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Clinical Markers in Italian-Speaking Children with and without Specific Language Impairment: A Study of Nonword and Real Word Repetition as Predictors of Grammatical Ability

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Abstract

Background—In many languages, a weakness in nonword repetition serves as a useful clinical marker of specific language impairment (SLI) in children. However, recent work in Italian has shown that the repetition of real words may also have clinical utility. For young typically developing Italian children, real word repetition is more predictive of particular grammatical abilities than is nonword repetition. This finding is important because these particular grammatical abilities – the production of present tense third person plural inflections and direct object clitic pronouns – are precisely those that are problematic for Italian-speaking children with SLI. Along with their grammatical requirements, these two morpheme types present a significant phonological/prosodic challenge for these children.

Aims—The goal of this study was to replicate the findings with young typically developing Italian children and then determine whether real word repetition is also more predictive of the use of these two morpheme types than is nonword repetition in a group of Italian-speaking children with SLI.

Methods—Seventeen Italian-speaking children with SLI and 17 younger typically developing children matched for mean length of utterance participated in tasks of real word and nonword repetition as well as tasks requiring the production of direct object clitic pronouns and present tense third person plural inflections.

Outcomes & Results—Children with SLI were less accurate than their younger peers on all measures. Importantly, for the younger typically developing children, real word repetition explained a significant amount of variance in the use of third person plural inflections and direct object clitic pronouns. For the children with SLI, in contrast, nonword repetition was a significant predictor whereas real word repetition was not a contributing factor.

Conclusions—It is argued that in Italian SLI, the grammatical details showing the greatest weakness present phonological/prosodic obstacles as well as grammatical challenges to these children.

Keywords

Specific Language Impairment; Italian; Grammar; Nonword repetition; Real word repetition

Introduction

The study of children with specific language impairment (SLI) has benefited greatly from the identification of specific clinical markers of this disorder. Two types of measures that have served this purpose are those that require children to repeat nonwords (NW) of varying length (e.g., Graf Estes et al., 2007) and those that evaluate children's ability to use grammatical morphology or grasp particular kinds of syntactic structure (e.g., Bedore and Leonard, 1998; Bortolini et al., 1997; Rice and Wexler, 1996).

In NW repetition tasks, children hear a nonsense word and repeat it immediately. The usual pattern is that typically developing (TD) children have no difficulty repeating one or two syllable items but by three syllables, repetition accuracy begins to decrease. It has been shown that when neighborhood density and phonotactic frequency are controlled, it is Phonological Short-Term Memory (PSTM) that is primarily responsible for NW repetition (e.g., Gathercole, 1995). Children with SLI show an extraordinary deficit in NW repetition, and the gap between the performance of these children and that of their TD peers becomes much larger when the NWs are three and four syllables in length (e.g., Gathercole and Baddeley, 1990). However, differences between children with SLI and their TD peers can even be found at the one-syllable level (e.g., see the meta-analysis of Graf Estes et al., 2007), suggesting that discrimination, encoding, or production factors may also contribute to the weakness of children with SLI in this area.

Given the link between NW repetition and PSTM, NW repetition is considered to reflect an endophenotype of SLI (Bishop, 2006). Lewis and colleagues (2011) defined an endophenotype as an objectively measurable cognitive or linguistic parameter that is closely associated with a specific behavioral trait. Because endophenotypes are viewed as the cause of a clinical phenotype, they are more directly related to the underlying genetic basis for the disorder. Twin studies of English-speaking children have indicated that weaknesses in NW repetition constitute a phenotype of a heritable form of language impairment in children with SLI. For example, in the Bishop et al. investigations (1996, 2006), monozygotic twins were found to be more concordant in their NW repetition weaknesses than were dizygotic twins. Moreover, Barry et al. (2007) showed that NW repetition is a good task to distinguish parents of probands with language impairment from parents of TD probands.

Like NW repetition, the second clinical marker – grammatical ability – also seems to have a genetic basis in many cases (Bishop et al., 2006). However, there is no consensus as to the specific mechanisms that are disrupted that might cause weaknesses in grammatical ability. Some accounts propose significantly delayed biological maturation of particular linguistic principles (e.g., Rice and Wexler, 1996) whereas others propose deficits in processing that can range from affecting broad areas of functioning to rather specific memory or attentional processes (e.g., Dispaldro et al., 2012; Lum et al., 2011).

Numerous studies have reported significant correlations between the NW repetition performance of children with SLI and their performance on various measures of grammatical ability (e.g., Conti-Ramsden et al., 2001; Montgomery and Evans, 2009). Yet,

twin studies have demonstrated that these two types of weaknesses in children with SLI, while heritable, are also genetically separable (Bishop et al., 2006).

Nonword repetition is a relatively robust measure for studying SLI, not only for English, but for Italian (Bortolini et al., 2006; Dispaldro et al., in press), Spanish (Girbau and Schwartz, 2007), and Swedish (Sahlén et al., 1999). Some studies have also found utility in real word repetition (RW) (Chiat and Roy, 2007; Dispaldro et al., in press). Repeating RWs involves activation of lexical representations in long-term memory; these lexical representations reflect not just phonological knowledge, but also semantic knowledge. PSTM capacity is less critical in RW repetition than it is in NW repetition, as shown by the fact that overall accuracy is higher in repetition of RWs than in repetition of NWs in English (Chiat and Roy, 2007), Italian (Dispaldro et al., 2009a, 2011, in press) and Swedish (Sahlén et al., 1999).

