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Assessment of linguistic abilities in Italian children with Specific Language Impairment

Andrea Marini[a,b,*], Alessandro Tavano[b], Franco Fabbro[a,b]

[a] University of Udine, Udine, Italy
[b] IRCCS "E. Medea: La Nostra Famiglia", San Vito al Tagliamento (Pn), Italy

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ABSTRACT

This study aims to describe in detail the linguistic skills of a large group of SLI participants. Particular attention is paid to the analysis of age-related effects on their linguistic performance and to whether a linguistic assessment of a narrative task can capture language impairments that might not be adequately pointed out by standardized neuropsychological tests assessing linguistic functions. The narratives produced by 62 children diagnosed with SLI with mixed expressive–receptive disorders were compared to those provided by a group of 195 children with Typical Language Development matched for chronological age and level of formal education. Furthermore, an age-related groups' performance analysis has been performed in order to determine possible correlations between patients' ages and types of language impairment. The SLI participants produced an amount of words comparable to that produced by the control group, albeit in a simpler fashion, as their narratives were teeming with omissions and/or substitutions of bound and free morphemes. These data suggest that the domains of morphosyntax and syntax were particularly impaired.

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1. Introduction

Specific Language Impairment (SLI) is a developmental disorder with unknown aetiology. It is characterized by language delay in children with otherwise normal physical, intellectual and cognitive development (Bishop, 1997; Cipriani & Chilosi, 1995; Leonard, 1998). Children diagnosed with SLI do not usually present any additional hearing problems, frank neurological deficits, or severe emotional disorders. However, recent investigations suggest that subtle auditory deficits reducible to temporal processing capacity may be present in at least some SLI children (Bishop & Mcarthur, 2005; Joanisse & Seidenberg, 1998; Segers & Verhoeven, 2005). Furthermore, several studies showed that SLI is linked to abnormalities in the brain structures involved in procedural memory, such as Broca's area, the basal ganglia, SMA and the cerebellum (Gauger, Lombardino, & Leonard, 1997; Jernigan, Hesselink, Sowell, & Tallal, 1991; Oki, Takahashi, Miyamoto, & Tachibana, 1999; Tallal, Jernigan, & Trauner, 1994; Ullman, 2004; Vargha-Khadem et al., 1998).

As far as linguistic skills are concerned, SLI is not a homogenous condition (Laws & Bishop, 2003). Indeed, children with Specific Language Impairment may present with a wide range of different disturbances in language processing, depending on the linguistic level (phonetic, phonological, morphological, syntactic, semantic, or even pragmatic) or the modality of language use (linguistic comprehension vs. production) that can be selectively compromised. One approach to dealing with this heterogeneity involved the identification of clinical subtypes of SLI (Bishop, 1997, 2004; Conti-Ramsden & Botting, 1999; Nation, 2005; Rapin & Allen, 1987). For example, the 10th Edition of the International Classification of Diseases (ICD-10) distinguishes the following amongst 4 different subgroups of Specific Language Impairment: (1) specific speech articulation disorder (ICD-10 code: F80.0), characterized by selective deficits in articulatory development; (2) expressive language disorder (ICD-10 code: F80.1), in which the child's ability to use expressive spoken language falls below the normal range, whereas language comprehension is within normal limits; (3) receptive language disorder (ICD-10 code: F80.2), characterized by comprehension deficits usually associated to a production impairment; (4) acquired aphasia with epilepsy (ICD-10 code: F80.3), in which the child loses both receptive and expressive language skills and the onset of the disorder is accompanied by paroxysmal abnormalities on the EEG. Such classification, however, is far from being universally accepted. Indeed, it would be more appropriate to distinguish between more linguistically oriented subgroups (Bishop, 2004). For instance, Conti-Ramsden and Botting (1999) suggest distinguishing

* Corresponding author at: Cattedra di Psicologia del Linguaggio, Università di Udine, Via T. Petracco, 8 – 33100 Udine, Italy. Tel.: +39 0335 5393224.
E-mail address: andrea.marini@uniud.it (A. Marini).

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between children with lexical-syntactic deficits, children showing verbal dyspraxia, children with phonologic programming deficit syndrome, children with phonological-syntactic deficit syndrome, and children with semantic—pragmatic deficits. Furthermore, Van der Lely and colleagues (Van der Lely, 1994, 1997a, 1997b, 2005; Van der Lely, Rosen, & McClell, 1998) proposed to identify a distinct subgroup of SLI children, termed Grammatical SLI (G-SLI), characterized by a "persisting deficit in syntax and morphology at 9 years and older" (Van der Lely, 2005, p. 57). This is a relatively rare form of SLI with an estimated prevalence of 10–20% within the population of G-SLI children older than 9 years (Van der Lely & Stollwerck, 1996).

With regard to the general aspects of linguistic production, problems in the codification of phonetic and phonological features of language processing (Bortolini, 1995; Stella, 2001) have been called upon to explain both the delayed production of the first words observed in many SLI children (Leonard, 1998) and the reduced amplitude of their mental lexicon (Rescorla & Schwartz, 1990). Nonetheless, morphology and syntax are usually more affected than vocabulary (Aram, Ekelman, & Nation, 1984; Tomblin & Zhang, 1999). Furthermore, their morphosyntactic profile varies quite dramatically depending on their native language. Compared to children with typical language development, SLI children produce shorter utterances (Paul & Smith, 1993; Redmond, 2004) and fewer sentences per narrative (Liles, 1985). Furthermore, their utterances are characterized by reduced grammatical accuracy (Fey, Catts, Proctor-Williams, Tomblin, & Zhang, 2004; Gillam & Johnston, 1992; Norbury & Bishop, 2003) and omission of those lexical elements (both content and function words) that are obligatorily requested by lexical and functional heads governing phrase and sentence generation (Chilosi & Cipriani, 1991). Indeed, the use of function words in the speech of Italian SLI patients is severely limited because of frequent omissions (Cipriani et al., 1991; Sabbadini, Volterra, Leonard, & Campagnoli, 1987) and/or substitutions (Leonard, McGregor, & Allen, 1992). Similar impairments are also evident in the use of verb inflection (e.g. Cipriani, Chilosi, Bottari, & Pfanner, 1993).

The purpose of the present study was two-fold. The primary goal was to describe in detail the linguistic skills of a large group of SLI participants and to control for potential age-related effects on their linguistic performance. The second goal was to determine whether a linguistic assessment of a narrative task could capture language impairments that might not be adequately pointed out by standardized neuropsychological tests assessing linguistic functions. Indeed, in story description tasks speakers tend to be more fluid communicators and make use of several linguistic skills in a communicatively oriented interaction (Marini, Caltagirone, Pasqualetti, & Carlomagno, 2007; Marini, Lorusso, et al., 2007). As a consequence, it was hypothesized that the analysis of the linguistic performance on a narrative task may allow to control for the interaction between several processing levels (e.g. between verb processing, argument structure generation, sentence production) and that such a detailed analysis of lexical, morphosyntactic and syntactic skills can highlight aspects of impaired processing in the SLI participants which may not be evident on a traditional linguistic analysis.

