed that of the Spoken Language Quotient of the Test of Language Development-2 (Newcomer & Hammill, 1988). While most studies have found an overlap between children with and without SLI, significant group differences have been reported consistently (see Graf-Estes et al., 2007). Even in a large population-based sample of school age children, extremely low NRT scores were four times more likely to occur in children with language impairment although poor nonword repetition was not exclusive to children with SLI (Ellis Weismer, Tomblin, Zhang, Buckwalter, Gaura Chynoweth, & Jones, 2000). Conti-Ramsden and colleagues included the Children's Test of Nonword Repetition (CNRep; Gathercole & Baddeley, 1996) consisting of 10 nonwords each of 2, 3, 4, and 5 syllables and standardized for children aged 4 to 9 years in an evaluation of potential clinical markers of SLI in a group of 5-year-old children (Conti-Ramsden, 2003), a group of 11-year-old children with a previous history of SLI (Conti-Ramsden et al., 2001), and a preschool group at risk for SLI (Conti-Ramsden & Hesketh, 2003). Results indicated that nonword repetition provided a useful clinical marker, although the more difficult task of sentence repetition was a more useful marker in the older age group.

There are several advantages to nonword repetition over traditional language measures such as standardized language tests. Traditional language tests rely heavily on prior knowledge of events, vocabulary, or language structures. In contrast, nonword repetition tests the ability to process new information. In theory, such processing-based measures should tap the underlying differences that presumably predispose the child to have significant difficulty acquiring language, and to be less biased by experience than knowledge-based measures. This conjecture is supported by several findings related to nonword repetition: Nonword repetition is less culturally biased than typical standardized language tests in that scores have not been found to distinguish typically-developing European-American from African-American children (Campbell, Dollaghan, Needleman, & Janosky, 1997; Rodekohr & Haynes, 2001). As well, nonword repetition scores are reported to be largely independent of performance IQ in children with both typical and atypical language development (Conti-Ramsden et al., 2001; Gathercole, Willis, Emslie, & Baddeley, 1994). For example, Ellis Weismer et al. (2000) found no differences in nonword repetition for groups of children with typically developing language skills and either low or normal IQ scores. Importantly, results from one study suggest that nonword repetition may assist in the assessment of language impairment in bilingual children (Kohnert, Windsor, & Yim, 2006). This population is especially difficult to assess as their language output may reflect either slow language learning, an underlying language impairment, first-language interference on second-language learning, or a combination of these. In the Kohnert et al. study, good nonword repetition was sufficient to rule out language impairment in bilingual children although poor nonword repetition did not necessarily rule language impairment in.

In keeping with findings that SLI has a strong genetic component (see Leonard, 1998, for a review), the severe

deficits in nonword repetition that accompany SLI are highly heritable. Bishop and colleagues have reported several twin studies (Bishop, North, & Donlan, 1995; Bishop et al., 1996; Kovas, Hayiou-Thomas, Dale, Bishop, & Plomin, 2005) comparing nonword repetition accuracy of monozygotic and dyzygotic twin pairs with a prior diagnosis of language impairment in at least one co-twin (Gathercole & Baddeley, 1996). Results of these studies have demonstrated that the characteristic nonword repetition deficit in SLI is highly heritable. The pattern of findings has led to the suggestion that the CNRep provides an effective marker of the phenotypic expression (behavioural manifestation) of SLI (Bishop et al., 1996). Findings from two large-scale studies aimed at understanding the chromosomal basis of the nonword repetition deficit in SLI have identified abnormalities on chromosome 16 (SLI Consortium, 2002, 2004). Further twin studies have established that the SLI impairment in nonword repetition is distinguishable from both the auditory temporal processing difficulties (Bishop, Bishop, Bright, James, Delaney, & Tallal, 1999) and the verb tense marking problems (Bishop, Adams, & Norbury, 2006) that are also characteristic of children with the disorder. In a related twin study of reading ability, reading heritability was high only when at least one co-twin also had poor nonword repetition, suggesting that poor nonword repetition may be an indicator of a distinct subgroup in this population (Bishop, Adams, & Norbury, 2004). These findings are important because they indicate that nonword repetition may be related to a core component of SLI worthy of clinical attention, and may even lead to the identification of subgroups within the realm of developmental language impairments.

