



## Which questions are most difficult to understand? The comprehension of Wh questions in three subtypes of SLI

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### ABSTRACT

This study explored Wh question comprehension in Hebrew-speaking children with syntactic SLI, comparing *which* and *who* questions and subject and object questions. The participants were 28 Hebrew-speaking children with SySLI aged 9;3–12;0, and the control group included 25 typically-developing children aged 9;1–10;0. The study used three picture selection tasks. The results indicated that the children with syntactic SLI had a severe deficit in the comprehension of *which* object questions. Most of them performed randomly on these questions, and each of them performed significantly poorer than the control group. They understood subject questions better than object questions, and *who* questions better than *which* questions. These results join a growing body of evidence suggesting a deficit in sentences derived by Wh movement in syntactic SLI. We suggest that this deficit relates to the assignment of a thematic role to an element which moved across another argument of the same type. The second part of the study explored subtypes of SLI. We compared the comprehension of Wh questions in three groups of children with SLI: syntactic SLI (S-SLI or SySLI), lexical SLI (LeSLI), and pragmatic SLI (PraSLI). The results showed that whereas children with SySLI have a significant deficit in the comprehension of *which* object questions, children with LeSLI and PraSLI understand Wh questions without difficulty.

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## 1. Introduction

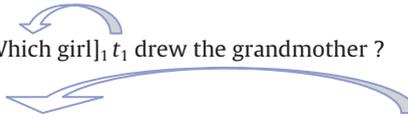
Wh questions like ‘*Which season do you like best?*’ include syntactic movement of a noun phrase (in this case, *which season*) to the beginning of the sentence. Children with Specific Language Impairment (SLI) have difficulty with the comprehension and production of sentences that include syntactic movement to the beginning of the sentence: relative clauses, topicalized prepositional phrases, and object topicalization structures. How do children with SLI understand Wh questions, which include the same type of syntactic movement? This study examines whether children with syntactic SLI have difficulty with the comprehension of Wh questions, and which types of Wh questions are the most difficult. Another focus of this study is the identification of subtypes of SLI and the assessment of Wh question comprehension in non-syntactic subtypes of SLI.

Wh questions are classified according to the position from which the Wh phrase has moved. Subject questions are derived by movement from subject position, as in example (1), whereas object questions involve movement from object position, as in example (2). In both cases, the moved element leaves a trace (marked by  $t_1$ ) in its original position (copy theory of traces

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assumes that a trace is a silent copy of the moved constituent, Chomsky, 1995). In all sentences, the verb assigns thematic roles to its arguments, namely, it determines the role of each of the noun phrases in the sentence. In the sentence ‘*The girl drew the grandmother*’, the verb *drew* assigns *the girl* the thematic role of the agent, and *the grandmother* the role of the theme of the action. Verbs that take an agent and a theme typically assign (in languages like English and Hebrew) the agent role to a noun phrase that precedes them, and the theme role to an argument that follows them. However, in questions such as (2), the theme does not follow the verb, but rather appears at the beginning of the sentence. In such cases, the verb assigns the thematic role to the trace of the moved element, and the thematic role is transferred from the trace to the moved element via a chain that connects the trace and the moved element in its new position (represented by an arrow in (1) and (2)). Subject questions also include movement, but this movement does not change the canonical order of arguments (which, in English and Hebrew, for example, is agent before theme), and does not involve crossing of another argument of the verb.

- (1) Subject question: [Which girl]<sub>1</sub> t<sub>1</sub> drew the grandmother ?
- (2) Object question: [Which girl]<sub>1</sub> (did) the grandmother draw t<sub>1</sub> ?
- 

In terms of the syntactic tree, the noun phrase that moves in Wh questions moves to the highest node of the syntactic tree, the specifier of CP. This movement is called “Wh-movement” (or “A-bar movement”) and it also occurs in relative clauses and in topicalization structures.

Crucially for our discussion, children with syntactic SLI (i.e., the subtype of SLI that entails a syntactic deficit) have considerable difficulty with structures that are derived by Wh-movement and do not maintain the canonical order of arguments, namely, those in which the theme precedes the agent. Children with Syntactic SLI show impaired comprehension of object relative clauses (Adams, 1990; Friedmann and Novogrodsky, 2004, 2007; pre-therapy performance in Levy and Friedmann, 2009; Stavrakaki, 2001), object topicalization in Hebrew (Friedmann and Novogrodsky, 2003), and topicalized prepositional phrases in English (van der Lely and Harris, 1990). The production of object relatives (Håkansson and Hansson, 2000; Novogrodsky and Friedmann, 2006; Schuele and Tolbert, 2001) is also impaired. If indeed the difficulty that children with syntactic SLI have in relative clauses and topicalized structures results from the existence of Wh-movement in a sentence, we would expect them to also experience difficulty with the comprehension and production of Wh questions, at least those in which the order of the arguments is not canonical.

Indeed, several studies showed that Wh questions are impaired in SLI. Studies of Wh question *production* showed that children with SLI have difficulties in Wh questions. They avoid the production of Wh questions, and produce non-target questions (see also de Villiers et al., 2011). Both subject and object questions are difficult to produce, but object questions show even poorer performance (Ebbels and van der Lely, 2001; Stavrakaki, 2006). The manifestation of this difficulty differs between languages: French-speaking children with SLI use in-situ Wh-words instead of Wh fronted questions in spontaneous speech and in elicited production tasks (Hamann, 2005; Jakubowicz, 2011; Jakubowicz and Gutierrez, 2007); English-speaking children produce Wh questions with filled gap, mainly in object questions (e.g., “What did Mrs. Brown break something?”, Ebbels and van der Lely, 2001; van der Lely and Battell, 2003); and Swedish and German speakers omit the Wh-word (Hansson and Nettelblatt, 2006; Penner et al., 1999). Swedish and French-speaking children with SLI are also reported to produce Wh questions without movement of the verb over the subject to the second sentential position (Hamann, 2005; Hansson and Nettelblatt, 2006).

Such responses can be used in production by children with difficulties in Wh-movement, when faced with the need to produce a Wh question. However, these alternative routes are impossible when the *comprehension* of a well-formed question is required. How do children with Syntactic SLI understand Wh questions?

Only few studies have tested the *comprehension* of Wh questions in SLI children. Ebbels and van der Lely (2001) administered an experimental treatment aimed at improving the production and comprehension of Wh questions and passives of four children aged 11;8–12;9 with “receptive and expressive SLI”. Their pre-treatment assessment indicated that 3 of the 4 participants had difficulty with the comprehension of *which* object questions, whereas they had no difficulty with the comprehension of *who* subject, *who* object, and *which* subject questions. Deevy and Leonard (2004) tested SLI children aged 4;3–6;10, and found no difference between (short) *who* subject and *who* object questions as well as no difference between the performance of the SLI and the control groups on these structures. Interestingly, Wong et al. (2004) tested the comprehension of subject and object questions in Cantonese, and there, too, the level of performance on object questions was significantly poorer than that of subject questions, although no overt movement is involved in the derivation of Wh questions in Cantonese. Finally, in a recent study in French, Jakubowicz and Gutierrez (2007, see Jakubowicz, 2011) found that SLI children aged 6–13 years old comprehended object in-situ questions better than fronted object questions. Long-distance Wh questions (e.g., “What did the girl say she found?”) constitute a special difficulty for children with SLI (Roeper, 2004; Jakubowicz, 2011).<sup>1</sup>

Thus, both the production and the comprehension of Wh questions are compromised in SLI. The rich literature on the comprehension of Wh questions in typical language acquisition, and in acquired syntactic impairment, agrammatic aphasia,

<sup>1</sup> Some data are also available with respect to the comprehension of paired questions and long distance questions in SLI. Paired questions (e.g., “Who eats what?”) are mastered at the age of 6–7 years (Schulz, 2007), and according to Roeper (2004) they form a developmental index between 4 and 9 years of age. Roeper (2004) and Schulz (2007) found that older children with SLI have difficulty understanding these structures.

suggests two dimensions that are crucial for the examination of Wh question comprehension: gap location – subject vs. object questions, and types of Wh elements – *which* and *who* questions.