2. Methods

2.1. Subjects

257 Italian-speaking participants, matched for chronological age, education and socio-economic status (SES), were included in the study (Table 1). They formed an experimental group and a control group. The experimental group consisted of 62 children diagnosed with SLI with mixed expressive and receptive disorder (ICD-10 diagnosis: F80.2) aged between 5 and 11 years old (mean 7 years and 6 months; S.D. 1.6). The patients' linguistic assessment was performed on data collected by one of the authors (F.F.) during standard linguistic evaluation at the IRCSS "E. Medea", Ass.ne "La Nostra Famiglia" in San Vito al Tagliamento during the years 1999–2001. All parents gave their consent to data processing.

Table 1
Means (and standard deviations) of the two groups' chronological age and level of education

	TLD	SLI
Chronological age	7.5 (1.7)	7.6 (1.6)
Education	2.5 (1.7)	1.6 (1.6)

The control group was formed by 195 participants with Typical Language Development (TLD). The control participants, aged between 5 and 11 years old (mean 7 years and 5 months; S.D. 1.7), had been randomly selected from mainstream schools for a previous research (Tavano, De Fabritiis, & Fabbro, 2005). They performed in the normal range on the block-design subtest of the WISC-R and in the tasks included in the "Test of Morphosyntactic Development" (TSM: Fabbro & Galli, 2001) which assesses their linguistic abilities in sentence comprehension, morphological transformations and word and pseudo-word repetition. The control participants showed average school performance in language and reading. In a preliminary interview, their teachers confirmed that they showed normal cognitive and learning development. Moreover, according to school records and parents' reports, none of them had a known history of psychiatric or neurological illness, learning disabilities, or hearing or visual loss. This group was included in order to compare the narratives produced by the group of SLI participants with those uttered by typically developing children, because no normative data are available for the picture description task (see the Section 2.2.3).

In order to control for age-related differences in the SLI participants' performance in the formal linguistic evaluation, the two groups were divided into 6 age-related subgroups. The first subgroup included 35 normally developing children and 9 SLI participants aged from 5 to 6 years of age. The second subgroup was formed by 27 normally developing participants and 9 SLI patients ranging from 6 to 7 years old. The third subgroup consisted of 35 controls and 14 SLI participants aged from 7 to 8 years of age. The fourth subgroup included 35 normally developing children and 11 SLI patients ranging from 8 to 9 years old. The fifth subgroup was formed by 28 controls and 9 patients with SLI ranging from 9 to 10 years of age. The sixth subgroup was made up of 35 normally developing children and 10 SLI participants ranging from 10 to 11 years of age.

2.2. Procedures

2.2.1. Intellectual assessment

The general (verbal and performance) intelligence of SLI participants was assessed by administering age-appropriate Wechsler Intelligence Scales: the WISC-R (Wechsler, 1993) for children older than 6 years and the WPPSI (Wechsler, 1996) for younger children.

2.2.2. Formal language assessment

The SLI participants' general linguistic abilities were analyzed by administering the "Batteria della valutazione del linguaggio in bambini dai 4 ai 12 anni" ("Battery for linguistic assessment of children from 4 to 12 years", Fabbro, 1999), the Italian adaptation of the "Batterie d'évaluation du langage oral de l'enfant aphasique" (ELOLA) (De Agostini et al., 1998). This battery provides an overview of the children's language functions across a variety of modalities to indicate the level of severity of the impairment and a profile of the group. This test battery examines phonological, lexical and syntactic skills in all modalities (i.e. comprehension, production and repetition).

With regard to comprehension, the participants' verbal auditory discrimination abilities were assessed administering a phonemic identity judgement task (S–D: Same–Different Judgement task). The subject is asked to say if a couple of heard words, either identical or constituting a "minimal pair", include the "same" or "different" words. Semantic comprehension was assessed by administering the Italian version of the British Picture Vocabulary Scale (BPVS: De Agostini et al., 1998), which requires matching each of 25 words read out by the examiner with one out of four pictures (the target and three semantic distracters). Morphosyntactic comprehension was assessed with the "Test of Grammatical Comprehension for Children" (TCGB: Test di Comprensione Grammaticale nei Bambini, Chilosi & Cipriani, 1995) where the participants are required to match each of 76 sentences of increasing complexity with one out of four pictures. Syntactic comprehension was assessed with the Italian version of the Token Test (De Agostini et al., 1998).

The subjects' production was assessed in a Naming task (NT) requiring subjects to name 36 object pictures and five pictures representing actions (De Agostini et al., 1998) and a Test of Semantic Fluency (SF) where subjects are prompted to name, in 90 s, as many words as possible belonging to two semantic categories: animals and house objects. The largest number of correct words produced in 60 consecutive seconds is recorded as a test score.

Repetition abilities were assessed by administering a Sentence Repetition (SR) task requiring the subjects to repeat a list of sentences of increasing length and complexity (Ferrari, De Renzi, Faglioni, & Barbieri, 1981; Vender, Borgia, Cumer Bruno, Freo, & Zardini, 1981). An additional test of Word Repetition (WR) and Non-word Repetition (NWR) was taken from the "Test of Morphosyntactic Development" (TSM: Fabbro & Galli, 2001). Finally, a test assessing articulation abilities was performed (Art: Test of Articulation).

2.2.3. Assessment of linguistic performance on the narrative task

The linguistic assessment was performed on the storytelling elicited with a picture-story description task. Each subject was asked to produce a narrative elicited with the help of a cartoon story (the "Nest Story": Paradis, 1987) consisting of a series of six drawings presented on the same page. Since no normative data are currently available for this picture description task, the narratives produced by the group of SLI participants were compared to those produced by the group of 195 healthy controls. In order to avoid poor performance due to short-term memory limitations, the cartoon story remained visible until the subject had finished his/her description. Each storytelling was tape-recorded and subsequently transcribed verbatim including phonological fillers, pauses, false starts and extraneous utterances. These transcriptions were compared in order to obtain highly reliable transcripts for the analysis. Discrepancies were discussed and resolved before the narratives were analyzed further.

The stories were subjected to a linguistic evaluation. Both simple values and ratios were considered in order to check for differences in story length. The scoring procedure was performed independently by two of the authors (A.M. and A.T.) and then compared. Reproducibility of the scoring procedures resulted in substantial agreement, as the raters reached an inter-coder reliability level of $k > 0.80$. The analysis focused on four main aspects of linguistic processing: verbal productivity, lexical organization, and morphosyntactic and syntactic organization (Marini, Boewe, Caltagirone, & Carlomagno, 2005; Marini, Carlomagno, Caltagirone, & Nocentini, 2005; Marini, Caltagirone, et al., 2007; Marini, Lorusso, et al., 2007). Examples of the most representative errors produced by the participants are provided in Appendix A.

