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The production of relative clauses in syntactic SLI:
A window to the nature of the impairment

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Abstract
The study explored the ability of children with syntactic SLI (S-SLI) to produce relative clauses, using two structured elicitation tasks. A preference task and a picture description task were used to elicit subject and object relative clauses. The participants were 18 Hebrew-speaking children with S-SLI aged 9;3 – 14;6, and the control group included 28 typically developing children aged 7;6 – 11;0. The rate of target responses as well as the types of other responses the S-SLI group produced were analysed and compared to the control group. The results of both tasks indicated that the children with S-SLI had a deficit in the production of object relatives. Their production of subject relatives was better, though below the performance of the control group. Several response types were used exclusively by the S-SLI group: avoidance of object relatives and production of subject relatives and simple sentences instead, thematic role errors and thematic role reduction. Importantly, the S-SLI children did not omit complementizers, nor did they make other structural errors. These results suggest that the deficit is related to thematic role assignment to moved constituents, and not to a structural deficit in embedding.

Keywords: *Relative clauses, Hebrew, specific language impairment, production, syntax.*

Introduction

Relative clauses like "The woman waited for the rain that the meteorologist promised" are complex sentences that include embedding (using *that*, *who*, *which*), and movement of a noun phrase from within the embedded clause (in this case, *the rain*). Children with Specific Language Impairment (SLI) have difficulties in the comprehension and production of relative clauses, and the current study asks whether this difficulty relates to structure, and specifically to embedding, or to syntactic movement.

Relative clauses are classified according to the position from which the constituent has moved. Subject relatives are derived by movement from the embedded subject position, as in example (1); object relatives involve movement from the embedded object position, as in (2). In both cases, the moved element leaves behind in its original position a trace (marked by t_1). 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 draws the grandmother", the verb *draws* assigns *the girl* the thematic role of the agent, and *the grandmother*

the role of the theme of the action. The verb typically assigns the agent role to a noun phrase that precedes it, and the theme role to an argument that follows it. However, in relative clauses like (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 constituent via a chain that connects the trace and the moved element in its new position. Some languages (like Hebrew, for example) also allow object relatives without a trace, with a pronoun in the trace position, termed "resumptive pronoun", as shown in example (3).

(1) Subject relative clause:
    The girl$_1$ [that t_1 draws the grandmother]
(2) Object relative clause:
    The girl$_1$ [that the grandmother draws t_1]
(3) Object relative with a resumptive pronoun:
    The girl$_1$ [that the grandmother draws *her*$_1$]

In terms of the syntactic tree, the noun phrase that moves in relative clauses moves to the highest node of the syntactic tree, the CP node (see Figure 1).[1]
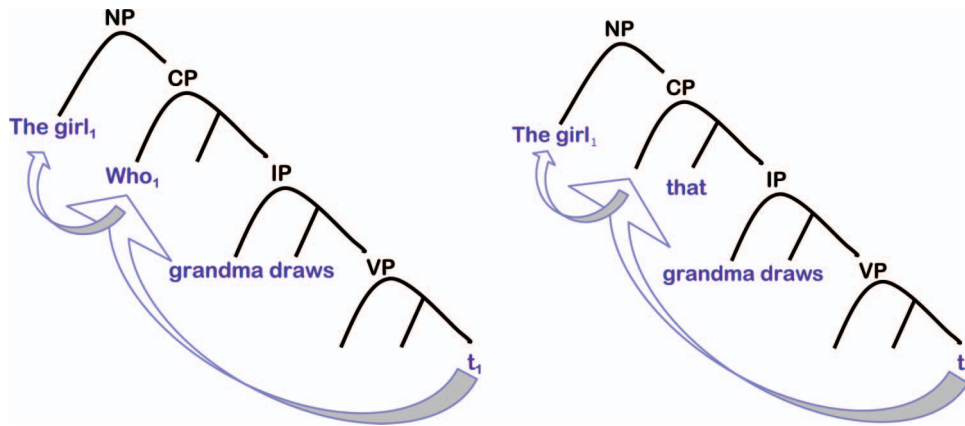
Figure 1. Schematic syntactic trees of object relative clauses with "who" and "that".

This movement is called "wh-movement" (and also A-bar movement) and it occurs also in wh questions and in topicalization structures. The CP node also hosts the complementizer *that*. Importantly, because CP hosts the embedding morpheme *that*, it is required not only in relative clauses, but also in other structures that include embedding, such as sentential complements of verbs (for example in the sentence "The woman said *that* she waited for the rain").

