Published in final edited form as:
Int J Lang Commun Disord. 2011 ; 46(5): 564–578. doi:10.1111/j.1460-6984.2011.00008.x.

A cross-linguistic study of real-word and non-word repetition as predictors of grammatical competence in children with typical language development

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Abstract

Background—Although relationships among non-word repetition, real-word repetition and grammatical ability have been documented, it is important to study whether the specific nature of these relationships is tied to the characteristics of a given language.

Aims—The aim of this study is to explore the potential cross-linguistic differences (Italian and English) in the relationship among non-word repetition, real-word repetition, and grammatical ability in three- and four-year-old children with typical language development.

Methods & Procedures—To reach this goal, two repetition tasks (one real-word list and one non-word list for each language) were used. In Italian the grammatical categories were the third person plural inflection and the direct-object clitic pronouns, while in English they were the third person singular present tense inflection and the past tense in regular and irregular forms.

Outcomes & Results—A cross-linguistic comparison showed that in both Italian and English, non-word repetition was a significant predictor of grammatical ability. However, performance on real-word repetition explained children's grammatical ability in Italian but not in English.

Conclusions & Implications—Abilities underlying non-word repetition performance (e.g., the processing and/or storage of phonological material) play an important role in the development of children's grammatical abilities in both languages. Lexical ability (indexed by real-word repetition) showed a close relationship to grammatical ability in Italian but not in English. Implications of the findings are discussed in terms of cross-linguistic differences, genetic research, clinical intervention and methodological issues.

Keywords

non-word repetition; real-word repetition; grammatical ability; crosslinguistic difference; typical language

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Introduction

In this paper, we explore potential cross-linguistic differences (between Italian and English) in the relationship among non-word repetition, real-word repetition, and grammatical ability in three- and four-year-old children with typical language development. Although relationships among these abilities have been documented (Botting and Conti-Ramsden 2001, Chiat and Roy 2007, Dispaldro *et al.* 2009), their precise nature remains elusive. By studying how these relationships change as a function of the language being acquired by the child, we may be able to come to a better understanding of the interacting learning mechanisms that may be involved.

Non-word and real-word repetition

Studies have shown that vocabulary size plays an important role in the development of children's grammatical abilities both in typical and atypical language development (Bates and Goodman 1999, Caselli *et al.* 1999, Devescovi *et al.* 2005). For example, the early appearance of grammatical morphemes is related to the number of words (especially verbs) in a child's vocabulary.

To the extent that the ability to succeed on real-word repetition tasks could reflect lexical ability, a relationship between real-word repetition performance and grammatical ability can be expected. For Italian, this appears to be the case: Dispaldro *et al.* (2009) found that a children's ability to repeat a list of real words was strongly related to their ability to produce verb inflections and clitic pronouns.

Dispaldro *et al.* (2009) also examined non-word repetition ability in the same Italian-speaking preschool children. Previous studies of English had found non-word repetition to be related to grammatical ability (Botting and Conti-Ramsden 2001, Chiat and Roy 2007). Similarly, Dispaldro *et al.* (2009) found that non-word repetition served as a significant predictor for grammatical ability in Italian when considered alone; however, these investigators also found that real-word repetition had greater predictive value than non-word repetition.

The authors interpreted this closer relationship between real-word repetition and Italian grammatical ability as a consequence of the fact that repetition of real words involves activation of the phonological form of a lexical representation in long-term memory (Chiat and Roy 2007, Dollaghan and Campbell 1998). This lexical representation captures not just phonological knowledge, but also semantic knowledge. In contrast, non-word repetition has links to lexical representations only in indirect ways; for example, non-words can differ in how word-like they are in the child's language (Dollaghan *et al.* 1993, Gathercole 1995), and how well they approximate the phonotactic sequences of words in the language (Edwards *et al.* 2004, Munson *et al.* 2005). Such factors influence children's non-word repetition accuracy. However, when lexical influences are controlled for, it is phonological short-term memory that is primarily responsible for non-word repetition performance (Gathercole *et al.* 1994). It should be noted that, in addition to phonological memory, other skills and knowledge such as speech perception and motor planning also contribute to performance on this complex task (Coady and Evans, 2008; Gathercole 2006).

The results described here for Italian-speaking children raise interesting questions about the relationship between the features of the language spoken by a child and differences between real-word and non-word repetition in their value as predictors of grammatical ability. At present no studies known to the authors have investigated this question.

Crosslinguistic differences between Italian and English

We believe that it is important to discover whether there are differences between non-word repetition and real-word repetition cross-linguistically and whether these differences are tied to the characteristics of a given language. In fact, differences in the grammatical characteristics of languages might well influence the relative accuracy of non-word repetition and real-word repetition as predictors of children's grammatical ability.

In this study, we compare English- and Italian-speaking children, and hypothesize that the relative strength of non-word repetition and real-word repetition as predictors of grammatical ability will differ across these two languages.

English is a language with a sparse grammatical morphology, relative to Italian (Radford, 2004). Although nouns and verbs can be inflected, these lexical forms appear much more frequently in the language as bare stems than as inflected forms. Infinitives are bare stems (e.g., *kick* in "We saw her *kick* the ball"; "He might *kick* the ball"; "They want to *kick* the ball") as are finite "zero-marked" forms (e.g., I *kick*, you *kick*, we *kick*, they *kick*). Most inflections are consonantal in nature (e.g., kick*s,* kick*ed*), thus differing only minimally from the bare stem equivalents of the same words. With such limited variations in the phonological forms of lexical items, and dependence on small phonological differences between bare stem forms and inflected forms, English-speaking children's acquisition of grammatical morphology may be more tied to the ability to focus on, and retain, small phonological differences than would be true for children learning other types of languages. As a consequence it is possible that these characteristics of grammar result in a stronger relationship between non-word repetition and grammatical ability in preschool English-speaking children.

We might expect a stronger tie between the lexicon and grammar for English irregular verbs since these forms may be acquired and represented as complete words (e.g, He *wrote*, I *ate*) whereas regular verbs are represented as bare stems with rule-based addition of the past tense morpheme (Marcus *et al.* 1992). However, it is well known that especially in the first phase of language acquisition children often treat irregular verbs as regular verbs (e.g., He writ*ed*, I eat*ed*) (overregularisation) (Marcus *et al.* 1992).

In contrast, Italian is a language in which nouns, verbs, adjectives, and pronouns are always inflected (Scalise 1994; Trifone and Palermo 2000). Nouns and adjectives will always be marked for number and gender (e.g. "little" piccol*o,* piccol*a,* piccol*i,* piccol*e*); finite verbs will always be marked for person, number, and tense (e.g., "I eat" mangi*o*, "we eat" mangi*amo*, "they ate" mangiav*ano*), and nonfinite verbs will always carry an infinitive or participle inflection (e.g., "[to] eat" mangi*are,* "eating" mangi*ando*, "eaten" mangi*ato*); pronouns, for example clitic pronouns, will always be marked for person, number and gender (e.g., "they eat them" *le* mangiano [feminine] or *li* mangiano [masculine], "they eat it" *la* mangiano [feminine] or *lo* mangiano [masculine]). Because in Italian the words carry grammatical marking as well as meaning, the ties between real-word repetition and grammatical ability might be expected to be relatively strong.