Verbal productivity was measured as the number of words produced by each participant during the storytelling. The number of words was used to obtain a measure of speech rate in terms of words per minute (words/m′).

The narratives' lexical organization was measured in terms of lexical processing. This aspect of production was assessed in two ways. At a first step, the analysis concerned the lexeme level (Levelt, Roelofs, & Meyer, 1999) of word processing, as the percentage of phonological paraphasias was computed by dividing the number of phonemic paraphasias by the number of words produced in each description. Furthermore, the lemma level of word processing was assessed in terms of production of semantic paraphasias and paragrammatic errors. The percentage of semantic paraphasias was calculated by dividing the number of semantic paraphasias by the number of words (Marini, Boewe, et al., 2005). Higher values represent more semantic errors per word. Such errors were scored when a target word was substituted by a semantically related word (Haravon, Obler, & Sarno, 1994). An example of semantic paraphasia is the word *mother* in the sentence "*here, he's talking to his mother*", where the speaker was implying his "*wife*". Morphosyntactic organization was evaluated in terms of paragrammatic errors and omissions. A paragrammatic error is a substitution of free or bound morphemes. Therefore, measures of paragrammatic errors included the percentage of substitutions of free morphemes, which in Italian involve mainly the substitution of function words (for example, *batte da una porta* "he is knocking *from* a door" – *da* instead of *a*) and the percentage of substitutions of bound morphemes (for example, *questo è una coppia* "this [*masc*] is a couple [fem]" – should be *questa*) was calculated by dividing the amount of free or bound morpheme substitutions by the number of words. The percentage of omission of content words and the percentage of omission of function words were calculated by dividing all omissions of content and function words registered in the story-tellings by the number of utterances, respectively.

The analysis of the syntactic organization of the narratives produced by the participants included a measure of utterance length and one of syntactic complexity. Mean Length of Utterance (MLU) and syntactic complexity. For each story description, the total number of utterances was assessed by following the criteria established in the Shewan Spontaneous Language Analysis System (Shewan, 1988). Under the assumption that longer utterances reflect the attempt to produce articulated sentences, a ratio measuring the MLU was calculated by dividing the total number of words by the number of utterances. However, utterance length does not directly reflect syntactic complexity (Hewitt, Scheffner Hammer, Yont, & Tomblin, 2005). Therefore, a percentage of syntactic complexity was calculated by dividing the total number of clauses produced by the number of utterances. The clause count included all the correctly generated clauses. A clause was considered grammatically complete if all the arguments required by the verb were inserted correctly in the body of the sentence and if there were no omissions or substitutions of free or bound morphemes.

Table 2
Average verbal, performance and full-scale IQ of the SLI participants

	Mean (S.D.)	Range
Full-Scale IQ	88 (10.7)	68–120
Performance IQ	95 (12.3)	74–134
Verbal IQ	83.3 (12.8)	61–122

2.2.4. Intellectual assessment

The average performance of the SLI participants on the Verbal and Performance Intelligence Quotient (IQ) was matched against general population norms and the results are expressed as Intelligence Quotient scores (mean 100, S.D. 15) (see Table 2). Overall, the Full-scale Intelligence Quotient (FIQ) scores (mean 88) were within 1 standard deviation (S.D.) below average, with a relative discrepancy between the Verbal Scale (mean 83.3: more than one S.D. below normal range) and the Performance Scale (mean 95: within normal range). No group-related difference was found either on the Full-scale IQ or the Performance IQ.

3. Results

3.1. Formal language assessment: between-group analysis

Table 3 shows the performance of the 6 age-related subgroups of SLI participants included in the study. All subgroups performed within the normal range in the tasks assessing semantic fluency (SF), semantic comprehension (BPVS) and naming (NT). However, marked impairment was evident on those tests assessing phonological awareness (S–D), morphosyntactic comprehension (TCGB), syntactic comprehension (Token test), word (WR), non-word (NWR) and sentence repetition (SR). On the articulation subtest (Art) of the "Batteria della valutazione del linguaggio in bambini dai 4 ai 12 anni", only SLI children aged from 5 to 7 years performed 2 S.D. below average, whereas older children scored within the normal range.

Table 3
Means and standard deviations of the performances of the SLI participants' performance on the linguistic assessment

	1 (5–6 y.o.)	2 (6–7 y.o.)	3 (7–8 y.o.)	4 (8–9 y.o.)	5 (9–10 y.o.)	6 (10–11 y.o.)
SF	15.9 (4.8)	18.3 (6.8)	20.6 (6.9)	22.5 (6.7)	23.2 (6.2)	26 (5.7)
NT	31.3 (2.6)	30.1 (4.5)*	30.9 (4.2)*	31.9 (3.4)	33.1 (2.1)	33.5 (2)
NWR	8.9 (5.2)**	10.2 (3.7)**	13.1 (2.4)**	12.9 (3.4)**	13.6 (2.3)**	13.3 (2)**
WR	9.9 (3.7)**	11.5 (2.7)**	13.2 (2.5)**	13.6 (2.6)**	14 (2)**	14.1 (1.4)**
SR	10.2 (7.5)**	9.6 (5.5)**	10.4 (2.2)**	11.1 (3.1)**	9.9 (2.6)**	10.8 (3.9)**
TCGB	18.9 (8.8)**	15.2 (11.6)**	9.5 (4.6)**	10.6 (6.7)**	7.9 (4.3)**	6.5 (3.9)**
Token	13.3 (4.1)**	12.5 (4.4)**	16.1 (3.1)*	16 (3.2)**	17 (1.4)**	17.8 (2.5)*
BPVS	16.5 (1.8)	17.7 (4.8)	19.2 (3.7)	21.6 (3)	23.1 (3.7)	23.9 (2.6)
Art	119.4 (43.8)**	142.2 (29.4)**	151.6 (37.3)	160 (30.6)	159.8 (19.5)	166.7 (8.4)
S–D	26.6 (3.4)**	25.1 (5.3)**	29.1 (2)*	28.8 (2.9)**	28.3 (3.4)**	29 (1.9)**

Asterisks (*) indicate whether group performance was 1 standard deviation (one asterisk, *) or two standard deviations (two asterisks, **) below normal values. Key: SF = semantic fluency; NT = naming task; NWR = non-word repetition; WR = word repetition; SR = sentence repetition; TCGB = "Test di Comprensione Grammaticale nei Bambini"; Token = token test; BPVS = British Picture Vocabulary Scale; Art = articulation; S–D = same–different judgement test.