In a series of studies, Dispaldro and his colleagues (2009a, 2011) have uncovered clear relationships between RW repetition, NW repetition, and the production of direct object clitic pronouns and present tense third person plural inflections. These authors found that both RW repetition and NW repetition were significantly correlated with these grammatical abilities in three- to four-year-old TD children; however, RW repetition explained more of the variance in these grammatical abilities than did NW repetition. This finding was viewed as consistent with the critical mass hypothesis – that incremental increases in the lexicon result in shifts in grammatical attainment (e.g., Bates et al., 1988). Specifically, it was assumed that RW repetition performance reflects lexical abilities, which, in turn, have a bearing on grammatical development. Nonword repetition, in contrast, primarily involves phonological memory and other phonological factors, with only limited (if any) influence from the lexicon.

Recently, Dispaldro et al. (in press) turned their attention to Italian children with SLI. They found that both NW repetition and RW repetition showed good diagnostic accuracy in distinguishing children with SLI from a group of typically developing (TD) peers matched for age. However, in this last study, the TD group performed at high levels of accuracy, and therefore the good diagnostic accuracy of the repetition measures might simply mean that Italian children with SLI are much weaker than TD children of the same age on both RW and NW repetition. The findings did not provide insight into whether RW repetition was as strong a predictor of grammatical abilities in the SLI group as Dispaldro and colleagues (2009a, 2011) found in their earlier studies of younger TD children who were not yet at ceiling on any of the measures. One goal of the present study was to answer this question.

There are reasons to question whether findings for Italian children with SLI will conform to the earlier findings for young Italian TD children. First, vocabulary is often stronger than grammar in Italian-speaking children with SLI, as in English-speaking children with SLI (e.g., Leonard et al., 1999). In both languages, select measures of grammar have shown good sensitivity and specificity (Bortolini et al., 2006; Rice and Wexler, 1996), but, to our knowledge, no measure of vocabulary has yet met a similar standard, in either language. To the extent that RW repetition is related to vocabulary skills, then, such a repetition measure might account for less variance in grammatical skills in a group of children with SLI than in a younger TD group.

Second, the diagnostically accurate grammatical measures in Italian consist of production tests of present tense third person plural inflections and direct object clitic pronouns (Bortolini et al., 2006). As noted by Bortolini and her colleagues (Bortolini and Leonard, 1996), both of these grammatical morphemes present special phonological/prosodic challenges to children with SLI. The former usually requires production of a verb consisting of at least three syllables with stress on the first syllable (e.g., *DORmono* '[they] sleep'), rather than the usual penultimate syllable. Such productions require the use of two weak syllables in succession following the initial stressed syllable. Direct object clitic pronouns are weak monosyllables that usually precede a finite verb (e.g., *lo MANgia* '[he/she] it eats'). Furthermore, when a subject precedes the clitic + finite verb sequence, the resulting utterance requires the clitic to be preceded by another weak syllable (as in *ANna la SPINge* 'Anna it pushes'), owing to the fact that most words in Italian end in a weak syllable. Leonard and Bortolini (1998) found that Italian children with SLI who have serious difficulties with these morphemes also tend to have subtle but detectable weaknesses with singular nouns that appear in the same phonological/prosodic contexts (e.g., *COMpito* 'homework' [cf. *COMprano*, *ANna la SPINge*; *latTUGa* 'lettuce' [cf. *lo MANgia*]). One of the weak syllables is vulnerable to omission in these instances (e.g., *COMpo* rather than *COMpito*, *TUGa* rather than *latTUGa*). To the extent that phonology/prosody is a weakness in Italian children with SLI, NW repetition, rather than RW repetition might prove to be a better predictor of these diagnostically significant grammatical weaknesses in these children.

In the present study, we examine whether RW repetition (as an index of lexical abilities) or NW repetition (as an index of phonological abilities) can account for a significant amount of variance in the use of third person plural inflections and direct object clitic pronouns by Italian children with SLI. In addition, we investigate whether the observed pattern diverges from that seen for younger TD children whose average utterance lengths are comparable to those of the children with SLI. Finding differences between these two groups of children in the predictor status of NW versus RW repetition could suggest that phonological/prosodic factors have a greater bearing on the grammatical use of children with SLI than in TD children and might be one reason for their extraordinary limitations in the area of grammar.

