

Sentence processing strategies in French-speaking children with SLI: a study of morphosyntactic cues

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Abstract

The sentence comprehension strategies used by children with specific language impairments (SLI) were examined within the framework of the Competition Model (Bates and MacWhinney, 1989). The experiment was a replication of Kail and Charvillat's experiment (1988) designed to investigate the use of different morphosyntactic cues (i.e. word order, clitic pronoun, verbal agreement) in sentence comprehension by children (4;6–6;6) with normal language development. They found that French speaking children used mainly information on word order with a lesser reliance on the other cues (word order > clitic pronoun > verbal agreement). In the present study, the same experiment was replicated with 25 French speaking children with SLI. The results suggested that children with SLI had specific difficulties in processing clitic pronouns, while verbal agreement could be processed (word order > verbal agreement > clitic pronoun). This pattern seems to be a specific strategy and not simply a delayed profile. In addition, our results were compatible with a theoretical account in terms of limitation in processing capacities.

Keywords: sentence processing, SLI, French, morphosyntactic cues.

Introduction

Despite normal hearing, age-appropriate scores on non-verbal tests of intelligence and no evidence of obvious neurological impairment, children with specific language impairment present important morphosyntactic difficulties (e.g. Leonard, 1998, for a review). These disorders are well-documented in numerous cross-linguistics studies. For instance, in the French language, research has shown impairments in verbal morphology (Jakubowicz, Nash & Van Velde, 1999) and difficulties in the acquisition of pronominal object clitics (e.g. *le, la, les* in French. For instance, 'le garçon *le* pousse'),

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both in production and comprehension (Hamann *et al.* 2003, Chillier *et al.* 2001, Jakubowicz, Nash, Rigault and Gerard, 1998). However, few studies have dealt with the use of morphosyntactic information in sentence comprehension processing. In addition, when comprehension was studied, the experimental design did not allow for the evaluation of different morphosyntactic cues at the same time.

This paper describes a study in which we tested the relative contribution of different morphosyntactic information to be used for sentence processing in order to address the following questions. First, could SLI children process several distinct pieces of morphosyntactic information in sentence comprehension? Second, did SLI children process these morphosyntactic cues in the same way as children with normal linguistic development?

The Competition Model (Bates and MacWhinney, 1989) offers a functional approach to grammatical comprehension, which can help in addressing these questions. According to this model, several cues (linguistic: i.e. acoustic, phonetic, semantic, morphological but also non-linguistic: stress, gesture) are simultaneously used to assign grammatical functions. Grammatical roles are form-function relations and morphosyntax is viewed as a means of expressing functions. For example, for the subject role, the functional level is composed of the concepts of agency and topicality. The formal level is position, agreement, nominative case, definiteness. Therefore, the grammatical subject is a complex set of multiple surface features (e.g. preverbal position, agreement with the verb) and communicative features (e.g. agent of the action, topic of the discourse) linked together. These connections vary from one language to another, depending on the usefulness of the cues in a given language. For instance, in English the word order cue is a very important one in assigning the subject function because in this language the subject occurs almost always both in preverbal and initial position. In contrast, this information is not as reliable in Italian. This theoretical frame thus allowed various cross-linguistics studies (English-Italian: Bates, Devescovi and D'amico, 1999; Spanish-English: Benedet, Christiansen and Goodglass, 1998; French-English-Italian: Kail and Charvillat, 1986). Although children were shown to be sensitive from the beginning to the information value of cues in their particular language, studies in language acquisition (e.g. Kail and Charvillat, 1986) showed that cue processing for children was also influenced by the cue cost. Some cues appeared to have a high cost (e.g. the use of the word order cues requires maintaining in memory the whole sentence) while others seemed to be less costly (e.g. semantic property of animacy). According to these studies, when the processing cost exceeds the available resources, children are more likely to use a cue with a lower cost. Such a model seems particularly interesting to investigate sentence processing in children whose limitation in processing capacities would account for the morphosyntactic disorders (see Bishop, 1992 for further details about the hypothesis of a limitation in general processing capacity in children with SLI).

Experiment

The experiment described hereafter is actually a replication of a study published by Kail and Charvillat (1988). This study was conducted in the Competition Model framework to investigate the use of different morphosyntactic cues (i.e. word order, clitic pronoun, verbal agreement) in sentence comprehension by French and Spanish children (4;6–6;6) with normal development of language. Kail and Charvillat found that the results were very much dependant on the mother tongue: the analysis of cue

strength showed that French speaking children used mainly information of word order (word order > clitic pronoun > verbal agreement) while Spanish children presented an inverse pattern (verbal agreement > clitic pronoun > word order). The results were discussed in terms of cue processing cost, introducing a continuum between local (i.e. verbal agreement), less local (i.e. clitic) and topological (i.e. word order) processing types.