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Table 4
Mean and standard deviations of the control group's performance on the narrative task

	Control participants					
	1 (5–6 y.o.)	2 (6–7 y.o.)	3 (7–8 y.o.)	4 (8–9 y.o.)	5 (9–10 y.o.)	6 (10–11 y.o.)
Words	48.2 (17.2)	54.1 (21.6)	91.7 (42.6)	73.7 (25.9)	83.3 (30)	76(23.3)
Speech rate	104.5 (27.9)	76.9 (37.2)	112.5 (27.5)	114.2 (22.8)	118.7 (24.9)	126.9 (22.6)
% Phonological paraphasias	.4 (.9)	.5 (1.3)	.1 (.5)	.0 (.0)	.0 (.0)	.0 (.0)
% Semantic paraphasias	1.1 (1.7)	.4 (1.2)	.2 (.5)	.2 (.5)	.2 (.6)	.0 (.2)
% Omissions of content words	5.1 (9)	2.5 (7.7)	1.6 (4.6)	.5 (2.4)	1 (3)	.4 (2.1)
% Omission of function words	6.2 (10.6)	1.4 (4.2)	1.1 (4.8)	.2 (1.4)	.7 (2.7)	1 (4.1)
% Substitution of free morphemes	1 (1.5)	.1 (.6)	.2 (.5)	.1 (.2)	.2 (.3)	.1 (.4)
% Substitution of bound morphemes	1 (2)	.3 (1)	.1 (.4)	.2 (.5)	.0 (.2)	.2 (.9)
Mean length of utterance	5.4 (1.2)	7.3 (2.3)	8.3 (1.9)	8.1 (1.9)	8.1 (1.8)	9.1 (2.7)
Syntactic complexity	1 (.2)	1.4 (.3)	1.3 (.2)	1.3 (.2)	1.4 (.2)	1.5 (.4)

3.2. Formal language assessment: within-group analysis

In order to determine the impact of age on linguistic performance, a multivariate analysis of variance with *age-group* (Group 1, 5–6 years of age; Group 2, 6–7 years of age; Group 3, 7–8 years of age; Group 4, 8–9 years of age; Group 5, 9–10 years of age; Group 6, 10–11 years of age) as a fixed factor, was performed on the scores from the 10 tasks. The criterion for significance was alpha = .05. In this analysis the level of statistical significance was defined as $p < 0.05$ after Bonferroni correction for multiple comparisons (alpha < 0.05/10–alpha < 0.005).

The within-group analysis showed the presence of a significant variation among the 6 subgroups of SLI participants on the following tests: Same–Different Judgement Test ([$F(5; 58) = 5.280$; $p < .001$]); Articulation test ([$F(5; 57) = 5.646$; $p = .000$]); BPVS ([$F(5; 60) = 8.549$; $p = .000$]); Token test ([$F(5; 59) = 7.261$; $p = .000$]); TCGB ([$F(5; 60) = 7.220$; $p = .000$]); Word repetition ([$F(5; 60) = 5.828$; $p = .000$]); Non-word repetition ([$F(5; 60) = 5.571$; $p = .000$]); Semantic fluency ([$F(5; 59) = 4.481$; $p < .002$]). Significant differences emerged only between Group 1 and Group 3 ($p < .013$), 4 ($p < .025$) and 6 ($p < .018$), and between Group 2 and Group 3 ($p < .013$), 4 ($p < .027$) and 6 ($p < .020$) on the task assessing phonological comprehension (S–D). With regard to semantic comprehension (BPVS), Tukey's post hoc analysis showed that the youngest group performed worse than groups with ages ranging from 8 to 11 years (Group 1 vs. Group 4: $p < .008$; Group 1 vs. Groups 5 and 6: $p < .000$). On the same test, post hoc analysis revealed a significant difference also between Group 2 and Groups 5 and 6 ($p < .005$ and $p < .002$, respectively) as well as between Group 3 and Groups 5 and 6 ($p < .028$ and $p < .010$, respectively). No relevant differences emerged among the remaining groups. The two youngest groups performed worse than the older ones also on those tasks assessing morphosyntactic and syntactic comprehension. On the Token test in particular, Group 1 performed worse than Groups 3 ($p < .018$), 4 ($p < .013$), 5 ($p < .002$) and 6 ($p < .000$) while Group 2 underperformed only with respect to Groups 4 ($p < .045$), 5 ($p < .007$) and 6 ($p < .002$). Similarly, on the TCGB test, Group 1 performed worse than Groups 3 ($p < .001$), 4 ($p < .003$), 5 ($p < .000$) and 6 ($p < .000$) while Group 2 underperformed only with respect to Group 6 ($p < .037$). On the word repetition task (WR), Group 1 performed significantly worse than Groups 3 ($p < .002$), 4 ($p < .001$), 5 ($p < .001$) and 6 ($p < .000$) while no significant differences emerged among the other groups. Similarly, on the non-word repetition (NWR) task, Group 1 performed significantly worse than Groups 3 ($p < .001$), 4 ($p < .003$), 5 ($p < .001$) and 6 ($p < .002$), while no significant differences emerged among the other groups. With regard to production, Tukey's post hoc analysis showed that the youngest group (Group 1: 5–6 years of age) performed worse than all the remaining age-related subgroups on the Articulation (Art) subtest of the Battery (Group 1 vs. Group 2: $p < .008$; Group 1 vs. Group 3: $p < .003$; Group 1 vs. Group 4: $p < .001$; Group 1 vs. Group 5: $p < .002$: Group 1 vs. Group 6: $p < .000$). On the Semantic Fluency (SF) subtest of the Batteria 4–12 Group 1 performed significantly worse than Group 5 ($p < .028$) and 6 ($p < .003$). Similarly, Group 2 performed worse than Group 6 ($p < .037$). No significant age-related differences emerged on the naming (NT) and on the sentence repetition (SR) tasks.

3.3. Linguistic assessment of the narrative task: between-group analysis

A multivariate ANCOVA with *group* (1, control participants; 2, SLI patients) as a fixed factor and *age-related subgroups* as the covariate was performed on the following 10 dependent variables: Word count; Speech Rate; % Phonological Paraphasias; % Semantic Paraphasias; % Omissions of Content Words; % Omission of Function Words; % Substitution of Free Morphemes; % Substitution of Bound Morphemes; Mean Length of Utterance; Syntactic Complexity. The criterion for significance was alpha = .05. In this analysis the level of statistical significance was defined as $p < 0.05$ after Bonferroni correction for multiple comparisons (alpha < 0.05/10–alpha < 0.005). Numeric data from the linguistic assessment of the narrative task

Table 5
Mean and standard deviations of the SLI group's performance on the narrative task

