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**Complexity markers in morphosyntactic productions in French-speaking children with
specific language impairment (SLI)**

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Abstract

Usage-based theory considers that the morphosyntactic productions of children with SLI are particularly dependent on input frequency. When producing complex syntax, the language of these children is therefore predicted to have a lower variability and to contain fewer infrequent morphosyntactic markers than that of younger children matched on morphosyntactic abilities. Using a spontaneous language task, the current study compared the complexity of the morphological and structural productions of 20 children with SLI and 20 language-matched peers (matched on both morphosyntactic comprehension and mean length of utterance). As expected, results showed that although basic structures were produced in the same way in both groups, several complex forms (i.e. tenses such as *Imperfect*, *Future* or *Conditional* and *Conjunctions*) were less frequent in the productions of children with SLI. Finally, we attempted to highlight complex linguistic forms that could be good clinical markers for these children.

Keywords: specific language impairment, morphosyntactic production, complexity markers.

Introduction

This study focuses on the development of morphosyntactic production in school-age children with specific language impairment (SLI). Following the usage-based framework, the morphosyntactic productions of these children should be especially dependent on input frequency: the children are expected to structure their language according to the frequency properties of their input. We looked at differences in the complexity of the morphological and structural productions between children with SLI and typically developing peers (TDL) matched on both morphosyntactic comprehension and mean length of utterance (MLU). We especially investigated aspects of language that are acquired late in typical language development. By focusing on the complex morphosyntactic forms used in spontaneous language samples of French-speaking school-age children with SLI, this paper attempts to highlight the complex linguistic forms that could be good clinical markers for these children.

Morphosyntactic disorders and SLI

Morphosyntactic disorders in production are particularly common in children with SLI (Hsu & Bishop, 2011). These difficulties have been studied during the early morphosyntactic development in young children. The first word combinations appear later in children with SLI than in typically developing children, and their grammatical morphology use is limited, characterized by short sentences with omissions and simplifications (Oetting, Hadley, & Schwartz, 2009). From preschool age, children with SLI have a lower MLU than TDL children (Hewitt, Hammer, Yont, & Tomblin, 2005).

Previous studies highlighted specific difficulties in verbal morphology (Oetting, Hadley, & Schwartz, 2009) with omissions of auxiliaries (Paradis & Crago, 2001), especially when the

argument structure is complex (Grela & Leonard, 2000). These children show less variability in the verbal forms they use (Conti-Ramsden & Jones, 1997). They also have problems with subject - verb agreement (Franck, Cronel-Ohayon, Chillier, Frauenfelder, Hamann, Rizzi, & Zesiger, 2004). Other studies have pointed out specific difficulties in these children with the production of verbal past inflexions (Blake, Myszczyzyn & Jokel, 2004; Marchman, Wulfeck, & Weismer, 1999). Marchman et al. (1999) found that these difficulties were greater for low frequency verbs and that these children regularized irregular verbs more often than TDL children. Omissions of tense marking continue through adolescence (Miller, Leonard, & Finneran, 2008). However, a typical developmental pattern is observed in SLI: present forms are acquired prior to past forms (Oetting & Horohov, 1997) and determiners are acquired before clitic pronouns (Jakubowicz & Nash, 2001). It thus seems that, even if delayed, the sequence of acquisition is the same in SLI as in TDL (Hamann, Ohayon, Dubé, Frauenfelder, Rizzi, Starke, & Zesiger, 2003). Even if a clear consensus is not reached, some authors also argue that the kind of errors made is similar in the two populations, and that there are no atypical errors in the verbal production of children with SLI (Thordardottir & Namazi, 2007).

Some authors investigated the mastery of complex syntactic structures in children with SLI. Analyses of spontaneous language samples showed that children with SLI produce fewer complex structures than TDL children (Marinellie, 2004; van der Lely, 2004). They show greater rigidity in the use of syntactic structures and alternate less between verbs than TDL children (King, Schelletter, Sinka, Fletcher, & Ingham, 1995; Thordardottir & Weismer, 2002). Again, a developmental improvement is observed and these difficulties mainly appear with more complex functional categories in older children. More generally, in older children with SLI, difficulties are mainly observed in the linguistic functions that are acquired late in typical language development. Compared to children with TDL, these children have difficulties producing prepositions (Grela, Rashiti, & Soares, 2004), passive sentences (Loeb,

Pye, Richardson, & Redmond, 1998), interrogative sentences (van der Lely, 2003), and relative clauses (Riches, Loucas, Baird, Charman, & Simonoff, 2010). Children with SLI encounter problems in producing the accurate relative marker (Schuele & Nicholls, 2000) or forget to produce one. Schuele & Tolbert (2001) found that children with SLI (5 to 7 years) forget the relative marker in 63% of cases while their peers (3 to 5 years) produce it every time. The production of subordinate clauses of cause and consequence is also difficult (Donaldson, Reid, & Murray, 2007). Some authors studied the morphosyntactic productions of adolescents with SLI and showed that difficulties persist in most children, as shown by poorer performance compared to speakers with TDL (Tuller, Henry, Sizaret, & Barthez, 2012). In an analysis of spontaneous language samples, adolescents with SLI usually showed behaviors of avoidance of complex structures to a larger extent than TDL children (Tuller et al., 2012).