In addition, the many alternative phonological forms of each noun, pronoun, verb, and adjective (e.g., "pretty" bell*o*, bell*a*, bell*i*, bell*e*) that result from the inflectional nature of Italian, require attention to this phonological variation on the part of children learning this language. Thus, non-word repetition ability will have predictive value also in Italian. However, the phonological differences among different inflected forms of the same word in Italian depend on detecting differences in vowels (e.g., "pretty" /ˈbe l:o/ vs. /ˈbe l:a/) or whole syllables (e.g., "they run" /ˈko r:o no/ vs. "we run" /ˈko r:ja mo/). This means that in Italian the phonological contrasts are more salient and therefore sensitivity to small

phonological differences, in order to discover the grammatical rules, could be less crucial than is the case for English.

Objectives and predictions

The aim of the present work is to investigate whether there are cross-linguistic differences between real-word and non-word repetition in their predictive strength as regards grammatical ability. The characteristics of English and Italian led us to expect that non-word repetition would account for a greater percentage of variance in children's scores on measures of grammar in English, whereas real-word repetition would account for a greater percentage of variance in children's scores on grammatical measures in Italian.

In order to investigate these objectives, two repetition tasks (one real-word list and one non-word list for each language) were presented to three- and four-year-old children with typical language development. The grammatical categories were the following: in Italian, the third person plural inflection (e.g., "they drink" bev*ono*) and the direct-object clitic pronouns (e.g., "they eat it" *lo* mangiano) and in English, the third person singular present tense (e.g., she teach*es*) inflection and the regular and irregular past tense (e.g., he paint*ed,* she *ate*). These particular grammatical morphemes were chosen because they have been identified as clinical markers of specific language impairment (SLI) in their respective languages. Thus, mastery of these morphemes serves as a good measure of typical and atypical language development (Bortolini *et al.* 2006, Conti-Ramsden *et al.* 2001, Rice and Wexler 1996).

The portion of the study on Italian is a replication of Dispaldro et al. (2009). This new sample of Italian children could enable us to confirm and extend the previous findings on the effect of lexical representation on grammatical ability in Italian.

Method

Participants

A total of 78 children with typical language development participated in this study: 48 of them were monolingual Italian speakers while 30 were monolingual English speakers. Each language group was further subdivided into three age groups with a mean age of 3;0 (years; months), 3;6, and 4;0 (see Table 1). All research procedures were conducted according to guidelines for the protection of human participants of the authors' institutions; parental consent was obtained for each child before inclusion in the study.

Italian-speaking population—The Italian-speaking children were recruited from nursery schools in Padua (Italy). Children were not included if they showed any language, articulatory, hearing, neurological or psychiatric deficit according to parent and teacher report.

English-speaking population—The English-speaking children were recruited through the Department of Speech, Language, and Hearing Sciences at Purdue University (West Lafayette, Indiana, USA). The Verbal Comprehension subtest of the Reynell Developmental Language Scales (Reynell and Gruber 1990) was used as a general measure of receptive language development. An articulation screener (Rice and Wexler 2001) was used to ensure that all children could produce the consonants required by the experimental grammatical task (i.e., /s/, /z/ and /t/, /d/ in the word-final position for the morphemes third singular present tense –s and past tense –ed). All children passed a pure-tone hearing screening bilaterally (20 dB HL) at 500 Hz, 1000 Hz, 2000 Hz, and 4000 Hz (American Speech-Language-Hearing Association 1997).

Procedure and Materials

The Italian-speaking children were tested individually in a quiet room in their nursery school in Padua. The English-speaking children were assessed individually in a quiet room in the Speech and Hearing Clinic at Purdue University. For all children, the tasks were administered over two or three sessions (one session per day), each lasting 20 minutes. 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 by a native speaker of the language tested (the first author for Italian and the second author for English).

Repetition Tasks

—The repetition stimuli were administered live-voice. Each list included three practice items. The experimenter said each word aloud, encouraging the child to repeat each one as accurately as possible. Practice items were repeated as necessary until the child was comfortable and responsive. The experimental stimuli were then presented, with each target word spoken only once. Non-contingent positive verbal reinforcement (e.g., "You're doing so well!") was given throughout the task and no corrective feedback was given. Transcription of responses was done after the experimental session. The order of stimuli presentation within each list was fixed. The lists themselves were administered on different days, in counterbalanced order, with half of the children receiving the real-word list first and half receiving the non-word list first.

Italian repetition task: The task was composed of a list of 16 real words and a list of 16 non-words, for a total of 32 targets (see Appendix A for a complete list) (Dispaldro *et al.* 2009). The words contained in the real-word list are assumed to be known by preschool children, based both on norms reported in the Barca *et al.* (2002) database and the results showed in Dispaldro *et al.* (2009). They were selected on the basis of their familiarity to reduce possible effects of differences in experience related to social-cultural background. The non-word stimuli closely matched the real words: for each real word, a non-word was constructed that used the same initial phoneme and replaced the other phonemes with ones similar in sonority or manner of articulation (for example, the non-word /'bofo/ was created to match the real word /'bava/).

The real-word and non-word lists contained equal numbers of two- and three-syllable words. Moreover, real- and non-word targets were matched for syllabic structure. Half the stimuli had a simple (Consonant/Vowel (CV)) syllabic structure; for example, the real-word "sugo" and non-word "simi" had [CV CV] structure); and half the stimuli had a complex syllabic structure (CCV or CVC); for example, the real-word "spada" and the non-word "frive" had [CCV CV] structure). All words had the same prosodic structure, with stress on the word's penultimate syllable. To minimize the articulatory difficulty of the repetition tasks, the stimuli were constructed such that the words' initial consonants were those known to be in the inventory of three-year-old children. To control for the influence of phonological representations stored in long-term memory (Edwards *et al.* 2004, Munson *et al.* 2005), both real and non-words were matched on neighborhood density and on phonotactic probability.

English repetition task: For the English real-word and non-word stimuli, we used the Preschool Repetition Test (PSRep) (Chiat and Roy 2007) (see Appendix B for a complete list), adapting it in two ways. First, because the Italian repetition task did not include one-syllable words, we did not use the PSRep's one-syllable real or non-words. Second, the PSRep uses Southern British Standard English pronunciation (for example, pronouncing the real word 'person' as /ˈpɜ sən/ and the corresponding non-word 'serpen' as /ˈsɜ pən/).

