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(Un)successful Subordination in French-speaking Children and Adolescents with SLI

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1. Introduction

1.1. Order of acquisition, computational complexity and processing load

In study of typical (TLD) and atypical language development (ALD) it has been observed that certain constructions emerge later than others, or cause long-term difficulties. Among these constructions are tensed clauses in languages like English (Wexler 1994, Rizzi 1994, Rice and Wexler 1995), object clitics in languages like French (Audolent and Tuller 2003, Hamann et al. 1996, Jakubowicz et al 1997, Tuller et al. to appear), passives (Borer and Wexler 1987, Fox and Grodzinsky 1998, van der Lely 1998) Wh-questions (Klima and Bellugi 1966, Roeper and de Villiers 1991, Roeper 1996, van der Lely 1998, Hamann 2000, Hamann 2006, Jakubowicz 2005), finite complement clauses (De Cat 2002, Owen and Leonard 2006) and (object) relative clauses (Labelle 1990, 1996, Friedmann and Novogrodsky 2004).

Various proposals have been made to explain why such constructions emerge slower/later in TDL and cause difficulties in ALD. Many of these are centered on the idea that such constructions involve greater computational complexity than constructions which emerge earlier and which do not seem to pose significant problems in ALD. Labelle's (1990, 1996) work on the acquisition of relative clauses pointed out strategies employed by French normally-developing children to avoid movement and thus reduce complexity. Wexler's (1998) Unique Checking Constraint and Rizzi's (2000) Principle of Structural Economy explicitly formulate (or can be interpreted as) developmental constraints which simplify or restrict computations in early grammar. Some of these constraints have also been used to explain the patterns of ALD. Another such constraint has been specially formulated for children with Specific Language Impairment (SLI): the Representation Deficit for Dependent Relations put forward by van der Lely (1998). Tsimpli (2001) argues that order of acquisition, and difficulty observed in children with SLI, are a function of lexical specification for functional features: those which are PF-interpretable only (and thus require either internal or external merge) are vulnerable, versus those which are LF-interpretable are not. More recently, Jakubowicz (2004, 2005) has proposed developmental constraints which are not specific to UG but which are sensitive to linguistic computational complexity as

made precise in her Derivational Complexity Metric, which restricts movement operations. Although the above proposals make radically different assumptions regarding the locus of the constraint (external or internal to grammar), they are similar in their conclusion that a) computational complexity can be characterized by the number and the nature of computational operations – specifically MERGE, internal and in some cases external, and b) (a)typically-developing children make use of less complex grammatical options and avoid complex derivations.

It is striking that the pattern of avoidance observed in acquisition is highly reminiscent of the pattern found in studies of processing difficulty. Work by Gibson (1998, 2000) and many others has shown that it is more difficult for ordinary adults to process, for example, object relatives than subject relatives. Effects of tense on processing difficulty have also been found. Processing constraints are taken to be related to how working memory uses computational resources, with some constructions being computationally more costly than others. This parallel suggests that developmental constraints that cause children to avoid complexity, both younger typically-developing children and older atypically-developing children, exist because of developmentally determined limitations on working memory. Convergence between work on development and work on processing in adults can be seen in the fact that both have made claims that less or local movement, shallow embedding, and the use of certain empty categories, especially empty subjects, reduce computational complexity. In particular Rizzi (2000) and Jakubowicz (2005) suggest that in language development less complex grammatical options are used or preferred precisely because they alleviate processing load.

With regard to ADL and specifically SLI, the notion of syntactic complexity has been appealed to in order to explain the linguistic profile of this population (Jakubowicz 1998, 2005, van der Lely 1998, Wexler 1998), Friedmann and Novogrodsky 2005, Hamann 2006). Although these studies have centered on tense, object clitics and Wh-movement, the assumption of computational complexity has obvious implications for subordination, as pointed out and illustrated by Tuller et al 2006.

In L1-acquisition, certain subordinate clauses appear before others. A wide array of studies have established partial orders: Adverbial clauses appear before other types of subordinates, infinitival complement clauses are earlier than finite complement clauses, subject relatives appear before object relatives, and in French, genuine relatives are preceded by clefts and so-called pseudorelatives. Tuller et al. 2006 show that such partial orders on the time scale in L1-acquisition manifest themselves as relative frequency in atypical populations such as children with hearing loss or benign childhood epilepsy. Investigating subordination in the spontaneous productions of children and adolescents with SLI will allow us to establish that avoidance strategies are indeed used by these populations and can be regarded as characteristic. It will also allow us to show that language patterns--error rates, but also frequency and other avoidance strategies--found in atypical populations can provide evidence for syntactic

complexity and processing load.

