

SOME NOTES ON SEMANTICS AND SLI

PETRA SCHULZ

1. Introduction

In this paper I propose that the domain of semantics can be impaired in language acquisition, similar to the types of impairments that have been found in the domains of syntax, phonology, pragmatics, and the lexicon for children with Specific Language Impairment (SLI). Drawing on two sets of studies I show that children with SLI may exhibit difficulties in the semantic domain that are not merely a repercussion of difficulties at other levels of the language system or of domain-general deficits, such as limited working memory, difficulties that may be best characterized as a deficit.

It is generally assumed that the human language faculty comprises several modules including syntax, phonology, pragmatics, semantics, and the lexicon. Given that SLI is a heterogeneous disorder that may affect various aspects of language (Bishop, 1997; Leonard, 1998), difficulties are then expected to occur in all modules. Impairments have been reported in syntax, phonology, lexicon, and in pragmatics (e.g., Bishop, 1997; Conti-Ramsden & Botting, 2006; Leonard, 1998). Moreover, several studies indicate that these modules can be selectively impaired (e.g., Friedmann & Novogrodsky, 2008; van der Lely, 2005).

In contrast, semantic impairments have received less attention and have mostly been considered in concert with pragmatic or lexical deficits (but see Conti-Ramsden & Botting, 2006). The term “semantic-pragmatic disorder” (Rapin & Allen, 1983) was coined to refer to children with normal production and comprehension of grammar, but impaired ability to understand and produce meaningful language. However, as semantic difficulties have been found to be not more characteristic of this group than of other children with SLI, the main deficit seems to be better characterized as pragmatic language impairment (Bishop, 1998). Likewise, the term “lexical-semantic deficit” (Rapin, 1996) is used for children’s difficulties with vocabulary acquisition (Bishop, 1997), word finding (Dockrell, Messer & George, 2001), and lexical-semantic organization (Sheng & McGregor, 2010), even though these difficulties seem to be more lexical than semantic in nature.

The exact boundaries between semantics and pragmatics or the lexicon may therefore be difficult to determine, and semantic and pragmatic or lexical deficits

may co-occur. Nevertheless, the modularity view of the language system, according to which pragmatics, semantics, and lexicon are independent modules, invites regarding semantic deficits as separate from pragmatic and lexical deficits. Semantics as a module is concerned with linguistic meaning as manifested in the systematic link between linguistic forms and things (Chierchia & McConnell-Ginet, 1990). The linguistic units feeding into the mapping between the different levels of representation may be words, sentences, or discourse.

The few existing studies on the semantic abilities of children with SLI suggest that deficits may occur at the word, sentence, and discourse level (e.g., Botting & Adams, 2005; Roeper, 2004). Despite these findings, difficulties children may have with semantics have not been considered to be central to SLI, as can be inferred from this quote: “...deficits in each of three components of grammar (syntax, morphology, phonology) can co-exist, and might all dissociate” (van der Lely, 2005: 58).

Looking into two semantic phenomena—telicity and exhaustivity in wh-questions— I explore in this paper the assumption that the semantic module can be impaired in children with SLI. Three questions (Q1), (Q2), and (Q3) will serve as guidelines for the discussion of the acquisition studies. The question of selectivity of the difficulties is addressed in (Q1). The domain-specificity of SLI is addressed in (Q2). While modular theories of SLI (Friedmann & Novogrodsky, 2008; van der Lely, 2005) state that the impairment is independent of other non-grammatical domains, domain-general accounts claim that grammatical deficits are a secondary consequence of lower level problems with speech perception or deficits in phonological working memory (e.g., Norbury, Bishop & Briscoe, 2002). The question of delay vs. deficit is addressed in (Q3). A delay exists if the structure is intact but subject to maturational delay; a deficit is attested if a piece of grammar is missing or if something is mis-set in the structure (de Villiers, 2003).

- (Q1) Are there semantic difficulties that are not repercussions of difficulties in the lexical, pragmatic, syntactic, or phonological module?
- (Q2) Is the semantic difficulty domain-specific, i.e. restricted to grammar, or domain-general?
- (Q3) Is the semantic difficulty caused by a delay or by a deficit?