Standard American English pronunciation was targeted in this study, thus adult pronunciations would be /ˈpɝ sn/ and /ˈsɝ pən/ for these words.

After these modifications, the PSRep test included two lists of 12 stimuli each: one list of real words and one list of non-words. The non-word targets (for example /lʌ ˈpis/) were created by reversing the consonants of the respective real word (for example /pʌ ˈlis/, "police") while maintaining vowels in their original positions. Real-word and non-word lists had equal numbers of two and three syllable words. Given the prosodic structure of English words the stimuli had the follows features: for two-syllable words the prosodic structure was SW (Strong/stressed – Weak/unstressed) or WS, while for three-syllable words the structure are SWS or WSW (For further details about the stimuli, see Roy and Chiat 2004).

Grammatical Tasks

Italian grammatical tasks: The morphological categories used were the *third-person plural inflection in the indicative present tense* (bev*ono* [they *drink*]) and the *third-person direct object clitic pronoun* (*la* spinge [she/he pushes *it*]. The indicative present tense in Italian marks person (first, second, and third) and number (singular and plural). Because Italian is a *pro-drop* language and verb morphology allows identification of the subject, the subject noun is not obligated in the child's responses (for example, the response 'mangiano' instead 'loro mangiano' [they eat] is acceptable). 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').

These morphemes constitute clinical markers in Italian; that is, Italian preschool children are accurate in the use of these grammatical categories (Leonard *et al*. 2002), while children with SLI show problems with them (Bortolini *et al*. 2006). Studies have shown that Italian-speaking children with SLI can be readily singled out from their typically developing peers on the basis of their inconsistent use of such morphemes. Measures of this type exhibit both high sensitivity and specificity (Bortolini *et al*. 2006). That is, they succeed in identifying children with SLI (sensitivity) while also correctly "passing" those children who have typical language (specificity).

In order to elicit the third-person plural present tense inflection, 18 colored drawings, each depicting an action, were presented on a computer screen (see Appendix C for a complete list) (Bortolini *et al*. 2006, Dispaldro *et al*. 2009, Leonard *et al*. 2002). 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.,'dormono' [they sleep]).

Nine items elicited the third-person plural inflection (through an action performed by two individuals; for example, two sleeping children) and nine were used to elicit the third-person singular inflection (through an action performed by one child; for example, one sleeping child). The third-person singular items were included in order to avoid an effect of perseveration on the plural form. These were excluded from the analyses. Singular and plural drawings were presented in random order. Three practice items were used to familiarize the children with the task.

In order to elicit the third-person direct object clitic pronoun, 16 pairs of colored drawings depicting two consequential actions were presented (Bortolini *et al*. 2006, Dispaldro *et al*. 2009, Leonard *et al*. 2002). The examiner described the first of the two drawings and prompted the child to complete the sentence by describing the second. For example, [first

picture] Experimenter: 'La bambina compra il gelato e poi..'; [second picture] Child: '*lo* mangia' (Experimenter: The girl buys an ice cream and then.. Child: she eats *it*') (see Appendix D for a complete list). 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. To familiarize the children with the task, three practice items were used.

English grammatical tasks: The morphemes used for English were the *third-person singular inflection in the indicative present tense* (he/she help*s*) and the *past tense* in regular and irregular forms (he/she paint*ed*; he/she *caught*). These morphemes are considered clinical markers of SLI in English, capable of distinguishing between children with typical language and children with SLI (Conti-Ramsden *et al.* 2001, Rice and Wexler 1996). The Test of Early Grammatical Impairment (TEGI, Rice and Wexler 2001) was used to elicit these morphemes.

The third-person singular portion of the TEGI was designed to assess correct grammatical usage of the third-person singular *-s*. The test consisted of 10 colored drawings depicting an action. The experimenter asked a question about the drawing to which the child was obligated to respond using a third-singular verb form (for example, Experimenter: 'Here is a teacher. Tell me what the teacher does'; Child: 'A teacher teach*es.*')

To assess the child's ability to produce the past tense in regular verbs (*-ed*) and irregular verbs, we used the past tense portion of the TEGI. This consisted of 18 pairs of colored drawings depicting two sequential actions. The first picture showed a person performing an action; the second picture showed the same person after he or she had finished the action. The experimenter read a sentence related to the first picture and then prompted the child to describe the second picture using the past tense form. For example, [first picture] Experimenter: "Here the boy is raking. Now he is done. Tell me what he did."; [pointing to second picture] Child: "He rak*ed.*" The task was composed of 10 regular and 8 irregular verb items.

Scoring

Italian and English Repetition Tasks—Children's repetitions were transcribed using the International Phonetic Alphabet (IPA) (broad transcription) by native speakers of each language (the first and second author for Italian and English, respectively) who were trained in phonetic transcription.

For both languages and for both word types, productions were scored using the method of Dollaghan and Campbell (1998). Each phoneme produced by the child was compared to its target and scored as incorrect if the child omitted it or substituted another phoneme. Phoneme additions and distortions were not counted as errors. If one or more syllables were omitted, the syllable sequence produced by the child was aligned to the target using the vowels as syllable anchors; once aligned, scoring of each phoneme proceeded as described. Non-responses were not included in the analyses.

The total number of phonemes repeated correctly was then divided by the total number of target phonemes to obtain a percentage of phonemes correct (PPC) score at each real-word and non-word length (2 and 3 syllables).

Grammatical Tasks

Italian grammatical tasks: For third-person plural inflection in the indicative present tense, productions of the inflection accurately marking person (third), number (plural) and tense (indicative) were scored as correct (for example, 'mangi*ano*' [they eat] for a drawing with

two children eating). Certain overregularizations were also scored as correct. In Italian some verbs are irregular in their root; an over-regularization is a production in which the verb's regular root is used instead of its irregular root. For example, for the infinitive verb /sal-*ire*/ [to go up], the child could produce the overregularization "sal-*ono*" instead of the correct irregular form,"salg-*ono*". These cases were scored as correct because the correct third-person plural inflection was used. All forms that did not correctly mark the target for person, number, or tense were considered errors (for example, the child produced 'mangi*a*' [s/he eat] for a drawing with two children eating).

Responses in the direct object clitic pronoun task were scored as correct if the pronoun agreed in gender and number with the direct object, for example, Experimenter: "I bambini raccolgono le *mele* e poi.. Child: *le* mangiano" [Experimenter: The boys pick the *apples* and then.. Child: they eat *them*]. Responses that were scored as errors included the omission of the pronoun (for example, "mangiano" [they eat]); an error of agreement in gender or number with the direct object (for example, "*la* mangiano" instead of "*le* mangiano" [they eat *it*]); and use of the direct object noun phrase instead of the clitic ("mangiano le *mele*" [they eat the *apples*]). For both morphemes tested, incomplete responses or ambiguous responses and non-responses were excluded from the analyses.