Method

Participants

Thirty-four monolingual Italian-speaking children ranging in age from 2;9 to 5;8 participated in the study. Seventeen preschool-age children (13 males and 4 females) formed the SLI group. They ranged in age from 4;1 to 5;8 ($M = 4;9$). The general criterion for inclusion in the SLI group was qualification for language intervention services based on an evaluation done by language therapists in one of two Health Services in the Northeast of Italy. All children passed a pure-tone hearing screening bilaterally (20 dB HL) at 500 Hz, 1000 Hz, 2000 Hz, and 4000 Hz. In addition, each child earned a nonverbal IQ score above 85 on the Italian version of the Wechsler Preschool and Primary Scale of Intelligence–III (Fancello and Cianchetti, 2008). Based on parent and clinician reports, no child had a physical impairment, global developmental delay, neurological dysfunction, emotional problems, or had suffered environmental deprivation. Although all of these children had

qualified for enrollment in speech-language services according to the Health Service guidelines, they had not yet begun therapy at the time of the study. All children in the SLI group were recruited by psychologists and language therapists employed by the Health Service.

The clinicians had judged the children eligible for services on the basis of clinical judgment and the results from one or more of several language tests used in Italy. These tests were used to identify below age-level receptive and expressive language skills in the areas of vocabulary and grammar. For receptive vocabulary, the tests were the Italian version of the PPVT-R (Stella et al., 2000) or the Test di Valutazione del Linguaggio (Cianchetti and Fancello, 2003). The tests used for receptive morphosyntax were the Prove di Valutazione della Comprensione Linguistica (Rustioni, 1994) or the Test di Comprensione Grammaticale per Bambini (Chilosi and Cipriani, 1995). For expressive vocabulary the Test di Valutazione del Linguaggio (Cianchetti and Fancello, 2003) was used. Finally, expressive morphosyntax was evaluated by therapists through analysis of the children's spontaneous language samples. Spontaneous language samples consisted of at least 100 utterances obtained when the children were looking at a picture book while interacting with the therapist. The sample was transcribed using the CHAT transcription format. The therapist used this language sample to rate expressive morphosyntax as "adequate," "mildly inadequate" or "highly inadequate" on the basis of mean utterance length and the presence of grammatical errors in the sample. As a group, the children's mean lengths of utterance (MLUs) in words averaged 2.72 ($SD = 0.61$; range = 1.74 – 3.61). According to Italian normative data (Cipriani et al., 1993), children with typical language reach this MLU range before three years of age (range 24–33 months). Based on the tests described above, all 17 children had been diagnosed as SLI with an expressive or receptive-expressive deficit. A summary of the children's test results appears in Appendix A.

The remaining 17 children (9 males and 8 females) were younger typically developing children, ranging in age from 2;9 to 3;7 ($M = 3;3$). These children were significantly younger than the children in the SLI group, $t(32) = 12.28, p < .001$. Each child in this group was matched to a child in the SLI group in MLU to within 0.2 words. MLU was calculated from at least 100 utterances obtained when the children were looking at a picture book while interacting with the experimenter. The sample was transcribed using the CHAT transcription format. MLUs for these children averaged 2.72 ($SD = 0.65$, range = 1.69 – 3.68). This matching resulted in very similar MLU values for the two groups, $t(32) = 0.04, p = .97$. Hereafter, these younger children are referred to as the TD-MLU children. The TD-MLU children were recruited from nursery schools in Padua. Children were not included if they showed any language, articulatory, hearing, neurological, or psychiatric deficit according to parent and teacher report. All children passed a pure-tone hearing screening bilaterally (20 dB HL) at 500 Hz, 1000 Hz, 2000 Hz, and 4000 Hz.

All research procedures were conducted according to the guidelines of the University of Padua for the protection of human participants. Parental consent was obtained for each child before inclusion in the study.

Materials and Procedures

Four tasks were administered to all participants – two grammatical tasks and two repetition tasks. The children were tested individually in a quiet room, with only the examiner present, for both the grammatical and repetition tasks. The tasks were completed by each child in random order. Data were collected over two sessions, each lasting 15–20 minutes, one session per day. All children's responses were recorded on a computer using a Sony ECM CZ-10 microphone and Audacity software. Responses were transcribed after the experimental session.

Grammatical tasks—The grammatical tasks tested two morphemes: the third person plural inflection in the indicative present tense (e.g., *corrono* '[they] run') and the third person direct object clitic pronoun (e.g., *la mangia* '[she/he] eats it'). These tasks have been used in previous studies (Dispaldro et al., 2009a, 2011), as production of these two morpheme types sharply distinguishes children with SLI from their TD peers (Bortolini et al., 2006).

The indicative present tense in Italian marks person (first, second, and third) and number (singular and plural). In order to elicit the present tense third person plural inflection (e.g., *mangiano* '[they] eat'), 9 colored drawings, each depicting an ongoing action (through an action performed by two individuals), were presented on a computer screen. Nine additional items were used to elicit a control inflection, the third person singular, using drawings that depicted an action performed by a single individual (e.g., *mangia* '[s/he] eats'). For the singular form, the actions depicted in the figure were the same as for the plural forms. The third person singular form is acquired quite early by children (e.g., Dispaldro et al., 2009b), and previous studies of children with SLI have shown near-mastery levels of use of this inflection at the ages studied here (Bortolini et al., 1997; Leonard et al., 1992). These items were inserted simply to ensure that children were attending to each picture and not perseverating on the plural form.