Specific morphosyntactic disorders in French children with SLI

Certain morphosyntactic disorders appear to be more prevalent in French-speaking children with SLI, namely inflectional verbal morphology and clitic pronouns. Concerning inflectional verbal morphology, particular difficulties have been reported in tense marking, verb person (Thordardottir & Namazi, 2007) and subject-verb agreement (Franck et al., 2004). French children with SLI present a consistent deficit in tense marking (Jakubowicz, Nash, & van der Velde, 1999; Paradis & Crago, 2001). For example, it appears that children with SLI aged five still use verbs in the infinitive while this trend disappears among their peers around the age of three (Hamann et al., 2003). More particularly, tense marking appears to be more impaired than subject-verb agreement (Paradis & Crago, 2001; Stavrakaki, Chrysomallis, & Petraki, 2011). On this point, Jakubowicz and Nash (2001) highlighted a particular past-tense deficit

in school-aged children with SLI compared to younger children with TDL. Similarly, school-aged children with SLI performed significantly less well than control children with TDL aged from 3 to 4 years old, on the *passé composé* and *pluperfect* past tenses in elicitation (Jakubowicz, 2003).

Concerning grammatical complexity, according to Hamann and colleagues (2003), French children with SLI older than five years show persistent difficulties with complement clitic pronouns. The acquisition of object clitics even by school-aged children is an especially vulnerable feature of the language of French children with SLI, as reported by several studies (Grüter, 2005; Jakubowicz, Nash, Rigaut, & Gérard, 1998; Paradis et al., 2003, 2006; Parisse & Maillart, 2004; Stavrakaki, Chrysomallis, & Petraki, 2011; Tuller, Delage, Monjauze, Piller, & Barthez, 2011). However, while school-age French-speaking children with SLI show a lower performance than TDL children aged 5 years in the use of clitic pronouns, the two groups do not differ in their use of articles (Jakubowicz et al., 1998). This deficit can be explained by the linguistic properties of clitics (Stavrakaki, Chrysomallis, & Petraki, 2011). Moreover, French children with SLI (3;1 to 9;1 years) have problems with the acquisition of wh-questions (Stavrakaki, Chrysomallis, & Petraki, 2011): they use an economical strategy for wh-question formation (Stavrakaki, Chrysomallis, & Petraki, 2011). The inverted structure *a-t-il* ('has he') when yes-no questions are elicited is also difficult for these children (Hamann, 2006).

Usage-based theory and SLI

Although the origin of language disorders in children with SLI is the subject of many studies and theoretical accounts, none of these theories completely explain all the difficulties they encounter. Usage-based theory offers an interesting perspective in considering that the mechanisms enabling the creation and retention of grammatical structures are governed by the

use of these linguistic forms (Bybee, 1995, 2001). Following this theoretical framework, language production is essentially influenced by the speaker's past language experience (Diessel, 2007). Children develop most of their new linguistic forms by complexifying and generalizing their own previous productions extracted from the input heard. It is in using their own language level that the children infer new syntactic representations and improve their morphosyntactic development. Although the production of complex syntax is an essential skill for school-aged children (Marinellie, 2004), defining 'complex syntax' remains difficult. Our concept of complexity differs from that developed within the generative framework and applied to research on French by Jakubowicz, Tuller and collaborators. Jakubowicz (2005) argued that "complexity can be measured by counting the number of instances of the syntactic operation merge (external merge, which is structure building due to lexical insertion, and internal merge, which is syntactic movement) that are involved in the derivation of a sentence" (Tuller, Henry, & Sizeret, 2012). These principles are dependent on the underlying grammatical theory and do not apply to theories such as construction grammars. We argue that complexity can be defined as linguistic structures that are rare, long, and nested as these characteristics are more closely linked to the principles at work in construction grammars.

The processing of rare, long and nested linguistic structures leads to more and more errors or to longer reaction times, suggesting that these variables are decisive in defining grammatical complexity. Concerning length, many studies have demonstrated a significant and persistent deficit in non-word repetition skills in children with SLI compared to children matched on age but also compared to children matched on lexical level (e.g. Archibald & Gathercole, 2006; Girbau & Schwartz, 2008; Marton & Schwartz, 2003; Montgomery, 2004), especially when the length increases (e.g. Girbau & Schwartz, 2008; Montgomery, 2004). Moreover, one study (Marton, Kelmenson, & Pinkhasova, 2007) found more errors in a sentence span task in children with SLI compared to their age-matched peers and even compared to their peers

matched on lexical level. As for rarity, information theory has shown that the rarer the information is, the more information we need in order to encode it (Shannon & Weaver, 1949). Moreover, frequent structures are less difficult to process. Following Diessel (2004), we argue therefore that rare, low-frequency structures are less deeply established in the mental grammar than frequent structures and are more complex. Concerning nesting, some earlier work highlighted that nested clauses are more complex to process (Kail, 1975; Kynette & Kemper, 1986). A further point is that SLI children may have particular difficulty in processing non-canonical structures (Jakubowicz, Nash, Rigaut, & Gerard, 1998).

In Usage-based theory (Bybee, 1985), frequency is crucially important not only for lexical acquisition but also for grammatical development since it has an impact on the comprehension, production, and emergence of linguistic structures (Bybee & Hopper, 2001; Diessel, 2007). Two types of frequency can be distinguished (Bybee, 2001). Token frequency is defined as 'how many times a specific item is used in a specific pattern' (Brandt, Verhagen, Lieven, & Tomasello, 2011, p. 328) whereas type frequency is related to 'how many different items are used in a specific pattern'. The token frequency of a specific form (i.e., the frequency with which this linguistic form is encountered) enables learning of the item (Diessel, 2007). Given that many items are used in a specific pattern, a high type frequency supports the generalization and productivity of new linguistic structures (Bybee, 1985, 1995), whereas a high token frequency is negatively correlated with productivity. Indeed, structures with a high level of token frequency (and thus a low level of variability) are greatly entrenched. They seem to be lexicalized and do not easily enable generalization to other structures (Bybee, 1995). Thus, type frequency is necessary to avoid the entrenchment of a morphosyntactic structure into a lexicalized form (i.e., to avoid rigidity) and to allow production variability and creativity.