English grammatical tasks: For the third-person singular probe, productions were scored as correct if they included a third-person singular subject followed by a third-person singular present tense verb form (for example, "S/he paint*s*"). Productions were scored as incorrect if the morpheme was omitted in a third-person singular context (for example, "S/he paint") or the verb was double marked (for example, "S/he *paintses*"). Scores were calculated by dividing the total number of correctly marked verbs by the total number attempted (correct and incorrect responses) and multiplying by 100 to get a percentage correct score. Responses were considered unscorable if the child produced any verb form or tense other than the third-person singular present tense (for example, "S/he played").

For the past tense probe, regular verbs were scored separately from irregular verbs. For regular verbs, a response was considered correct if it included a subject followed by a correct production of the regular past tense form of the verb (for example, "S/he paint*ed*"). A response was considered incorrect if the child omitted the morpheme – *ed* in a past tense context (for example, "S/he paint"). For irregular verbs, a response was considered correct if it included a correctly formulated irregular past tense (for example, "S/he *wrote*") or if the verb was overregularized (for example, "S/he wroted" or "S/he writed"). A response was considered incorrect if it was not correctly formulated (for example, "S/he write"). The percentages correct of the total past tense are an average of the percentages correct for regular and irregular forms. Responses were considered unscorable if the child's production included any verb tense other than past (for example. "He will paint").

For both morphemes, unscorable responses and non-responses were excluded from the analyses.

Results

Italian Language

Repetition Tasks—The mean PPCs and standard deviations for each age group are reported in Table 2. Means are reported for all words (TPPC, total percentage of phonemes correct), for two syllable words (2PPC), and for three syllable words (3PPC).

A mixed-design analysis of variance (ANOVA) was carried out on the percentage of phonemes correct (PPC) as a dependent variable, with Word Type (real-word list and non-

word list) and Word Length (two and three syllables) as within-subjects variables and Age level (3;0, 3;6, and 4;0 years) as a between-subjects variable.

The analysis showed a significant main effect of Age ($F(1, 45) = 3.870$, $p = .028$, $\eta p^2 = .147$); post-hoc (Bonferroni) showed that 4;0 year-olds scored higher (95%) than 3;0 year-olds (90%). A significant main effect of Word Type ($F(1, 45) = 22.828$, $p < .0001$, $\eta p^2 = .337$) was found which showed that children repeated real words (94%) more accurately than non-words (91%). There was also a significant main effect of Word Length ($F(1, 45) = 6.211$, $p = .016$, $\eta p^2 = .121$) such that two-syllable words were easier (93%) to repeat than three syllable-words (91%). Finally, there was a significant two-way interaction between Word Type and Syllable Length ($F(1, 45) = 4.255$, $p = .045$, $\eta p^2 = .086$) which showed that as length in syllables increased, accuracy of repetition decreased to a greater degree for non-words than for real words. Finally, we tested for a correlation between performance on real-word repetition and non-word repetition and found that the two were highly correlated ($r = 0.807$, $p < 0.0001$). This suggests that although differences in lexical knowledge led to differences in performance, real-word and non-word repetition tasks also tap many of the same underlying abilities (e.g., phonological working memory, speech perception, and motor planning).

Grammatical tasks—The mean percentages correct for clitic pronouns and the third-person plural inflection are shown in Table 3 (both variables were normally distributed: in Kolmogorov-Smirnov test, all $ps > 0.05$). A mixed-design ANOVA was carried out on the percentages of correct productions with Grammatical Categories (pronouns and verb inflections) as a within-subjects variable, and Age (3;0, 3;6, and 4;0 years old) as a between-subjects variable.

The analysis showed a significant main effect of Age ($F(2, 45) = 4.755$, $p = 0.013$, $\eta p^2 = 0.174$); Bonferroni post-hoc testing at the 0.01 level revealed that 4;0 year-old children scored better (77%) than 3;0 year-olds (53%). Moreover, the interaction between Grammatical Category and Age was also significant ($F(2, 45) = 4.424$, $p = 0.018$, $\eta p^2 = 0.164$). This interaction reflected the fact that the increase in children's accuracy over time for clitic pronouns was greater than that seen for the third-person plural inflection.

Relationship Between Repetition Tasks and Grammatical Abilities In Italian—To explore the relationship between performance on the repetition tasks and performance on the grammatical tasks, two regression analyses were performed. To identify which list is the best predictor of grammatical abilities, the real-word list was entered as a predictor into a regression analysis (Table 4) and the non-word list was entered into a second regression analysis (Table 5). The outcome variable (grammatical ability) was computed by averaging the percentage correct for the direct object clitic pronoun and the third-person plural inflection(the correlation between these two grammar measures was significant ($r = .398$ $p = 0.005$). The first predictor variable entered into each regression was Age (this was a categorical variable, with age 3;0 used as the baseline level); the second was repetition performance (real-word repetition was entered in the first regression analysis and non-word repetition in the second).

To assess each regression's goodness of fit, several residual diagnostic plots were performed (using the function *plot.lm* in the software *R*) (R version 2.8.1). These methods are useful for detecting unusual data including outliers, high/leverage points and influential observations; moreover, they allow us to check the normality of the residuals (Cook and Weisberg 1982). In particular we calculated the Cook's distance measure (Cook and Weisberg 1982) on the dependent variable (grammatical ability). Cook's distance is very useful for identifying influential data points. It measures the influence of an outlier on both

the dependent variable (grammatical ability) and on the set of predictors (real-word list and non-word list). Cook and Weisberg (1982) indicated that a Cook's distance greater than 1 would generally be considered large; this provides a "red flag" for identifying outliers (Stevens 1996).

The analysis suggested a satisfactory goodness of fit for the two regression models and no outliers were detected.

A fixed-order multiple regression was first computed to test the contribution of real-word performance to grammatical ability (Table 4). In Step 1, Age explained 16.22% of the variance (Sig. F change, $p = .018$). In Step 2, real-word performance explained 51.78% of the variance beyond that explained by age (Sig. F change $p < .0001$) and significantly predicted performance on grammatical ability ($\beta = 9.608$; t = 8.438, $p < .0001$).

The second fixed-order multiple regression was conducted to identify the contribution of non-word performance to grammatical ability (Table 5). The results for Age (Step 1) were the same as in the previous analysis; in Step 2 the results showed that non-word performance explained 38.38% of the variance, beyond that explained by Age (Sig. F change, $p < 0.0001$) and significantly predicted performance on grammatical ability ($\beta = 7.917$; t = 6.098, $p <$. 0001).