I will first discuss studies on acquisition of telicity and then on exhaustivity in wh-questions and as a conclusion provide preliminary answers to the three questions.

2. Difficulties with telicity

2.1. Background

Verbs can be classified according to the type of event they designate (Pustejovsky, 1991). Complex events involve a transition from one subevent to another. Telic verbs designate transitions from a process to a state, with the endstate subevent being more prominent than the process subevent. Thus, the endstate is specified as the head-of-event. Telic verbs can only designate events with their terminal endpoint reached (1a). If the endpoint is not reached (referred to as incomplete event), this is incompatible with the verb meaning (1b).

- (1) a. Mary opened the box. → box is open (completed event)
 b. #Mary opened the box, but the box is not open. (incomplete event)

Process-oriented transitions, on the other hand, are typically expressed by atelic verbs. They can designate events with the implicated endpoint reached (2a) or not reached (2b).

- (2) a. Mary drew, and the picture is done. (completed event)
 b. Mary drew, but the picture is not finished. (incomplete event)

Telicity is determined via the lexical semantics of the verb (e.g., *open*, *find*) or compositionally via the interaction with the verb's morpho-syntactic context (e.g., *draw* - *draw a flower*) (Schulz & Penner, 2002; van Hout, 2000). In German, the telicity marking of inherently telic particle verbs such as *aufmachen* 'open' is transparent, because the particle (e.g., *auf*'OPEN') denotes the endpoint.

Previous studies in German revealed that typically developing (TD) children exhibit an adult-like interpretation of inherently telic verbs starting at age three (Wittek, 2002). That is, in a truth-value-judgment-task, they consistently reject telic verbs for incomplete events. In contrast, children with SLI, diagnosed as exhibiting receptive and expressive language deficits, but with nonverbal intellectual functioning within age-appropriate limits, perform significantly below their four-year-old age-matched peers and still exhibit difficulties at age 7 (Penner, Schulz & Wymann, 2003; Schulz, Wymann & Penner, 2001). Penner et al. (2003) propose that this deficit results from an incorrect event-semantic representation of telic verbs, in which the head-of-event is optional. This strategy, referred to as "No-endstate orientation", would point to a semantic impairment in the sense of (Q1). However, as picture sequences were used, these studies leave open the possibility that SLI children's difficulties with telicity result from domain-general difficulties, e.g., with processing complex events presented in pictures. Moreover,

as children's knowledge of atelic verbs and general lexical abilities were not assessed, low performance in telicity may reflect a broad lexical deficit. Both points are addressed in turn in the two studies below.

2.2 Repercussion of a domain-general difficulty?

Using a truth-value-judgment task, in the first study participants were asked to match their interpretation of sentences containing telic as well as atelic verbs with completed or incomplete events. Rather than depicting the events in two-picture sequences, all scenes were acted out by a puppet in front of the child by the first experimenter, and a second experimenter asked a yes/no-question (e.g., telic: *Did she open the box?* or atelic: *Did she draw?*). This way the (in)completeness of the event was made explicit and thus task demands for the child were lower (for details, see Schulz & Wittek, 2003).

16 five-year-old children with SLI and 16 chronologically age-matched TD children participated in this study. 16 adults served as a control group. The children with SLI met the following criteria: They were diagnosed by speech therapists as exhibiting receptive and expressive language deficits, their cognitive functioning was reported to be within age-appropriate limits, and there was no report of hearing impairments (thus meeting the typical exclusionary criteria for SLI, cf. Leonard, 1998). All children with SLI were enrolled in a preschool program for children with language disorders. Each participant saw 16 scenes, with telic verbs (e.g., *aufmachen* 'open') or atelic verbs (e.g., *malen* 'draw'). In the test trials the event was incomplete, e.g., a container was manipulated without opening it or a half of a car was drawn. While the TD children interpreted both telic and atelic verbs adult-like, the children with SLI performed adult-like on atelic verbs and showed chance performance on telic verbs in the incomplete event condition. An individual analysis confirmed that telic verbs were mastered by 80% of the TD children, but only by 50% of the children with SLI.