The nine different verbs used for the third person plural items were *bevono* '(they) drink', *dormono* '(they) sleep', *telefonano* '(they) phone', *scrivono* '(they) write', *corrono* '(they) run', *piangono* '(they) cry', *salgono* '(they) go up', *mangiano* '(they) eat', and *cantano* '(they) sing'. These same verbs were used for the third person singular items serving as a control. All verbs consisted of at least three syllables when used with the third person plural inflection. Verbs had simple and complex syllable structure (CV and CVC or CCV) with primary stress early in the word (the first syllable for all but *telefonano*), leaving the third person plural inflection to be produced with two weak syllables (e.g., *DORmono* '[they] sleep'). This stress pattern differs from the canonical weak-strong-weak syllable pattern seen in most Italian words (e.g., *poMAta* 'ointment').

The examiner prompted the child to describe each picture by asking 'Cosa succede qui?' ('What's happening here?'). This question was used in order to elicit production of the target morpheme (e.g., *piangono* '[they] cry'). Three practice items were used to familiarize the children with the task.

The direct object clitic pronoun in Italian marks person (first, second, and third), number (singular and plural), and grammatical gender (masculine and feminine). The third person direct object clitic pronouns assume two singular forms (masculine *lo* and feminine *la*) and two plural forms (masculine *li* and feminine *le*). The task consisted of 16 items with four items obligating the use of each of the four clitic pronouns.

In order to elicit the third person direct object clitic pronoun, a pair of colored drawings depicting two successive actions was presented. The examiner described the first of the two drawings and prompted the child to complete the sentence by describing the second, as in (1).

1. (Experimenter points to the first drawing and then the second drawing)

Experimenter La bambina lava i piatti e poi.....

‘The girl washes the dishes and then....’

Child Li asciuga

‘[She] dries them’

The first drawing appeared on the left-hand side of the computer screen, while the second was on the right-hand side. The order of presentation of items was random. Three practice items were presented.

Repetition tasks—The repetition tasks included a list of 24 real words (RW) and a list of 24 nonwords (NW). These lists were used in a previous study, as they elicit responses that exhibit both high sensitivity and specificity in distinguishing children with SLI from TD peers (Dispaldro et al., in press).

All RWs were taken from the Barca et al. (2002) database. These words were assumed to be known by five-year-old children based on Age of Acquisition estimates made by adults in the Barca et al. study. However, Dispaldro et al. (2009a) showed that these words were already known by three- year-old children. Moreover, according to the Italian MacArthur database (Caselli et al. 2007), three of the words used, *nebbia* ‘fog’, *tamburo* ‘drum’, and *torre* ‘tower’, are acquired prior to three years of age.

Real words had simple and complex syllable structure (CV and CVC or CCV), consistent with the articulatory and phonotactic characteristics of Italian. They had primary stress on the penultimate syllable, the most frequent stress pattern in Italian (e.g., *poMAta* ‘ointment’).

Items in the NW repetition task were constructed to be similar in phonemic structure to those in the RW task. Each NW was created from a RW by using the same initial phoneme and, wherever possible, replacing the remaining phonemes with ones similar in sonority and/or manner of articulation. The two sets of stimuli were matched for length in phonemes (from 4 to 9 phonemes) and syllables (2, 3, and 4 syllables), initial phoneme (with respect to sonority and manner of articulation), syllabic structure, sparse phonological neighborhood

density, and low phonotactic probability. We created stimuli that would be easy to repeat for young children, given that the phonemic and syllabic characteristics of the nonwords are usually mastered by children as young as three years of age (Bortolini, 1995).

Scoring

Grammatical tasks—For the third person plural inflection, productions of the inflection that accurately marked person and number (third, plural) were scored as correct (e.g., *mangiano* ‘[they] eat’ for a drawing of two children eating). In Italian, some verbs are irregular in their stem; overregularizations of these verbs were also scored as correct. For example, for the infinitive verb *salire* ‘to go up’, the child could produce the overregularization *salono* instead of the correct form, *salgono*. These cases were scored as correct because the correct third person plural inflection was used. Because Italian is a ‘null-subject’ language, in which the subject noun is not obligatory in the child’s responses (e.g., the response *mangiano* can be used instead of *loro mangiano* ‘they eat’), productions of the correct verb form without a subject were acceptable. All forms that did not correctly mark the target verb for person, number, or tense (e.g., *mangia* ‘[she/he] eats’ instead of *mangiano* ‘[they] eat’) were considered errors.

For the direct object clitic pronoun task, responses were scored as correct if the pronoun agreed in gender and number with the direct object (for example, Experimenter: *La bambina raccoglie le mele e poi*. Child: *le mangia* [Experimenter: ‘The girl picks the apples and then...’ Child: ‘[she] eats them’]). Pronoun omissions were scored as errors (e.g., *mangia* ‘[she] eats’ instead of *le mangia* ‘[she] eats them’)) as were errors of agreement in gender or number with the direct object (e.g., *la mangia* ‘[she] eats it’ instead of *le mangia* ‘[she] eats them’)). In addition, the use of the direct object noun phrase instead of the clitic was scored as an error (for example, *mangia le mele* ‘[she] eats the apples’)).