Thus, the construction of relative clauses requires two syntactic abilities: one is wh-movement and thematic role assignment via a chain of movement, the other is the construction of the syntactic tree to its highest node, the CP node. The findings from typical development show that relative clauses are already produced around the age of 3 years (Crain, McKee, & Emiliani, 1990; McKee, McDaniel, & Snedeker, 1998; Pérez-Leroux, 1995; see Berman, 1986, 1997; Friedmann & Lavi, 2006; Günzberg-Kerbel, Shvimer, & Friedmann, in press; Varlokosta & Armon-Lotem, 1998, for the acquisition of relative clauses in Hebrew, the language tested in the current study). Wh-movement and syntactic structure building show different time courses of development, with embedding and structure acquired earlier than wh-movement, but both are already mastered at around the age of 6.

Children with SLI show difficulties in the comprehension of relative clauses at a much older age (Friedmann & Novogrodsky, 2004; Friedmann & Novogrodsky, in press; Stavrakaki, 2001). Is the deficit in relative clauses in SLI related to movement and thematic roles or to the ability to construct the syntactic tree? In the current study we used the production of relative clauses to learn about the syntactic impairment of children with SLI. A deficit in movement and thematic roles is expected to reflect in thematic role errors in structures with movement, whereas a deficit in structure building and in embedding should reflect in problems with the embedding marker, both in relative clauses and in other embedded sentences.

Studies that examined the production of relative clauses in *preschool* children with SLI found sig-

nificant impairment in elicitation tasks and in spontaneous speech. These difficulties reflected in omissions of the complementizer and in a 2-year delay in the onset of relative clause production (Håkansson & Hansson, 2000; Leonard, 1995; Schuele & Dykes, 2005; Schuele & Nicholls, 2000; Schuele & Tolbert, 2001). Importantly, most of the SLI children in these studies were at a preschool age. At this age, the difficulty in relative clause production seems to relate to the ability to construct the structure.

Is this a stable phase? Do older children with SLI continue to omit complementizers? Two children who were longitudinally tested, an Italian-speaking child, who was tested from the age 5 to 13 years by Cipriani, Bottari, Chilosi, and Pfanner (1998), and an English-speaking child, who was tested by van der Lely (1997) from age 10;3 to 14;5, did not produce relative clauses in spontaneous speech and narrative. These studies indicate continued avoidance of relative clauses even in school age. Marinellie (2004) analysed 100 conversation utterances of 15 SLI school-age children in 3rd to 5th grade. Although she found, like previous studies, that SLI children used fewer relative structures compared to the control group, in contrast to the two longitudinal studies, the SLI children in her study did produce relatives, and ungrammatical sentences occurred only rarely in their production. Still, spontaneous speech might not be the best method to assess the ability to produce relative clauses, because it allows for avoidance and does not permit the control of target sentences.

In the current study we used two structured elicitation tasks to further examine the production of relative clauses in school-age children with SLI. The aim of the study was to assess, in addition to whether the school-age children with SLI can produce relative clauses in structured tasks, whether their deficit relates to syntactic movement or to syntactic structure, by means of analysis of the responses they produced. A deficit in movement and thematic role assignment to moved elements is expected to manifest itself in errors of thematic roles,

whereas a deficit in the syntactic node CP would manifest itself in a deficit in embedding, and in the production of the embedding marker.

Method

Participants

The participants in the SLI group were 18 Hebrew-speaking children, aged 9;3 to 14;6 years (mean = 12;6, SD = 1;7: four 9-year-olds, four 10-year-olds, three 11-year-olds, three 12-year-olds, and three aged above age 13;8). All of them were attending regular classes in regular schools, in 4th to 8th grade. All the participants met all the exclusionary criteria for SLI (Leonard, 1998): They had no hearing impairment 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 within the age-appropriate level, as indicated by the *Wechsler Intelligence Scale for Children* (93–106 in the performance subtests, and one participant had 138 on the performance subtests) or by their score on the *Raven's Matrices* (within 1 SD from the average of their age range, except for one participant who was more than 1 SD above the average). Sixteen of the children also had an age-appropriate performance in the forward and backward digit span tasks from the WISC, and two performed below the average. With respect to the inclusion criterion, all the participants in the SLI group were diagnosed with SLI prior to the study through clinical tests, done by speech-language pathologists and educational specialists, based on reading comprehension assessment and non-standardized tests that are used in the clinics (there are no standard language assessment tests for high-school children with SLI in Hebrew yet—there is one test that assesses only lexical-semantic abilities and is standardized only up to 6th grade). We therefore thoroughly assessed their abilities using syntactic, lexical-semantic, and phonological tests, and compared their performance to control groups.