To summarize, the vast majority of children with SLI have difficulty repeating nonwords. Nonword repetition is an effective clinical marker that discriminates children with SLI or very young children at risk for SLI from typically developing children. Nonword repetition appears to be a culture- and IQ-fair task that also may assist in ruling out language impairment in children learning more than one language. The nonword repetition deficit in SLI is highly heritable and persists even when other measures are no longer sensitive to a language difference. It is clear that nonword repetition has some promising diagnostic utility making it worthy of consideration for clinical use. The following section addresses questions and challenges relevant to the clinician considering adopting nonword repetition in practice.

Is nonword repetition a practical tool? Nonword repetition is a simple task to administer that can be completed by children as young as 2 years of age (Roy & Chiat, 2004). The CNRep (Gathercole & Baddeley, 1996) can be administered in less than 10 minutes, and is scored online at the item level (40 items). Most researchers have preferred phoneme level scoring both for the CNRep (Gray, 2003) and other measures of nonword repetition (Dollaghan & Campbell, 1998; Sahlen, Reuterskiold-Wagner, Nettelbladt, & Radeborg, 1999). Although phoneme level scoring must be considered a richer coding method, phoneme scoring lacks clinical utility in that it necessitates time-consuming offline review of recorded files. We compared online item level scoring of the CNRep to item level scoring derived from phonetic transcriptions of recorded files available from our previously published study of 12 children with SLI aged 7 to 11 years, 12 age-matched, typically developing children, and 12 children matched for receptive vocabulary ability (Archibald & Gathercole, 2006a). There was a 0.17 mean difference (95% confidence interval: -0.80 to 1.14) in raw scores (items correct) and -0.33 mean difference (95% confidence interval: -2.90 to 2.24) in standard scores. The correlations between the two sets of raw and standard scores were r=0.90 and r=0.95, respectively (p<.001, both cases). This very high agreement between online and offline scoring points to the effectiveness of the more practical (online) outcome measure. However, it should be noted that these data were established for the 40 items of the CNRep and scoring errors on nonword repetition tests employing fewer items may have a greater impact on the overall score. The clinician should be cognizant as well of any unusual patterns of performance that may unduly influence item over phoneme level scoring such as a refusal to attempt many or longer nonwords. A review of the data for both the children with SLI and typically developing language in our study (Archibald & Gathercole, 2006a) revealed that both groups rarely refused to attempt repetition, and attempts rarely involved syllable omissions.

Is nonword repetition a reliable measure? Gray (2003) evaluated the CNRep scored at the phoneme level in distinguishing between groups of typically developing preschool children and those with SLI. Acceptable test-retest reliability and excellent sensitivity (identifying impaired individuals as impaired) and specificity (identifying only impaired individuals as impaired) were reported.

What does nonword repetition test? It follows from a discussion of the reliability of nonword repetition to question the validity of the measure. However, in order to determine whether the task is testing what it purports to test (i.e., it is valid), we must know what nonword repetition measures. The question of how poor nonword repetition should be interpreted continues to be hotly debated. Although there is agreement that nonword repetition distinguishes impaired from typical language learners, the underlying cognitive mechanisms tapped by nonword repetition are not well understood. There is considerable interest and research effort aimed at developing this knowledge as understanding the cognitive processes constraining an ability linked to language impairment such as nonword repetition may provide important clues as to the nature of language impairment itself.