There is a close relationship between complexity and frequency. The frequency of a structure in the input and the age of emergence in language are correlated (Diessel, 2004). Moreover, the development of complex sentences seems to be determined by input frequency and the child's productions. Consequently, the more an item is heard, the more it is used, the more easily it is learned and the more strongly this item is entrenched in the child's grammatical knowledge network. In the usage-based approach, the strength and depth of the stored representation of a linguistic element is related to its frequency of occurrence (Bybee, 1995; Diessel, 2004; Langacker, 1987). So, constructions that occur with high frequency in language use are more entrenched in internal grammar than rare expressions (Diessel, 2004). Diessel also argues that the acquisition of complex constructions is similar to that of simpler constructions, and emphasizes the important role of language input for complex constructions. Indeed, he highlights that the frequency of different relative clauses in the children's productions is highly correlated with the frequency of the corresponding relative clauses in the productions of their mothers.

To conclude, a combination of the two types of frequency is required to generalize a linguistic structure: high token frequency allows the entrenchment of the most frequent forms while high type frequency is directly related to productivity (Bybee, 2001; Leroy, Parisse, & Maillart, 2013). The two frequencies are essential to produce a functional language.

Previous studies are congruent with a usage-based explanation of the morphosyntactic production difficulties encountered in children with SLI. These children show limited morphosyntactic creativity and variability compared to TDL children and are more input-dependent, producing only the most frequent forms easily because their entrenchment is greater than in the infrequent forms (Conti-Ramsden & Jones, 1997; Riches, Faragher, & Conti-Ramsden, 2006; Skipp, Windfuhr, & Conti-Ramsden, 2002). Moreover, given this entrenchment, children with SLI tend to use these forms in the way they heard them, with a

lack of variability and/or creativity. Following the usage-based account of the morphosyntactic production difficulties in children with SLI, their linguistic system mainly contains forms with a very high token frequency, and a very weak type frequency (Leroy, Parisse, & Maillart, 2013).

Aims of the study

We predict a link between the frequency of the linguistic structures used in spontaneous speech and their presence in children's language. The structures that are frequently heard in input are primarily used and become lexicalized. As children with SLI are more input-dependent and less creative with their language (Jones & Conti-Ramsden, 1997; Riches, Faragher, & Conti-Ramsden, 2006; Skipp, Windfuhr, & Conti-Ramsden, 2002), this relationship is likely to be stronger in this group than in controls. At the same level of morphosyntactic complexity (as measured by morphosyntactic reception and MLU), the language of children with SLI can be expected to contain fewer infrequent morphosyntactic markers because they are considered to be less able to generalize their use (lower type frequency). Even if these markers are present, they should be used less productively. However, we expect no difference between the two groups for the frequent markers which are heard (and used) often enough to be accurately generalized. These predictions should hold for verbal morphology (inflectional verbal morphology with different tense markers) which is considered to be particularly fragile in children with SLI (Marchman & al., 1999; Rice & Wexler, 1996) and also for the variety of structures (grammatical complexity) which are more rigid in this population (Thordardottir & Weismer, 2002). Following the usage-based account, we expect that:

1. Children with SLI compared to TLD children matched on several language levels (lexical reception, lexical production, morphosyntactic reception, MLU) will show

lower variability in their productions (as measured by type frequency), even on overall measures (number of words, number of verbs, etc.).

2. Children with SLI will produce less complexity in their verbal forms than their peers (Marchman & al., 1999; Rice & Wexler, 1996). Complex verbal forms will be less well mastered by these children than simpler verbal forms. At the same level of morphosyntactic complexity, the performance of both groups of children is predicted to depend on the nature of the markers. Common forms (infinitives) will be more abundant in the productions of children with SLI than rarer forms. Indeed, as these markers are sufficiently automated by children with SLI, we predict no difference between the two groups. According to the developmental acquisition in children with TDL (Parisse & Morgenstern, 2012), we predict group differences on the rarest markers (less than 5% in spontaneous speech), such as the infrequent category of imperfect, future, and conditional forms.
3. At the same level of morphosyntactic complexity (as measured by MLU and morphosyntactic reception), the study of differences between children with SLI and their peers will highlight the best markers of complexity.

Method

- Participants

Twenty monolingual French-speaking children with SLI aged 111 to 163 months (16 boys; mean age = 139.95 months; SD= 12.31) were recruited through speech-language therapists, in the French-speaking part of Belgium. They were recruited from specific language classes in special needs schools. Prior to the study, children were diagnosed as with SLI by speech-

language therapists and child neurologists. All of the children with SLI had a nonverbal intellectual quotient (IQ) of 85 or greater. Nonverbal IQ was measured by using Wechsler Nonverbal (WNV: Wechsler & Naglieri, 2006). They had normal hearing, vision, oral and speech motor abilities, and scored more than -1.25 SD below expected normative performance in 2 language areas (according to the SLI criteria adopted by Leonard et al., 2007). The children's language abilities were assessed by means of several French tests. Phonological reception was assessed with the Epreuve Lilloise de Discrimination Phonologique (ELDP: Test of Phonological Discrimination, Macchi, Descours, Girard, Guitton, Morel, Timmermans, & Boidein, 2012). The phonological production component was assessed with a nonword repetition task from the L2MA-2 (L2MA-2 : Batterie de langage oral, langage écrit, mémoire, attention (2ème édition), Chevrie-Muller, Maillart, Simon, & Fournier, 2010). For two tasks of the L2MA-2 assessing lexical reception and sentence comprehension, children were instructed to select the picture that corresponded to a word (for lexical reception) or an utterance (for sentence comprehension) among four choices. We administered another receptive lexical test, the EVIP (Echelle de Vocabulaire en Images Peabody, EVIP, Dunn, Thériault-Whalen, & Dunn, 1993). The other three subtests were expressive. A picture-naming task assessed the lexical production component. The morphosyntactic production component was assessed with a sentence production task. All children passed a hearing acuity screening (20 dB at 500, 1000, 2000, and 4000 Hz, per ASHA guidelines).