English Language

Repetition Tasks—A mixed-design analysis of variance (ANOVA) was carried out on the percentage of phonemes correct, with Word Type (real-word list and non-word list) and Word Length (two and three syllables) as within-subjects variables and Age level (3;0, 3;6, and 4;0 years) as a between-subjects variable. The mean percentage of phonemes correct and standard deviations for each age group are reported in Table 6. The analysis showed a main effect of Age on repetition ($F(1, 27) = 3.556$, $p = .043$, $\eta p^2 = .208$); however, post-hoc (Bonferroni) testing at the .01 level revealed no significant difference between the three age groups. There was also a main effect of Word Type ($F(1, 27) = 5.268$, $p = .030$, $\eta p^2 = .163$): children repeated real words (93%) more accurately than non-words (91%). No Word Length effect was found.

As in Italian, performance on the real-word repetition and non-word repetition tasks were highly correlated ($r = 0.708$, $p < 0.0001$).

Grammatical tasks—The mean percentages correct for third-person singular and total past tense (regular and irregular forms) are shown in Table 7 (both third-person singular and total past tense were normally distributed: in Kolmogorov-Smirnov test, all $ps > 0.05$). The percentages correct of the total past tense are an average of the percentages correct for regular and irregular past tense. Looking at the irregular past tense column in Table 7, it is important to note the different contributions made to these percentages by correct irregular productions (e.g., s/he *ate*) and overregularizations (e.g., s/he eat*ed*). At 3;0 years old, 33% of irregular verbs were produced correctly (e.g., s/he *ate*) while 67% were overregularized (e.g., s/he eat*ed*); at 3;6, 30% of irregular verbs were produced correctly and 70% were overregularized; finally, at 4;0, 37% were produced correctly and 63% were overregularized. These percentages show that in our study children often treated irregular past tense verbs as regular verbs, using the regular past tense rule.

A mixed-design ANOVA was carried out on the percentages of correct production with grammatical categories (third-person singular and total past tense inflection) as a within-subjects variable, and age (3;0, 3;6 and 4;0 years old) as a between-subjects variable.

The analysis showed a main effect of grammatical categories ($F(1, 27) = 7.445$, $p = 0.011$, $\eta^2 = 0.216$) such that third-person singular verbs were produced more accurately than past tense verbs.

Relationship Between Repetition Tasks and Grammatical Abilities In English Language—Two fixed-order multiple regression analyses were performed, the first using performance on the real-words list and the second using performance on the non-words list, to determine which list was the best predictor of grammatical ability (Table 7). In each regression analysis the outcome variable was the average of the correct productions of the two grammatical morphemes (grammatical ability). The correlation between these two grammar measures was $r = .673$, $p < 0.0001$. Age was entered as the first predictor variable in both regressions (Age was a categorical variable; 3;0 years was used as baseline level); repetition performance was entered as the second predictor in both analyses (real word for the first regression analysis and non-word first for the second analysis).

Several residual diagnostic plots were first performed to assess goodness of fit for each regression, as was done with the Italian data. In this case the two models presented a satisfactory goodness of fit and no outliers were detected (Cook and Weisberg 1982).

The first regression was computed to test the contribution of real-word performance to grammatical ability (Table 8). In Step 1, age explained 9.44% of variance (Sig. F change, p = n.s.). In Step 2 real words explained 4.5% of the variance beyond that explained by age (Sig. F change p = n.s.).

The second regression was conducted to identify the contribution of non-word performance (Table 9). In Step 1, age explained 9.44% of the variance (Sig. F change p = n.s.). In Step 2 the non-word lists explained 22.26% of the variance beyond that explained by age (Sig. F change $p = .008$) and significantly predicted performance on the grammatical ability tasks ($\beta = 1.8327$; $t = 3.285$, $p = .003$).

Comparison Between the Two Languages

So far, we have assessed the relationship between repetition ability and grammatical ability within each of the two languages. The results supported two different models: for the Italian data, performance on the real-word repetition task explained more of the variance (51.78% beyond that explained by age) in grammatical ability than performance on the non-word repetition task did (38.38% beyond that explained by age); age explained 16.22% of the variance. In contrast, for the English data, performance on non-word repetition tasks explained more variance (22.26% beyond that explained by age) in grammatical ability than performance on the real-word repetition tasks did (4.5% beyond that explained by age); age explained 9.44% of the variance.

In this last section we explore whether there are cross-linguistic differences by directly comparing the real-word performance for Italian and English and non-word performance for both languages. The aim of this comparison is to better understand the importance of a given repetition task (e.g., real-word) in the two languages; only this kind of analysis can clarify the role of language-specific characteristics in the relationship between repetition tasks and grammatical ability. Even though the dependent variable (grammatical ability) is based on different set of morphemes in Italian and English, the comparison is theoretically and empirically motivated because each set constitutes a clinical marker in the respective language.

In order to test these differences we followed three steps. The example here compares Italian and English real words, but the same method was used to compare Italian and English non-words:

1. In the first step the effect of Age was excluded both from Italian Grammatical Ability and English Grammatical Ability. We named these *Italian Grammatical Ability Residual Adjusted for Age* and *English Grammatical Ability Residual Adjusted for Age* (see Figure 1 *Grammatical Ability Residual Adjusted for Age*).
2. The correlation between Italian Grammatical Ability Residual Adjusted for Age and Italian real-word repetition was calculated; separately, the correlation between English Grammatical Ability Residual Adjusted for Age and English real-word performance was calculated.
3. These two correlations were compared using the Test of Difference Between Two Independent Correlations (Cohen and Cohen, 1983).

The results showed that there were not significant differences between the two languages in the relationship between grammatical ability and non-word repetition, whereas there were significant differences in the relationship between grammatical ability and real-word repetition (Figure 1).

Discussion and Conclusion

The main aim of this study was to investigate the possible cross-linguistic differences between real-word and non-word repetition in their potential to predict grammatical ability. A group of Italian monolingual and a group of English monolingual children were selected. Both groups were composed of three- to four-year-old children with typical language development. Each child was administered two repetition tasks and two tasks testing grammatical ability.

For both the Italian and the English groups, children's performance confirmed what was already known from previous studies: real words are easier to repeat than non-words (Chiat and Roy 2007, Dispaldro *et al.* 2009). Also, for both groups, children's grammatical performance confirmed that they were developing language in a typical fashion. (Leonard *et al.* 2002, Rice and Wexler, 1996, Conti-Ramsden *et al.* 2001). Contrary to expectations, we did not find a syllable length effect in English non-word repetition (whereas, in Italian it was evident). We interpret this result with caution and note some possibly relevant aspects of the study that may have led to this finding. The first has to do with the well known fact that long-term language knowledge facilitates repetition accuracy; for example, children repeat non-words more accurately when the stressed syllable is a real word (e.g., *bath*esis - *bath*) than when it is not a real word (*fath*esis) (Dollaghan *et al.* 1993). Many of Roy and Chiat's non-words contain or are very similar to real English words and some of these are familiar to children ("*jam*ic" /ˈdʒæ *m*ɪk/ : ["*jam*" /ˈdʒæ *m*/]; "lodi*hay*" /ˈlɑdə*he*/ : ["*hay*" /ˈ*he*ɪ/]; "*serpen*" /ˈ*sɜ*ˑ*pn*/ : ["*serpent*" /ˈ*sɜpə*n*t*/]; "*sin*odaur" /ˈ*saɪn*ʌdɔˑɹ/ : ["*sign*" /ˈ*saɪn*/]; "sha*meen*" /ʃʌ ˈ*min*/ : ["*mean*" /ˈ*min*/]; "gaza*meen*" /gæ zʌ ˈ*min*/ : ["*mean*" /ˈ*min*/]; "riga*sette*" /rɪ gʌ *sɛt*/ : ["set" /ˈ*sɛt*/]). Lexical support during non-word repetition could have facilitated the performance of the English-speaking children, but it should have improved non-word performance overall, leaving any length effect intact. On the other hand, this overall improvement may have raised children's scores to ceiling so that differences related to syllable length were not detectable.