Repetition tasks—The children’s responses were transcribed using the International Phonetic Alphabet (IPA) by the first author, a native speaker of Italian. The production of a word was considered correct if children produced the phonemes in the same order as the target with no omissions or substitutions (additions and distortions were allowed) (Dollaghan and Campbell, 1998). Moreover, we took into account children’s articulation ability (e.g., Dispaldro et al., in press) for both groups by treating developmental errors as correct. Minimizing the impact of developmental phonological errors on scores allowed us to assess more accurately the contributions of PSTM to repetition performance. As a result, we could be more confident that group differences were not driven by differences in articulation. Accordingly, we examined the responses of the children and scored as correct any substitution that reflected a developmental phonological error in Italian, following Bortolini (1995). Other substitutions and omissions were scored as errors. This scoring procedure represented a highly conservative approach, because it narrowed the potential differences between the two groups.

The total number of phonemes repeated correctly was then divided by the total number of target phonemes to obtain a percentage of phonemes correct score at each length (2, 3 and 4 syllables). Separate calculations were made for the RW and NW tasks.

Audiorecordings from five children from each group were randomly selected and transcribed independently by a second trained listener. Phoneme-by-phoneme percentage of agreement for judgments of correctness was 94% (range = 90%–100%).

Results

Analysis Plan

In this experiment, we evaluated two kinds of measures and the relationship between them. The first measure tested accuracy in the production of two types of grammatical morphemes, the third-person plural inflection in the indicative present tense and third-person direct object clitic pronouns. The second measure was NW and RW repetition accuracy. Analyses of group differences are presented; we expected that the children in the SLI group would perform at lower levels than children in the TD-MLU group. Two effect-size estimates are used. The first is partial eta squared (η^2), often employed in analysis of variance designs. It describes the ratio of variance explained in the dependent variable by a predictor while controlling for other predictors. Based on eta squared values, a value of 0.0099 constitutes a small effect size, whereas 0.0588 and 0.1379 represent medium and large effect sizes, respectively (Cohen, 1988). The second effect size is d . Cohen's, appropriate for the comparison between two means; it expresses the difference between the means in standard deviation units. A d value between 0 and 0.3 is a small effect size, a value between 0.3 and 0.6 is considered to be a medium effect size, and a d value larger than 0.6 represents a large effect size (Cohen 1988). Assuming that a difference between groups was confirmed, the second aim of this study was to examine the relative potential of each repetition measure to predict the children's grammatical abilities.

Grammatical Measures

A summary of the children's use of the key grammatical morphemes – third person plural inflections and direct object clitic pronouns – appears in Table 1. As expected, the control morpheme type, third person singular inflections, did not reveal a difference between the SLI ($M = 88\%$, $SD = 15$) and TD-MLU ($M = 93\%$, $SD = 12$) groups, $t(32) = .962$, $p = .343$. However, the TD-MLU children showed greater accuracy on direct object clitic pronouns, $t(32) = 5.63$, $p < .001$, $d = 1.88$. In addition, the difference between the TD-MLU and SLI groups (favoring the former) on third person plural inflections approached significance, $t(32) = 2.016$, $p = .052$, $d = 0.56$. These two measures were significantly correlated, $r = .369$, $p = .032$. Accordingly, we derived a composite measure by averaging each child's score on third person plural inflections and direct object clitics, as was done in earlier work (Dispaldro et al., 2009a, 2011). On this composite measure, the TD-MLU children scored significantly higher than the children with SLI, $t(32) = 4.65$, $p < .001$, $d = 1.49$. Hereafter, we refer to this composite measure as the Grammatical Composite measure, a term that captures its emphasis while distinguishing it from NW and RW repetition.

Real Word and Nonword Repetition

A summary of the children's RW and NW repetition performance appears in Table 2. A mixed-design ANOVA was carried out on the percentage of phonemes correct, with word type (RW, NW) and word length (2 syllables, 3 syllables, 4 syllables) as within-subjects

factors, and participant group (SLI, TD-MLU) as a between-subjects factor. A significant main effect for word type was found, $F(1, 32) = 38.99, p < .001, \eta^2 = .549$, which showed that children repeated RWs more accurately than NWs. The results also showed a main effect for participant group, $F(1, 32) = 7.24, p = .011, \eta^2 = .18$, with higher scores earned by the TD-MLU group than by the SLI group. Length, too, showed a significant main effect, $F(2, 64) = 27.14, p < .001, \eta^2 = .459$, with accuracy decreasing with increasing length, as is evident in Table 2. We also observed a significant length x word type interaction, $F(2, 64) = 5.80, p = .005, \eta^2 = .153$. Post-hoc testing revealed higher scores for RWs than for NWs at each length (2 syllables $p = .015, d = 0.33$; 3 syllables $p = .001, d = 0.43$; 4 syllables $p < .001, d = 0.65$), with the largest difference seen at the 4-syllable level. No interactions involving participant group were significant (all $ps > .431$).