1.2. Subordination

Subordination in French involves finite and non-finite complement, adjunct, and relative clauses. Among the factors involved in these constructions are: movement, overt versus null complementizers, overt versus null (PRO) subjects, and tense/mood dependencies. These factors imply partial scales of relative complexity. Adverbial clauses are less complex than other clauses because they are not selected and do not involve movement thus do not create dependencies. Since they are also merged to CP or IP (not to V or N) they involve shallower embedding (at phase edge) than complement or relative clauses. Finite embedded clauses are more complex than non-finite embedded clauses since there is no tense dependency and normally no overt subject. Finite complement clauses involve dependencies on several levels: there is Complementizer-Tense agreement, subject-verb agreement, there are mood and tense dependencies between the matrix and the embedded clause, there are overt subjects and overt complementizers which agree in Wh-features with the force of the clause. Relative clauses involve movement and should therefore be more complex than other embedded clauses, with object relatives more complex than subject relatives. The latter can be easily derived by Gibson (1998)'s notion of distance, where distance is measured by the number of referential expressions intervening between the dependent elements. In terms of grammar only, it could be suggested that theta-assignment in non-canonical orders, i.e. theta-assignment to chains, is more complex than direct assignment. We could also speculate that movement across two phases is more costly than movement across only one phase.

If children and adolescents with SLI have a problem with computational complexity – due to constraints on the derivations their grammars allow or to processing limitations – then we predict on a global level that subordination will be difficult, which will manifest itself in high error rates. On a more fine-grained level we predict that the constructions identified above as more complex than others will show higher error rates. We also propose to show that language progress with age in this population may at least in part be due to development of avoidance strategies which reduce error rates, and does not necessarily mean that these individuals have outgrown SLI.

2. Method

2.1. Participants

Our study compares spontaneous language samples from ten children with SLI with those from normally-developing monolingual French children. The children with SLI were recorded every three months over a period of two years during the Geneva University Interfaculty Project (see Hamann et al. 2003, Cronel-Ohayon 2004 for details). All of these children had received a clinical

diagnosis for SLI, before data taking began. A complete language battery and a cognitive battery were administered to each child. The characteristics of these children complied with accepted diagnostic criteria for SLI (Leonard 1998). We focus here on the last recordings for each child—ages 5;10 to 10;5, and will therefore call this group “SLI 6-10”.

Table 1. The SLI 6-10 Group

	Age	Sex	<i>N</i> Utterances in lg. sample
Raphaëlle	5;10	F	358
Aurélie	6;5	F	364
Loris	6;9	M	365
Corentin	6;9	M	265
Martin	7;1	M	297
Fabrice	7;9	M	270
Noëlle	8;9	F	461
Léa	10;1	F	231
Candide	10;2	M	124
Noa	10;5	F	214
<i>M (SD)</i>	8;0 (1;9)		295 (94)

We also compare the SLI 6-10 group with a group of 18 adolescents with a childhood diagnosis for SLI (made at the same university teaching hospital, which applies usual exclusionary criteria), now aged between nearly 11 and nearly 16. The data for this group, which we call “SLI 11-16”, come from a cross-sectional inter-pathology corpus collected and analyzed by the Laboratoire Langage et Handicap at the University of Tours (see Henry 2006, Tuller and Henry, 2007 for details on the SLI 11-16 group).

Table 2. The Other Groups: SLI 11-16, TD-6, TD-8, and TD-11

Group	Age		Sex		N Utterances	
	Range	<i>M (SD)</i>	M	F	Range	<i>M</i>
SLI 11-16	10;11 - 15;7	12;6 (1;2)	14	4	58-68	60.2
TD-6	6;1 - 6;7	6;4 (0;2)	7	5	52-65	57.1
TD-8	7;9 - 8;7	8;2 (0;3)	6	6	52-66	60.3
TD-11	11;1 - 11;9	11;4 (0;4)	6	6	51-69	60.2

Control groups include 12 six-year-olds, 12 eight-year-olds, and 12 eleven-year-olds, analyzed by the Tours cross-sectional inter-pathology project. The TD-6 group corresponds in age to the youngest of the children with SLI, while the TD-8 group corresponds in age with the average age of the SLI 6-10 children. The TD-11 children are rough age-equivalents for the SLI 11-16 group, and the TD-6 group provides a rough language match for the SLI 11-16 (in that comparison of mean MLU between the two groups yields no significant difference: 6.44 (SD = 0.72) for the SLI 11-16 group and 7.05 (SD = 0.86) for the TD-6 group).