Another reason that a length effect was not evident for English non-words could be the small sample size. In a small group, individual performance can have a greater impact on group means. Despite the fact that we found no statistical outliers, there were children who

performed at ceiling on non-word repetition. In a small group, these children's performance could have minimized the difference between two and three syllables non-words. Perhaps the length effect could only be shown with more power.

Regarding the relationship between repetition tasks and grammatical ability, there were two main results:

1. A cross-linguistic comparison showed that in both Italian and English, non-word repetition significantly predicted grammatical ability.
2. Performance on real-word repetition predicted children's grammatical ability in Italian but not in English; in particular, in Italian, real-word repetition explained children's grammatical ability better than non-word repetition.

Addressing first the predictive power of non-word repetition as a function of language spoken, our results showed that non-word repetition predicted grammatical ability in both languages. Based on consideration of the different characteristics of grammatical morphology in the two languages, we had suspected that non-word repetition would be more predictive of grammar in English than in Italian. That is, success in learning English morphology would appear to rely, to a greater extent than Italian, on the ability to encode and retain small and infrequent phonological differences in words. Although not the only contributors to non-word repetition ability, phonological processing and storage are considered to be central to this task (Gathercole 2006). In Italian, inflectional morphology is more salient and varied phonologically as well as more tied to meaning; thus, the relationship between non-word repetition and grammar might not be as strong. Although cross-linguistic differences in the strength of non-word repetition as a predictor of grammar were not borne out, the presence of a significant relationship in each language suggests that the abilities underlying non-word repetition play an important role in the development of children's grammatical abilities, at least for children with typical language.

Our second main result addresses the relationship between grammatical ability and real word repetition. In English, this relationship was not significant; in Italian, the two abilities were more strongly related than were non-word repetition and grammar. The fact that we found a significant relationship in Italian but not in English is consistent with differences in the nature of grammatical morphology in the two languages. In Italian, unlike in English, grammatical morphology is pervasive and carries significant meaning; for example, because Italian does not require overt subject pronouns, the referent of the verb's subject must be recovered from the person, number, and gender marking on the verb. Thus, it would not be surprising that lexical knowledge (as indexed by real-word repetition) and grammatical ability would be closely intertwined in Italian.

Differences in the relationship between lexical and grammatical knowledge have been observed in previous work on children acquiring English and Italian (Caselli *et al.* 1999, Devescovi *et al.* 2005). While vocabulary and grammar have been found to be strongly related during acquisition in both languages (Bates and Goodman 1999), there are also cross-linguistic differences. Caselli *et al.* (1999) found a linear relationship in Italian between function words and vocabulary size; function words appeared early and increased at a steady rate, as a function of a vocabulary size. In contrast, for English, they found that this relationship was non-linear; the rate of increase in the proportion of function words remained flat until vocabulary size reached about 400 words and only then began to increase. In another study, Devescovi *et al.* (2005) looked at the relationship between syntactic complexity, quantified by various types of utterance length measures, and vocabulary size. They also found non-linear components in this relationship for English but not for Italian. For Italian, syntactic complexity developed early and increased steadily with vocabulary size, whereas in English, syntactic complexity lagged behind vocabulary growth.

Relating these findings to our own study, if lexical and grammatical knowledge are more closely linked in development for Italian speaking children than for English speaking children, then we might expect real-word repetition (insofar as it indexes lexical knowledge) to have a closer relationship to grammatical measures. Devescovi *et al.* (2005) suggested that this tighter relationship between vocabulary and grammar in Italian was due to characteristics of Italian grammatical morphology. Specifically, Italian is a system that provides "a large but consistent set of regularities", requiring less input in order for the learner to abstract generalizations. For English on the other hand, fewer exemplars of the targeted grammatical elements might lead to slower learning.

Although our findings on real word repetition and grammar ability are consistent with this understanding of language learning and cross-linguistic differences, we must be cautious. For example, we cannot exclude the possibility that the lack of significant relationship between real word repetition and grammar for English was not due to differences between the Italian and English real-word stimuli relating to differences in Age of Acquisition. The words contained in the Italian real-word list were used in a previous study (Dispaldro *et al.* 2009); the authors showed that the majority of these words were already known by the 3 and 4 year-old children. Moreover, according to the Italian MacArthur database (Caselli *et al.* 2007) 'nebbia' [fog], 'tamburo' [drum] and 'torre' [tower] are acquired respectively at 33 months, 29 months, and 28 months. Age of Acquisition was not a criterion in the selection of the English real words, but we presume that some of these words are acquired before three years of age. Consequently, it is possible that English real-words were highly familiar even to the youngest age group, leading to a ceiling effect: whereas, for Italian, real word repetition consistently improves across age groups, for English, performance in the 3;6 group is already close to ceiling. The failure for English real-words to predict grammatical competence may be due to these ceiling effects.

The findings of our study also have implications for genetics research. Bishop *et al.* (2006) have discovered that some of the abilities examined in this study (non-word repetition ability, grammatical ability) appear to have a genetic basis. However, given the cross-linguistic differences observed, a given ability may prove to be less, or more, important depending on the properties of the language being learned. For example, it could be the case that an ability reflected in real-word repetition tasks is heritable in all children. However, in languages such as Italian, this ability might serve as a predictor of grammatical ability whereas in a language such as English, this ability may not have the same predictive value.

These possibilities raise an interesting question about how phenotypes should be treated across languages. One possibility is to treat them in the manner in which they have just been discussed, namely, as universal abilities whose relevance to grammatical ability will have to be determined on a language-by-language basis. Another possibility is to treat the particular language being learned as an additional predictor, along with the phenotype. Here, language might be regarded as an environmental predictor, much as measures such as maternal education level are used. In this case, the question is how much variance in grammatical ability can be explained by the phenotype when the particular language being learned is also included in the model.