Method

Participants

Children with normal language abilities

The children evaluated by Kail and Charvillat were used as control children (hereafter NL children). These authors had tested 45 French children living in the Paris suburbs. The participants were initially divided into three age groups (Group 1: 4;6 years, Group 2: 5;6 years, Group 3: 6;6 years) but in the absence of the age effect on the main factors and significant interactions between age and within variables, all the children were considered together. (NB. As the authors did not specify the distribution of age among the participants, it was actually impossible to compute the mean and the SD for this sample.)

Children with SLI

Twenty-five monolingual French-Speaking children with a clinical diagnosis of specific language impairment were included in the study. All these children were diagnosed by a multidisciplinary team and were undergoing regular language therapy for severe language disorders. In Belgium, the therapy addressed to children with SLI mainly aims to complete the linguistic input by the use of gesture. This therapy has a major communicative objective. No specific morphosyntactic treatment was conducted. The children ranged in age from 7;3 years to 11;7 years, with a mean age of 8;6 years. There were four girls and 21 boys. All these children presented a non-verbal IQ within normal range, no sensorineural hearing loss and no known physical or emotional cause for language impairment. Moreover, all the children of this study can be considered as ER-SLI, following the classification of Evans (1996), i.e. they presented both expressive and receptive impairment. They performed at -1.6 SD from the mean on the French version of the Test of Reception of Grammar (Ecosse, Lecocq, 1996) and they presented with important expressive disorders. In order to obtain homogenous subgroups of children, we created three subgroups according to the morphosyntactic comprehension level (Ecosse) of the children: those who had a comprehension age of 5;6 ($n = 8$), 4;6 ($n = 8$) or under 4;0 ($n = 9$). We matched the children on comprehension level. However, it was not possible to form a subgroup with a comprehension age of 6;6 since the children with SLI never achieved this level. As the results did not show any significant main effect of the comprehension level interaction, nor interactions between main factors and comprehension level, all the children were considered together.

Material

Material and procedure were similar to those of the study of Kail and Charvillat mentioned above. For this reason, only a succinct presentation of the material will be gi-

ven here. Fifty-four grammatical and semi-grammatical sentences were created with two common nouns (N), (singular or plural) and a verb (V) in the 3rd person (singular or plural). The verbs (move along, fall and turn) were used in periphrastic causative forms in order to ensure distinctive pronunciations between singular and plural 3rd person occurrence in French (e.g. *fait tomber* vs. *font tomber*). Word order was either NVN, NNV or VNN. Three combinations of agreement were investigated (A0: agreement is ambiguous (both nouns were singular or plural); A1 the verbs agreed with the first noun (hereafter N1); A2: the verbs agreed with the second noun (hereafter N2)). Similarly, three clitic pronouns were evaluated (C0: no clitic pronoun; C1: reinforced the choice of N1 as agent, i.e. N2 was the clitic pronoun's co-referent because it shared the same number/gender; C2: reinforces the choice of N2 as agent). Examples of experimental sentences are given in table 1.

Procedure

Each child with SLI was tested individually in a quiet room and was asked to act out the 54 sentences with puppets. The sentences were given orally with standard intonation by the experimenter. Prior to the test, children were exposed to training to familiarize them with the items used in the task and to be sure that children knew the name of each object. The dependent variable was percentage choice for first noun (N1) as agent.

Results

Kail and Charvillat's results on NL children

Before investigating further the results of the children with SLI, the results of Kail and Charvillat obtained on French NL children will be briefly presented and discussed. Firstly, it clearly appeared that the word order cue (with NVN > VNN &

Table 1. *Examples of experimental sentences*

Word order	C	A	
NVN	0	0	le bricoleur fait avancer le pêcheur (the handyman moves along the fisher)
NVN	1	2	*la jardinière les font avancer les balayeuses (the gardener them move along the road sweepers)
NNV	2	1	*le pêcheur les cuisiniers le fait tomber (the fisher the cooks him knocks over)
NNV	0	1	les bricoleurs la jardinière font tomber (the handymen the gardener knock over)
VNN	1	2	*le fait avancer les balayeuses le bricoleur (him moves along the road sweepers the handyman)
VNN	2	0	le fait tomber le pêcheur le boulanger (him knocks over the fisher the baker)

*Ungrammatical sentence

NNV, i.e. N1 was more often chosen as agent in NVN condition) was a determining factor in sentence interpretation while both clitic (with $C1 > C0 > C2$) and verbal agreement (with $A1 > A0 > A2$) were taken into account in role assignment. Nevertheless, the clitic effect cannot be understood without reference to word ordering. In the absence of canonical word order information (VNN and NNV), the clitic helped distinguish the OSV interpretation for NNV from the VSO interpretation for VNN (N2 as agent in NNV and N1 in VNN). In addition, the estimation of the strength of linguistic cues calculated using the mean square provided the following hierarchy: word order (35.11) > clitic pronoun (12.00) > verbal agreement (4.79). Such a hierarchy was interpreted in terms of cue cost: the verbal agreement requiring more memory demands than word order for children, this cue was less used.