One reason that nonword repetition has proven difficult to pin down is that the task involves several

steps including hearing, perceiving, and segmenting the phonological form, encoding and retaining the phonological representation, and planning, programming, and executing the output. Children with language deficits have been found to be impaired in several of these areas including speech perception (e.g., Stark & Tallal, 1981), phonological processing (e.g., Bird, Bishop, & Freeman, 1995), and speech motor coordination (Goffman, 1999, 2004). Perhaps it is no wonder that nonword repetition is sensitive to the broad spectrum of language impairments as it taps so many of the processes involved in language. It has been suggested that nonword repetition consistently identifies SLI despite the heterogeneity inherent in the disorder because the ability to repeat novel phonological forms is constrained by multiple processes at least one of which may be impaired in any particular child with SLI (Archibald & Gathercole, 2006a; Ellis Weismer & Edwards, 2006).

Nevertheless, researchers have attempted to examine the role of individual component processes in nonword repetition. One important line of inquiry has explored the memory demands of nonword repetition. Evidence that nonword repetition relies critically on short-term memory for phonological information comes from a number of sources. First, longer nonwords are more difficult to repeat correctly (Baddeley, Thomson, & Buchanan, 1975; Cowan, Saults, Winterowd, & Sherk, 1991). Longer nonwords take more time to perceive and to repeat, and thus their phonological representations may decay before they can be repeated or rehearsed in the mind. Second, recall accuracy is greater for words than nonwords, indicating that lexical knowledge supports retention (e.g., Hulme, Maughan, & Brown, 1991). This support is unavailable or reduced in the case of nonwords, forcing increased reliance on phonological short-term memory. Third, performance on nonword repetition tasks is highly correlated with scores on standard measures of short-term memory such as digit span (e.g., Baddeley, Gathercole, & Papagno, 1998; Gathercole et al., 1994). Thus, one interpretation of poor nonword repetition is that it reflects a phonological short-term memory deficit (Gathercole, 2006; Gathercole & Baddeley, 1990). Consistent with this suggestion, SLI groups show the greatest repetition decrement for the lengthiest nonwords (see Graf-Estes et al., 2007, for a review of 23 studies). As well, children with SLI also perform poorly on standard measures of short-term memory such as digit recall and word list recall (Archibald & Gathercole, 2006c).

Another important area of inquiry has considered the extent to which prior word knowledge supports nonword repetition. According to this view, nonwords or even parts of nonwords activate existing lexical and sublexical units, which in turn support retention (Snowling, Chiat, & Hulme, 1991). Vocabulary growth leads to progressive segmentation such that abstract phonological representations become established separately from the lexicon. As the child develops even the phonemes within nonwords activate existing phonological knowledge supporting temporary storage. Children with slower vocabulary growth such as those with a language impairment will be at a disadvantage in nonword repetition due to a delay in the development of their phonological knowledge. Munson, Kurtz, and Windsor (2005) compared the performance of children with SLI, typically developing children matched for age, and younger children matched for receptive vocabulary on the repetition of nonwords differing in phonotactic probability, a measure of the frequency with which a sequence of sounds occurs in the lexicon of a language. In English, high-probability sequences such as [ft] occur in many real words such as after and fifty, whereas low-probability sequences such as [fk] occur rarely. It would be expected that children with larger vocabularies and more robustly abstracted phonological representations would be at an advantage in repeating nonwords with low-probability sequences. Results revealed that while the SLI group performed at lower levels overall than the age-match group and equivalent to the receptive-vocabulary match group, the SLI group was further disadvantaged relative to the age-match group when repeating the nonwords with low-probability sequences. It was suggested that the SLI deficit in nonword repetition particularly for low-probability phoneme sequences reflects the smaller vocabularies and less robust phonological representations of the SLI group. It should be noted that children with phonological impairments have not been found to be further disadvantaged in repeating nonwords with uncommon phonological sequences (Munson, Edwards, & Beckman, 2005). This finding suggests that children with phonological impairment are able to develop abstract phonological representations as expected for their age.