As described in detail in the next section, all of them had a syntactic deficit in comprehension, and were therefore diagnosed with syntactic SLI (S-SLI, i.e., SLI in which the syntactic component is impaired). Each of the participants performed poorer than 2 SD below the mean of typically developing 4th graders on at least one test of relative clause comprehension, and each of them performed significantly poorer than the typically developing 4th graders group using Crawford t-test (Crawford & Howell, 1998), p < .05. In addition to the syntactic tests they were also tested using lexical-semantic tests (MAASE, Rom & Morag, 1999, and the SHEMESH

naming test, Biran & Friedmann, 2005) and tests of phonological ability—phonologically complex non-word- and word-repetition test (BLIP, Friedmann, 2003). The testing of the additional abilities indicated that most of them had a selective S-SLI, without lexical or phonological deficits. One of them had, in addition to S-SLI also lexical retrieval difficulties, and two had a phonological impairment. Thirteen of them participated in the preference task, and 16 participated in the picture description task (11 participated in both tasks).

The participants in the control groups for the elicitation tasks were 28 typically-developing children. They were 7;5–11;0-years-old (mean = 9;0, SD = 1;1). In order to assess whether a developmental change could be detected in the production of relatives within the tested ages, the control group was further divided into three subgroups on age: eight 7-year-olds, thirteen 9-year-olds, and seven 10-year-olds.

Prior data on the participants' comprehension of syntactic structures

The comprehension of relative clauses of the children with S-SLI was assessed prior to the current study by three tasks: a binary sentence-picture matching task, a task of comprehension questions, and a reading and paraphrasing task. In the binary sentence-picture matching task each of them heard 40 subject- and object- right-branching relative sentences and was asked to choose the picture corresponding to the sentence between a matching picture and a picture with reversed roles (with pictures similar to Figure 2). Their performance in this task indicated a significant difficulty in the comprehension of right-branching object relatives, which was only 73% correct, whereas children with unimpaired language perform 85% correct on this task at age 6;0 and at ceiling at age 7;0 (see Friedmann & Novogrodsky, 2004). Their comprehension of right-branching subject relatives was significantly better, with 95% correct responses. The errors they made, derived from the nature of the task, were thematic role reversals, namely, pointing to the picture that included reversed roles. The results of the comprehension of 10 of them are reported in Friedmann and Novogrodsky (2004).

In the comprehension questions task, each participant heard 90 centre-embedded or right-branching subject and object relatives and answered comprehension questions about the thematic roles in the relative clauses. The children with S-SLI performed 73.7% correct, whereas the 50 control participants, who were in fourth grade, performed 91% correct.

The reading and paraphrasing task included centre-embedded object relative clauses, and the participants were required to read a sentence and paraphrase it. The performance of all of the participants indicated that they were able to construct the structure of the sentence, but they were
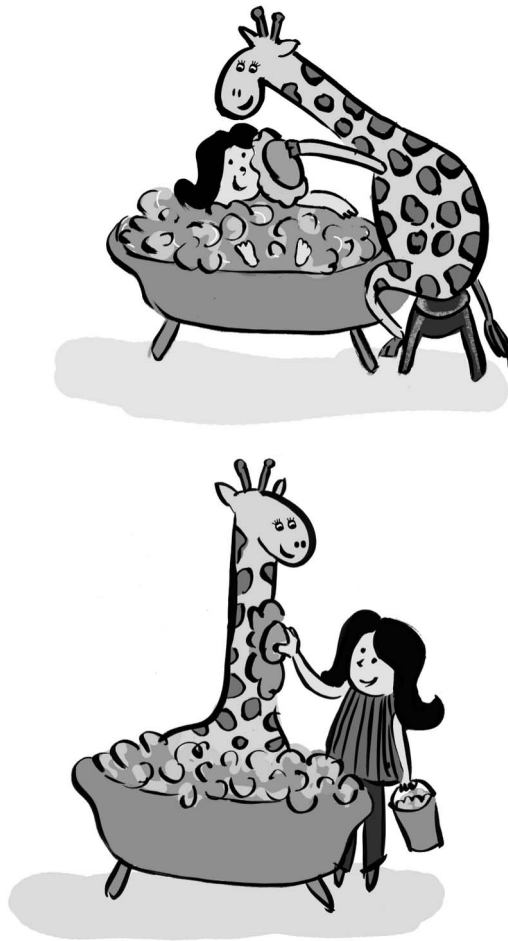
Figure 2. An example of a picture pair used in the picture elicitation task.

two children (two boys for a male participant, two girls for a female participant) performing two actions, see example (4); the questions that elicited object relatives described two children who are the themes of different actions performed by the same figure, or an action performed by different figures (5).

(4) Elicitation of a subject relative:
There are two children. One child gives a present, the other child receives a present. Which child would you rather be? Start with "I would rather be..." or "The child..."
Target answer:
(hayiti ma'adif lihiot) ha-yeled she-mekabel matana
(would-1sg prefer to-be) the-child that-receives present
"(I would rather be) the child who receives a present."