These findings are in line with the results reported above for picture-sequences (Penner et al., 2003; Schulz et al., 2001) and provide evidence that lowering the task demands did not improve SLI children's ability to interpret telic verbs. Taking also into account that SLI children interpreted atelic verbs target-like, this study then suggests that difficulties with telicity cannot be accounted for by domain-general problems with processing complex events, and that this semantic difficulty is domain-specific (Q2).

2.3 Relation to lexical difficulties?

To explore whether SLI children's difficulties with telicity result from a general lexical deficit, in a second study children with SLI were tested on telicity and on their vocabulary (for details, see Schulz & Kiese-Himmel, 2006). As acting out the events did not improve SLI children's performance, telicity interpretation was assessed using the original TVJ task from Penner et al. (2003) that comprised eight test items, showing incomplete or completed events, and four controls. Children's active vocabulary was tested with a standardized test that required naming pictures depicting 64 nouns and 17 verbs (AWST, Kiese-Himmel & Kozielski, 1996).

20 five-year-old children with SLI, diagnosed in a speech therapy clinic, participated in this study. They all met the exclusionary criteria for SLI (Leonard, 1998) and exhibited expressive language deficits in morpho-syntax and phonology; eight children also showed lexical deficits.

Performance on the standardized vocabulary test was in the lower normal range (mean T-value: 44.0). Individual T-values moreover confirmed the expert classification regarding lexical deficits. Supporting the results from the previous studies, the children with SLI showed chance performance on telic verbs in the incomplete event condition. An individual analysis confirmed that telic verbs were mastered only by half of the children with SLI, with mastery defined as 75% correct responses to both the incomplete and the completed event condition. There was no correlation between performance on the telicity task and on the vocabulary test. In addition, children who mastered telicity did not have a significantly larger overall vocabulary (mean: 45 words) than children who failed telicity (mean: 43 words); verb vocabulary size did not differ significantly either between telicity masters and failers (mean: 10 vs. 8, out of a total of 17). These results, together with the finding on adult-like interpretation of atelic verbs (cf. Section 2.1), suggest that difficulties with telicity are independent of a general lexical deficit or a deficit in verb naming (Q1).

2.4 Telicity: Interim summary

The two studies on (a)telic verbs revealed that difficulties with telicity do not reflect general difficulties in the lexical domain, but constitute a genuine semantic difficulty (Q1). This semantic difficulty with telic verbs is not caused by general difficulties with processing complex events in picture sequences, pointing to a domain-specific rather than a domain-general problem (Q2). It was proposed that SLI children's difficulty results from a "No-Endstate orientation", which leads to a representation of endstate-oriented transitions with an optional rather than

obligatory head-of-event. This mis-setting in the event-semantic representation, which only applies to telic but not to atelic verbs, qualifies as a deficit (Q3).

3. Difficulties with exhaustivity in wh-questions

3.1 Background

Exhaustivity occurs in both single and multiple wh-questions. Non-exhaustive single wh-questions such as (3a) require a mention-some answer (3b) and involve existential quantification (3c) (Nelken & Shan, 2004).

- (3) a. Where is a gas station?
 b. There is one just down the road.
 c. $\exists x. \Box p, p = Gx$ (where $\Box p$ = it is common ground or known that p)

In contrast, exhaustive single wh-questions such as (4a) require a complete list of all individuals (4b), rather than singleton (4c) or plural (4d) answers. Exhaustivity can be modeled in the semantic representation as 'hidden' universal quantification (4e) (Nelken & Shan, 2004) and is assumed to be an inherent part of the question meaning (Schulz & Roeper, in press). Quantifying particles such as *alles* 'all' in German (Reis, 1992) always result in an exhaustive reading (5).

- (4) a. Who is sitting?
 b. Mary, Jane, and Sue. (exhaustive answer)
 c. #Mary. (singleton answer)
 d. #Mary and Jane. (plural answer)
 e. $\forall x_n. p \rightarrow \Box p, p = Sx$
- (5) Wer ist alles gegangen?
 'Who ALL left?'