Twenty monolingual French-speaking TDL children (8 boys; mean age = 93.80 months; SD= 13.19) were also recruited for this study. Their linguistic performances were controlled and all of them were at or above age-level expectations. These children were matched on children with SLI on morphosyntactic comprehension and on maternal education level (education level was rated for each child from 1 to 4: levels ranged from “primary education” to “higher

education’’). The two groups did not differ in their lexical comprehension, lexical production, sentence comprehension or nonverbal IQ scores. However, both groups were significantly different on other standardized language measures (see Table 1).

- *Insert Table 1 about here* -

Informed consent was obtained from the parents of all participating children. They came from families with a low or middle-class socioeconomic background, as determined by their mother’s education level. The parents were administered an anamnestic questionnaire, allowing us to ensure that all the children were French native speakers, had no history of psychiatric or neurological disorders, and no neurodevelopmental delay or sensory impairment. The local research ethics committee approved the study, which was carried out in accordance with the guidelines of the Helsinki Declaration.

- **Procedure**

A 20-minute spontaneous speech sample was recorded, transcribed and analyzed for each child. Four different sampling conditions of 5 minutes each (cartoon recall, interview, referential communication task, and description of a comic book) were used to maximize the productions.

We first collected overall data on production: the token frequency of verbs, the type frequency of verbs, the MLU, the number of turns, and the number of utterances. Second, we collected production data on inflectional verbal morphology with different tense markers: the accurate use of present tense, imperative, imperfect, conditional, future, past participle, infinitive, modals, and auxiliaries. We used MOR and POST from CLAN (*Computerized Language Analysis*)

which are part of the CHILDES (*Child Language Data Exchange System* - MacWhinney, 2000) set of computational tools. In order to increase the amount of data in each type, we grouped together the verbal forms of the same relative frequency: present and imperative were grouped together, and imperfect, conditional and future in another group. For each variable, both the token frequency and the type frequency were calculated. As a reminder, the token frequency reflects the occurrence of each specific form (e.g. *eat*, *eat* and *drive* are separate occurrences of verbs), and the type frequency reflects the variability with which a specific category (e.g. verb) is used (in this case, *eat* and *drive* bring variability to the verb category). Third, we collected production data about grammatical complexity. We selected several categories identified as interesting grammatical markers by previous studies focusing on language acquisition and that we considered more closely associated with increases in language and a relevant basis for the study of the evolution of syntax in children with SLI. We calculated the proportion of adjectives, adverbs (Parsse & Maillart, 2006), conjunctions (Sekali, 2012), determiners (Jakubowicz et al., 1998; Paradis, Crago, & Genesee, 2006), prepositions (Grela, Rashiti, & Soares, 2004; Morgenstern & Sekali, 2009), pronouns (Jakubowicz & Nash, 2001; Parsse & Le Normand, 2000), relative pronouns (Hamann & Tuller, 2010; Riches et al., 2010; Tuller et al., 2012), interrogative pronouns (van der Lely, 2003) and interrogative adverbs. Again, for each variable, both the token frequency and the type frequency were calculated. In order to increase the number of occurrences, the relative pronouns, interrogative pronouns, and interrogative adverbs were grouped together. Lastly, we also calculated the number of utterances with two verbs (See Table 2).

- *Insert Table 2 about here* -

Results

All the children understood the instructions. No child was excluded from the study. As the data were normally distributed (determined by the Kolmogorov–Smirnov test), we used t-tests.

- **Overall data**

Table 3 shows the overall data as a function of group (SLI or TDL) and effect size. These measures were each submitted to a Student's t-test for independent samples. The group effect was significant, with better performances in the TDL than in the children with SLI group for the variables *Number of verbs type* ($p < .05$, $d = .65$). There were more *Turns of speech* ($p < .05$, $d = .68$) in samples of the experimental group (SLI) than in those of their peers. For the other variables, the difference did not reach the level of significance.

- *Insert Table 3 about here* -

- **Inflectional verbal morphology with different tense markers**

We used Student's t-test for independent samples. Statistical analyses were carried out on proportional data. They focused on the *proportions of verbs* for each child to avoid the results of children who produce the most verbs influencing the analyses.

For example, the *Present + Imperative Token* variable was calculated by dividing the token frequency of all verbs used in the present tense or the imperative form by the token frequency of verbs produced. In the same way, the *Present + Imperative Type* variable was calculated by dividing the type frequency of verbs used in the present or the imperative by the type frequency of verbs produced.

Table 4 shows the inflectional verbal morphology with different tense markers as a function of group (SLI or TDL) and effect size. These measures were each submitted to a Student's t-test

for independent samples. The group effect was significant, revealing a larger use in the TDL group than in the children with SLI group for the variables *Imperfect + Future + Conditional Token* ($p < .01$, $d = .90$) or *Type* ($p < .05$, $d = .84$), *Modals Token* ($p < .05$, $d = .78$) or *Type* ($p < .05$, $d = .80$). The group effect was also significant, but with a more frequent use in children with SLI than in TDL children for the variable *Infinitives Type* ($p < .05$, $d = .74$). For the other variables, the difference did not reach the level of significance.

- *Insert Table 4 about here* -

- **Grammatical complexity**

We used Student's t-test for independent samples. Again, statistical analyses were carried out on proportional data to avoid the results of children who produce the most words influencing the analyses.