(5) Elicitation of an object relative:
There are two children. The father combs one child, the barber combs another child. Which child would you rather be? Start with "I would rather be..." or "The child that..."
Target answer:
(hayiti ma'adif lihiot) ha-yeled she-ha-aba mesarek
(would-1sg prefer to-be) the-child that-the-father combs
"(I would rather be) the child who the father combs."

unable to tell "who did what to whom", making, again, thematic role errors—the children with S-SLI made 34% thematic role errors, whereas the control participants had only 8% thematic errors (for detailed method, results and discussion see Friedmann, Gvion, & Novogrodsky, 2006; Friedmann & Novogrodsky, in press).

Materials and procedures

Right-branching relative clauses were elicited using two tasks: a preference task and a picture description task. All the target sentences were semantically reversible and included two noun phrases. As seen in examples (4),(5),(7), and (8), the word order in the target relative clauses in Hebrew is identical to the English one, and the syntactic analysis of Hebrew relative clauses is identical to English relative clauses (see Shlonsky, 1992, 1997, for an analysis of Hebrew relative clauses).[2]

In the preference task the experimenter presented two options and asked the participants to choose which one they preferred. The task was constructed in a way that the choice would have to be formed as a relative clause. Half of the items elicited subject relatives and half elicited object relatives. The questions that elicited subject relatives described

There were 12 questions per participant, six eliciting subject relatives and six eliciting object relatives. The order of the subject and object relative target sentences was randomized.

In the picture description task subject and object relative clauses were elicited as a description of a figure in a picture. Picture pairs were presented, each picture included two figures (see Figure 2). One picture described one figure performing an action on the other; the second picture included the same figures in reversed roles. The experimenter described the two pictures using simple sentences, and then asked about one of the figures and its role in each of the pictures, see example (6). The target responses were either subject relatives (7) or object relatives (8). There were 10 picture pairs that elicited 10 subject relatives and 10 object relatives. The order of the subject and object relatives was randomized between the pictures.

(6) Elicitation procedure: Here are two girls. In one picture the girl is washing the giraffe, in the other picture the giraffe is washing the girl. Which girl is this (pointing to the girl in one picture)? Start with "This is the girl...". And now, which girl is this? (pointing to the girl in the other picture).

(7) Target response – subject relative:
   zo ha-yalda she-roxecet et ha-jirafa
   this the-girl that-washes ACC the-giraffe
   "This is the girl that is washing the giraffe."
(8) Target response – object relative:
   zo ha-yalda she-ha-jirafa roxecet
   this the-girl that-the-giraffe washes
   "This is the girl that the giraffe is washing."

Responses were analysed for total number on target (subject relative for a subject relative target, object relative for an object relative target). The addition of a resumptive pronoun in object relatives (but not in subject relatives) is optional in Hebrew, and we therefore counted the object relatives with a resumptive pronoun as target responses.

Each of the participants was tested in a quiet room. No time limit was imposed during testing, and no response-contingent feedback was given by the experimenter. All the responses of the participants were recorded in a digital tape and transcribed both during the session and from the recording. The scoring was done by the two authors, reliability exceeded 95%, and the few disagreements were resolved by consensus.

Results

The results of both tasks indicated that children with S-SLI have difficulties in the production of relative clauses, especially in object relatives, that were mainly related to thematic role assignment. The children in the control groups produced both subject and object relatives without difficulty. They were 98% correct on subject relatives and 94% correct on object relatives. A comparison of the production of object relative clauses in the three age subgroups of the control group (7-, 9-, and 10-year-olds) indicated that age was not a factor in the production of relative clauses

in this age range. The average number of responses of each type (object relatives with and without resumptive pronouns, subject relative instead of an object relative) in the three age subgroups was either identical or virtually the same with no significant difference in both tasks (using t-test and an alpha level of .05). None of the participants in either of the age groups avoided relatives. These results might indicate that at age 7 and a half, children already master the production of right-branching relative clauses, and therefore no developmental effects were found between the age groups. Because of their similar performance, the data of the three age subgroups were combined into one control group.

A comparison of the production of subject and object relatives in the S-SLI group to that of the control group is presented in Figure 3.[3] The performance of the S-SLI participants was poorer than that of the control participants on both subject- and object-relatives and on both tasks. In the preference task the S-SLI children produced significantly fewer target object relatives than the control participants (60% compared to 94%), $t(39) = 6.80$, $p < .0001$, $d = 2.34$, and significantly fewer target subject relatives (94% compared to 99%), $t(39) = 2.29$, $p = .01$, $d = 0.79$. In the picture elicitation task as well, the S-SLI children produced significantly fewer target object relatives than the control participants (46% compared to 94%), $t(42) = 6.25$, $p < .0001$, $d = 2.01$, and significantly fewer target subject relatives (83% compared to 98%), $t(42) = 3.64$, $p = .0003$, $d = 1.17$.