Some studies of typical language acquisition have found similar performance on subject and object questions (in English, Avrutin, 2000; Deevy and Leonard, 2004; Hirsch and Hartman, 2006; Stromswold, 1995; and French, Jakubowicz and Gutierrez, 2007). Other studies, however, have found differences in performance between subject and object questions. Tyack and Ingram (1977) tested children aged 3;0-5;5, and found that they performed better on subject- than on object-questions. De Vincenzi et al. (1999) tested 4–11 year-old Italian children and found that whereas four year olds already understood subject questions well, object question were only acquired at age 11. Similarly, Jakubowicz and Gutierrez (2007) found that in Basque, 4 year olds respond more accurately to subject questions than to object questions. Friedmann and Szterman (in press) report that Hebrew-speaking typically developing 5-year olds repeat subject *which* questions at ceiling, but still find it relatively difficult to repeat object *which* questions. Friedmann et al. (2009) report a clear difference between *which* object questions, comprehended only at a level of 58%, and *which* subject questions, comprehended correctly 78% of the time, by typically developing Hebrew-speaking children aged 3;7-4;10. Interestingly, they did not find this subject-object asymmetry when *who* subject questions were compared to *who* object questions. In this case, the comprehension performance was 81% correct on *who* subject questions and 75% correct on *who* object questions, a difference that was not significant. This leads us to a further source of difference in performance between question types—the difference between *which* questions and *who* questions. In Friedmann et al.'s study, the difference between *which* and *who* object questions was significant (58% vs. 75%). A similar pattern was reported in a study of 15 English speaking children aged 3;5-5;2 (Avrutin, 2000), who performed 86% correct on *who* object questions, and only 48% correct on *which* object questions. Namely, in both Friedmann et al.'s and Avrutin's studies, subject and object questions did not differ on *who* questions, but they did differ on *which* questions, with *which* object questions significantly poorer than the other type of *which* question, *which* subject questions, and from the other type of object question, *who* object questions.

Similar dissociations were reported in adults who have agrammatic aphasia, a syntactic impairment following a brain lesion. In this population too, the comprehension of subject questions is significantly better than object questions, and some of the individuals also show better comprehension of *who* questions compared to *which* questions (Friedmann, 2002; Hickok and Avrutin, 1996; Thompson et al., 1999; van der Meulen, 2004). *Which* object questions were found to be significantly more difficult to understand than subject *which* questions also for Hebrew and Palestinian-Arabic speaking children with hearing impairment (Friedmann et al., 2010; Friedmann and Szterman, in press; Nave et al., 2009).

The few studies on Wh question comprehension in SLI partly suggest that a similar pattern of dissociations between subject and object questions and between *who* and *which* questions exists in SLI as well. The four participants in Ebbels and van der Lely's study (2001) showed impaired comprehension of *which* object questions, and significantly better comprehension of subject questions, and of *who* questions, and no difference between *who* subject and object questions. Deevy and Leonard (2004) have also reported there to be no difference between *who* subject and object (short) questions, but Wong et al. (2004) did find such a difference in Cantonese.

Therefore, it seems crucial to include these comparisons when testing the comprehension of Wh questions in SLI. The current study thus compared the comprehension of subject and object questions, and of *which* and *who* questions in children with SLI.

## 2. Part 1: comprehension of Wh questions in syntactic SLI

### 2.1. Method

#### 2.1.1. Participants

The participants in the Syntactic SLI (SySLI) group who participated in tasks 1 and 2 were 14 Hebrew-speaking children aged 9;3-12;0 (mean = 10;4, SD = 0;11: five 9-year-olds, five 10-year-olds, three 11-year-olds, and one 12-year-old). All of them were attending regular classes in regular schools, in 4th to 6th grade. All the participants met all the exclusionary criteria for SLI (Leonard, 1998): they had no hearing impairments and no recent episodes of Otitis Media, no abnormalities of oral structure or problems in oral function; they showed no evidence of obvious neurological impairment or impaired neurological development; they had no symptoms of impaired reciprocal social interaction or restriction of activities that are typical of autism or PDD.

Their nonverbal intellectual functioning was at the age-appropriate level, as indicated by their score on the Raven's Matrices test (Raven, 1965), in which they performed within 1 SD of the average for children their age.<sup>2</sup> Three of the participants were also tested using the Wechsler Intelligence Scale for Children (WISC-R95, Hebrew adaptation, Cahan, 1998) and received scores of 93–106. Eleven of the participants demonstrated age-appropriate performance in the forward and backward digit span tasks from the WISC, and three performed below the average.

With respect to the inclusion criterion, all the participants in the SLI group had been diagnosed with SLI prior to the study through clinical tests, done by speech-language pathologists and educational specialists, based on reading comprehension assessments and non-standardized tests that are used in clinics (at this point there are no standard language assessment

<sup>2</sup> Five of the participants were examined only using subtests A and B of the Raven test. The scores for each of these subtests were within 1 SD of the average of their age range, except for OS who performed below her age range in subtest A (the least complex subtest), but within the normal range in other nonverbal tasks.

tests in Hebrew, except one that assesses only lexical-semantic abilities). We therefore thoroughly assessed their abilities using syntactic, lexical, and phonological tests, and compared their performance to a control group.

Children were included in the SySLI group on the basis of their performance in five syntactic comprehension and production tests, described below in section 2.1.1.1. In addition to the syntactic tests, the children with SySLI were also tested using a battery of lexical and phonological tests (for a detailed description of these tests, see section 3.1.1). These tests indicated that ten of the participants had selective SySLI, without lexical or phonological deficits; two of them also had, in addition to SySLI, a phonological impairment, and two had a phonological impairment and a lexical retrieval deficit in addition to the syntactic deficit.

*2.1.1.1. Background data on the syntactic abilities of the participants with SySLI.* The participants were diagnosed with syntactic SLI using 5 tests: 3 tests of relative clause comprehension and 2 tests of relative clause production. Participants were included in the SySLI group if they failed on at least 3 out of the 5 tests. Each of the SySLI participants failed in at least two comprehension tasks and at least one production task. Failure in a test was defined as performance significantly poorer than the mean score of typically developing children and was tested using the Crawford and Garthwaite (2002; see also Crawford and Howell, 1998) *t*-test for the comparison of a single subject to a group, with an alpha level of 0.05.