Table 5 shows the grammatical complexity data as a function of group (SLI or TDL) and effect size. The group effect was significant, with a larger use in TDL children than in children with SLI for the variables *Conjunctions Token* ($p < .001$, $d = 1.26$), *Prepositions Token* ($p < .05$, $d = 0.76$) or *Type* ($p < .05$, $d = .68$), *Pronouns Token* ($p < .05$, $d = .64$), *Relative pronouns + Interrogative pronouns + Interrogative adverbs Token* ($p < .01$, $d = .93$). The group effect was nearly significant, with a larger use in TDL children than in children with SLI for the variable *Utterances with two verbs* ($p = .06$, $d = .59$). On the contrary, the group effect was significant, with a larger use in children with SLI than in TDL children for the variable *Determiners Token* ($p < .05$, $d = .69$). For the other variables, the difference did not reach the level of significance.

- *Insert Table 5 about here* -

- **Further Results**

Discriminant analyses evaluating group classifications (i.e., children with TLD; children with SLI) were then performed on the most relevant measures (as showed by *t* tests and effect size) in order to find the best clinical marker (between *Conjunctions Token*, *Relative pronouns + Interrogative pronouns + Interrogative adverbs Token* and *Imperfect + Future + Conditional Token*) to distinguish typical from atypical language functioning. We conducted independent analyses for each scoring measure. First, *Conjunctions Token* was entered into the discriminant analysis. Wilk's Lambda was significant ($\lambda = 0.70$; $F(1.38) = 15.91$, $p < .001$): 65% of children with SLI were correctly classified and 85% of children with TDL were correctly classified. The overall classification power was 75%. The second scoring procedure, taking into account *Relative pronouns + Interrogative pronouns + Interrogative adverbs Token*, also presented a significant Wilk's Lambda ($\lambda = 0.81$; $F(1.38) = 8.52$, $p < .01$). The overall classification power was lower (70%): 75% of children with SLI were correctly classified and 65% of children with TLD were also correctly classified. The third scoring procedure, taking into account *Imperfect + Future + Conditional Token*, also presented a significant Wilk's Lambda ($\lambda = 0.82$; $F(1.38) = 7.98$, $p < .01$). The overall classification power was the lowest (60%): 70% of children with SLI were correctly classified and 50% of children with TLD were also correctly classified.

The combination of *Conjunctions Token* and *Relative pronouns + Interrogative pronouns + Interrogative adverbs Token* improved classification ($\lambda = 0.61$; $F(1.37) = 11.51$, $p < .001$): the overall classification power was 75%. Seventy-five percent of children with SLI were correctly classified and 65% of children with TLD were also correctly classified (See Table 6).

Discussion

This study focused on the development of morphosyntactic production in French-speaking school-age children with SLI. Using spontaneous speech productions, we looked at differences in the frequency with which complex morphological and structural forms were used between children with SLI and TDL children matched on morphosyntactic abilities. We expected to find differences between the two groups in the variability of the productions (i.e., type frequency) as well as in token frequency for the more complex morphosyntactic markers.

The results partially corroborate our predictions. **Concerning overall data**, children with SLI did not differ from TDL children in the raw number of verbs they produced (similar token frequency), but their verbal productions were less varied, as observed by a lower type frequency. When producing sentences, it thus seems that children with SLI often use the same frequent verbs. Another interesting result is that children with SLI needed significantly more turns of speech in the samples to produce the same quantity of utterances. They thus produce fewer utterances per turn of speech and require more promptings to expand their speech. **Concerning inflectional verbal morphology with different tense markers**, results showed that children with SLI performed more poorly than language-matched children for the infrequent morphological forms *Imperfect + Future + Conditional* and *Modals* for both type and token variables, as predicted. These children use a lesser amount of these infrequent verbal forms, and also show a lower level of variability in their use of these forms. Inversely, children with SLI show a higher level of variability in their use of a frequent form, namely *Infinitives* (different type frequency), than language-matched children. As predicted, they are more productive in their use of more frequent forms than their typically developing peers, even if they did not produce a larger amount of infinitive forms (similar token frequency). For

the other variables, children with SLI performed in the same way as their peers. **Concerning grammatical complexity**, results showed that children with SLI performed less well than language-matched children for *Prepositions* for both type and token variables as predicted. They use a lower amount of these infrequent structural forms, and also show a lower level of variability in their use of these forms. For other infrequent structural forms, children with SLI produced fewer *Conjunctions*, *Pronouns*, *Relative pronouns + Interrogative pronouns + Interrogative adverbs* (different token frequency) as predicted; but their productions presented the same variability (similar type frequency) for these variables. Concerning frequent forms, children with SLI produced more *Determiners* (different token frequency) but their use showed the same variability as that of their peers (similar type frequency). The group effect was nearly significant, with better performances in the TDL group than in children with SLI for the variable *Utterances with two verbs*. **Further results** showed that *Conjunctions token* was better to discriminate children with TLD whereas *Relative pronouns + Interrogative pronouns + Interrogative adverbs Token* was more effective at discriminating children with SLI. The marker *Imperfect + Future + Conditional Token* did not seem to be a good discriminator of the two groups of children. Finally, the combination *Conjunctions token and Relative pronouns + Interrogative pronouns + Interrogative adverbs Token* improved the classification power.

- **Overall Data**

As in other studies (Conti-Ramsden & Jones, 1997; Skipp, Windfuhr, & Conti-Ramsden, 2002; Watkins, Rice, & Moltz, 1993), children with SLI showed less variability in the verbal forms they use. There appears to be a developmental change: older children with SLI do not use fewer verbs as observed in younger children (Conti-Ramsden & Jones, 1997), but they differ significantly from their TDL peers in the variability of the verbal forms they use. This result confirms previous studies suggesting the weakness of verbal forms in children with

SLI. The variety of verbs they possess is restricted to those that are very frequent in the input (King et al., 1995; Thordardottir & Weismer, 2002). This could be caused by abstraction difficulties that may limit their learning of verbs (Riches, Faragher, & Conti-Ramsden, 2006; Skipp, Windfuhr, & Conti-Ramsden, 2002), requiring more presentations than TDL children (Riches, Tomasello, & Conti-Ramsden 2005) to achieve the same level of productive use.