	SLI participants					
	1 (5–6 y.o.)	2 (6–7 y.o.)	3 (7–8 y.o.)	4 (8–9 y.o.)	5 (9–10 y.o.)	6 (10–11 y.o.)
Words	42.4 (15)	51.3 (21.2)	75.5 (27.8)	73.8 (26.7)	86.8 (32.2)	87.4 (49.2)
Speech rate	56.1 (15.9)	81.9 (27.3)	84.6 (26.2)	75.4 (35.1)	85.7 (31.2)	80(22.5)
% Phonological paraphasias	17.3 (16.2)	3.3 (7.5)	3.7 (4.7)	3.7 (5.7)	1 (1.6)	1 (1.3)
% Semantic paraphasias	2.6 (4.9)	1.6 (1.7)	1.2 (1.5)	.8 (1.1)	.6 (.9)	.8 (.8)
% Omissions of content words	40.9 (22.7)	35.7 (33)	27.6 (9)	19.1 (12.5)	26.8 (13.2)	22.3 (10.8)
% Omission of function words	34.3 (34.5)	10.6 (19.3)	10.2 (17.5)	8.8 (11.4)	2.6 (4.3)	1.9 (3.1)
% Substitution of free morphemes	3(3.9)	.8 (1.3)	2.1 (1.6)	1.7 (2)	1 (.9)	1.1 (1.3)
% Substitution of bound morphemes	2.1 (2.5)	.2 (.6)	1.1 (1.2)	1.2 (1.4)	.6 (.9)	.7 (1.2)
Mean length of utterance	4.9 (1.3)	5.9 (1.5)	5.7 (1.6)	6.3 (1.6)	6.7 (1.5)	6.5 (1.5)
Syntactic complexity	.4 (.4)	.7 (.2)	.6 (.2)	.9 (.3)	1 (.3)	.9 (.1)

Table 6
Results of the linguistic analysis of the speech samples

	SLI	TLD
Words	70.5 (33.6)	71.4 (31.8)
Speech rate*	77.9 (28.5)	109.9 (30.8)
% Phonological paraphasias*	4.8 (9)	.2 (.7)
% Semantic paraphasias*	1.3 (2.2)	.4 (1)
% Omissions of content words*	28.2 (18.6)	1.9 (5.6)
% Omission of function words*	11.1 (20)	1.8 (5.9)
% Substitution of free morphemes*	1.6 (2.1)	.3 (.8)
% Substitution of bound morphemes*	1 (1.5)	.3 (1.1)
Mean length of utterance*	6 (1.5)	7.7 (2.3)
Syntactic complexity*	.8 (.3)	1.3 (.3)

Asterisks (*) indicate when the group-related difference is significant.

are presented in two distinct tables for Control (Table 4) and SLI participants (Table 5).

As shown in Table 6, clear-cut group-related differences emerged on all linguistic measures with the sole exception of words. With regard to verbal productivity, even if both groups produced an equivalent amount of words, the control group had a faster speech rate [$F(1;\ 254) = 59.832$; $p = .000$]. Conversely, SLI participants produced more phonological ([$F(1;\ 254) = 54.589$; $p = .000$]) and semantic paraphasias ([$F(1;\ 254) = 21.353$; $p = .000$]). Furthermore, more omissions of content ([$F(1;\ 254) = 325.039$; $p = .000$]) and function words ([$F(1;\ 254) = 36.526$; $p = .000$]), as well as more substitutions of free ([$F\ (1;\ 254) = 59.241$; $p = .000$]) and bound morphemes ([$F(1;\ 254) = 16.543$; $p = .000$]) were detected in the narratives uttered by the SLI participants. With regard to measures of grammatical complexity, the control group produced longer utterances ([$F(1;\ 254) = 37.942$; $p = .000$]) and more complex sentences ([$F(1;\ 254) = 203.017$; $p = .000$]).

z-Scores for each variable in each age-group were computed in order to determine the presence of subgroup-related differences across the two groups (Control and SLI participants). As shown in Table 7, no age-related relevant deviations from normal values were scored for words. With regard to speech rate, with the only exception of Age-Group 2 only, all the other subgroups of SLI participants showed a moderate (more than 1 S.D. below average) to severe deficit (more than 2 S.D. below the mean). With regard to lexical processing, all age-related subgroups of SLI patients showed a severe deficit in phonological processing (from 2.1 to 35.3 S.D. below average on % of Phonological Paraphasias) and a moderate to severe deficit in lexical-semantic processing (from 1 to 4.9 S.D. below the mean on % of Semantic Paraphasias). In the domain of grammatical processing, all SLI subgroups showed relevant deficits. Indeed, with the only exception of MLU only, all age-related subgroups showed particularly severe deficits on all measures assessing morphosyntactic and syntactic processing: % omission of both function and content words; % omission of content words; % of paragrammatic errors; and consequently produced less grammatically complete sentences than their normal peers.

3.4. Linguistic assessment of the narrative task: within-group analysis

In order to determine whether age-related differences and IQ variability might have affected the performance of the SLI participants on the narrative task, a multivariate ANCOVA with *age-group* (Group 1, 5–6 years of age; Group 2, 6–7 years of age; Group 3, 7–8 years of age; Group 4, 8–9 years of age; Group 5, 9–10 years of age; Group 6, 10–11 years of age) as fixed factor and IQ as a covariate was performed on the same variables as those described in Section 3.3. In this analysis, the level of statistical significance was defined as $p < 0.005$ after Bonferroni correction for multiple comparisons (alpha < 0.05/10–alpha < 0.005). A post hoc Tukey's test was performed when a significant effect was found. No age-related difference was detected in measures assessing verbal productivity (i.e. words and speech rate).

Clear-cut group-related differences were found in one measure of lexical organization, i.e. the percentage of phonological paraphasias [$F(5;\ 55) = 6.089$; $p = .000$]. Tukey's post hoc test confirmed that the youngest group (i.e. children ranging from 5 to 6 years of age) produced more phonological paraphasias than Groups 2 ($p < .003$), 3 ($p < .001$), 4 ($p < .002$), 5 ($p = .000$) and 6 ($p = .001$) (i.e. SLI participants ranging from 6 to 11 years of age). Conversely, no significant group-related differences were found in the percentage of semantic paraphasias. Similarly, no significant group-related differences were detected in the measures assessing morphosyntactic organization (% Omissions of Content Words; % Omissions of Function Words; % Substitution of Free Morphemes; % Substitution of Bound Morphemes).

With regard to syntactic organization, no significant difference was found in MLU whereas different performances emerged in syntactic complexity [$F(5;\ 55) = 6.757$; $p = .000$], as the youngest group produced fewer grammatically well-formed sentences than groups 4 ($p < .001$), 5 ($p = .000$) and 6 ($p < .001$) (i.e. SLI participants ranging from 8 to 11 years of age).