Several additional factors are known to influence nonword repetition. For example, phonological awareness (Metsala, 1999) or a more general phonological processing factor (Bowey, 1996, 2001) have been found to explain unique variance in nonword repetition performance. Bowey (2006) has argued that phonological processing is involved in each step of nonword repetition including recognizing, segmenting, and encoding the novel phonological form, and assembling the output. It may be, too, that the reduced recall accuracy for longer nonwords is due to the greater phonological processing demands imposed by the longer nonwords (Snowling et al., 1991) rather than the increased memory demands as described above. An additional factor that appears to be problematic for children with SLI is the articulatory complexity of the nonword. Children with SLI have more difficulty repeating nonwords associated with greater articulatory demands such as those that include consonant clusters (Archibald & Gathercole, 2006a; Bishop et al., 1996). Children with SLI may have subtle speech motor output deficits that contribute in part at least to their difficulties in nonword repetition.

Will nonword repetition assist with differential diagnosis? The answer to this question must be no, at the present time. Nonword repetition consistently

discriminates those with language impairment from those who are typically developing (e.g., Conti-Ramsden, 2003; Conti-Ramsden & Hesketh, 2003). Results from one study also suggest that nonword repetition may be useful in differentiating typical from impaired development in children learning a second language (Kohnert et al, 2006). The question that nonword repetition appears destined to fail is whether recall performance can distinguish those with different types of language impairment, for example, differentiating specific language impairment from general (non-specific) language impairment (NLI), or from a language impairment secondary to a syndrome such as autism. At this point in time, poor nonword repetition has been reported for a variety of groups in addition to SLI including nonspecific language impairment (Ellis Weismer et al., 2000), specific reading disabilities (Brady, 1997), autism (Bishop, Maybery, Wong, Maley, Hill, & Hallmayer, 2004), learning disability (Jarrold, Baddeley, Hewes, Leeke, & Phillips, 2004), Down's syndrome (e.g., Cairns & Jarrold, 2005; Laws, 2004), children with cochlear implants (Carter, Dillon & Pisoni, 2002), and children with fluency disorders (Hakim & Ratner, 2004). Only a few studies have provided direct comparisons between disorder groups. Nonword repetition performance has not been found to distinguish SLI and Down's syndrome groups (Laws & Bishop, 2003), or SLI and NLI groups (Ellis Weismer et al., 2000). A similar magnitude of the nonword repetition deficit was reported for groups of children with either SLI or a sensorineural hearing loss, although the scores of the SLI group were lower on phonologically complex nonwords (Briscoe, Bishop, & Norbury, 2001). In two older studies, lower nonword repetition accuracy was reported for SLI compared to reading impaired groups (Kamhi & Catts, 1986; Kamhi, Catts, Mauer, Apel, & Gentry, 1988). The question of differential diagnosis is an important one, and one that is sure to be addressed in future research. It may be that qualitative differences between groups can be identified that will assist in differential diagnosis in future clinical practice.

What test of nonword repetition should be administered? It is tempting to remark that there are as many nonword repetition tasks as there are research groups investigating the topic; however, this would be somewhat of an exaggeration. There are two tests that are most commonly employed, the Children's Test of Nonword Repetition (CNRep; Gathercole & Baddeley, 1996) and the Nonword Repetition Test (NRT; Dollaghan & Campbell, 1998). In an independent study (Archibald & Gathercole, 2006a) and a review (Graf-Estes et al., 2007), the effect size for the SLI group deficit was greater for the CNRep. As well, the CNRep contains 40 items rather than the NRT's 16, providing a greater sampling of the skill and a more robust measure for item level scoring. The CNRep is a published test with 10 nonwords at each of 2-, 3-, 4-, and 5-syllable lengths presented in a fixed random order by prerecorded audiocassette. There are some problems with the measure, however. The test is standardized on a UK sample for ages 4 to 8 years of age, and the norms appear to have a negative bias (i.e., even typical children receive low standard scores), making the normative data suspect for a Canadian population. A number of the items are similar to real words (e.g., trumpetine) or have real words in them (e.g., pennel), and half the items contain consonant clusters. As a result, the CNRep may rely on vocabulary knowledge and articulatory production to a greater extent than other tests of nonword repetition.