The children with S-SLI produced significantly more target subject relatives than target object relatives (with and without resumptive pronouns) in both the preference task, $t(12) = 4.07$, $p = .001$, $d = 1.82$, and the picture description task, $t(15) = 4.03$, $p = .001$, $d = 1.30$. No difference was detected between the tasks with respect to the
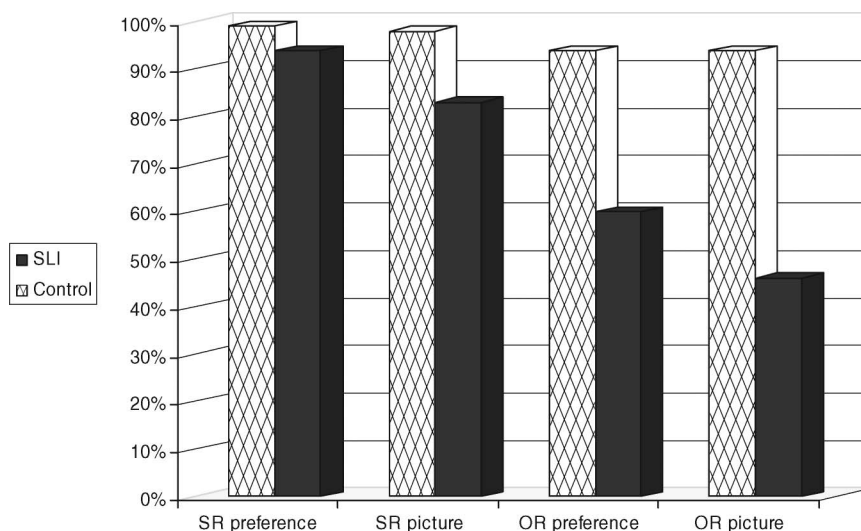

Figure 3. Production of subject relatives (SR) and object relatives (OR, with and without a resumptive pronoun) in the preference and the picture description tasks.

production of target object relatives, t(27) = .96, p = .35, or subject relatives, t(27) = 1.58, p = .13. An additional analysis was conducted only for the 11 children who participated in both tasks, using paired-sample t-test. This analysis also yielded no difference between tasks in subject relatives, t(10) = .62, p = .55, or in object relatives, t(10) = 1.33, p = .21.

An analysis of the types of errors and preferred responses lent additional information as to the syntactic abilities and the underlying deficit of the S-SLI participants. For the *subject relatives*, the few non-target responses in the preference elicitation task included the production of simple sentences instead of the target subject relatives (example (9)). This occurred in five cases in the S-SLI group (6%) and did not occur in the control group. One control participant also produced a single case of a resumptive pronoun in subject position (which is illicit in Hebrew). In the picture task the errors included an NP at the embedded subject position, of either a resumptive pronoun (example (10)) or doubling of the relative head (example (11)), both are ungrammatical in Hebrew. This occurred in 6% and 5% of the responses respectively for the S-SLI group, and 2% and 0% for the control group. (This error also occurred twice in subject relatives that the S-SLI participants produced instead of a target object relative). The remaining non-target responses, which

occurred only in the S-SLI group, were 3% simple sentences instead of relatives, and 1% subject relatives without the object.

(9) Simple sentence:
ha-xayelet ha-zot malbisha et ha-axot
the-(female)-soldier the-this dresses ACC the-nurse
"This soldier dresses the nurse."

(10) Resumptive pronoun in subject position:
ze ha-leican she-hu soxev ta-dubi
this the-clown that-he carries ACC-the-teddy-bear
"*This is the clown that *he* carries the teddy bear."

(11) Doubling of the relative NP head:
ze ha-yeled she-ha-yeled roxec et ha-aba
this the-boy that-the-boy washes ACC the-father
"*This is the boy that *the boy* washes the father."

When the target was an *object relative*, the S-SLI children differed from the control group not only in the percentage of non-target responses, but also with respect to the distribution of the responses, as can be seen in Tables I and II. The S-SLI participants produced significantly fewer target object relatives

Table I. Distribution of responses to target object relatives in the preference elicitation task (six target object relatives per participant).

	Type of response	SLI (73 sentences*) (%)	Control (168 sentences) (%)
Grammatical object relatives	Object relative	33	64
	Object relative with a resumptive pronoun	27	30
Thematic role reduction and error	Participant reduction: Object relative with an empty subject	4	–
	Participant reduction: Reflexivization	4	–
	Subject relative, incongruent with the question	10	6
No movement from object position	Subject relative, congruent, verb change	4.5	–
	Subject relative, with full passive	1	–
	Object relative with relative head doubling	2.5	–
No relative	Simple sentences and sentence fragments	11	
	Adjectival passives	3	–

*Three participants received only five target sentences and another participant answered only four of the six target sentences.

Table II. Distribution of responses to target object relatives in the picture description task (10 target object relatives per participant).