Children with SLI

In our experiment, a $3 \times 3 \times 3 \times 3$ mixed-model ANOVA, with percentage of N1 selection as the dependent variable, was conducted. The three within variables were word order (NVN, NNV, VNN), clitic pronouns (C0, C1, C2) and verbal agreement (A0, A1, A2) and the between-subject factor was comprehension level (4, 4;6, 5;6). The results indicated significant main effect for word order ($F(2, 44) = 63.73$, $p < 0.0001$), verbal agreement ($F(2, 44) = 11.61$, $p < 0.0001$) and clitic ($F(2, 44) = 3.92$, $p < 0.03$). There was also a significant order by agreement interaction ($F(4, 88) = 2.58$, $p < 0.04$) as well as a significant clitic by agreement interaction ($F(4, 88) = 3.32$, $p < 0.01$). As the results did not show any significant main effect of the comprehension level interaction, nor interactions between main factors and comprehension level, the analysis of the data will mainly focus on global effects.

First of all, when the mean square was used to provide the hierarchy of cues, a quite different pattern could be observed for children with SLI: word order (10.33) > verbal agreement (1.25) > clitic (0.32). Although both NL and SLI groups of French speaking children principally used information on word order, children with SLI gave a lesser importance to the information value of clitic. A backward regression analysis confirmed this pattern: word order cues and verbal agreement information predicted significantly the first noun selection (respectively, $F = 148.09$, $p < 0.0001$ and $F = 19.12$, $p < 0.0001$) while clitic cues could not be considered as a reliable predictor ($F < 1$).

The analysis of the processing of word order revealed a well-known canonical order effect (NVN > NNV = VNN) in children with SLI, which was similar to the word order effect obtained by Kail and Charvillat and already confirmed by previous data obtained for the French language (Sinclair and Bronckart, 1972; Kail and Charvillat, 1986; Kail, 1987). When canonical word order was not available, the performance did not differ from the random level (N1 was chosen as often than N2). Contrary to what was observed for NL children, the word order by clitic interaction did not reach the level of significance, which suggests that the information carried by the clitic does not contribute to function assignment (cf. table 2).

The information carried by the verbal inflection seemed to be taken into account by children with SLI. However, contrary to NL children who respected the predicted hierarchy for the percentage of first noun choice ($A1 > A0 > A2$), children with SLI did not seem to take advantage of the presence of an inflection reinforcing the first noun strategy ($A1 = A0 > A2$) while the presence of an inflection reinforcing the choice of the second noun as agent led to performance not distinct from random. This

Table 2. *Word order by clitic interaction in NL children and children with SLI, with the percentage of first noun choice in brackets. N1 = first noun selection, N2 = second noun selection, random = at random level. C0, no clitic, C1 = clitic pronoun's coreferent N2, C2 = clitic pronoun's coreferent N1*

	NL children (from Kail and Charvillat)			Children with SLI		
	C1	C0	C2	C1	C0	C2
NVN	N1 (96)	N1 (91)	N1 (74)	N1 (90)	N1 (87)	N1 (84)
NNV	N1 (61)	random	N2 (25)	random	random	random
VNN	N1 (74)	N2 (35)	random	random	random	random

Table 3. *Verbal agreement by word order interaction in children with SLI, with the percentage of first noun choice in brackets. N1 = first noun selection, N2 = second noun selection, random = at random level. A0, ambiguous agreement, A1 = the verb agreed with N1, A2 = the verb agreed with N2*

	A1	A0	A2
NVN	N1 (92)	N1 (84)	N1 (84)
NNV	random	random	N2 (38)
VNN	random	N1 (61)	N2 (39)

verbal agreement effect had to be interpreted in light of the word order by verbal agreement interaction (see table 3). In the absence of word order canonical cues, the children with SLI appeared to use verbal agreement information as indicated by the presence of a significant effect of verbal agreement in both NNV and VNN conditions, while such an effect was absent in canonical NVN condition. In both non canonical conditions, the choice of second noun as agent increased significantly when the verbal agreement supported this choice.