Moreover, to produce an equivalent number of utterances at a similar MLU level to their peers, children with SLI needed more solicitations provided by the experimenter than TDL. This observation supports the hypothesis that these children present a verbal hypospontaneity (Parisse & Maillart, 2009). Without solicitation, children with SLI spontaneously speak less, producing a lower number of utterances per turn. The number of utterances per turn could thus be an interesting marker of syntactic difficulties and verbal hypospontaneity in older children with SLI. According to our theoretical framework, the development of the linguistic system is progressive; it is by using their own language that children infer new syntactic representations and refine their morphosyntactic development. Children complexify and generalize their own previous productions to construct their future linguistic system (Bybee, 2010). So, if children with SLI speak less, they have less opportunity to develop their language. To avoid this vicious circle, the quality of child-directed speech and solicitations by the parents are essential.

- **Inflectional verbal morphology with different tense markers**

Concerning the frequent forms, the two groups performed similarly for the production of verbs in the present and imperative both in quantity (token) and variability (type). The most frequent forms in spontaneous language of the TDL group were the present and imperative forms, which are the shortest verbal forms in French (Parisse & Morgenstern, 2012). According to these authors, children live mostly in the here and now and thus speak for the

most part in the present tense. They argued too that these forms represent 50 to 80% of their spontaneous language. These results corroborate the usage-based theoretical framework: the most frequent verbal forms can be automated by school-age children with SLI and are sufficiently simple for them to use at the same frequency and with the same productivity as in their TLD peers. In the same vein, the two groups did not differ with respect to the production of verbs in the past participle, either in quantity (token) or variability (type). The second most frequent verbal category in the spontaneous language of TDL children contains past participle forms. These forms represent 10 to 25% of the spontaneous language of French-speaking TDL children (Pariße & Morgenstern, 2012). Our results suggest that this category is mastered by school-age children with SLI and also corroborates the usage-based theory account. French developmental data on auxiliaries are not available but our results (showing no significant differences between the two groups) suggest that this category is also mastered in school-age children with SLI. This result, which contradicts previous results in younger children in English (e.g. Paradis & Crago, 2001), can be explained by the fact that the children in our study are older and had been exposed for longer to this functional class. Another explanation could be that, contrary to English, the French phonological form of the past participle is often the same as the infinitive form, virtually increasing the input frequency of such a form. Together, these results highlight that these frequent forms in the input enable automation by school-age children with SLI.

Differences between groups emerge in the less frequent categories. In rare forms such as the imperfect, future or conditional, which account for only 5% of spontaneous language (Pariße & Morgenstern, 2012), or modals as already observed by previous studies (Conti-Ramsden & Jones, 1997; Rice & Bode, 1993), the groups differ both in occurrence and variability. These complex verbal forms appear later in typically developing language and could be interesting markers of morphosyntactic difficulties in children with SLI. Even if children with SLI are

older, have a greater experience of language and preserved cognitive abilities, it seems not to be enough to compensate for their language deficiencies.

Interestingly, children with SLI produced more different infinitive forms than their peers, showing creative mastery of this form. Some authors (Parisse & Morgenstern, 2012) showed that infinitive forms are some of the earliest forms produced by children with TLD. Indeed, this form corresponds to a moderately frequent category which represents 10 to 25% of children's verbal forms. A previous study also found that French-speaking children with SLI produced more infinitives than TDL children (Hamann et al., 2003). This suggests that infinitive forms are overrepresented in the productions of French-speaking children with SLI by way of compensation.

- **Grammatical Complexity**

Both groups obtained the same performance for adjectives, adverbs and possessive determiners, revealing no specific difficulties in children with SLI. Previous studies demonstrated that the production of adverbs and determiners is preserved in children with SLI (Moore & Johnston, 1993). A weakness with adjective production was observed in children with SLI as they tend to replace adjectives with specific meanings by more general terms (Tribushinina & Dubinkina 2012), but this weakness does not seem to affect their raw production frequency.

In the present study, children with SLI produced fewer conjunctions, pronouns, relative pronouns, interrogative pronouns and interrogative adverbs than children with TDL. This finding supports the observations of previous studies concerning difficulties with pronouns in French (Hamann et al., 2003; Grüter, 2005; Jakubowicz et al., 1998; Paradis et al., 2006; Tuller et al., 2011) and with conjunctions of coordination or subordination (Bellon-Harn, Byers, & Lappi, 2014; Leclercq Quémart, Magis, & Maillart 2014; Marinellie, 2004).

Moreover, several authors have highlighted the difficulties encountered by pre-school age children with SLI with relative clauses (Hamann & Tuller, 2010; Schuele & Dykes, 2005; Schuele & Nicholls, 2000; Schuele & Tolbert, 2001; Tuller et al., 2012) and with interrogative adverbs as demonstrated by problems with *wh*-in situ questions in French (Hamman, 2006; Stavrakaki, Chrysomallis, & Petraki, 2011). Apparently these categories are not yet mastered by older children with SLI. We did not observe any difference in type frequency for these categories, probably due to the low number of items produced in both groups. Our results emphasize that it is better to measure grammatical development on the basis of a whole set of markers rather than of only one specific and highly significant marker, due to the wide variability in children's learning styles. Such an approach is also more coherent with theories of usage-based development than with theories based on innate abstract grammars. Not only do the latter not incorporate the concept of frequency, they even suggest that the frequency has no effect on grammar. If we consider that frequency plays a role in language acquisition, it is important to consider only elements with similar frequencies in all children. Unfortunately, the natural variability of language makes it impossible to find low-frequency markers that have the same frequency in all children. So, instead, we used a large set of markers which averages the various frequencies found in all children.