Multiple wh-questions (Dayal, 2006) generally receive an exhaustive reading. A complete answer to (6a) consists of an exhaustive list of all pairs of individuals and objects who stand in an eating relation to each other (6b), whereas non-exhaustive alternatives, exemplified in (6c) to (6e), are incorrect. The semantic representation can be modeled as universal quantification over two variables (6f).

- (6) a. Who is eating what?
 b. John is eating a pear and Mary an apple. (exhaustive pair list)

- c. #John is eating a pear. (one pair)
 d. #John and Mary. (exhaustive subject list)
 e. #John. (one subject)
 f. $\forall x_n \forall y_m. p \rightarrow \neg p, p = Exy$

Previous studies in English and German, using question-with-picture tasks with questions such as (4a) and (6a), indicate that exhaustivity emerges around age five in TD children (Heizmann, 2007; Roeper & de Villiers, 1993), with no stage of plural answers like (4d) attested. In contrast, children with SLI provide incorrect singleton answers to exhaustive single wh-questions up to age 7 (Schulz & Roeper, in press) and show below age performance on paired wh-questions up to age 9 (Roeper, 2004). This persistent inability to universally quantify over the variables in wh-questions suggests a semantic impairment in the sense of (Q1).

As overt exhaustivity markers were not included, it is unclear, however, whether children with SLI have difficulties giving exhaustive answers in general or whether this problem is specific to wh-variables, suggesting a deficit (Q3). Second, as children's working memory was not tested, these studies leave open the possibility that SLI children's difficulties with exhaustivity result from domain-general difficulties. Third, children's interpretation of the syntax of wh-questions was not assessed; low performance in exhaustivity may thus reflect a syntactic deficit. These three points are addressed in the two studies below.

3.2 Deficit or delay?

To explore whether SLI children's difficulties with exhaustive wh-questions result from a general inability to provide complete list answers, in the first study children with SLI were tested on single wh-questions with and without *alles* and on paired wh-questions (for details, see Schulz & Roeper, in press). 20 5-year-old TD children, 20 5-year-old children with SLI, and 20 adults participated in the study. All children with SLI met the exclusionary criteria for SLI (Leonard, 1998) and performed below average in at least two out of five SETK 3-5 (Grimm, 2001) subtests, while the TD children performed within age-appropriate limits.

Using a question-with-picture task, a total of 26 subject wh-questions were presented to each participant, among them five single wh-questions (4a), five single wh-all-questions (5), and five paired wh-questions (6a). Each question was accompanied by a picture that depicted several individuals a subset of whom fulfilled the property being asked about. While adults' and TD children's performance was at ceiling across conditions, children with SLI interpreted only wh-all-questions adult-like and performed significantly worse than the TD children on single (75% correct) and paired (49% correct) wh-questions. Incorrect

responses to single wh-questions were predominantly singleton answers (4c), and incorrect responses to paired wh-questions mostly exhaustive subject lists (6d).

These findings support previous results showing that children with SLI exhibit difficulties with wh-questions, when exhaustivity marking is covert (Roeper, 2004). What is more, SLI children interpreted wh-all-questions target-like, which mark exhaustivity overtly and possibly without underlying universal quantification. This result provides evidence that difficulties with exhaustive wh-questions cannot be attributed to a general problem with giving list answers. Rather, I suggest that SLI children's problems with exhaustivity are rooted in a semantic deficit: The hidden universal quantification underlying the exhaustive readings of single and paired wh-questions is missing (Q3). If exhaustivity were subject to maturational delay, children with SLI would be expected to perform more similarly on wh-questions with and without an overt exhaustivity marker.

3.3 How narrow is the deficit?

This second study explored how domain-specific and how semantic-specific SLI children's difficulties with exhaustivity are. In this section the results on the exhaustivity task are presented; the influence of working memory is reported in Section 3.3.1 and the relation to syntactic aspects of wh-questions in Section 3.3.2.