2.2. Language measures

Language samples were transcribed in the CHAT-format, verified, and hand-coded for analysis with the CLAN-programs (McWhinney 2000). We coded all subordinate clauses for type of embedding, finiteness, level of embedding (1), and grammaticality. Ungrammatical complex utterances contain errors in the matrix (2a) and/or the subordinate clause (2a, b); these errors can be related to subordination (2b, resumptive pronoun in 2a) or unrelated (gender error in 2a). We coded specifically for complementizer omission, which can be grammatical, (3a), in colloquial French or ungrammatical, (3b).

- (1) a. [Parce qu'elle est trop vite] *[SLI, Rafaëlle]* **Level-0**
 'Because she is too fast'
- b. C'est un peu difficile [parce qu' y a des trous] *[SLI, Loris]* **Level-1**
 'It's a bit hard because there are holes'
- c. C'est des nageurs [qui l'ont pris [pour mettre dans un aquarium]] *[TD-6]*
 'Some swimmers took it to put it in an aquarium' **Level-2**
- (2) a. Et pis y a **une** (= un) sou qu'**il** est vraiment **ronde** (= rond) *[SLI, Loris]*
 'And, well, there is a coin that it is really round'
- b. Mais normalement c'est nous qui **doit** (= devons) avoir l'école *[SLI, Rafaëlle]*
 'But normally we're the ones who have school'
- (3) a. Je pense (**qu'**) on va faire des jeux *[SLI, Rafaëlle]*
 'I think (that) we're going to play games'
- b. Mais on dirait ***(qu')** elle est toute petite *[SLI, Rafaëlle]*
 'But it seems that she is very small'

In addition to grammaticality, we coded attempts at subordination such as juxtaposition of matrix clauses (4a), missing matrix or subordinate verb (4b), ungrammatical complementizers (4c), or self-interruptions (4d). Juxtapositions are very close to what we call alternative strategies, which were also coded for and which include direct speech (5a) and interpolated clauses (5b).

- (4) a. Non [j'ai fait avec ma maîtresse] *(qui) [il s'appelle Doris] *[SLI, Noëlle]*
 No, I did with my teacher (who) he's called Doris
- b. Et pis une fois quand on était ... je crois on allait ... on allait lui ... une qui
 assyait ... qui était assise = je crois qu'il y en avait une qui était assise
 'And then once when one was...I think that one was going...one was going
 him...one who was seating...who was seated' (target: 'I think there was one who
 was seated') *[SLI, Rafaëlle]*
- c. La petite fille est là [par*(ce que) elle suce toujours son petit doigt]
 the little girl is there because she sucks always her little finger *[SLI, Aurélie]*
- d. Après on attend [qu'ils applau...] *[SLI, Rafaëlle]*
 after one waits that they applau...
- (5) a. Je dis "Je sais". *[SLI, Fabrice]*
 'I say "I know"'
- b. Normalement c'est déjà [je crois bien] un et trois. *[SLI, Noëlle]*
 'Normally it's already, I really think, one or two'

On the basis of this coding, we calculated the percentage of complex utterances (percentage of verbal utterances containing at least one subordinate clause), and the percentage of ungrammatical complex utterances (over all complex utterances). Relative frequencies and grammaticality were calculated for the different types of subordinate clauses. Given the (well-known) high inter-subject variation found in groups of individuals with SLI, we have chosen to report group measures as means over mean rates calculated for each individual language sample, rather than rates calculated after collapsing samples into one corpus. Inter-group comparisons were evaluated through use of the Mann Whitney non-parametric test for independent samples.

3. Results

3.1. Children with SLI

In a first analysis, we establish rate and grammaticality of embedding. Figure 1 shows that the children with SLI, compared to both TD-6 and TD-8, have a lower mean percentage of complex clauses (SLI < TD-6, $U = 27$, $p < .05$, and SLI < TD-8, $U = 20$, $p < .01$) and that a much higher rate of these are ungrammatical (SLI > TD-6, $U = 2$, $p < .001$, and SLI > TD-8, $U = 2$, $p < .001$).