Finally, the results of this study also have clinical relevance. Many researchers have argued that the repetition task is a simple and practical tool that can be scored online and easily adapted to the clinic environment. However, our study suggests that the best choice of target in this task (real-word vs. non-word) could depend on the specific language spoken by the child. Non-words have been considered the best type of target given that numerous studies have shown that it is a sensitive test of language impairment (Bortolini *et al.* 2006, Conti-Ramsden *et al.* 2001). While this is true, our study has shown that there may be different

"best predictors" for Italian and English. This finding is very important in that it could allow us to maximize predictive power in each language.

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Appendix A. Italian Real-word and Non-word List

Syllable Lenght	REAL-WORDS		NON-WORDS
2	/ ˈba va /	drool	/ ˈbo fo /
2	/ ˈne b:ja /	fog	/ ˈno d:je /
3	/ ve ˈl:u to /	velvet	/ vi ˈl:o pa /
3	/ tam ˈbu ro /	drum	/ tun ˈda lo /
2	/ ˈfra se /	sentence	/ ˈfri ve /
3	/ po ˈma ta /	ointment	/ pa ˈno ko /
3	/ di ˈlu vjo /	deluge	/ di ˈru sja /
2	/ ˈse me /	seed	/ ˈsi mi /
3	/ ga ˈle ra /	prison	/ go ˈre lo /
3	/ mar ˈmo t:a /	marmot	/ mol ˈmi t:o /
2	/ ˈku bo /	cube	/ ˈko be /
2	/ ˈpal ma /	palm	/ ˈpar na /
3	/ vul ˈka no /	volcano	/ vir ˈto ma /
2	/ ˈto r:e /	tower	/ ˈta m:o /
2	/ ˈkor vo /	crow	/ ˈkan sa /
3	/ mu ˈli no /	mill	/ mo ˈru na /

Appendix B. English Real-word and Non-word Lists (adapted from Chiat and Roy, 2007)

Syllable Length	REAL-WORDS	NON-WORDS
2	/ ˈmæ dʒ ɪk /	/ ˈdʒæ mɪk /
3	/ ˈhɑ lə de /	/ ˈlɑ də he /
3	/ bʌ ˈnæ nʌ /	/ nʌ ˈnæ bʌ /
2	/ ˈlæ dɚ /	/ ˈdæ lɚ /
2	/ ˈpɝ sn /	/ ˈsɝ pn /
3	/ ˈdɑi nʌ sɔr /	/ ˈsɑi nʌ dɔr /
2	/ pʌ ˈlis /	/ lʌ ˈpis /
3	/ kʌm ˈpju dr /	/ tʌŋ ˈkju pr /
2	/ mʌ ˈʃin /	/ ʃʌ ˈmin /
3	/ sɪ gʌ ˈret /	/ rɪ gʌ ˈsɛt /
3	/ mæ gʌ ˈzin /	/ gæ zʌ ˈmin /
2	/ bʌ ˈlun /	/ lʌ ˈbun /

Appendix C. Italian Grammatical Task: Third person plural inflection in the indicative present tense verbs

BEVONO	THEY DRINK
DORMONO	THEY SLEEP
telefona	she phones
scrive	he writes
TELEFONANO	THEY PHONE
piange	she cries
SCRIVONO	THEY WRITE
CORRONO	THEY RUN
PIANGONO	THEY CRY
SALGONO	THEY GO UP
dorme	she sleeps
corre	she runs
sale	she goes up
mangia	she eats
canta	she sings
beve	she drinks
MANGIANO	THEY EAT
CANTANO	THEY SING

Appendix D. Italian Grammatical Task: Third person of direct object clitic pronouns

I bambini lavano i piatti e poi..LI asciugano.	The boys wash the plates and then..they wipe them.
Le bambine comprano il gelato e poi..LO mangiano.	The girls buy the ice-cream and then..they eat it.
Il bambino lava la macchina e poi..LA spinge.	The boy washes the car and then..he pushes it.
I bambini raccolgono le mele e poi..LE mangiano.	The boys pick the apples and then..they eat them.
La bambina lava la macchina e poi..LA spinge.	The girl washes the car and then..she pushes it.
Le bambine lavano i piatti e poi..LI asciugano.	The girls wash the plates and then..they wipe them.
La bambina raccoglie le mele e poi..LE mangia.	The girl picks up the apples and then..she eats them.
Il bambino compra il gelato e poi..LO mangia.	The boy buys the ice cream and then..he eats it.
Le bambine lavano la macchina e poi..LA spingono.	The girls wash the car and then..they push it.
Il bambino raccoglie le mele e poi..LE mangia.	The boy picks the apples and then..he eats them.
Il bambino lava i piatti e poi..LI asciuga.	The boy washes the plats and then..he wipes them.
La bambina compra il gelato e poi..LO mangia.	The girl buys the ice cream and then..she eats it.
Le bambine raccolgono le mele e poi..LE mangiano.	The girls pick up the apples and then..they eat them.
La bambina lava i piatti e poi..LI asciuga.	The girl washes the plates and then..she wipes them.
I bambini lavano la macchina e poi..LA spingono.	The boys wash the car and then.. they push it.
I bambini comprano il gelato e poi..LO mangiano.	The boys buy the ice cream and then..they eat it.

What this paper adds

What is already known on this subject

Children's scores on non-word repetition tasks are good predictors of measures of grammatical development. Moreover, the non-word-repetition task is a clinical marker that can identify children with language difficulties.

Since non-word repetition does not rely on lexical representations, phonological short-term memory contributes strongly to this task. In contrast, in the repetition of real words the phonological input activates the phonological form of the lexical representation stored in long-term memory. For this reason real words are easier to repeat than non-words.

What this study adds

The abilities underlying non-word and real-word repetition could contribute in different ways to the development of grammatical ability, depending on the features of the language learned by the child.

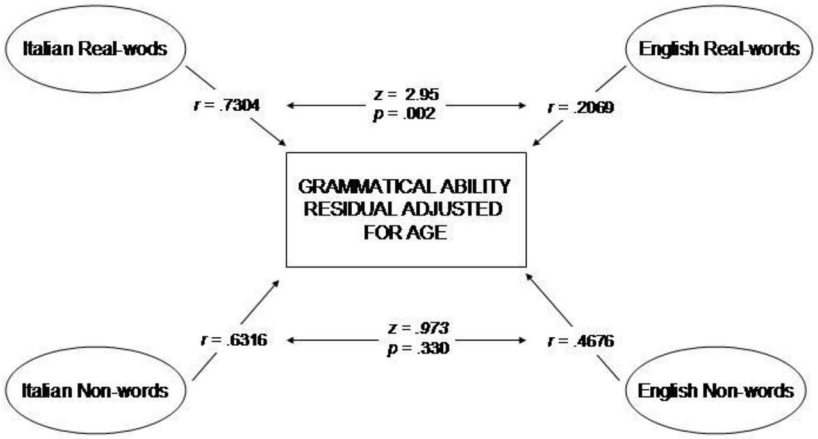

Figure 1.