19 5-year-old children with SLI, 20 4-year-old and 20 5-year-old TD children and 20 adults as a control participated. All children with SLI met the exclusionary criteria for SLI (Leonard, 1998) and performed below average in at least one out of three SETK 3-5 subtests (Grimm, 2001), while the TD children performed within age-appropriate limits on all three subtests. One of the subtests was a non-word repetition task, assessing working memory. Additionally, all children were tested on the subtest 'simple wh-questions', as part of the standardized test LiSe-DaZ (Schulz & Tracy, to appear) to test children's interpretation of the syntax of wh-questions. In the main test, a question-with-picture design was used.¹ Each participant was presented with 36 pictures, accompanied with pre-recorded wh-questions: eight single wh-questions (4a), eight paired wh-questions (6a), and in a later session eight single wh-all-questions (5a) to avoid possible influence on the other test conditions. Twelve controls served to elicit singleton answers. As can be inferred from Figure 1, adults performed well, and the two TD groups did not differ significantly in the three conditions. Children with SLI interpreted wh-all-questions like the four- and five-year-old TD children. SLI children's performance on single and paired wh-questions was not significantly different from the four-year-old TD children, but significantly worse (paired wh-questions: $p < .01$) and marginally worse (single wh-questions: $p = .06$) than performance of the age-matched TD peers.

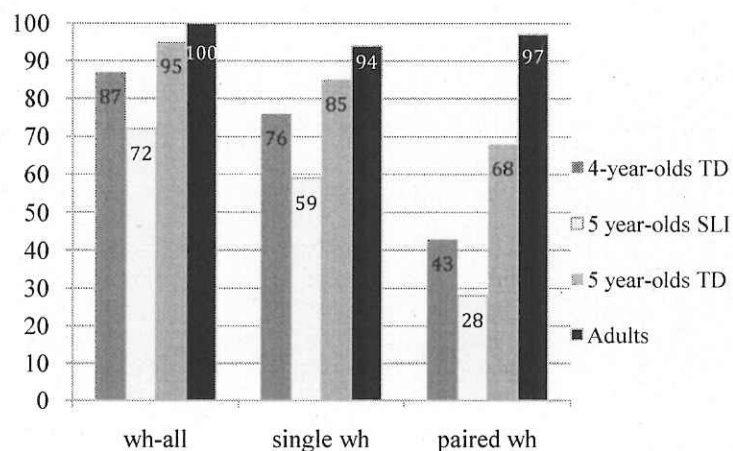


Figure 1. Percentage of correct performance on the test conditions in the test groups.

Regarding error-types, SLI- and TD-children's predominant errors for single wh-questions were singleton answers (4c). Distribution of errors for paired wh-questions differed significantly between both TD-groups and the SLI-group (X^2 , $p < .05$): One-subject answers (6e) were predominant in SLI-children's errors, and exhaustive subject-list answers (6d) in TD-children's errors.

3.3.1 Repercussion of a domain-general difficulty?

The influence of working memory on the ability to provide exhaustive answers was assessed via the non-word repetition task (18 test items, SETK 3-5, Grimm, 2001). Within the SLI group, there was no significant correlation between non-word repetition and either single wh-questions ($p = .45$) or paired wh-questions ($p = .43$). Evaluating all children tested, 20 children failed paired wh-questions, i.e. they gave less than 7/8 correct responses, but showed average or above non-word repetition skills. Thus, failure to exhaust cannot be reduced to children's low working memory abilities. In addition, there was no effect of the size of the answer set on the children's ability to provide exhaustive answers. Both findings indicate that SLI children's difficulties with exhaustivity do not result from domain-general problems with working memory (Q2).

3.3.2 Relation to syntactic difficulties?

The relation between syntactic aspects of wh-questions and exhaustivity was explored by comparing children's performance on the exhaustivity task and on the

LiSe-DaZ subtest wh-questions (Schulz & Tracy, to appear). In a question-after-story task, each participant had to answer 10 non-exhaustive wh-questions (2 subject-, 4 object-, 4 adjunct-questions). A typical object-question is given in (7).

- (7) Lead in: The children are helping the dog out of the bin. It is locked in and cannot get out by itself.
Wh-question: Whom do the children help out of the bin?
Target answer: (the) dog.