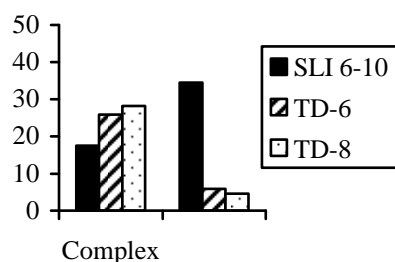


Figure 1. Rate and grammaticality of complex utterances: SLI 6-10

The relative frequency of different types of subordinate clauses is equivalent across groups. Adverbial, relative and non-finite complement clauses are all produced more frequently than finite complement clauses (Figure 2).

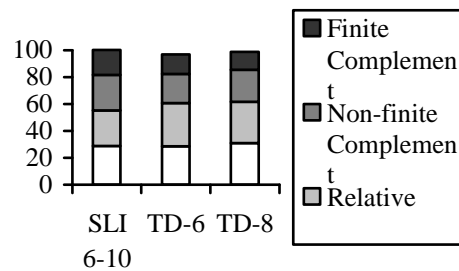


Figure 2. Relative Frequencies of Embedded Clauses: SLI, TD-6, TD-8

Though the SLI-group does not differ from the controls with respect to relative frequencies, their rates of ungrammaticality are strikingly high (see Figure 1). Errors rates of complex utterances vary according to the type of subordinate clause they contain: 49.6% of those containing a Finite Complement clause, 38% of those containing Adverbials and Relatives, and 36.1% of those containing Non-Finite Complement clauses. These differences do not reach significance.

Note the extremely high error-rate in complex utterances containing a finite complement clause. Note also that, contrary to expectation, relative frequencies and error rates of adverbial and relative clauses are about equal. Since the analysis so far does not distinguish between types of relatives, this is not surprising. A more fine-grained analysis reveals that subject relatives are by far the most frequent type of relative used in each group (67.2% in TD-6, 77.4% in TD-8, and 78.1% in SLI). Object relatives occur at a rate of 11.0% in SLI, 23.6% in TD-6 and 16.1% in TD-8, and adverbial relatives have a similar distribution with 10.9% in SLI, 9.2% in TD-6, and 6.5% in TD-8.

Once again, rates of ungrammaticality are strikingly high in the SLI group. SLI children produce 36.2% errors in complex utterances containing a subject relative, whereas TD-6 children do so only at 1.8% and TD-8 show 8.6% such errors. For SLI children 45.2% of object relative clauses and 50% of adverbial relatives are erroneous, whereas TD-6 children show these errors at a rate of 8.3% and 12.5% respectively, and TD-8 children do not make any errors in these types of complex utterances.

A second factor influencing the relative frequency of relative clauses is that not all relative clauses are “genuine” relatives in the sense that they may not involve movement (Labelle 1990: 112-114), or arguably involve shallower embedding due to adjunction to a root CP (or IP), rather than embedding within DP (Clech-Darbon et al 1999, De Cat 2002). Among these are clefts (6), and pseudorelatives (7). Another type of relative, which is rather formulaic, and which might also involve a less complex structure, is the presentational in (8).

- (6) C'est ma maman qu'a fait le bonhomme de neige [SLI, Fabrice]
 It's my mom that made the snowman

implementation of avoidance and compensatory strategies. We sought to explore this general hypothesis by comparing the SLI 6-10 group with a group of 18 older individuals with SLI aged 11 to 16. Looking at language production in SLI after childhood offers the possibility of investigating not only persistent difficulties, but also just how language progress is achieved. A comparison with children with SLI addresses the developmental aspect of this question.

Analysis of the SLI 11-16 language samples revealed that these adolescents do not produce on average significantly more complex sentences ($M = 22.5$, $DS = 7.8$) than the SLI 6-10 children ($M = 17.5$, $DS = 7.5$) ($p = .130$). In other words, rates of embedding do indeed appear to stagnate. The rate of ungrammatical complex utterances ($M = 24.1\%$, $DS = 11.1$) decreases, though the decrease does not reach significance ($p = .079$). Both of these measures significantly distinguish the SLI 11-16 group from each of the TD groups.