Comparison between Italian and English language

NOTE 1: The *p* value was obtained using the Test of Difference Between Two Independent Correlations (Italian sample $n = 48$, English sample $n = 30$)

NOTE 2: The square of each single correlation is equivalent to the proportion of the total variance of Grammar accounted for by Word Type after adjusting for Age (see R^2-*change* in Table 4,5,8,9)

Table 1

Participants

age	*range*	Italian	English	total
3;0	*2;11-3;1*	14	10	24
3;6	*3;5-3;7*	17	10	27
4;0	*3;11-4;1*	17	10	27
total	*2;11-4;1*	48	30	78

Table 2

Mean Percentage Phonemes Correct (and Standard Deviations) at each Word Length for Real-words and Non-words in Italian

Age groups	Length	Real-words	Non-words	Total
	TPPC	92 (4)	88 (5)	90 (4)
3;0	2PPC	92 (5)	91 (6)	92 (6)
	3PPC	91 (5)	86 (7)	88 (6)
	TPPC	92 (9)	90 (7)	91 (8)
3;6	2PPC	93 (6)	92 (5)	92 (5)
	3PPC	92 (12)	87 (12)	89 (12)
	TPPC	97 (4)	94 (6)	95 (5)
4;0	2PPC	97 (4)	94 (8)	96 (6)
	3PPC	96 (4)	94 (6)	95 (5)
	TPPC	94 (6)	91 (6)	92 (7)
total	2PPC	94 (5)	92 (6)	93 (6)
	3PPC	93 (7)	89 (8)	92 (9)

Table 3

Percentages correct (standard deviations) and range for clitic pronouns, third-person plural verbs and grammatical ability

Age	Clitic pronouns	Third-person plural verbs	Grammatical Ability
3;0	45 (26) *(0–88)*	62 (20) *(25–100)*	53 (24)
3;6	67 (33) *(6–100)*	58 (30) *(7–89)*	63 (31)
4;0	82 (19) *(19–100)*	71 (23) *(22–100)*	77 (22)
Total	65 (26)	64 (26)	65 (27)

Table 4

Results of the first regression analysis on Grammatical Ability

	predictors	R^2-change	β	t	p
Step. 1	**AGE**	**.1622** [a]			
	3;6 year-old		**.2906**	**1.079**	**.286**
	4;0 year-old		**.7779**	**2.889**	**.005**
Step. 2	**AGE**				
	3;6 year-old		**.2251**	**1.336**	**.188**
	4;0 year-old		**.2726**	**1.526**	**.013**
	Real-words	**.5178** [b]	**9.608**	**8.438**	**<.0001**

NOTE: R^2 total .68

[a] $F(2,45) = 4.355$ $p = .018$

[b] $F(1,44) = 71.202$ $p < .0001$

Int J Lang Commun Disord. Author manuscript; available in PMC 2013 May 20.

Table 5

Results of the second regression analysis on Grammatical Ability

	predictors	R^2-change	β	t	p
Step. 1	**AGE**	**.1622** [a]			
	3;6 year-old		**.2906**	**1.079**	**.286**
	4;0 year-old		**.7779**	**2.889**	**.005**
Step. 2	**AGE**				
	3;6 year-old		**.2089**	**1.040**	**304**
	4;0 year-old		**.3455**	**1.625**	**.111**
	Non-words	**.3838** [b]	**7.917**	**6.098**	**<.0001**

NOTE: R^2 total .546

[a] $F(2,45)=4.355$ $p = .018$

[b] $F(1,44) = 37.190$ $p < .0001$

Table 6

Mean Percentage Phonemes Correct (and Standard Deviations) at each Word Length for Real-words and Non-words in English

age groups	Length	Real-words	Non-words	Total
	TPPC	90 (8)	86 (8)	88 (8)
3;0	2PPC	92 (7)	87 (9)	89 (9)
	3PPC	88 (11)	86 (9)	87 (10)
	TPPC	96 (4)	92 (6)	94 (5)
3;6	2PPC	96 (4)	92 (6)	94 (6)
	3PPC	97 (3)	93 (7)	94 (6)
	TPPC	94 (6)	94 (4)	94 (5)
4;0	2PPC	92 (8)	95 (5)	93 (7)
	3PPC	96 (4)	94 (5)	95 (4)
	TPPC	93 (6)	91 (7)	92 (7)
Total	2PPC	93 (7)	91 (7)	92 (7)
	3PPC	93 (6)	91 (7)	92 (8)

Table 7

Percentages correct, standard deviations and range for third-person singular present tense, total past tense verbs and grammatical ability

Age	Third-person singular verbs	Total past tense verbs	Regular past tense	Irregular past tense	Grammatical ability
3;0	74 (25) *(33–100)*	60 (17) *(39–83)*	64 (17)	56 (18)	67 (22)
3;6	81 (28) *(13–100)*	72 (29) *(0–100)*	71 (27)	73 (33)	76 (28)
4;0	87 (24) *(22–100)*	80 (16) *(45–100)*	80 (19)	80 (18)	83 (20)
total	80 (25)	71 (22)	72 (21)	70 (23)	76 (24)

Int J Lang Commun Disord. Author manuscript; available in PMC 2013 May 20.

Table 8

Results of the first regression analysis on Grammatical Ability

	predictors	R^2-Changc	β	t	p
Step. 1	**AGE**	**.0944** [a]			
	3;6 year-old		**.0904**	**.950**	**.351**
	4;0 year-old		**.1592**	**1.673**	**.106**
Step. 2	**AGE**				
	3;6 year-old		**.0475**	**0.468**	**.644**
	4;0 year-old		**.1286**	**1.311**	**.201**
	Real-words	**.045** [b]	**0.7643**	**1.166**	**.254**

NOTE: R^2 total .1394

[a] $F(2, 27) = 1.401$ $p = .262$

[b] $F(1, 26) = 1.245$ $p = .254$

Int J Lang Commun Disord. Author manuscript; available in PMC 2013 May 20.

Table 9

Results of the second regression analysis on Grammatical Ability

	predictors	R^2-change	β	t	p
Step. 1	**AGE**	**.0944** [a]			
	3;6 year-old		**.0904**	**.950**	**.351**
	4;0 year-old		**.1592**	**1.673**	**.106**
Step. 2	**AGE**				
	3;6 year-old		**−0.0195**	**−0.221**	**.826**
	4;0 year-old		**.1332**	**.143**	**.887**
	Non-words	**.2226** [b]	**1.8327**	**3.258**	**.003**

NOTE: R^2 total .357

[a] $F(2, 27) = 1.401$ $p = .262$

[b] $F(1, 26) = 10.614$ $p = .003$