Children with SLI performed significantly worse (69% correct) than both the four- and the five-year-old TD children (89% and 92% correct, $p < .05$). However, within the SLI group, dissociation was found between mastery of non-exhaustive and exhaustive single wh-questions. Of the eight children who failed exhaustivity, two had mastered the non-exhaustive wh-questions; of the eleven children who mastered exhaustivity, four failed non-exhaustive wh-questions. The latter finding may result from the fact that all exhaustive wh-questions were subject-questions, which are acquired before other question types (Friedmann & Novogrodsky, 2007). Consequently, SLI children's difficulties with exhaustivity may reflect a semantic deficit that is separate from syntactic difficulties (Q1). Further research should investigate whether this result also holds for truly reversible subject-/object-wh-questions (Friedmann & Novogrodsky, 2007).

3.4 Exhaustivity: Interim summary

The two studies on exhaustive wh-questions showed that SLI children's difficulties with exhaustivity are semantic. It was proposed that these difficulties result from a lack of universal quantification underlying the exhaustive readings of single and paired wh-questions. This missing feature in the semantic representation, which does not apply to overt exhaustivity with *alles*, qualifies as a deficit (Q3). The semantic difficulty with exhaustive wh-questions verbs was argued to be domain-specific rather than domain-general (Q2): Children with SLI did not exhibit difficulties with giving exhaustive list answers in general, their ability to exhaust the answer was independent of the size of the answer set, and, most importantly, their difficulty with exhaustivity did not result from domain-general problems with working memory. The dissociation between performance on exhaustive wh-questions and non-exhaustive wh-questions in varying syntactic functions suggests that exhaustivity failures cannot be reduced to problems at the syntactic level of wh-questions, but constitutes a genuine semantic difficulty (Q1).

4. Conclusion

Based on two acquisition studies of the semantic phenomena telicity and exhaustivity in *wh*-questions, I proposed that the domain of semantics can be impaired in language acquisition, in ways that are similar to the types of impairments that have been found in the domains of syntax, phonology, pragmatics, and the lexicon for children with SLI. In response to (Q1), children with SLI were found to exhibit difficulties in the semantic module that could not be reduced to impairments of other modules within the language system. Difficulties with telicity were independent of lexical deficits, and difficulties with exhaustivity were dissociated from problems with the syntax of *wh*-questions. As for (Q2), these semantic impairments were argued to be domain-specific rather than domain-general. Failure to interpret telic verbs correctly did not result from children's difficulty with perceiving complex events depicted in picture sequences, and lack of exhaustive answers was unrelated to limited working memory. Note, however, that this leaves open whether difficulties in other domain-general areas could explain SLI children's performance. Finally regarding (Q3), it was argued that the semantic difficulties discussed here are best characterized as a deficit, i.e. as grammars with a piece missing or mis-set (de Villiers, 2003). For telicity, it was claimed that children with SLI do not obligatorily mark the head-of-event in endstate-oriented transitions. For exhaustivity, it was hypothesized that the underlying universal quantification may be absent from SLI children's semantic representation of exhaustive *wh*-questions. Further evidence for the deficit view comes from the fact that children with SLI show an asymmetrical performance pattern with high performance on minimally different structures, as exemplified in the target-like interpretation of atelic verbs and of exhaustive *wh*-questions with the overt exhaustivity marker *alles*.

The telicity and exhaustivity studies clearly indicate that semantics can be impaired in children with SLI. Whether difficulties with telicity and exhaustivity occur in the same group of children or whether they constitute even more narrow subgroups of impairment remains at this point unresolved. Moreover, parallel to what has been found with optional tense marking (Rice & Wexler, 1996) it may be that semantic difficulties occur in different guises in different languages. Due to the language-specific instantiations of telicity across languages, it may be that telicity deficits look different in different languages. In contrast, exhaustivity of *wh*-questions, which seems to follow the same acquisition path across different languages (Schulz, 2010), may be a good candidate for an impairment that is observable cross-linguistically.

If these results hold up under further scrutiny, then—assuming that domains can be selectively impaired in children with SLI—semantic difficulties are predicted to

occur independently of difficulties in other domains of language. Whether such a subtype “semantic SLI” exists, is subject to further research.

Notes

¹ The task was developed during the COST Action A33 (PI: Uli Sauerland, ZAS Berlin) in Working Group 3. For details, see Schulz (2010).

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