The NRT has been found to be highly consistent in identifying children with language impairment across a number of studies. The design of the items was carefully controlled to simplify articulatory demands (i.e., no consonant clusters or late developing consonants), improve acoustic salience (i.e., use of tense vowels only), and reduce wordlikeness (e.g., equal stress across syllables unlike English words). The test is available in the original article (Dollaghan & Campbell, 1998), which contains the phonetic transcriptions of the four nonwords at each of 1-, 2-, 3-, and 4-syllable lengths. The items were presented from an audiorecording in the order listed, and the child's responses were recorded for offline phoneme level scoring. The chief disadvantages of this test include the small number of items, the absence of normative data for either phoneme or item level scoring, and the lack of availability of prerecorded items for standard administration.

It should be noted that nonword repetition is a subtest included in the Comprehensive Test of Phonological Processing (CTOPP; Wagner, Torgensen, & Rashotte, 1999). The test was designed to provide a comprehensive assessment of phonological abilities, and was normed in the United States for individuals aged 5 to 24. The nonword repetition subtest includes 18 nonwords, 15 of which are test items ranging in length from 1- to 7-syllables. The non-words are administered by audiocassette recording roughly in order of length beginning at the shortest length.

How should a nonword repetition test be administered? Most researchers employ recorded stimuli when administering nonword repetition tasks to participants. Recorded lists clearly have the advantage of presenting identical stimuli to each child. It may be argued that spoken presentation is more clinically relevant (Chiat & Roy, 2007; Roy & Chiat, 2004); however, spoken presentation also introduces a certain degree of variability in the administration. Individuals vary their speech pattern when they are speaking to children, the elderly, or to someone they perceive to be less competent in the language. Clinicians may unwittingly influence the nonword repetition performance of their clients by hyperarticulating more difficult or longer nonwords, or when clients are doing poorly.

To whom should nonword repetition be administered? A nonword repetition test can be administered to persons of any age. It will be the clinical question at hand that drives task selection. Obviously, there is the issue of

identification of children with language impairment as discussed throughout this paper. Nonword repetition has been successful in discriminating language deficits across the life span from children as young as 2 years of age (Chiat & Roy, 2007) to adolescents with a history of language impairment (e.g., Conti-Ramsden et al., 2001). Thus, a nonword repetition test may be a useful screening tool in identifying young children at risk for language impairment (Conti-Ramsden & Hesketh, 2003). In addition, nonword repetition may provide important information in the assessment of older children referred due to language difficulties but whose deficits are not captured by standardized language tests. While the evidence-base is strongest for use of nonword repetition in the identification of language impairment, qualitative analysis of recall performance may provide clues as to the ability of the repeater to represent and retain phonological information. Frequent phoneme errors may reflect difficulties in either encoding or maintaining material whereas consistent loss of syllables especially from the final positions of longer nonwords may point to a particular difficulty remembering phonological information.

How severe is the nonword repetition deficit in SLI? In a review of 23 studies, Graf-Estes et al. (2007) reported an effect size for the nonword repetition deficit in SLI of 1.27 standard deviations. It appears, then, that although children with SLI consistently have difficulty repeating novel phonological forms, the magnitude of the deficit is not great. Given the fairly modest group differences, it is important to remember that not all individuals with SLI will receive low scores on a test of nonword repetition (Smith, 2006).