Relationship between Real Word/Nonword Repetition and the Grammatical Composite Score

The previous analyses showed that children repeated NWs less accurately than RWs, with an especially large difference ($d = 0.65$) seen at the level of 4 syllables. We assume that this larger difference occurred at the 4-syllable level because, at this level, there are greater demands on PSTM capacity. For this reason, performance on 4-syllable RWs and NWs could be a good measure to test the capacity of PSTM, with and without the support of lexical knowledge.

To examine the contribution of RW/NW repetition scores to the Grammatical Composite scores, we selected the children's scores for RW and NW repetition of 4-syllable items. For the TD-MLU children, the correlation between 4-syllable RW repetition and the Grammatical Composite scores was $r = .809, p < .001$; for 4-syllable NW repetition, the correlation was $r = .585, p = .014$. For the children with SLI, the correlation between 4-syllable NW repetition and the Grammatical Composite scores was significant, $r = .563, p = .019$, whereas for 4-syllable RW repetition the correlation was not significant, $r = .400, p = .112$.

We performed two regression analyses, with Grammatical Composite scores as the outcome measure. The data for the TD-MLU and SLI groups were examined separately given that the pattern of correlations was different for the two groups. Both analyses examined the contribution of each of the two repetition measures after taking into account the contribution of age. This approach provided a direct test of whether the two types of repetition measures were interchangeable.

Summaries of the regression analyses are provided in Tables 3 and 4. For the TD-MLU children, age accounted for a significant 38% of the variance ($t = 3.032, p = .008$) and RW repetition explained an additional significant 31% of the variance ($t = 3.706, p = .002$) after taking age into account. NW repetition, on the other hand, did not contribute to the model ($t = 1.537, p = .147$). The results were quite different for the children with SLI. For these children, age did not explain any variance in these children's Grammatical Composite scores ($t = -.545, p = .594$). However, NW repetition accounted for a significant 32% of the variance ($t = 2.680, p = .021$) in these children's Grammatical Composite scores. RW repetition did not contribute to the model ($t = 1.823, p = .090$).

Discussion

We begin by making three observations that we believe support the generalizability of the findings reported here. First, the results for the TD-MLU children replicate the earlier findings of Dispaldro et al. (2009a, 2011) that RW repetition is a significant predictor of grammatical abilities in young TD children. Second, as in the earlier work on Italian children with SLI (Bortolini et al., 1997, 2006), the children with SLI in our study were weaker in their use of third person plural inflections ($d = 0.56$) and significantly impaired in their use of direct object clitic pronouns ($d = 1.88$) relative to a younger group of TD children matched for MLU. Such findings confirm that these particular grammatical details represent extraordinary weaknesses in children with SLI that cannot be attributed to limitations in utterance length. Third, the children with SLI participating in the present study had already qualified for language intervention services on the basis of a collection of tests best described as general measures of grammatical and vocabulary abilities. Yet these children were also uniformly weak on our very specific measures of grammatical ability - third person plural inflection use and the use of direct object clitic pronouns. This observation suggests that our findings are probably applicable to children who may be identified as exhibiting SLI through a variety of more traditional clinical procedures.

RW repetition and NW repetition share several skills (e.g., speech perception, motor planning, PSTM), and can be influenced by some of the same factors (e.g., neighbourhood density, phonotactic frequency). However these two tasks differ in that PSTM is probably dominant in NW repetition, whereas RW repetition is based largely on phonological and semantic knowledge stored in long-term memory. The finding that, for both groups, RW repetition yielded higher scores than NW repetition lends credence to the assumption that RW repetition enabled the children to benefit from their lexical knowledge, over and beyond PSTM (Chiat & Roy 2007; Dispaldro et al., in press.). Consistent with this assumption is our finding of a word type x length interaction showing that the differences between the word types increased with increasing length. For NWs, increasing length could be expected to put greater strain on PSTM given that these items provided few or no links to the children's lexicons.

The children with SLI were less accurate than the TD-MLU children on RW as well as NW repetition. With respect to NW repetition, limitations in PSTM might have been responsible for the poorer performance of the SLI group (Dispaldro et al., in press.). However, children with SLI appeared to be less accurate than the younger children even at the two-syllable level. In our view, limitations in discrimination and/or encoding might also have contributed to the group differences. With respect to the difference between groups on RW repetition, it seems likely that this difference was in part due to differences in the two groups' ability to capitalize on the meaning of the RWs. These RWs were selected from words that are familiar to Italian children of preschool age (Barca et al., 2002). However, children with SLI may have had a more limited grasp of the meaning of some of these RWs, a suspicion rendered more credible by the fact that some of these children met clinicians' criteria for clinical services because of limitations in vocabulary as well as grammar (see Appendix A). Of course, the requirement of producing these RWs may have made the task even more

challenging for the children with SLI given that all children in this group had documented deficits in expressive language.