4. Discussion

The present work investigated linguistic abilities in a group of children diagnosed with Specific Language Impairment. As expected, the group of SLI participants showed a discrepancy between Verbal IQ (mean 83.3) and Performance IQ (mean 95). In the formal linguistic assessment, the SLI children performed significantly worse than control participants on tasks assessing morphosyntactic processing (for similar results on SLI children matched to younger controls on vocabulary, or on general measures of grammar see Van der Lely & Battell, 2003; Van der Lely & Ullman, 2001). Indeed, their performance was within the normal range only on tasks tapping semantic fluency, naming and semantic comprehension, thus suggesting preserved production skills and adequate levels of lexico-semantic processing. However, they showed marked deficits in morphosyntactic and syntactic comprehension tasks as well as on a test assessing phonological comprehension. These results suggest that their deficit prevalently reflects a language comprehension impairment on almost every level of linguistic processing: phonological, morphosyntactic and syntactic. Consequently, they underperformed in tasks assessing repetition abilities. Within-group analysis showed that several aspects of linguistic processing tend to evolve in SLI patients. Indeed, children aged 5–6 years performed significantly worse than older children on almost all tasks assessing comprehension, repetition and production skills with the only relevant exception being naming. This confirms the high prevalence of morphosyntactic comprehension deficits in the group of the SLI patients included in this study. Furthermore, relevant articulatory problems were detected only in the younger children (i.e. SLI children aged 5–7 years), whereas older children scored within the normal range in the articulatory subtest of the formal linguistic assessment. Nonetheless, the articulatory impairment found in the youngest children may lie in comprehension problems as evidenced by concomitant low performance in the phonological comprehension task.

Interestingly, contrary to what emerged from standardized formal linguistic assessment, the analysis of the patients' narratives

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Table 7
Performance of the 6 SLI age-groups compared to the Control participants on the narrative task

	Words	Sp.R.	MLU	SC	Ph.P	S.P.	Om.C.	Om.F.	S.F.M.	S.B.M.
Age-group 1 (5–6 y.o.)	−0.3	−1.7	−0.5	−2.6	18.3	0.9	4.0	2.6	1.3	0.6
Age-group 2 (6–7 y.o.)	−0.1	0.1	−0.6	−2.7	2.1	1.0	4.3	2.2	1.0	−0.1
Age-group 3 (7–8 y.o.)	−0.4	−1.0	−1.4	−3.7	7.0	2.1	5.7	1.9	3.7	2.4
Age-group 4 (8–9 y.o.)	0.0	−1.7	−1.0	−1.7	35.8	1.2	7.8	6.1	6.9	2.0
Age-group 5 (9–10 y.o.)	0.1	−1.3	−0.8	−2.1	8.8	0.6	8.7	0.7	2.4	3.5
Age-group 6 (10–11 y.o.)	0.5	−2.1	−1.0	−1.6	8.6	4.9	10.4	0.2	2.3	0.6

Values are expressed as mean *z*-scores. Key: Sp.R. = speech rate; MLU = mean length of utterance; SC = syntactic complexity; Ph.P. = % phonological paraphasias; S.P. = % semantic paraphasias; Om.C. = % omission of content words; Om.F. = % omission of function words; S.F.M. = % substitution of free morphemes; S.B.M. = % substitution of bound morphemes.

showed the presence of generalized deficits in linguistic production. Indeed, SLI participants produced story descriptions that were qualitatively lower than those uttered by typically developing children. Interestingly, relevant difficulties were found in the SLI group on all linguistic measures with the sole exception of word production. Indeed, the control group talked with a faster speech rate while SLI participants produced more phonological and semantic paraphasias, thus indicating problems in accessing both the lemma and lexeme levels of lexical processing. These data are in line with previous reports where problems in the codification of phonetic and phonological features of language processing have been reported in SLI children (e.g. Bortolini, 1995; Stella, 2001). Morphology and syntax were more affected than vocabulary (see also Aram et al., 1984; Tomblin & Zhang, 1999). Compared to the group of children with typical language development, the group of SLI participants produced shorter utterances, fewer complex sentences and made more omissions of content and function words, as well as more substitutions of free and bound morphemes. The omissions of content (especially verbs and nouns) and function words explain the reduced syntactic complexity of their utterances. Furthermore, a qualitative analysis of the substitutions of free and bound morphemes showed a high prevalence of errors in nominal, adjectival and verbal inflection, especially when person and number agreement markers had to be inserted as flexive morphemes. These results are coherent with previous reports suggesting that children with SLI demonstrate difficulties in syntax and morphology (e.g. Chilosi & Cipriani, 1991; Cipriani et al., 1991; Fey et al., 2004; Gillam & Johnston, 1992; Leonard et al., 1992; Norbury & Bishop, 2003; Paul & Smith, 1993; Redmond, 2004). Interesting additional data came from the assessment of the performance of the 6 SLI age-groups compared to the 6 age-matched subgroups of typically developing children and from the within-group analysis of the performance of the 6 subgroups of SLI participants, respectively. The former analysis confirmed the absence of age-related relevant deviations from normal values for words and the presence of moderate to severe deficits on all other measures, particularly those assessing morphosyntactic and syntactic processing. With regard to lexical processing, all age-related subgroups of SLI patients showed a severe deficit (more than 2 S.D. below the mean) in phonological processing (from 2.1 to 35.3 S.D. below average on % of Phonological Paraphasias) and a moderate (more than 1 S.D. below average) to severe deficit in lexical-semantic processing (from 1 to 4.9 S.D. below the mean on % of Semantic Paraphasias). In the domain of grammatical processing, all the SLI subgroups showed relevant deficits. Indeed, with the sole exception of MLU, all age-related subgroups showed particularly severe deficits on all measures assessing morphosyntactic and syntactic processing. Their narratives were filled with omissions of both function and content words and paragrammatic errors. Consequently, they produced fewer grammatically complete sentences than their normal peers. With regard to within-group assessment, no age-related differences were detected on measures assessing verbal productivity (i.e. words and speech rate), production of semantic paraphasias, and on all measures assessing morphosyntactic organization (% Omissions of Content Words; % Omission of Function Words; % Substitution of Free Morphemes; % Substitution of Bound Morphemes). However, even after correction for FIQ, SLI children ranging from 5 to 6 years old produced more phonological paraphasias than those aged from 6 to 11 years of age. With regard to syntactic organization, no significant difference was found in MLU whereas different performances emerged in syntactic complexity, as the youngest group, again, produced fewer grammatically well-formed sentences than older groups. This finding is important in light of the re-evaluation of MLU as a measure of syntactic development. Indeed, it confirms that utterance length does not directly reflect syntactic complexity (Hewitt et al., 2005) and should be retained only as a gross measure of linguistic development.