How might a nonword repetition deficit reflect a language learning impairment? Nonword repetition is closely and specifically linked to one particular aspect of language learning, vocabulary acquisition in typically developing children. Nonword repetition is highly associated with vocabulary knowledge of both the native language (e.g., Gathercole & Baddeley, 1989; Gupta, 2003) and non-native languages (e.g., Cheung, 1996; Masoura & Gathercole, 1999). Typically, the association is strongest during the early stages of language acquisition. For example, in a longitudinal study of vocabulary development in 4 to 8 year old children conducted by Gathercole et al. (1992), there was a marked decrease in the link between nonword repetition and vocabulary skills for the 8 as compared to 4 year olds. In foreign language learning as well, once individuals gain some facility with the foreign language, there is a diminished relationship with memory skills (Cheung, 1996; Masoura & Gathercole, 2005). This pattern of findings has led to the suggestion that two resource pools support vocabulary development (Baddeley, Gathercole, & Papagno, 1998; Gathercole, 2006). According to Gathercole (2006), in the early stages of learning when there is little available support from existing lexical knowledge, the ability to briefly store phonological forms plays an important role in new word learning. In later stages, however, the amassed lexical store supports vocabulary learning; novel phonological forms activate similar lexical and sublexical units within long-term memory, thereby facilitating acquisition. This proposal is supported by evidence linking nonword repetition with the speed of learning the phonological forms of new words, but not the acquisition of semantic features (e.g., Gathercole, Hitch, Service, & Martin, 1997; Gupta, 2003).

What are the clinical implications of a nonword repetition deficit? It is important to recall that the underlying cause of a nonword repetition deficit is as yet poorly understood. Studies have implicated phonological processing abilities including the abilities to recognize and segment phonemes, develop abstract phonological representations, and hold phonological information in mind for brief periods of time. It would follow, then, that appropriate intervention strategies would include those aimed at improving phonological knowledge and short-term memory for phonological material. In recent years, treatment methods targeting phonological awareness have proved effective in developing phonological knowledge (e.g., Gillon, 2000; Laing & Espeland, 2005; Segers & Verhoeven, 2004). The majority of intervention strategies aimed at improving short-term memory, however, are based on sound theoretical principles and clinical expertise. Much work remains in order to establish a solid evidence base for these methods, and clinicians must employ these techniques with some healthy scepticism and a view to carefully monitoring effectiveness for each individual with whom they are employed. Montgomery (2002) has compiled a list of assessment and intervention suggestions based on the assumption that deficits in temporary memory systems are causally linked to SLI. The intervention strategies aimed at improving phonological encoding and retention include engaging the child in repetition tasks that encourage children to notice the sound patterns in the language (i.e., phonological awareness activities), increasing the use of verbal rehearsal, and teaching chunking or paraphrasing strategies. We have assembled learning support strategies for use in classroom situations that either focus on enhancing retention or encouraging compensation for memory deficits (Archibald & Gathercole, 2006b). For example, when introducing new or arbitrary information, the emphasis should be on storing (or learning) the information, rather than on manipulation or processing of the information. Strategies that will facilitate the transfer of new information to long-term memory in a 'quality-rich' state should be adopted such as heightening awareness of the individual phonemes in the new word, and pairing repeated repetitions with rich contextual information. Thus, teaching of new vocabulary should focus on the words themselves initially, and tasks requiring more complex use of these words such as sentence creation or following multi-step directions should be introduced once the new material becomes familiar. Conversely, compensatory strategies are necessary when the memory and processing components are inherent in the task and cannot be minimized such as in reading comprehension or word problems in math.

Accommodations include reducing memory demands by using highly familiar vocabulary, or by providing external aids to make retention unnecessary.

Nonword repetition is a deceptively simple task that mimics native language learning. Individuals with difficulties in learning language typically are poor at repeating novel phonological forms. Children with SLI, at risk for SLI, and with a history of SLI are distinguished by their impaired nonword repetition from typically developing monolingual groups, and from children who are learning a second language. Therefore, nonword repetition may be a practical clinical tool to aid in the identification of individuals with SLI and other language impairments.

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