The regression model for the TD-MLU children showed that age was a significant predictor of Grammatical Composite scores. Such a finding is not surprising, given that during the age range studied here (2;9–3;7) grammatical development is still underway. For the children with SLI, age was not a predictor of Grammatical Composite scores. Although the age range of these children (4;1–5;8) was sufficient to detect a developmental shift, in clinical populations such as children with SLI, severity of deficit is also an important factor. Across a very large population of children with SLI, age is likely to be a predictive factor. However, within a group of 17 children as in the present study, a few older children with relatively severe deficits could easily render age less predictive of language ability. For example, from Appendix A it can be seen that one of the oldest children with SLI (Child 9, age 5;8) had a severe deficit in expressive morphosyntax, and another five-year-old (Child 7) not only had a severe deficit of the same type but also had a shorter MLU than most of the four-year-olds with SLI.

The finding that RW repetition was predictive of grammatical abilities in the TD-MLU group seems to be in line with the critical mass hypothesis offered by Bates and colleagues, an hypothesis that appears to have empirical support not only for English (e.g., Bates et al., 1988) but for Italian as well (e.g., Caselli et al., 1999). However, we do not have direct measures of the size of the children's lexicons and it is equally plausible that the relationship observed between RW repetition and grammatical abilities is a simple reflection of the children having comparable developmental skill in these two areas of functioning. The fact that RW repetition was not a predictor of the use of third person plural inflections and direct object clitics by the children with SLI indicates that, for these children, such grammatical abilities are less tied to lexical skills than may be the case for TD children. This seems especially plausible given that grammatical deficits are often reported for children with SLI whose lexical abilities are less deficient (Leonard et al., 1999). However, it is also possible that the children with SLI in this study had a more limited grasp of the lexical items in the RW repetition task than did the TD-MLU children; without a test of their comprehension of these words, we cannot rule out this possibility.

Why was NW repetition predictive of Grammatical Composite scores in the SLI group? After all, there is strong reason to believe that the abilities tapped through NW repetition and those assessed in our grammatical measures are separable (and heritable) deficits (Barry et al., 2007; Bishop et al., 2006). However, it is also true that a greater proportion of children show a deficit in both of these areas (e.g., Conti-Ramsden et al., 2001; Montgomery and Evans, 2009) than would be predicted on the assumption that these are completely independent weaknesses. For the case of Italian, there seem to be two plausible answers to the question of why NW repetition predicted Grammatical Composite scores in children with SLI. First, it is possible that what might appear to be a double deficit is actually an interaction between a grammatical deficit and a prosodic characteristic that is more universally challenging to children. For example, in repetition tasks that vary the prosodic structure of words, young children are more likely to omit a weak syllable that immediately precedes a strong syllable than a weak syllable that immediately follows a strong syllable

(Chiat and Roy 2007; Sahlén et al., 1999). Both the third person plural inflections and direct object clitic pronouns comprising the Grammatical Composite require a sequencing of syllables that runs counter to the strong syllable - weak syllable sequencing that young children seem to prefer. It seems likely that the non-canonical nature of such prosodic sequences constitutes part of the difficulty because one can find these same morphemes produced more accurately when they appear in other prosodic contexts. For example, Leonard et al. (1992) found that Italian children with SLI had less difficulty when third person plural inflections were required with verbs with monosyllabic stems, as in *FANno* '[they] do/make', *DANno* '[they] give', and *STANno* '[they] stay'. Note that in these words the (weak syllable) inflection immediately follows a strong syllable.

Leonard and Bortolini (1998) found that accuracy with clitics can also vary according to context. After finding that a group of children with SLI omitted direct object clitic pronouns more frequently than MLU-matched control children, these investigators examined contexts in which the clitic could follow rather than precede the lexical verb. Such contexts are seen when, for example, the clitic is placed after an infinitive. An example is *lo* 'it' in a sentence such as *Ho SMESso di FARlo* 'I stopped doing it'. In these contexts, the weak syllable clitic immediately follows a stressed syllable, thus allowing for a strong-weak syllable sequence (*FARlo*). Leonard and Bortolini found that the children with SLI were more accurate in their clitic use in these favorable prosodic contexts.

Prosodic sequences that deviate from the preferred strong-weak syllable sequence are somewhat challenging even for typically developing children. We assume that the same holds for children with SLI. Consequently, if the children with SLI had grammatical weaknesses to begin with, it could be expected that particular grammatical forms that must be expressed in prosodically challenging contexts would be placed in even greater jeopardy. Such might have been the case for these children's extraordinary difficulty with third person plural inflections and direct object clitic pronouns. NW repetition might have been a significant predictor because the prosodic requirements for production exacerbated the children's difficulty with these grammatical details, rather than being the primary source of the difficulty.

The second possibility is that a double deficit was, in fact, involved. In this case, one deficit area - the phonologically based deficit - might have encroached on another - the grammatical deficit - to a greater extent than in other languages given the particular prosodic requirements of these Italian morphemes. Because the influence that the phonologically based deficit might exert on these already vulnerable morphemes would be quite direct in this case, the deficit in this area could have been relatively mild and still have caused a drag on these children's Grammatical Composite scores.

In conclusion, we believe that the importance of our findings extends beyond their implications for SLI in Italian. In other languages, too, we might discover that particular profiles of special weakness in SLI reflect not just a primary problem but the influence of underlying difficulties in other areas. Identification of these kinds of weaknesses will give us a better understanding of the nature of the disorder.

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Appendix

Appendix A.