Conversely, children with SLI produced more determiners than TDL children, attesting to a good mastery of this very frequent structure in school age SLI children. In their study, Jakubowicz and colleagues (1998) showed a similar result in younger children: the production performance in children with SLI did not differ from that of their TD peers. Surprisingly, children with SLI produced more prepositions than TDL children and with more variability. However, this result was mainly attributed to the two most frequent prepositions in French, 'dans' (in) and 'à' (at) (Morgenstern & Sekali, 2009). When these two prepositions were

removed from the analysis, the group effect disappeared, attesting to their mastery of the structure only for the most frequent prepositions. The difference disappears for rarer prepositions.

More generally, these results show that our older children with SLI did not necessarily produce ungrammatical utterances, but that they were less likely to use rare prepositional phrases and produce complex sentences.

- **Further results**

Following Plante and Vance (1994), we considered that measures that have a discriminant accuracy for the two groups above 80% were “fair” discriminators. The only individual variable that had fair specificity was *Conjunctions*. However, the sensitivity was quite low (65%). The marker *Relative pronouns*, *Interrogative pronouns* or *Interrogative adverbs* had a better sensitivity, approaching fair sensitivity (75%), but the specificity and also the overall classification were lower. The marker *Imperfect*, *Future* or *Conditional* seemed to be quite weak to discriminate the two groups. Importantly, the overall predictive accuracy of the discriminant function is called the ‘hit ratio’. As most researchers accept a hit ratio that is 25% larger than that due to chance, our results show that *Conjunctions* with a hit ratio of 75% is the most relevant marker to distinguish children with SLI from children with TLD. Lastly, the combination of *Conjunctions* and *Relative pronouns*, *Interrogative pronouns* or *Interrogative adverbs* improved the classification power with a nearly fair specificity and a fair sensitivity.

These findings are fully compatible with several studies which also highlighted difficulties for conjunctions and relative pronouns (Hamann & Tuller, 2010; Leclercq Quémart, Magis, & Maillart 2014; Tuller et al., 2012) or for interrogative pronouns (Stavrakaki, Chrysomallis, & Petraki, 2011; van der Lely, 2003) in these children whereas the category of determiners

remains preserved (Paradis, Crago, & Genesee, 2006). However, although we showed (as attested by t-tests) consistent deficits in the tense domain, confirming previous studies (Jakubowicz, Nash, & van der Velde, 1999; Paradis & Crago, 2001; Royle & Thordardottir, 2008), tense marking cannot be considered the best clinical marker (as attested by discriminant analysis on *Imperfect + Future + Conditional*) compared to conjunctions and relative pronouns. This is an encouraging result but not sufficient to diagnose specific language impairment. It remains necessary to compare performance in spontaneous language with standardized test scores to obtain strong diagnostic tools, especially as spontaneous language tasks encounter the phenomenon of avoidance of complexity by children with SLI (e.g. Delage, Monjauze, Hamann, & Tuller, 2007; Tuller et al., 2012). Diagnostic tools require high levels of sensitivity and specificity (Plante & Vance, 1994). Thus, it is important to ensure both high levels of specificity and sensitivity. There are no clearly established guidelines to define acceptable thresholds for this, but most researchers concur with Plante and Vance's (1994) suggestion that 80% is acceptable and 90% is a good level. Our results show that spontaneous markers are not sufficiently discriminating and do not reach these recommended thresholds. That is why it remains necessary to compare performance in spontaneous language with standardized test scores to obtain strong diagnostic decisions.

- **Conclusion and perspectives**

Our results corroborate the usage-based prediction of a better mastery of frequent than of rare linguistic forms in children with SLI. Our results show that children with SLI use rare verbal and structural categories less frequently and less productively than TDL children, while being as productive as TDL children for the more frequent ones. However, children with SLI exhibit

a good mastery (in terms of both productivity and variability) for more frequent verbal and structural forms. They thus seem to follow the same developmental pattern as typically developing children but with a delay.

Consequently, rare and complex verbal and structural forms could be good clinical markers in spontaneous speech but are not sufficient to identify the children with SLI / to discriminate the children with SLI from control children. Indeed, the frequent and productive use of tenses such as *Conjunctions* and *Relative pronouns*, *Interrogative pronouns* or *Interrogative adverbs*, appeared to be able to differentiate school age children with SLI from typically developing children.

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Declaration of Interest

The authors report no conflict of interest.

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Table 1. Age, IQ and standardized scores for language assessment measures for the SLI and the TDL groups.

Variable	SLI (n=20)			TDL (n=20)			t (38)
	M	SD	Range	M	SD	Range	
Age	139.95	12.31	111-163	93.80	13.19	76-121	11.43***
in months							
WVN	97.90	7.81	85-113	100.90	5.38	88-108	-1.41
Nonverbal IQ							
ELDP	23.75	3.61	18-31	28.90	2.29	25-34	-5.38***
Phonological reception							
L2MA2	2.45	1.79	0-6	8.25	2.19	5-10	-12.00***
Nonword repetition							
EVIP	103.75	13.67	80-128	103.35	13.26	72-125	-0.09
Lexical reception							
L2MA2	35.25	7.33	21-49	33.15	5.91	25-46	0.99
Lexical production							
L2MA2	13.4	1.75	10-16	13.6	2.03	11-18	-0.33
Sentence comprehension							
L2MA2	3.70	2.71	0-11	9.05	1.84	5-11	-7.28***
Sentence repetition							

Note. IQ = Intelligence Quotient ; *** p<.001

Table 2. French example (in italics) for each measure.