	Type of response	S-SLI (160 sentences) (%)	Control (280 sentences) (%)
Grammatical object relatives	Object relative	13	60
	Object relative with resumptive pronoun	33	34
Thematic role reduction and error	Participant reduction: Object relative with an empty subject	12	4
	Participant reduction: Reflexivization	3	–
	Subject relative, incongruent with the picture	3	2
No movement from object position	Subject relative, congruent with picture	3	–
	Subject relative, with full passive	14	–
	Object relative with relative head doubling	5	–
	Subject relative, theta roles incongruent with verb morphology	9	–
No relative	Simple sentences and sentence fragments	4	–

without a resumptive pronoun compared to the control participants in both the preference task, t(39) = 3.58, p = .0005, d = 1.23, and the picture task, t(42) = 4.23, p < .0001, d = 1.36. Whereas the control group produced around two-thirds of the responses in both tasks as object relatives without resumptive pronouns, the S-SLI group produced these sentences only in a third of the responses in the preference task, and an even lower rate of 13% in the picture task.

The S-SLI and the control group did not differ significantly with respect to the production of object relatives with resumptive pronouns, which are grammatical in Hebrew (example (12)). Both groups produced approximately one-third of the target object relatives with a resumptive pronoun, with no significant difference between the groups, t(39) = 0.31, p = .38, in the preference task, and t(42) = 0.07, p = .47, in the picture task.

(12)   Object relative with a resumptive pronoun:
        ha-yeled she-ha-saba menashek oto
        the-child that-the-grandfather kisses him
        "The child that grandfather kisses *him*."

The non-target responses in both tasks included thematic errors and reduction of thematic roles, avoidance of movement from object position, relative head doubling, and production of simple sentences without a relative clause. The distribution of these responses in each task is presented in Tables I and II.

One group of non-target responses, which occurred frequently in both tasks, was the production of sentences with one less participant (reduction of a thematic role) or with wrong thematic roles. These included the production of object relatives with an impersonal subject,[4] (example (13)); the use of a reflexive instead of a transitive verb (example (14)), which reduces the theme argument and includes only one argument, an agent, and therefore both included one less participant, and eliminated the need for movement from object position (and changed the meaning of the sentence); and the use of a subject relative with thematic roles incongruent with the picture or the preference question (example (15)).

(13)   Object relative with an arbitrary subject:
        Ha-yeled she-mecalmim oto
        the-child that-photograph-pl him
        "The child that (someone) photographs."
        (target: "The child that the guide photographs.")
(14)   Subject relative with a reflexive verb:
        ha-yeled she-mitraxec
        the-child that-washes-refl
        "The child that washes himself."
        (target: "The child that the father washes.")
(15)   Subject relative incongruent with the question or picture:
        ha-mora she-melamedet yeled exad

the-teacher that-teaches child one
"The teacher that teaches one child." (target: "The child that the teacher teaches.")

The use of subject relatives instead of object relatives allowed the S-SLI participants to avoid moving a phrase from the embedded object position. Other productions of subject relatives instead of object relatives included subject relatives congruent with the question or picture but with a change of the target verb (example (16)), and subject relatives with full passives (example (17)). The subject relatives with passives occurred mainly in the picture description task, and included passives that are ambiguous between adjectival and verbal passives, and some passives that are only adjectival.

Another response that might have also resulted from the avoidance of movement from the embedded object position was the production of object relatives with a copy (doubling) of the relative head at the trace position (example (18)). This type of response was produced mainly by one participant.

In Hebrew, lexical operations derive unaccusatives, reflexives and passives from their transitive counterparts and change the verb morphology. Four of the S-SLI participants in the picture description task also produced subject relatives in which the number of sentential participants was incongruent with the morphology of the verb they used. In all of these cases, the correct sentence required an object relative with a transitive verb, and the participants used a verb form that is created after a lexical operation that reduced one thematic role, and therefore the verb could assign only one thematic role. The participants used these verb forms with two noun phrases. Most of these sentences included a reflexive verb (example (19)), that is created in Hebrew from its transitive alternate by an operation in the lexicon that reduces the internal argument (that it is identified with its external coargument, Reinhart, 1997; Reinhart & Siloni, 2004, 2005). Additional sentences in which the number of arguments did not match the verbal morphology were adjectival passives and unaccusative verbs, both including one less thematic role following a lexical operation that reduces an argument from their transitive counterpart.

(16)   Subject relative with a verb change:
        ha-yeled she-mekabel xibuk
        the-child that-receives a-hug
        "The child that received a hug."
        (target: "The child that the mother hugs.")
(17)   Subject relative with full passive:
        Ha-aba she-nitfas al-yedei ha-yeled
        The-father that-caught by-the-boy
        "The father that is caught by the boy."
        (target: "The father that the boy catches.")
(18)   Doubling of the relative head:
        *ha-yeled she-ha-saba menashek yeled exad

the-child that-the-grandfather kisses child
one
"*The child that grandfather kisses *one*
child."
(target: "The child that grandfather kisses.")