Summary of test scores for the children with SLI

Child	Age ^a	PIQ ^b	Expressive Language			Receptive Language			
			Lexicon	Grammar		Lexicon	Grammar		
			TVL ^c	EM ^d	MLU ^e	PPVT ^f	TVL ^g	TCGB ^h	PVCL ⁱ
1	5;5	106	1°	M	2.74	104		50°	
2	4;6	115	50°	H	1.74		95°	75°	
3	5;0	91	1°	H	1.88	70		10°	
4	5;8	85	1°	M	2.86	72		25°	
5	4;1	96	1°	H	2.54		15°	10°	
6	4;9	90	1°	H	1.88		45°	10°	
7	5;0	98	15°	H	1.87		35°	10°	
8	4;3	105	25°	H	3.26	83			HM
9	5;8	85	25°	H	3.31		45°	50°	
10	4;10	96	5°	M	3.39	84		25°	
11	4;4	106	1°	H	2.97		5°	10°	
12	4;5	85	5°	H	2.97		35°		LM
13	5;1	85	1°	H	2.63		25°	75°	
14	5;3	98	1°	H	3.50		25°	10°	
15	4;8	85	1°	H	2.28		1°		G
16	4;4	96	35°	M	2.86		25°	25°	
17	5;4	100	25°	M	3.62		25°	25°	

^a AGE is expressed in years;months.

^b PIQ (Performance IQ, WPPSI-III) has a mean of 100 and a SD of 15

^c TVL (Test di Valutazione del Linguaggio): Expressive vocabulary is expressed in 11 centile points (1°, 5°, 15°, 25°, 35°, 45°, 55°, 65°, 75°, 85°, 95°).

^d EM: Expressive Morphosyntax was evaluated by clinicians through spontaneous language samples as adequate (A), mildly inadequate (M) or highly inadequate (H).

^e MLU is expressed in words.

^f PPVT: has a mean of 100 and a SD of 15.

^g TVL (Test di Valutazione del Linguaggio): Receptive vocabulary is expressed in 11 centile points (1°, 5°, 15°, 25°, 35°, 45°, 55°, 65°, 75°, 85°, 95°).

^h TCGB (Test di Comprensione Grammaticale per Bambini): results are expressed in 5 centile points (10°, 25°, 50°, 75°, 95°).

ⁱ PVCL (Prove di Valutazione della Comprensione Linguistica): results are expressed in 6 classes (I = insufficient, P = poor, LM = low middle, M = middle, HM = high middle, G = good, VG = very good).

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What this paper adds**What is already known on this subject**

Phonological short-term memory is primarily responsible for nonword repetition, whereas in the repetition of real words the phonological input activates lexical knowledge stored in long-term memory. For typically developing children, scores on real word repetition tasks are good predictors of particular measures of grammatical ability, namely, the production of present tense third person plural inflections and direct object clitic pronouns.

What this study adds

Nonword repetition, rather than real word repetition, is predictive of the ability to produce these two types of morphemes in children with SLI. This result indicates that certain grammatical abilities in these children may depend more on phonological/prosodic factors than is true for their younger typically developing peers.

Table 1.

Mean Percentages (Standard Deviations) for Clitic Pronouns, Third Person Plural Verb Inflections and Grammatical Composite Scores

Groups	Clitic Pronouns	Third Person Plural Inflections	Third Person Singular Inflections	Grammatical Composite ^a
SLI	30 (26)	54 (39)	88 (15)	42 (26)
TD-MLU	78 (24)	76 (20)	93 (12)	77 (16)

^aThe Grammatical Composite score is a mean of the percentages for clitic pronouns and third person plural verb inflections

Table 2.

Mean Percentages (and Standard Deviations) of Phonemes Correctly Repeated at Each Word Length for Real Words (RW) and Nonwords (NW)

Group	2 Syllables		3 Syllables		4 Syllables		Total	
	RW	NW	RW	NW	RW	NW	RW	NW
SLI	89 (12)	86 (9)	83 (15)	75 (15)	79 (15)	70 (15)	84 (13)	77 (12)
TD-MLU	97 (5)	94 (5)	92 (11)	94 (5)	91 (13)	80 (14)	93 (9)	87 (10)
Total	93 (10)	90 (9)	88 (14)	82 (17)	85 (15)	75 (16)	89 (12)	82 (12)

Table 3.

Multiple Regression Analysis for Contribution of Real Word (RW) and Nonword (NW) Repetition Performance to the TD-MLU Group's Performance on the Grammatical Composite Measure

	R²	R² Change	B	SE	β	F	p
Step 1: Age	.380	.380	.041	.013	.616	9.193	.008
Step 2: RW	.687	.308	.871	.235	.680	13.736	.002

Table 4.

Multiple Regression Analysis for Contribution of Real Word (RW) and Nonword (NW) Repetition Performance to the SLI Group's Performance on the Grammatical Composite Measure

	R²	R² Change	B	SE	β	F	p
Step 1: Age	.019	.019	-.006	.011	-.139	.297	.594
Step 2: NW	.340	.321	.984	.377	.566	6.800	.021