Measure	Example
Adjective	« C'est un <i>petit</i> garçon. C'est un chien <i>dangereux</i> ,... » [He is a <i>small</i> boy. It's a <i>dangerous</i> dog]
Adverb	« Il est <i>très</i> grand, <i>gentiment</i> ,... » [He is <i>very</i> tall. kindly]
Preposition	« Le jouet est <i>dans</i> le lit. » [The toy is <i>in</i> the bed.]
Conjunction	« Le garçon est triste <i>parce que</i> le robot est cassé.» [The boy is sad <i>because</i> the robot is broken.]
Determiner	« <i>Le</i> garçon est en colère. » [<i>The</i> boy is angry.]
Pronoun	« <i>Il</i> prend la pomme. <i>Il la</i> mange ». [<i>He</i> takes the apple. <i>He</i> eats <i>it</i> .]
Relative pronoun	« Il regarde la fille <i>qui</i> est jolie. » [He looks at the girl <i>who</i> is pretty.]
Interrogative pronoun	« <i>Qui</i> a volé mon biscuit ? » [<i>Who</i> has stolen my cookie? »]
Interrogative adverb	« <i>Quand</i> partiras-tu en vacances ? » [<i>When</i> will you go on holiday?]
Utterance with two verbs	« <i>La fille pleure parce qu'elle est tombée.</i> » [The girl is crying because she fell.]

Table 3. Proportion of productions in the two groups: overall data.

Variable	SLI (n=20)		TDL (n=20)		t (38)	<i>d</i>
	M	SD	M	SD		
Number of verbs Token °	381.75	156.48	449.05	129.97	-1.47	0.46
Number of verbs Type °	149.35	47.10	177.55	38.92	-2.06*	0.65
MLU	6.03	2.27	7.04	1.47	1.66	0.53
Number of utterances	279.85	97.85	287.85	99.83	-0.25	0.08
Turns °°	158.75	49.37	131.55	27.91	-2.14*	0.68

Note. * $p < .05$

° Token frequency: number of verbs produced; Type frequency: number of different verbs produced

°° Number of turns of speech between the experimenter and the child

Table 4. Proportion of productions in the two groups: inflectional verbal morphology with different tense markers.

Variable (Proportions on number of verbs)	SLI (n=20)		TDL (n=20)		t (38)	d
	M	SD	M	SD		
Present + Imperative Token	59.90	7.97	58.80	16.90	-0.26	0.08
Present + Imperative Type	18.91	7.53	16.72	3.05	0.23	0.41
Imperfect + Future + Conditional Token	4.69	3.39	9.25	6.31	2.82**	0.90
Imperfect + Future + Conditional Type	7.79	4.86	12.37	6.10	-2.62*	0.84
Past participles Token	10.94	4.86	10.34	5.42	-0.37	0.11
Past participles Type	6.49	5.12	5.52	2.31	-0.77	0.24
Infinitives Token	11.34	2.49	10.71	2.64	0.77	0.24
Infinitives Type	17.55	3.07	15.26	3.10	-2.35*	0.74
Modals Token	17.37	3.95	20.71	4.53	-2.48*	0.78
Modals Type	14.41	2.83	16.59	2.56	2.55*	0.80
Auxiliaries Token	10.72	5.66	10.72	5.08	0.0008	0
Auxiliaries Type	4.39	1.06	4.70	1.48	0.75	0.24

Note. * p < .05 ; ** p < .01

Table 5. Proportion of productions in the two groups: grammatical complexity.

Variable Proportions on number of words	SLI (n=20)		TDL (n=20)		t (38)	d
	M	SD	M	SD		
Adjectives Token	27.97	1.03	26.65	0.5	0.51	0.52
Adjectives Type	5.3	0.7	6.4	3.5	-1.45	0.43
Adverbs Token	3.06	1.01	3.24	0.84	0.64	0.19
Adverbs Type	6.00	4.34	5.83	1.13	0.16	0.05
Conjunctions Token	7.21	2.07	9.40	1.31	-3.98***	1.26
Conjunctions Type	2.98	1.79	2.83	0.61	0.35	0.11
Determiners Token	13.58	1.54	12.63	1.17	2.18*	0.69
Determiners Type	4.76	1.92	3.89	0.72	-1.88	0.60
Prepositions Token	5.71	0.96	5.13	0.47	-2.41*	0.76
Prepositions Type	3.27	1.52	2.51	0.43	-2.14*	0.68
Pronouns Token	17.14	2.07	18.23	1.17	2.04*	0.64
Pronouns Type	7.29	0.66	6.15	2.54	-1.93	0.61
Relative pronouns + Interrogative pronouns + Interrogative adverbs Token	1.27	0.64	1.77	0.41	2.91**	0.93
Relative pronouns + Interrogative pronouns + Interrogative adverbs Type	1.43	0.23	1.36	0.81	-0.33	0.11
Utterances with two verbs °°°	11.27	6.15	15.11	6.77	1.88(*)	0.59

Note. (*) p=.06 ; * p < .05 ; ** p < .01 ; *** p<.001

°°° Proportion on number of utterances

Table 6. Percentage of children correctly classified with SLI (sensitivity) or TLD (specificity).

Measure	Sensitivity	Specificity	Overall classification power
<i>Imperfect + Future + Conditional Token</i>	70% (14/20)	50% (10/20)	60%
<i>Relative pronouns + Interrogative pronouns + Interrogative adverbs Token</i>	75% (15/20)	65% (13/20)	70%
<i>Conjunctions Token</i>	65% (13/20)	85% (17/20)	75%
<i>Conjunctions + Relative pronouns + Interrogative pronouns + Interrogative adverbs Token</i>	80% (16/20)	70% (14/20)	75%