The comprehension of relative clauses of the children with SySLI was assessed by three tasks from the BAMI syntactic test battery (Friedmann and Novogrodsky, 2002): a binary sentence-picture matching task, a task of comprehension questions, and a reading and paraphrasing task. In the *binary sentence-picture matching task* (Bambi ZTI), each participant was orally presented with 40 subject- and object-right-branching relative sentences and was asked to choose the picture corresponding to the sentence between two pictures: a matching picture and a picture with reversed roles (with pictures similar to Fig. 1). The participants' performance in this task indicated a significant difficulty with the comprehension of (right-branching) object relatives, with only 71% correct responses, whereas children with unimpaired language perform 85% correct on this task at age 6;0 and at ceiling at age 7;0 (for detailed method and results of typically-developing children, see Friedmann and Novogrodsky, 2004; Friedmann and Szterman, 2006). The errors they made, derived from the nature of

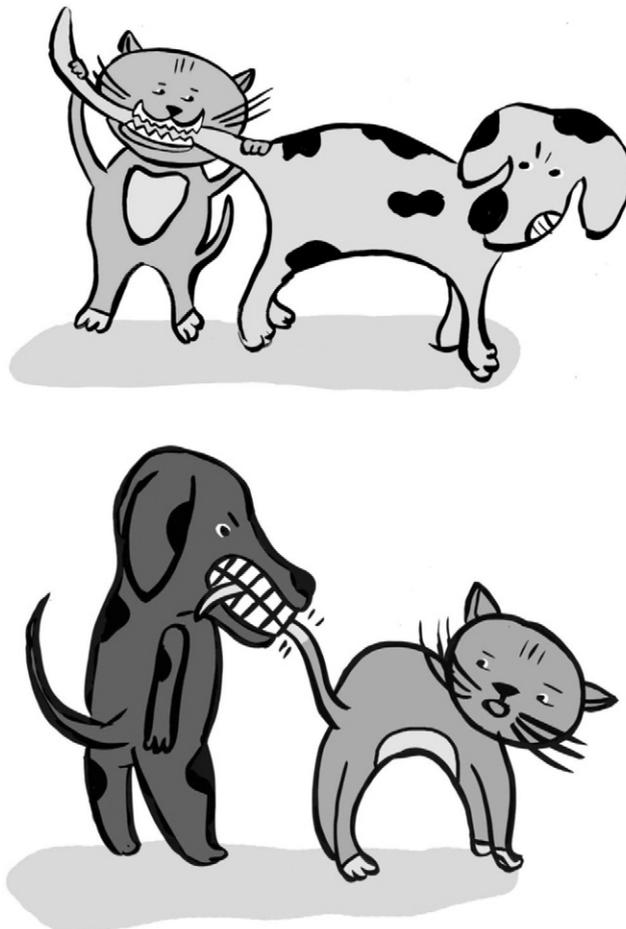


Fig. 1. An example for a picture pair used in the two-figure task.

the task, were thematic role reversals, namely, pointing to the picture that included reversed roles. The participants' comprehension of (right-branching) subject relatives was considerably better, with 97% correct responses.

In the *comprehension questions task* (Bambi ZIKA MEGUVANA), each participant heard 90 center-embedded or right-branching subject and object relatives and answered questions that required the comprehension of the thematic roles in the relative clauses ("who kissed?").<sup>3</sup> The children with SySLI had 68% correct responses on left branching object relatives, and 55% correct on center-embedding object relatives, whereas children with unimpaired language in 4th–6th grade perform 91% correct on left-branching object relatives, and 80% on center-embedded object relatives in this task.

The *reading and paraphrasing task* (Bambi ZIKRIA) included center-embedded object relative clauses, and the participants were required to read sentences and paraphrase them. The children with SySLI had only 59% correct paraphrases (although their reading aloud was unimpaired), whereas children with unimpaired language perform 92% correct on this task in 4th–6th grade (for detailed method, typically-developing children results, and discussion see Friedmann et al., 2006; Friedmann and Novogrodsky, 2007).

The *production of relative clauses* was assessed using two elicitation tasks: a picture description task and a preference task (Bambi ZIBUV and Bambi ADIF, for detailed method and results see Friedmann and Szterman, 2006; Novogrodsky and Friedmann, 2006). The production of object relatives in the SySLI group was 55% correct in the picture description task, and 68% correct in the preference task. Children with unimpaired language perform 94% correct on both of these tasks at ages 7;5–11;9 years (with no significant changes between the ages within the control group).

Thus, a considerable syntactic impairment in the comprehension and production of relative clauses was established at the group level as well as for each individual with SySLI.

All 14 participants with SySLI participated in the first task of Wh question comprehension, and eight of them also participated in the second task.

The participants in the control group were 25 typically-developing children without record of learning disabilities or language difficulties, aged 9;1–10;0 ( $M = 9;6$ ,  $SD = 0;3$ ). Thirteen of them were tested on both *which* and *who* questions, and 12 were tested on *which* questions alone.

### 2.1.2. Material and procedure

The comprehension of Wh questions was tested in this group of participants using two binary picture-selection tasks. Task 1 included pictures with two figures and task 2 included three figures. In addition, to test another configuration of the figures in the pictures, we tested another group of 14 children with SySLI aged 9;10–14;10, task 3. The experimenter asked a question while the participant was looking at a page with two pictures, presented one above the other. The participant was then requested to point to the picture that matched the question. Each of the participants was tested individually in a quiet room. No time limit was imposed during testing, and no response-contingent feedback was given by the experimenter. The experimenter repeated every item as many times as the participant requested. All the questions were semantically reversible so that comprehension of the meaning of the words alone could not determine the meaning of the sentence (namely, we did not use irreversible sentences such as *which boy is eating an apple*, only reversible sentences such as *which boy is kissing the grandfather*). Prior to the tests, each participant was presented with the pictures and was asked to point to the figures by name ("Show me a cat" and "Show me a dog" for the picture pair in Fig. 1). All participants performed well on this lexical pretest.

### 2.1.3. Task 1: picture selection with two different figures

In this task, the pictures presented to the participants included two figures: In one picture, the roles matched the sentence, whereas in the other picture, the roles were reversed (see Fig. 1). A total of 80 Hebrew questions were presented to each participant. These questions included 20 *who* subject questions, 20 *which* subject questions, 20 *who* object questions, and 20 *which* object questions (see examples (3)–(6) for questions that were presented with Fig. 1). All verbs were agentive transitive verbs. In each picture the figures were always of the same gender and number (a female nurse and a female soldier; a giraffe and a cow, which are both feminine in Hebrew; a little boy and a grandfather, etc.), in order to preclude an agreement cue on the verb (as verbs in Hebrew agree with the subject in gender, number, and person).

- (3) *Who* subject  
mi noshex et ha-xatul?  
who bites ACC the-cat  
'Who is biting the cat?'
- (4) *Which* subject  
eize kelev noshex et ha-xatul?  
which dog bites ACC the-cat  
'Which dog is biting the cat?'

<sup>3</sup> The questions used in the comprehension questions task were questions that are not problematic for Hebrew-speaking children with SySLI: subject *who* questions and object *who* questions with arbitrary *pro* subject (*et mi nishku?* = ACC who *arb-pro* kiss-plural).

- (5) *Who* object  
 et mi ha-xatul noshex?  
 acc who the-cat bites  
 'Who is the cat biting?'
- (6) *Which* object  
 et eize kelev ha-xatul noshex?  
 acc which dog the-cat bites  
 'Which dog is the cat biting?'