Taken together, the present results suggest that for the SLI children recruited in the present study, the domains of morphosyntax and syntax were particularly impaired. Indeed, the SLI participants produced an amount of words comparable to that uttered by the control group, but arranged in a simpler fashion, as their narratives were teeming with omissions and substitutions of bound and free morphemes. Therefore, impaired morphosyntactic and syntactic processing seems to be an indicator of the impairment rather than vocabulary. A final issue concerns the importance of including a linguistic assessment of a narrative task in the standard evaluation of language performance in SLI patients, as traditional standardized neuropsychological tests assessing linguistic functions may not be sensitive enough to capture an individual's communicative performance. Indeed, in story description tasks, speakers tend to be more fluid communicators and to make use of several linguistic skills in a communicatively oriented interaction (Marini, Caltagirone, et al., 2007; Marini, Lorusso, et al., 2007). As a consequence, the analysis allows one to control for the interaction among several processing levels (e.g. those between verb processing, argument structure generation, sentence production). Indeed, the analysis of the narratives made it possible to further evaluate the linguistic skills of the SLI participants in an online task and showed that their problems were not limited to comprehension but extended also to selective aspects of linguistic production, especially those involving morphosyntactic and syntactic processing. Further research is required to explore additional aspects of linguistic performance, such as informativeness and discourse-level processing.

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Appendix A. Examples for the categories coded in the linguistic analysis of the narrative task

Coding feature	Example	Explanation
Phonological paraphasia	ha visto l'ussellino	Fonemic substitution
	$\emptyset_{Pro3rdSing}$ saw the little bird	/s/instead of/tʃ/
Semantic paraphasia	ha rotto l'albero	Semantic substitution
	$\emptyset_{Pro3rdSing}$ broke the tree	"albero" instead of "ramo", *branch*
Omission of content words	Lui # (3 s) l'albero	Main clause verb omission
	He # (3 s) the tree	
Omission of function words	Vede albero	Definite determiner omission
	$\emptyset_{Pro3rdSing}$ sees tree	
Substitution of free morpheme	È seduto con il letto	Preposition substitution
	$\emptyset_{Pro3rdSing}$ is sitting with the bed	"con", *with* for "su", *on*
Substitution of bound morpheme	È caduto dalla rama	Substitution of gender feature:/a/, *FEM* for/o/, *MASC*
	$\emptyset_{Pro3rdSing}$ fell off the $branch_{FemSing}$	

References

Aram, D., Ekelman, B., & Nation, J. (1984). Preschoolers with language disorders: 10 years later. *Journal of Speech, Language, and Hearing Research*, *27*, 232–244.

Bishop, D. V. M. (1997). *Uncommon understanding: Comprehension in specific language impairment*. Hove, UK: Psychology Press.

Bishop, D. V. M. (2004). Diagnostic dilemmas in specific language impairment. In L. Verhoeven & J. Van Balkom (Eds.), *Classification of developmental language disorders* (pp. 309–326). Mahwah, NJ: Erlbaum.

Bishop, D. V. M., & Mcarthur, G. M. (2005). Individual differences in auditory processing in specific language impairment: A follow-up study using event-related potentials and behavioural thresholds. *Cortex*, *41*, 327–341.

Bortolini, U. (1995). I disordini fonologici. In G. Sabbadini (Ed.), *Manuale di Neuropsicologia dell'età evolutiva*. Bologna, Italia: Zanichelli.

Chilosi, A. M., & Cipriani, P. (1991). *Il Bambino disfasico*. Pisa, Italia: Edizioni Del Cerro.

Chilosi, A. M., & Cipriani, P. (1995). *Test di comprensione grammaticale per i bambini*. Pisa, Italia: Edizioni Del Cerro.

Cipriani, P., & Chilosi, A. M. (1995). Classificazione dei ritardi e disordini di acquisizione del linguaggio. In G. Sabbadini (Ed.), *Manuale di Neuropsicologia dell'età evolutiva*. Bologna, Italia: Zanichelli.

Cipriani, P., Chilosi, A. M., Bottari, P., & Pfanner, L. (1993). *L'acquisizione della morfosintassi in italiano*. Padova, Italia: Unipress.

Cipriani, P., Chilosi, A. M., Bottari, P., Pfanner, L., Poli, P., & Sarno, S. (1991). L'uso della morfologia grammaticale nella disfasia congenita. *Giornale Italiano di Psicologia*, *18*, 765–779.

Conti-Ramsden, G., & Botting, N. (1999). Classification of children with specific language impairment: Longitudinal classifications. *Journal of Speech, Language, and Hearing Research*, *42*, 1195–1204.

De Agostini, M., Metz-Lutz, M. N., Van Hout, A., Chavance, M., Deloche, G., Pavao-Martins, I., et al. (1998). Batterie d'eĭvaluation du langage oral de l'enfant aphasique: Standardisation française (4-12 ans). Oral language evaluation battery of aphasic children: A French standardisation. *Revue de Neuropsychologie*, *8*, 319–367.

Fabbro, F. (1999). Neurolinguistica e neuropsicologia dei disturbi specifici del linguaggio nel bambino: Proposta di un esame del linguaggio. *Saggi*, *25*, 11–23.

Fabbro, F., & Galli, R. (2001). *Test dello Sviluppo morfosintattico*. Milano, Italia: Editore Ghedini Libraio.

Ferrari, E., De Renzi, E., Faglioni, P., & Barbieri, E. (1981). Standardizzazione di una batteria per la valutazione dei disturbi del linguaggio nell'età scolare. *Neuropsichiatria Infantile*, *235*, 148–158.

Fey, M. E., Catts, H. W., Proctor-Williams, K., Tomblin, B. J., & Zhang, X. (2004). Oral and written story composition skills of children with language impairment. *Journal of Speech, Language, and Hearing Research*, *47*, 1301–1318.

Gauger, L. M., Lombardino, L. J., & Leonard, C. M. (1997). Brain morphology in children with specific language impairment. *Journal of Speech, Language, and Hearing Research*, *40*, 1272–1284.

Gillam, R. B., & Johnston, J. R. (1992). Spoken and written language relationships in language/learning-impaired and normally achieving school-age children. *Journal of Speech, Language, and Hearing Research*, *35*, 1303–1315.

Haravon, A., Obler, L., & Sarno, M. (1994). A method for microanalysis of discourse in brain-damaged patients. In R. Bloom, L. Obler, S. De Santi, & J. Ehrlich (Eds.), *Discourse analysis and applications: Studies in adult clinical populations* (pp. 47–80). Hillsdale: Lawrence Erlbaum.

Hewitt, L. E., Scheffner Hammer, C., Yont, K. M., & Tomblin, J. B. (2005). Language sampling for kindergarten children with and without SLI: Mean length of utterance, IPSYN, and NDW. *Journal of Communication Disorders*, *38*, 197–213.

Jernigan, T. L., Hesselink, J. R., Sowell, E., & Tallal, P. A. (1991). Cerebral structure on magnetic resonance imaging in language- and learning-impaired children. *Archives of Neurology*, *48*, 539–545.

Joanisse, M. F., & Seidenberg, M. S. (1998). Specific Language Impairment: A deficit in grammar or processing? *Trends in Cognitive Sciences*, *2*, 240–247.

Laws, G., & Bishop, D. V. M. (2003). A comparison of language abilities in adolescents with Down Syndrome and children with Specific Language Impairment. *Journal of Speech, Language, and Hearing Research*, *46*, 1324–1339.