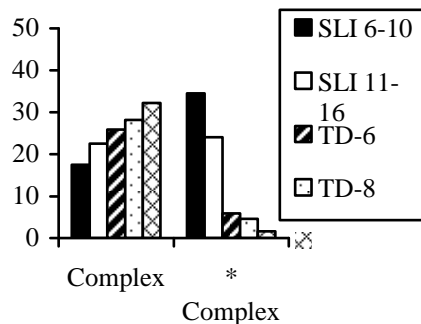


Figure 3. Rate and grammaticality of complex utterances: SLI 11-16

Examination of individual scores reveals that the proportion of erroneous complex sentences is under 10% for one-third of the adolescents with SLI, a rate not found for any of the SLI 6-10 (whose ungrammaticality rate ranges from 14.3 to 50.4%). Strikingly, these six adolescents (aged 11;5, 11;9, 12;2, 12;5, 13;2, and 15;7) display one of two patterns. For three of them, a very low rate of ungrammaticality corresponds with a very low rate of production of complex utterances: these adolescents did not produce any ungrammatical complex utterances, however they produced $\leq 15\%$ complex utterances (a low rate not found for any of the TD-11 children, and only three of the 24 TD 6- and 8-year-olds, whose mean rates are 25.9 and 28.2, respectively). The other three adolescents with low error rates had normal rates for production of complex utterances, however, the complex utterances produced overwhelmingly involved less complex embedding (two of these subjects did not produce a single finite complement clause, and half of the other adolescent's complex utterances involved subordination of an adverbial clause). In other words, these subjects are successfully avoiding complexity (see Tuller and Henry 2006). We may assume

that the age range of the SLI 11-16 group may be at least partially responsible for the fact that only a minority of them have developed successful avoidance: we note, however, that the extent to which compensation is attainable for all individuals with SLI is a question in need of further research.

Turning to attempts at subordination and alternative strategies, although inter-subject variation is high, we believe that our results indicate that measures of this type, taken over larger corpora, may be useful indices of avoidance strategies. We illustrate with presentation of measures of the use of direct speech, the frequency of zero-level embedding of relative clauses, and the frequency of object relatives. Whereas utterances with direct speech represent a smaller and smaller proportion of verbal utterances in the TD groups (2.1%, 1.5%, and 0.9%, respectively, for the TD-6, -8, and -11 groups), this percentage does not decrease between the two SLI groups (1.7% and 2.3% respectively). Similarly, whereas the use of 0-level relative clauses decreases in the TD groups (7.3%, 10.6%, and 4.9%, respectively), it continues to be widely and regularly used in the SLI 11-16 groups (18.3% for SLI 6-10 and 21.3% for SLI 11-16). Finally, mean frequency of object relatives, with respect to all other subordinate clauses, remains below 5% in the SLI 11-16 group ($M = 4.8$, $SD = 8$), whereas they represent 11.1% ($SD = 6.3$) of subordinate clauses in the TD-11.

4. Conclusion

We have sought to explore the idea that complexity can be studied via analysis of relative frequency and relative ungrammaticality in atypical language acquisition, just as it has been explored via order of acquisition in typical L1 acquisition. Measuring complexity in terms of number, nature, and distance of syntactic operations, and use of empty over lexical categories predicts partial orders of relative complexity: relative clauses > other subordinate clauses, object relatives > subject relatives, finite clauses > non-finite clauses, and adverbial clauses < other subordinate clauses. These predictions were confirmed by frequency and agrammaticality measures of language samples of the SLI 6-10 children. Specific results highlight the pertinence of complexity proposals: 1) the relative clause findings point to the pertinence of number and nature (and distance) of syntactic operations, 2) the fact that non-finite complements clauses are more frequent than finite ones and the evidence for C-drop support the proposal that processing load can be alleviated via empty categories (see also Santos 2006), and 3) the predominance of adverbial clauses over other types of embedding suggests that merger at phase edge is less costly. Finally, it was suggested that complexity should be particularly identifiable via comparison between younger and older individuals with SLI, as we would expect that frequency of embedding might stagnate, while ungrammaticality drops, and avoidance/compensatory strategies continue to be manifest. This is precisely the picture that emerged when the SLI 6-11 and the SLI 11-16 groups were compared, in contrast with the comparison between the TD 6- and 8-year-olds, on the one hand, and the TD-11 group, on the other hand. We conclude that the

notion of processing load can not only be informed by linguistic theory, but can be studied in atypical development through relative frequencies, error rates and avoidance strategies.

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