The questions were randomly ordered, and presented in 2 sessions of 40 sentences each (10 questions of each type per session). The participants saw 20 picture pairs four times; each picture pair appeared with all 4 question types. The correct picture in each pair was randomized both within each session (in each session 20 sentences matched the upper picture, and 20 matched the lower picture), and between sessions (the matching picture in each pair was sometimes the top picture, and sometimes the bottom picture). One of the SySLI participants, ID, was only tested on *which* questions.

#### 2.1.4. Task 2: picture selection with three different figures

In this task each page (the two pictures together) included three different figures; we used this task because we wanted to examine whether it is more pragmatically felicitous, with a question like *Who does the girl draw?*, to have to choose between two completely different figures rather than two figures of the same type (a mother and a witch instead of two cats for example). One of the figures was the agent of the action in one picture, and the theme of the same action in the other picture, as seen in Fig. 2. In such a design only *who* questions could be used (it is impossible to ask *which witch* when there is only one



Fig. 2. An example for a picture pair used in the three-figures task.

witch, and if we ask *Which witch does the girl draw* when there is only one witch, the choice of the picture is obvious even without syntactic analysis). Thus, this task included only *who* subject and *who* object questions (as in examples (7) and (8)). This task included 40 questions, 20 questions of each type, randomly ordered and presented with 20 pictures, each presented twice. This task was administered in one session.

- (7) *Who* subject  
mi mecayer et ha-yalda?  
who draws ACC the-girl  
'Who is drawing the girl?'
- (8) *Who* object  
et mi ha-yalda mecayeret?  
ACC who the-girl draws  
'Who is the girl drawing?'

### 2.1.5. Task 3: figure selection in a picture with three figures

To further assess the methodological aspect of the picture selection task, we tested Wh question comprehension using yet another configuration of figures in the pictures, with another group of children with SySLI. This task included the same design and *which* subject and object questions, but each picture included 3 figures, two of the same type, and one of a different type. The first figure was performing an action on the second, and the second figure was performing the same action on the third figure, which was of the same type as the first figure. For example, as shown in Fig. 3, a dog biting a cat, which is biting another dog. (BAFLA ST-TLAT, described in Friedmann et al., 2009; Friedmann and Szterman, in press; Nave et al., 2009; Haddad-Hanna and Friedmann, 2009). This task allowed us to evaluate subject and object *which* questions in a picture which might be pragmatically more felicitous.

The participants in task 3 were another group of 14 children with SySLI who had significant difficulties in the comprehension and production of relative clauses and topicalized structures. They were aged 9;10–14;10, and their average performance in a relative clause comprehension task was 66.8% correct (SD = 24.0) on (right branching) object relatives, and 93% (SD = 24.2) correct on the subject relatives.

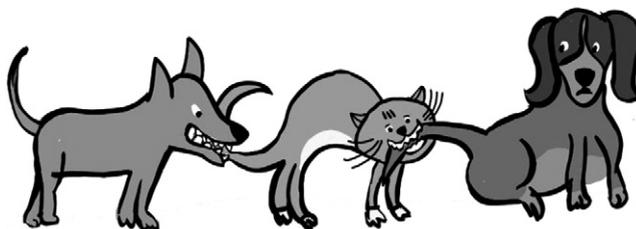


Fig. 3. A figure selection task in a 3-figure picture used in Task 3.

## 2.2. Results

### 2.2.1. Task 1

The main result of task 1 was that the children with SySLI had considerable difficulty understanding *which* object questions. The results, summarized in Fig. 4, show that they performed well, and similarly to the control group, on both *who* and *which* subject questions ( $M = 95$ ,  $SD = 4$ , and  $M = 98$ ,  $SD = 3$  percent correct, respectively) as well as on *who* object questions ( $M = 93$ ,  $SD = 9$ ). However their performance on *which* object questions was poor ( $M = 62$ ,  $SD = 12$ ) and significantly worse than that of the control group,  $t(37) = 8.72$ ,  $p < .0001$ . No differences were found between the groups in the comprehension of *who* and *which* subject questions,  $t(24) = 0.37$ ,  $p = .24$ , and  $t(37) = 0.92$ ,  $p = .18$ , respectively. The comprehension of *who* object questions did not differ significantly from that of the control group, although it approached significance in a one-tailed comparison,  $t(37) = 1.45$ ,  $p = .08$ .

The performance of the SySLI group on *which* object questions was significantly poorer than their performance on *which* subject questions,  $t(13) = 10.70$ ,  $p < .0001$ , *who* subject questions,  $t(12) = 9.21$ ,  $p < .0001$ , and *who* object questions,  $t(12) = 7.15$ ,  $p < .0001$ . The other comparisons, between the two types of subject questions and between the two types of *who* questions, did not yield significant differences (the comparison between *who* and *which*

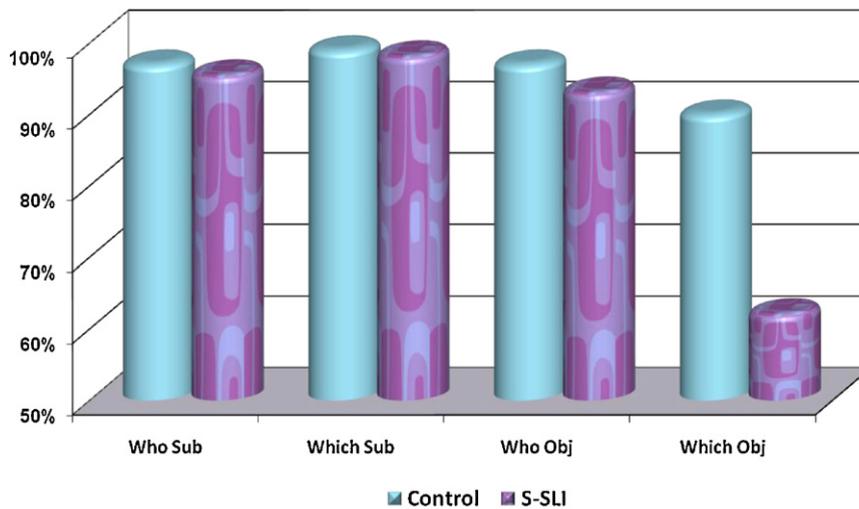


Fig. 4. The performance of the SySLI and the control group on the four question types.

subject questions yielded  $t(12) = 1.48, p = .17$ ; the comparison of *who* subject and object questions yielded  $t(12) = 0.83, p = .42$ .<sup>4</sup>

The comparison of the performance of each of the participants to chance level (using the binomial test,  $p < .05$ ) indicates that whereas all the children with SySLI performed significantly above chance level on the *who* and *which* subject questions, and only one participant was at chance level on the *who* object questions, 12 of the 14 participants performed at chance level on the *which* object questions, indicating a guessing pattern. All the participants in the control group performed above chance level on all question types.

In the comparison of the performance of each individual SySLI participant in each question type to the control group using Crawford and Garthwaite's (2002)  $t$ -test, all 14 SySLI participants performed significantly poorer than controls on the *which* object questions ( $p < .09$ ), two performed below the controls also on *who* object questions, and one performed below the controls on each type of subject questions (see Appendix A for individual performance of the participants with SLI on each of the question types).