Leonard, L. B. (1998). *Children with specific language impairment*. Cambridge, MA: MIT Press.

Leonard, L. B., McGregor, K., & Allen, G. (1992). Grammatical morphology and speech perception in children with specific language impairment. *Journal of Speech, Language, and Hearing Research*, *35*, 1076–1085.

Levelt, W. J. M., Roelofs, A., & Meyer, A. S. (1999). A theory of lexical access in speech production. *Behavioral and Brain Sciences*, *22*, 1–37.

Liles, B. Z. (1985). Production and comprehension of narrative discourse in normal and language disordered children. *Journal of Communication Disorders*, *18*, 409–427.

Marini, A., Boewe, A., Caltagirone, C., & Carlomagno, S. (2005). Assessment of age-related differences in the processing of textual descriptions. *Journal of Psycholinguistic Research*, *34*, 439–463.

Marini, A., Caltagirone, C., Pasqualetti, P., & Carlomagno, S. (2007). Patterns of language retrieval in patients with non-chronic non-fluent aphasia following specific therapies. *Aphasiology*, *21*, 164–186.

Marini, A., Carlomagno, S., Caltagirone, C., & Nocentini, U. (2005). The role played by the right hemisphere in the organization of complex textual structures. *Brain and Language*, *93*, 46–54.

Marini, A., Lorusso, M. L., D'Angelo, G., Civati, F., Turconi, A. C., Fabbro, F., et al. (2007). Evaluation of narrative abilities in patients suffering from Duchenne Muscular Dystrophy. *Brain and Language*, *102*, 1–12.

Nation, K. (2005). Developmental language disorders. *Psychiatry*, *4*, 114–117.

Norbury, C. F., & Bishop, D. V. M. (2003). Narrative skills of children with communication impairments. *International Journal of Language and Communication Disorders*, *38*, 287–313.

Oki, J., Takahashi, S., Miyamoto, A., & Tachibana, Y. (1999). Cerebellar hypoperfusion and developmental dysphasia in a male. *Pediatric Neurology*, *21*, 745–748.

Paradis, M. (1987). *The assessment of bilingual aphasia*. Hillsdale, NJ: Erlbaum.

Paul, R., & Smith, R. L. (1993). Narrative skills in 4-year-olds with normal, impaired, and late-developing language. *Journal of Speech, Language, and Hearing Research*, *36*, 592–598.

Rapin, I., & Allen, D. (1987). Developmental dysphasia and autism in pre-school children: Characteristics and subtypes. In *Proceedings of the First International Symposium on Specific Speech, and Language Disorders in Children*.

Redmond, S. M. (2004). Conversational profiles of children with ADHD, SLI and typical development. *Clinical linguistics and Phonetics*, *18*, 107–125.

Rescorla, L., & Schwartz, E. (1990). Outcome of specific language delay (SELD). *Applied Psycholinguistics*, *2*, 393–408.

Sabbadini, G., Volterra, V., Leonard, L., & Campagnoli, M. G. (1987). Bambini con disturbo specifico del linguaggio: aspetti morfologici. *Giornale di Neuropsichiatria dell'Età Evolutiva*, *7*, 213–222.

Segers, E., & Verhoeven, L. (2005). Effects of lengthening the speech signal on auditory word discrimination in kindergartners with SLI. *Journal of Communication Disorders*, *38*, 499–514.

Shewan, C. M. (1988). The Shewan Spontaneous Language Analysis (SSLA) system for aphasic adults: Description, reliability and validity. *Journal of Communication Disorders*, *21*, 103–138.

Stella, G. (2001). I disturbi specifici del linguaggio. In L. Camaioni (Ed.), *Psicologia dello sviluppo del linguaggio*. Bologna, Italia: Il Mulino.

Tallal, P., Jernigan, T. L., & Trauner, D. (1994). Developmental bilateral damage to the head of the caudate nuclei: Implications for speech-language pathology. *Journal of Medical Speech-Language Pathology*, *2*, 23–28.

Tavano, A., De Fabritiis, P., & Fabbro, F. (2005). Contributo alla valutazione standardizzata dell'eloquio narrativo nei bambini. *Giornale di Neuropsichiatria dell'Età Evolutiva*, *25*, 1–16.

Tomblin, J. B., & Zhang, X. (1999). Language patterns and etiology in children with specific language impairment. In H. Tager-Flusberg (Ed.), *Neurodevelopmental disorders* (pp. 361–382). Cambridge, MA: MIT Press.

Ullman, M. T. (2004). Contributions of memory circuits to language: The declarative/procedural model. *Cognition*, *92*, 231–270.

Van der Lely, H. K. J. (1994). Canonical linking rules: Forward versus reverse linking in normally developing and specifically language impaired children. *Cognition*, *51*, 29–72.

Van der Lely, H. K. J. (1997a). Language and cognitive development in a grammatical SLI boy: Modularity and innateness. *Journal of Neurolinguistics*, *10*, 75–107.

Van der Lely, H. K. J. (1997b). Narrative discourse in grammatical specific language impaired children: A modular language deficit. *Journal of Child Language*, *24*, 221–256.

Van der Lely, H. K. J. (2005). Domain-specific cognitive systems: Insight from Grammatical-SLI. *Trends in Cognitive Sciences*, *9*, 53–59.

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Van der Lely, H. K. J., & Battell, J. (2003). Wh-movement in children with grammatical SLI: A test of the RDDR hypothesis. *Language*, *79*,153–181.

Van der Lely, H. K. J., Rosen, S., & McClell, A. (1998). Evidence for a grammar-specific deficit in children. *Current Biology*, *8*, 1253–1258.

Van der Lely, H. K. J., & Stollwerck, L. (1996). A grammatical specific language impairment in children. An autosomal dominant inheritance? *Brain and Language*, *52*, 484–504.

Van der Lely, H. K. J., & Ullman, M. (2001). Past tense morphology in specifically language impaired children and normally developing children. *Language and Cognitive Processes*, *16*, 113–336.

Vargha-Khadem, F., Watkins, K. E., Price, C. J., Ashburner, J., Alcock, K. J., Connelly, A., et al. (1998). Neural basis of an inherited speech and language disorder. *Proceedings of the National Academy of Sciences USA*, *95*, 12695–12700.

Vender, C., Borgia, R., Cumer Bruno, S., Freo, P., & Zardini, G. (1981). Un test di ripetizione di frasi. Analisi delle performances di bambini normali. *Neuropsychiatria Infantile*, *243*, 819–831.

Wechsler, D. (1993). *WISC—R. Scala d'intelligenza Wechsler per bambini riveduta*. Firenze, Italia: Organizzazioni Speciali.

Wechsler, D. (1996). *WPPSI. Scala d'intelligenza Wechsler per bambini. Firenze*. Firenze, Italia: Organizzazioni Speciali.

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