In addition, a weak but significant effect of clitic was present in children with SLI ($C1 > C2$ while $C0 = C1$ and $C0 = C2$). Whatever the information brought by the clitic pronoun, a weak tendency to apply a first noun strategy could be observed. Finally, in both groups, the clitic by agreement interaction reached the significant level (see table 4). According to Kail and Charvillat, choices of the NL children were highly consistent when both cues brought compatible information either on the first or second noun. For competition items, children reverted to a 'first noun = agent' strategy. In contrast, children with SLI were weakly influenced by compatible information: highest choices of N1 were observed when only one cue was available. Similarly, the competition between cues had a small effect, these children using a first noun strategy by default.

Discussion and conclusion

Although both NL and SLI children principally used word order information during comprehension, their sentence processing strategies differed. NL children resorted to

Table 4. *Verbal agreement by clitic interaction in NL children and children with SLI, with the percentage of first noun choice in brackets. N1 = first noun selection, N2 = second noun selection, random = at random level. A0, ambiguous agreement, A1 = the verb agreed with N1, A2 = the verb agreed with N2. C0, no clitic, C1 = clitic pronoun's coreferent N2, C2 = clitic pronoun's coreferent N1*

	NL children (from Kail and Charvillat)			Children with SLI		
	C1	C0	C2	C1	C0	C2
A1	N1 (80)	N1 (64)	N1 (65)	N1 (63)	N1 (73)	N1 (64)
A0	N1 (64)	N1 (65)	Random ? (54)	N1 (74)	N1 (63)	N1 (63)
A2	N1 (74)	Random ? (58)	N2 (34)	N1 (63)	Random	random

information brought by clitic to complete and to modulate the word order cues. The verbal agreement seemed then to have a minor influence but it could be used adequately. The presence of a competition between items modified the performance and, in the absence of canonical information of word order, two compatible cues reinforced their choices. In contrast, word order always remained the determining factor in sentence interpretation for children with SLI of the same comprehension level. When such information was available and useful (NVN condition), neither clitic nor verbal agreement cues influenced their choices, as suggested by the absence of clitic and verbal agreement effects in this condition. Moreover, neither convergence nor competition modified the performance. When the word order cues were not reliable (NNV & VNN condition), these children resorted to the verbal agreement rather to clitic cues to select the agent.

Children with SLI were thus able to process different morphosyntactic cues in sentence comprehension (word order, verbal agreement or, even weakly, clitics). Nevertheless, they seemed to process only a single cue in one go and did not modulate their choice consistently in regard to other cues. Previous studies (Kail and Charvillat, 1986, 1988) have shown that two cues, even when they are compatible, are always more costly to process than a single one. Our results were therefore compatible with a hypothesis in terms of limitation of processing capacities in children with language disorders. This limitation prevented them from considering several cues together or from processing cues involving too costly mechanisms.

Children with SLI did not use the morphosyntactic cues in the same way as children with a normal linguistic development. The major difficulty in processing the clitic pronouns confirmed the findings of Hamann *et al.* (2003). After studying the language of children with SLI using an elicited production task, the authors proposed that the omission and avoidance of object pronouns would be a genuine and persistent characteristic for French SLI. The nature of these difficulties would be found in the clitic nature of the French pronoun. By definition, they cannot receive focal stress. In addition, they cannot be separated from the verb, be conjoined, modified or used in isolation. Moreover, the third person clitic pronouns used in this study (le, la, les) are ambiguous: there are homophonous with the definite articles (le, la, les) and 'les' is ambiguous in gender. The surface hypothesis (Leonard, 1989) could account for specific difficulties with unstressed grammatical morphemes in children with SLI. This

theory assumes a general capacity limitation in children with SLI, this limitation having an effect on the joint operation of perceiving grammatical morphemes and hypothesizing their grammatical function. The perceptual properties of the clitic object pronoun joined to the overload in processing due to the ambiguous pattern could be at the origin of the difficulties of the children with SLI.

Finally, it could be observed that neither NL nor SLI children presented any modification of their sentence processing strategies in function of their chronological age in the first place, nor their comprehension age in the second, which could suggest that the observed hierarchy remained consistent between 4;6 and 6;6. However, the same experiment carried out in French adults (Kail, 1989) pointed out that French adults presented a mirror hierarchy (verbal agreement > clitic > word order). So, between 6;6 and adulthood, French children must go through a reorganization of their comprehension system, switching from word order dominance to a primary reliance on morphology. Bates and MacWhinney (1989) suggest that this reorganization could be a consequence of the fact that in French complex cliticized structures within informal adult speech, the word order did not provide the correct interpretation. Consequently, the adults paid more attention to the other cues. If the children with SLI did not manage to process clitic, they would not perceive the risk of incorrect interpretation based on word order and they would not reorganize their sentence processing. In this case, the hierarchy word order > verbal agreement should be found in older children with SLI or in adults presenting a developmental SLI.

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