### 2.2.2. Task 2 results

The results of task 2, which tested only *who* questions, were very similar to the results of the *who* questions in task 1. The comprehension of both types of *who* questions was good, with an average of 98% (SD = 5%) correct answers on both subject and object questions. The subject and object (*who*) questions did not yield differential performance,  $t(7) = 0, p = 1$ . The performance of the eight participants who participated in both tasks 1 and 2 did not differ between the tasks on the subject *who* questions,  $t(7) = 0.51, p = .62$ , nor on the object *who* questions,  $t(7) = 1.68, p = .14$ .

### 2.2.3. Task 3 results

The results of the three-figure *which* questions task, ran with a different group of 14 SySLI children, yielded very similar results to the two-figure pairs task (task 1). The participants demonstrated poor comprehension of object *which* questions ( $M = 68.8, SD = 16.5$ ), which was significantly poorer than that of the control group,  $t(24) = 6.32, p < .0001$  (control results of 12 children aged 7;5-9;0 years taken from Friedmann and Szterman, in press). Their comprehension of *which* subject questions was significantly better than of which object questions, with an average correct performance of 94.9% (SD = 7.9),  $t(13) = 4.78, p = .0002$ .

Thus, it seems that it does not matter whether the picture in the question comprehension task includes two pairs of figures or three figures in a row – the results using these tasks were the same: the children with SySLI had difficulty in object *which*-questions, and better performance in subject questions.

<sup>4</sup> For all the paired comparisons we used  $t$ -tests for correlated samples as well as its non-parametric alternative, the Wilcoxon signed ranks test. In the text we present the  $t$ -test results, but all the analyses yielded similar results—everything that was significant in the paired  $t$ -tests was also significant in the Wilcoxon tests, and all comparisons that did not show significant differences in the  $t$ -tests were also not significantly different in the Wilcoxon tests, except for the comparison of *who* object questions between the two tasks, which according to the Wilcoxon test was marginally significantly better in the second task ( $p = .06$ ), but did not approach significance in the  $t$ -test ( $p = .13$ ). Similarly, for all the comparisons between groups (SySLI and control, SySLI and LeSLI), we did the analysis also with the non-parametric Mann–Whitney test. Again, all the significant differences with independent  $t$ -tests were significant with the Mann–Whitney tests, and all the non-significant ones remained non-significant with the Mann–Whitney tests.

### 3. Part 2: subtypes of SLI and Wh question comprehension

An additional goal of this study was to test the modularity within the language system, as viewed from selective developmental language impairments. In the previous section we focused on the syntactic deficit in children with SySLI. In this section we identify two additional subtypes of SLI: LeSLI (Lexical SLI) and PraSLI (Pragmatic SLI), evaluate their lexical, phonological, and pragmatic abilities, and test their comprehension of Wh questions.

The SLI literature describes SLI as a heterogeneous deficit, which causes difficulties in various aspects of language: word retrieval, phonology, morphology, syntax, semantics, and pragmatics (e.g., Bishop, 1997, 2006; Bishop and Rosenbloom, 1987; Clahsen, 1989; Leonard, 1998; Rice and Wexler, 1995; van der Lely, 1996, 1997, 1998; van der Lely and Battell, 2003; van der Lely and Christian, 2000). Within this heterogeneous group, several sub-groups can be identified. Rapin and Allen (1983) suggested categories of SLI, including a phonological-syntactic deficit and a semantic-pragmatic deficit. More recent large-scale studies on SLI have confirmed that different subgroups of SLI exist, each with different characteristics of the deficit (Bishop, 2006; Conti-Ramsden and Botting, 1999, 2006; Conti-Ramsden et al., 1997, 2001; Korkman and Häkkinen-Rihu, 1994; van Daal et al., 2004). Some of these studies have suggested classifications similar to the original Rapin and Allen categories, whereas others have suggested other categories.

In the current study we wish to further explore the subtypes of SLI and to suggest sub-classifications in terms of linguistic modules. Because syntax, phonology, pragmatics, semantics, and the lexicon are distinct modules in the language system, we would like to examine the postulation that each of these modules can be selectively impaired, creating a different type of SLI—Syntactic SLI (SySLI), Phonological SLI (PhoSLI), Pragmatic SLI (PraSLI), Semantic SLI (which will not be discussed in this study, but see Schulz and Roeper, 2011),<sup>5</sup> and Lexical SLI (LeSLI).

Thus, we suggest that the subtypes described by Rapin and Allen (1983) can be subdivided further—the phonological-syntactic subtype can be subdivided into phonological SLI and syntactic SLI, and the semantic-pragmatic SLI subtype can be subdivided into a semantic deficit and a pragmatic deficit, and another SLI type should be added with impairment in lexical retrieval. In the first part of this study (see Participant description section 2.1.1) we already saw that ten of the 14 children with SySLI, who had severe deficits in syntax, showed normal phonological abilities. Bishop (2006) described a group of children who showed the other direction of the dissociation. Their phonology was impaired, whereas their syntax was unimpaired. These findings support further sub-categorization of the syntactic-phonological group into two categories: phonological and syntactic, although they can sometimes coincide (such co-morbidity is reported for example in van der Lely, 2005).

One of the clusters that emerged from Conti-Ramsden and Botting's (1999) study was "lexical-syntactic deficit syndrome". In this case, too, we suggest that the two deficits can appear independently, and therefore should be regarded as two different types of selective SLI—syntactic SLI and lexical SLI (sometimes referred to as *dysnomia* or *anomia*). There are already some indications for a double dissociation between lexical retrieval and syntactic deficits. Dockrell et al. (2005) described a group of children with SLI with a lexical deficit (difficulties with word finding) whose syntactic abilities were preserved. Korkman and Häkkinen-Rihu (1994) described a specific *dysnomia* sub-type in their classification of SLI. The other direction of the dissociation between syntax and lexical retrieval has also been reported. van der Lely (2005) described a group of children who had a selective impairment in grammar, whose vocabulary<sup>6</sup> was impaired but to a lesser extent than their grammar (syntactic and phonological abilities). Friedmann and Novogrodsky (2004, 2006, 2007) reported a group of school-age children with SLI who had a syntactic deficit, but without lexical retrieval deficits and without phonological deficits. The first section of the current paper showed a similar group—ten of the 14 participants in Part 1 of this study (section 2.1.1) had a selective syntactic impairment, with normal lexical retrieval and phonological abilities.

Another subtype that we test in this study is pragmatic SLI (PLI, or actually PraSLI, to avoid confusion with PhoSLI, phonological SLI). Whereas some researches lump this disorder together with semantic deficits under the label of "semantic-pragmatic disorder", we prefer the term PraSLI because we believe that semantic difficulties are not the core of this language impairment (Bishop, 1998; Conti-Ramsden and Botting, 2006). Children with pragmatic difficulties are reported to have communication difficulties in social interaction. They tend to be verbose, respond to questions in a literal way, and have problems in understanding connected discourse (Bishop, 1998). These children can have pragmatic disorder without impairment in other language abilities. This was demonstrated for example in a longitudinal study by Conti-Ramsden et al. (2001), who used a language assessment battery that tested various language domains. In their study, seven of 200 children with SLI were diagnosed with pragmatic difficulties, and had no autistic deficit or impairments in the other language domains. In recent years, there has been debate regarding whether this deficit is indeed a subtype of SLI as described by Rapin and Allen (1983) and Bishop and Rosenbloom (1987), or whether it is actually a descriptive term for the communication difficulty found in verbal high-functioning children with autism. In the current study we did not try to decide between these approaches.