(19) Theta roles incongruent with the verb's
morphology:
zo ha-yalda she-mistareket al-yedei ha-safta
This the-girl that-combs-refl by the-grand-
mother
"*This is the girl that combs-herself by the
grandmother."
(target: "The girl that the grandmother
combs.")

(20) Adjectival passive:
ha-yeled ha-mecuyar
the-child the-painted
"The painted child."
(target: "The boy that the teacher paints.")

(21) Fragments of sentences:
ha-yeled she-saba
the-child that-grandfather
"*The child that grandfather."
(target: "The boy that grandfather feeds.")

Finally, S-SLI participants, but not the control
participants, had some responses in which they
completely avoided relatives. This included the
production of simple sentences (example (9)),
phrases with adjectives or adjectival passive instead
of a relative clause (example (20)) and sentence
fragments (example (21)).

To summarize, the analysis of the responses
indicated a variety of structures that the children
used in order to provide a task-appropriate response
without using the impaired syntactic abilities,
namely, without moving the object from within the
relative clause and having to assign thematic roles to
two arguments. They made thematic role errors and
reversals, reduced the number of arguments in the
sentence, and refrained from using an object relative
by producing a simple sentence or a subject relative.
Importantly, no complementizer was omitted, and
except for the aforementioned thematic role errors
with respect to verb morphology, and NPs at the
trace position, all their utterances were grammatical.

Discussion

The main result of the current study is that school-age
children with S-SLI have great difficulty in the pro-
duction of relative clauses. Similar to previous results
from comprehension tasks, the deficit was most pro-
minent in object relatives, whereas the production of
subject relatives was considerably better, but still
impaired compared to the control group. The analysis
of the types of responses the children with S-SLI
produced in the two elicitation tasks suggests some
further insights as to their underlying impairment
in movement-derived sentences.

Possibly the most important outcome of the
analysis of responses is that the children with S-SLI
did not produce structural errors, and never omitted
the embedding marker, but rather made errors and
modifications to target sentences that related to
thematic roles. This suggests that their deficit is
related to the assignment of thematic roles in
sentences that involve movement, rather than to a
deficit in the construction of the syntactic tree.

The participants with S-SLI did not make struc-
tural errors and did not seem to have a problem in
building the syntactic tree up to its highest nodes.
Unlike preschool children with SLI, none of our
participants omitted the complementizer (the embed-
ding marker). It seems that at this age S-SLI children
already have the syntactic tree to support the
production of embedded sentences, but they still
cannot assign correctly thematic roles to moved
constituents. The current results, together with
previous findings of younger children with SLI,
suggest a possible developmental route in SLI. In
preschool age, SLI children have difficulty in
constructing the syntactic structure of relatives and
omit the relative morpheme (Håkansson & Hansson,
2000; Schuele & Tolbert, 2001). At school age (in the
current study around the age of 10), their ability to
construct the syntactic tree that is required for
embedding is available. At this stage, the assignment
of thematic roles to moved elements is still impaired.[5]
These results are in the same vein with Clahsen,
Rothweiler, Woest, and Marcus (1992) suggestion
that SLI children have difficulties in producing
morphemes that encode relationships between syn-
tactic structures, and with van der Lely's (1997, 1998,
2005) description of SLI as a selective deficit in
dependencies. It is also consistent with studies that
reported deficits in another structure that involves
wh-movement in SLI: Wh questions (Jakubowicz &
Rigaut, 2005; and see papers by Hansson &
Nettelbladt, 2006; Stavrakaki, 2006).

The difficulty in assigning thematic roles to moved
arguments manifested itself in several types of
responses in the current study. These responses
can be characterized by a tendency to produce,
instead of object relatives with two participants, a
response that included only one participant instead
of two, or a response that included movement from
subject position instead of object position (by
producing a reversed-roles sentence, by changing
the verb form, such as reflexive instead of transitive,
or by using a different verb altogether), or a
combination of both. These responses caused a
change in the thematic structure of the target
sentence: they either changed the thematic role of
an argument, reversed the thematic roles of the
arguments, or omitted one argument. Some addi-
tional responses were sentences that did not include
movement at all.

The general tendency to reduce a thematic role
or to simplify the thematic structure of the

sentences indicates that sentences in which only one argument requires a thematic role are easier for S-SLI children, and that sentences that do not include movement at all or that include movement from subject position are easier than sentences that are derived by movement from the embedded object position. All these response types point in the same direction: the S-SLI children have a deficit that is related to assigning two thematic roles in sentences that involve movement (particularly, so it seems, movement of one argument across another), and they therefore refrain from producing these sentences in a variety of ways. The question regarding why movement from subject position was easier than movement from object position in the SLI group is still open. One possible way to think about the reason for this asymmetry between subject- and object relatives is along the lines of the accounts that were suggested for this asymmetry in comprehension. For example, by assuming some kind of a strategy that assigns the first NP in the sentence the agent role (see Grodzinsky, 1990) or a preference to assign the head of the relative clause the role of the subject of the relative clause, or a preference to construct the shortest chain. The application of such an approach to production, however, requires further inquiry and a detailed account of how a canonical-order strategy or a preference for a subject as the relative head actually apply during production.