In what follows, we describe the way we identified two subgroups with a selective deficit in lexical retrieval or pragmatics and then describe the way these children understand Wh questions, using the same test we used with the children with SySLI in Part 1 of this study.

<sup>5</sup> It still remains to be seen what the characteristics of a semantic deficit are, and whether the deficit is at the level of lexical semantics or rather in compositional semantics. Most probably, there would be two different types of semantic SLI, at the lexical level and at the compositional level, which can occur independently.

<sup>6</sup> In our current discussion of lexical SLI we do not refer to impoverished vocabulary, but rather to lexical retrieval deficits, which can result from a deficit in one of the stages of lexical retrieval: semantic lexicon, phonological lexicon, phonemic output buffer, or the connections between them (see Biran and Friedmann, 2005; Nickels, 1997).

### 3.1. Method

#### 3.1.1. Participants

*LeSLI participants.* The participants in the LeSLI group were 7 Hebrew-speaking children aged 9;2 to 12;3 years (mean = 10;8, SD = 1;2, two 9-year-olds, one 10-year-old, two 11-year-olds, and two 12-year-olds), of which 5 were boys and 2 were girls. All of them were attending regular classes in regular schools, in 4th to 6th grade. They all met the exclusionary criteria for SLI (described in detail in section 2.1.1). Their nonverbal intellectual functioning was at the age-appropriate level. Five of them were tested on Raven's Matrices test (Raven, 1965), and their scores were within 1 SD of the average for their age range; three were tested on the Wechsler Intelligence Scale for Children with scores between 102 and 122 (one participant was assessed with both tests). Five of the participants were tested in the forward and backward digit span tasks from the WISC and had an age-appropriate performance.

With respect to the inclusion criterion, all the participants in the SLI group were diagnosed with SLI prior to the study through clinical tests, by speech-language pathologists and educational specialists, based on reading comprehension assessments and non-standardized tests used in the clinics. The participants were included in the LeSLI group if their performance in at least two of the five lexical tests was significantly below the norm. The tests included the SHEMAH naming test (Biran and Friedmann, 2005), which includes 100 colored pictures for naming; the MAASE test (Rom and Morag, 1999), a norm-referenced test of vocabulary and lexical processing; a task of retrieving words for 20 definitions (Cohen-Mashiach, 1990); and two verbal fluency tasks—a semantic fluency task in which the participants were asked to name as many animals as they could in one minute, and a phonological fluency task in which the participants were asked to name words that start with a given letter for 3 different letters, with a 30 s time limit for each letter.

In addition, we administered four tests that assess various aspects of phonological ability. Children who failed on at least two of the four tests were classified as having a phonological deficit. The phonological tests included a test of repetition of phonologically complex nonwords and words (BLIP REP, Friedmann, 2003), which included 26 nonwords and 29 words, with various types of phonological complexity (initial and medial clusters, no onset, feature similarity, etc.); a judgment test of nonwords (BLIP SHIPUX, Friedmann, 2003) in which 38 pairs of nonwords were given, one of which was phonologically plausible, and the other violated phonological constraints such as sonority (slanim-lsanim; droz-rdoz) as well as Hebrew-specific phonological rules. The participants were asked to choose which of the nonwords “sounds more like a word in Hebrew”; The LAC test (Lindamood and Lindamood, 1979), which assesses phonemic awareness on tasks of analysis and synthesis using a visual representation of phonological sequences with colored blocks; and the working memory subtest from the Wechsler Intelligence Scale for Children (WISC-R95) that requires forward and backward recall of digit sequences.

The results of these tests indicated that all seven participants had a significant difficulty in the SHEMAH naming task, and on at least one additional lexical task. Their average performance on the SHEMAH test was 85% correct (SD = 3%), and each of their scores was significantly poorer than the average of 57 typically developing children in 3rd–6th grade ( $M = 95%$ ,  $SD = 2.9%$ ). Their naming difficulty was manifested not only in naming errors and in a failure to retrieve words, but also in response times longer than 5 seconds, hesitations, circumlocutions, descriptions instead of naming, and use of gestures. The lexical difficulty was also evident in our conversations with the participants during the assessment. The testing of their phonological ability indicated that one of the participants, DR, failed on three of the phonological tests, suggesting that he had a phonological deficit in addition to his lexical deficit.

*PraSLI participants.* The participants with Pragmatic SLI were 6 children aged 8;3–14;3 years old, 2 girls and 4 boys. Their intellectual functioning was at the age-appropriate level, as indicated by their performance in the Wechsler Intelligence Scale for Children (mean = 105). Prior to the assessment their teachers reported that they had difficulties in conversations with other children and with adults. Our initial meeting and conversation with them indicated that they often violated discourse maxims (Grice, 1975) of quantity, relation, and manner—they often gave very long answers that were irrelevant to the task or question. For example, in the SHEMAH naming test they frequently discussed various aspects of the picture instead of simply naming it as requested. In story telling and picture description tasks, they produced incoherent texts. In spontaneous speech they used pronouns without prior establishment of their reference in discourse, they incorrectly used definite determiners where they were not licensed by the discourse, and in elicited tests and in sentence judgment tasks they preferred full NPs over pronouns in contexts in which typically developing children and adults use pronouns.

The pragmatic components of the CCC questionnaire (Children's Communication Checklist, Bishop, 1998), filled in by two teachers for each child, yielded poor scores that indicate a pragmatic deficit, between 108 and 132, with an average of 119 (norm reference score is 153.68,  $SD = 6.49$ ).

The aTOMic battery, a comprehensive test of Theory of Mind, which included 4 items of first order ToM, 4 items of 2nd order ToM, 6 items that related to knowledge gaps, and 4 items testing *faux pas* (violation of accepted social rules) and empathy comprehension (Balaban et al., 2008), indicated a severe deficit of ToM for each of the six participants, especially in 2nd order ToM and knowledge gap items, in which they scored 40% and 67%, respectively. All these tests clearly indicated a discourse-pragmatic deficit for each of the six participants, with an effect on the language abilities that hinge on pragmatic ability. The lexical retrieval of 5 of them was intact, with 92–96% correct naming in the SHEMAH test (Biran and Friedmann, 2005), although they did produce unusual responses that were typically much more detailed than required. One participant scored 88% correct in naming, which is below the normal range. The phonological abilities of all six participants, measured by nonword repetition (BLIP REP, Friedmann, 2003), were intact.

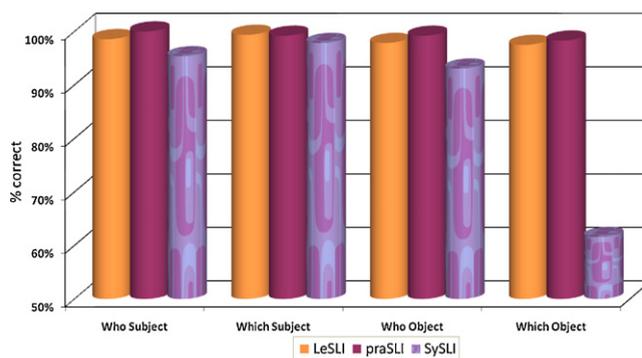


Fig. 5. Wh question comprehension in the three subtypes of SLI: LeSLI, PraSLI, and SySLI.

### 3.1.2. Material and procedure

The materials and procedure for the assessment of Wh question comprehension were identical to task 1 that was administered to the SySLI participants.

### 3.2. Results

The results indicated that, in marked contrast with the performance of the children with SySLI in the comprehension of Wh questions, the children with LeSLI and PraSLI had no difficulties in any type of Wh question, as can be seen in Fig. 5.

The children with LeSLI performed significantly better than the children with SySLI on the *which* object questions,  $t(19) = 7.58, p < .0001$ . No significant differences were detected between the SySLI and the LeSLI groups in the other questions types, *who* subject, *which* subject, and *who* object questions,  $t(18) = 1.79, p = .09$ ,  $t(19) = 1.07, p = .30$ , and  $t(18) = 1.39, p = .18$ , respectively, all of which the children with LeSLI understood relatively well. Each of the individuals with LeSLI performed significantly above chance level on all question types, and none of them performed poorer than the control group on any question type (Crawford and Garthwaite, 2002, *t*-test,  $p > .22$ ), see the Appendix for individual performance.

Similarly, the participants with PraSLI performed normally on the four question types, and significantly better than the participants with SySLI on the *which* object questions,  $t(18) = 7.16, p < .0001$ . Their performance did not differ from that of the children with SySLI on *which* subject and *who* object questions,  $t(18) = 0.91, p = .37$ ,  $t(17) = 1.65, p = .12$ , respectively (the performance on *who* subject questions could not be compared using a *t*-test because all PraSLI participants performed flawlessly, and hence, the SD was 0. A Mann–Whitney comparison revealed better performance in the PraSLI group than in the SySLI group on *who* subject, *who* object, and *which* object questions,  $p < .001$ ).

## 4. Discussion

The two main results of the current study are that school-aged children with SySLI experience great difficulty in the comprehension of *which* object questions, and that other subtypes of SLI can be identified whose main deficit relates to lexical retrieval or to pragmatic abilities, with unimpaired comprehension of Wh questions. We will first discuss the comprehension of Wh questions in SySLI, and then move on to the issue of subtypes in SLI.

### 4.1. Wh question comprehension in syntactic SLI

The difficulty in the comprehension of Wh questions in SySLI was clearly manifested in that all the 28 participants with SySLI (14 participants in tasks 1,2 and the 14 additional children with SySLI tested in task 3) performed significantly worse than the control group on *which* object questions. It was also reflected in the chance-level performance of the participants when asked to point to a picture matching a *which* object question. This means that they could not determine the thematic roles of the arguments in the question that included a moved object, and, in the absence of lexical-semantic clues and of canonical order, were forced to guess.

These results are consistent with the two other studies of Wh question comprehension in SLI in English (Deevy and Leonard, 2004; Ebbels and van der Lely, 2001). Similarly to Deevy and Leonard (2004), the comprehension of simple short *who* subject and *who* object questions was not compromised, and similarly to Ebbels and van der Lely's (2001) pre-treatment results, *which* object questions were impaired, whereas *who* questions and subject questions were unimpaired. Thus, two dissociations were revealed in the participants' comprehension: between subject and object questions, and between *who* and *which* questions.

How can these differences be explained? Firstly, an asymmetry between subject and object questions was evinced (within the *which* questions): the comprehension of object questions was poor, whereas subject questions were understood well. Similar subject–object asymmetry in question comprehension was reported in studies of typical language acquisition (Avrutin, 2000; Friedmann, 2006; Friedmann et al., 2009), agrammatic aphasia (Friedmann, 2002; Hickok and Avrutin, 1996; Thompson et al., 1999; van der Meulen, 2004), and children with hearing impairment (Friedmann et al., 2010; Friedmann and Szterman, in press). If we maintain the assumption that the deficit in SySLI relates to the transfer of thematic roles to moved elements (Friedmann and Novogrodsky, 2004, 2007), the better comprehension of subject questions can be accounted for by restricting the deficit further. We suggest that the deficit in SySLI is not a general deficit in the assignment of thematic roles to a moved element, but rather a deficit in the assignment of thematic roles to a moved element, when this movement crosses over another argument.<sup>7</sup> This explains why subject questions do not pose a problem for comprehension, but (some) object questions do. As seen in examples (9) and (10), the assignment of thematic roles to the moved argument crosses over another argument in object questions, but not in subject questions. In the object question in (10), the *grandmother* interferes in the assignment of the thematic role to the moved argument *which girl*.

(9) Subject question: [Which girl]<sub>1</sub> t<sub>1</sub> drew the grandmother ?

(10) Object question: [Which girl]<sub>1</sub> (did) the grandmother draw t<sub>1</sub> ?

What about the dissociation found between the poor comprehension of *which* (object) questions and the good comprehension of *who* questions? In order to explain this difference, the account must be further modified. In its current form, this account predicts that *who* object questions would also be poorly understood, contrary to fact. A modification that can capture the picture is that not every crossing of another argument hampers comprehension. Comprehension fails only when the arguments are similar, namely, when they are of the same type. However, when the two arguments differ, for example, when one is referential and the other is non-referential, one does not block the other.<sup>8</sup> Under this formulation, in *who* object questions (such as *Who did grandma draw?*) the moved phrase, *who*, is non-referential, whereas the intervening NP (*grandma*) is referential. Thus, the intervener is not of the same type as the moved *who* phrase, and therefore does not block the assignment of a thematic role to the *who* phrase.<sup>9</sup> In *which* questions, on the other hand, the moved phrase is referential (*which girl*, for example), so that when the intervening element is also referential (*grandma*), it is of the same type as the *which* phrase, and therefore blocks the assignment of the thematic role to the moved *which* phrase. This is why *who* questions do not pose problems to children with SySLI, but *which* questions (with a referential NP subject) do.

Such an account has been suggested by Friedmann and Shapiro (2003:295) and Friedmann (2008) for agrammatic aphasia, and has been given a more specific formulation in terms of recent developments of the Relativized Minimality (Rizzi, 1990, 2004) by Friedmann et al. (2009) for typical language acquisition, and by Grillo (2005, 2008) for aphasia. (See Warren and Gibson, 2002, 2005 for a similar account for normal adult processing.)

Zooming out, this generalization can account not only for the current data regarding Wh questions, but also for a list of structures that are impaired in SySLI, as well as for structures that show better comprehension. The shared property of referential object questions, headed object relatives, topicalization structures, and object clefts is that the assignment of thematic roles to the theme, or the establishment of a dependency that involves the theme, involves movement of an argument across another argument of the same type, in these structures—the object that crosses a similar subject. As a result, children with SySLI fail to understand them. The picture is different in other structures: SVO sentences do not include Wh movement at all, subject relatives and subject questions include movement but do not require crossing over another argument, and *who* object questions include movement and require crossing over another argument, but the argument is of a different type, and thus the transfer of thematic roles in these structures is successful.<sup>10</sup>

<sup>7</sup> The subject–object asymmetry might also be explained using the account suggested for this asymmetry in comprehension in agrammatic aphasia (Grodzinsky, 1990, 2000). According to this account, a strategy assigns the thematic role of agent to the first argument in the sentence when the syntactic mechanism that assigns thematic roles fails. It is unclear, however, what such a “first NP” strategy would do for example in cases of relative clauses in which the moved element (the relative head) is not the first NP in the sentence (sentences like “The girl saw that the woman that the grandmother drew smiled”).

<sup>8</sup> The notion “of the same type” needs to be made more specific by future studies that will manipulate various types of similarity.

<sup>9</sup> Various theories (Cinque, 1990; Pesetsky, 1987; Rizzi, 1990) suggest different analyses for *who* and *which* questions, which can underlie their different behavior in language acquisition and breakdown. According to Cinque and Pesetsky, *which* and *who* phrases differ with respect to their *referentiality* (in Cinque’s terms) or *D-linking* (discourse linking, in Pesetsky’s terms). Whereas *which* phrases are D-linked and hence refer to members of a set that the speaker and the hearer have in mind, *who* phrases are non-D-linked, and as such, do not refer to pre-established referential sets in the discourse. According to Cinque (1990), this distinction creates a difference in the chain type of these questions. *Which* questions form binding chains, whereas *who* questions are part of government chains, because a phrase can enter a binding relation only if it is intrinsically referential and can receive a referential thematic role. On this basis, Avrutin (2000) suggested that the delay in the acquisition of *which* questions is due to the additional discourse-related operations that are required in these questions. Notice, however, that in the tasks used in the current study, all questions were D-linked, even the *who* questions. This is because the pictures served as the discourse context from which a selection was to be made, even in *who* questions.

<sup>10</sup> It remains to be seen whether this account could or should be extended to other types of movement (for example, A-movement in passive sentences). Our testing of the pronoun binding of these children with SySLI suggests that not all types of dependency are impaired—as their performance in pronoun binding comprehension was normal (Novogrodsky and Friedmann, 2010).

This difficulty of children with SLI with assigning a thematic role to an argument that crossed over another argument of a similar type can also be seen in their productions. Firstly, when they try to produce a Wh question, Hamann (2005) and Jakubowicz and Gutierrez (2007, see Jakubowicz', 2011) have found that children with SLI produce Wh questions in situ. In situ questions allow the assignment of the thematic role without movement, and are thus easier than fronted Wh questions for children with SLI. Similarly, this account can explain their pattern of production in relative clause elicitation. Novogrodsky and Friedmann (2006) elicited the production of subject and object relative clauses in 18 Hebrew-speaking children with SySLI aged 9;3–14;6 (11 of them also participated in the current study). These children showed considerable difficulty in relative clause production, especially of object relatives. Particularly interesting to our current discussion is the fact that their difficulty in assigning thematic roles to moved arguments manifested itself in a tendency to produce, instead of object relatives with two arguments, responses that included only one overt referential argument, or a response that included movement from subject position instead of object position, or a combination of both. These responses point in the same direction as the approach we suggested: if the deficit is indeed related to a difficulty in assigning a thematic role across another argument of the same type, a way to reduce the difficulty would be to either produce a structure in which no crossing over an argument is required, i.e., subject relatives instead of object relatives, or to produce an object relative that requires the crossing over an argument of a different type, such as an empty subject (phonologically null arbitrary pro), or a non-referential relative head (free relative).

#### 4.2. Subtypes of SLI

The other main issue explored in this study was whether it is possible to identify subgroups within SLI with a selective deficit in various modules of the language system: syntax, lexicon, phonology, and pragmatics. The first part of the study presented a group of children who have a syntactic deficit: ten of them did not show impairments in lexical retrieval or in phonology, two had a deficit in phonology in addition to their syntactic impairment, and two had a deficit in syntax, phonology, and lexical retrieval. The syntactic deficit of all these children manifested itself in a severe deficit in the comprehension of non-canonical sentences derived by movement.

Importantly, we were also able to identify two additional selective subgroups of SLI, without a syntactic deficit. One was a subgroup with a selective deficit in lexical retrieval, LeSLI. Seven children were identified with lexical retrieval deficit, but with unimpaired syntax. Six of them had a selective lexical deficit, and one also had a phonological deficit. All these children performed at a normal level on tests of Wh question comprehension. Finally, we reported on six children with pragmatic disorder (PraSLI). Although their discourse abilities and Theory of Mind performance were impaired in a way that also affected their use of pronouns, for example, their purely syntactic abilities were unimpaired, as demonstrated in their normal comprehension of Wh questions. Interestingly, their good comprehension of *which* questions might be taken as an argument against the analysis of the difficulty of children with SLI as resulting from a discourse deficit (as has been suggested for typically-developing children by Avrutin, 2000). The participants with PraSLI had significant discourse impairment, but were unimpaired in the comprehension of *which* questions.

These findings support the notion of subtypes in SLI (Conti-Ramsden and Botting, 1999, 2006; Conti-Ramsden et al., 1997, 2001; Korkman and Häkkinen-Rihu, 1994; Rapin and Allen, 1983; van Daal et al., 2004). The dissociations between lexical and syntactic abilities are in line with studies by van der Lely (2005) and Dockrell et al. (2005). The results of the participants with PraSLI are in line with studies that have reported dissociation between pragmatic impairment and intact abilities in other language domains (Bishop, 1998; Conti-Ramsden et al., 1997, 2001). This pragmatic–syntactic dissociation is further complemented by findings with regard to the other side of the dissociation: Schaeffer et al. (2003) reported a group of children with SLI who had grammatical impairments but still showed intact pragmatic ability.

These results suggest that it is important to assess various linguistic modules to identify the exact locus of deficit in children with SLI in order to apply specific intervention programs for children with specific language needs. The results also provide corroboration for the modularity of language from a developmental aspect.

To conclude, this study showed that children with SySLI have considerable difficulty in the comprehension of *which* object questions. These results converge with data from previous studies to suggest that children with SySLI have a deficit in sentences derived by Wh-movement when thematic roles need to be assigned to an argument that moved across an argument of a similar type. The results also emphasize the importance of classification of SLI into subgroups in which different linguistic modules are impaired – whereas the children with SySLI had considerable difficulty in Wh question comprehension, children with selective lexical or pragmatic impairment (LeSLI or PraSLI) understood Wh questions at a normal level.

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**Appendix A. Percentage of correct responses for each of the SLI participants, and the average control performance**

		Task 1				Task 2	
		Who Sub.	Which Sub.	Who Obj.	Which Obj.	Who Sub.	Who Obj.
SySLI	MT	95	100	70	75	100	100
	SN	95	100	100	75	100	100
	RZ	100	95	95	60	90	100
	DO	95	100	95	35	100	100
	GH	95	90	80	55	100	90
	OS	95	95	95	70	100	100
	TL	100	100	95	47	90	90
	HD	95	95	100	65	100	100
	DK	100	100	95	65		
	NY	90	100	100	45		
	YT	100	100	90	60		
	RI	85	100	95	70		
	GG	95	95	100	70		
	ID		100		70		
LeSLI	GL	100	100	95	95		
	AM	100	95	95	95		
	ZV	95	100	100	95		
	DR	95	100	100	100		
	OM	100	100	100	100		
	MK	100	100	100	100		
	YF	100	100	95	95		
PraSLI	IR	100	100	95	100		
	SH	100	100	100	100		
	EY	100	100	100	100		
	LN	100	95	100	100		
	ED	100	100	100	100		
	BR	100	100	100	90		
Control	M (SD)	97 (3.8)	99 (3.0)	97 (3.8)	90 (8.1)		

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