Regarding the use of passives instead of object relatives by the SLI group and its implications, it is important to start by pointing out that the passive construction is rarely used in Hebrew. It is infrequent even in formal written texts, and is associated largely with academic or journalistic prose (Berman, 1979), and school-age children use passives very rarely even in written texts compared to other languages (Jisa, Reilly, Verhoeven, Baruch, & Rosado, 2002). This can also be seen in that the elicitation tasks used in the current study could theoretically elicit passives, not just object relatives, but still the children in the control group did not use passives at all.

In this context, why did some children in the SLI group use passives? It seems less likely that the use of passives in the SLI group was because A-movement (the type of movement in passives) is easier for them than A-bar movement (the movement in relative clauses and wh questions), because then we would expect them to use passives in the preference task as well, which they did not, and also because at least in English there are studies reporting that the interpretation of passives is also impaired in SLI (van der Lely, 1996; van der Lely & Harris, 1990). The fact that the SLI group used passives almost only in the more formal task, the picture description task, could indicate that the use of the passives in the formal task was a result of formal teaching of passive in treatment sessions of SLI.[6]

Furthermore, it is unclear that when the children with S-SLI used passives they really analyzed them as structures that involve A-movement. Hebrew has four morphological forms for passive. Three of them are ambiguous between verbal and adjectival passive; the fourth bears only the adjectival meaning (Horvath & Siloni, 2005; Meltzer, 2005). Most of the passives that were produced by the S-SLI group were ambiguous between adjectival and verbal passives, but some of their passives, even in the full passive constructions, were of the adjectival-only type. This might indicate that the passives they produced were actually adjectival, without movement, rather than verbal passives, and this might be the reason for them using passives instead of relatives.[7]

Two other populations that experience deficits in movement-derived sentences are individuals with agrammatic aphasia and orally-trained children with hearing impairment. A close inspection of the differences between these groups in the production tasks shows that the comparisons between different groups with syntactic impairment can be revealing with respect to the nature of the deficits, and it also shows how important it is to test production as well as comprehension (and also that structured tasks are sometimes more telling than the analysis of spontaneous speech, in which avoidance is possible). Although the three groups fail in the comprehension of object relatives as measured by sentence-picture matching tasks, their performance on relative clause production tasks suggests that their underlying deficit is different.

Firstly, unlike the children with S-SLI, individuals with agrammatism have severe problems in producing both subject relatives and object relatives, and their responses include mainly ungrammatical sentences and many complementizer omissions (Friedmann, 1999, 2001, 2006). The underlying deficit in agrammatism is thought to be structural, a deficit in building the syntactic tree up to its highest nodes (the Tree Pruning Hypothesis, Friedmann & Grodzinsky, 1997; Friedmann, 2006). Seeing as the complementizer resides in the highest node of the syntactic tree (CP), and both subject- and object-relatives require the complementizer, they are both impaired. This is in contrast to the responses of the children with S-SLI in the current study, who almost never produced ungrammatical utterances, did not omit the complementizer and frequently produced correct subject relatives. This contrast between individuals with agrammatism, who have a structural deficit, and children with S-SLI, further supports the idea that the deficit in S-SLI is not structural, and that they do not have a specific deficit in accessing the high nodes of the syntactic tree. This is also supported by the results of a study we recently conducted, in which the participants (who participated in the current study as well) repeated embedded sentences. The embedded sentences included sentences with sentential embedding (without relative clauses) and sentences with

relative clauses. In this task, none of the participants omitted complementizers (Friedmann & Novogrodsky, 2005).

Turning to orally-trained children with hearing impairment (OTCHI), both the children with S-SLI and the OTCHI demonstrate poor comprehension of object relatives (without resumptives) and other structures that are derived by wh-movement (Adams, 1990; Friedmann & Novogrodsky, 2004; Friedmann & Szterman, 2006; Stavrakaki, 2001), and both groups have difficulties in the production of object relatives (Friedmann & Szterman, 2006; Håkansson & Hansson, 2000). These similarities suggest that both groups have a deficit related to movement, but a closer comparison of the production of relative clauses in the two groups reveals that the locus of the underlying deficit in movement of the two populations is different. The two groups crucially differ with respect to the way they treat the trace, and specifically in the tendency to produce noun phrases at the trace position. The school-age OTCHI produce significantly more relative clauses with resumptive pronouns than the S-SLI group, and significantly more sentences with doubling of the relative head (Friedmann, Novogrodsky, Szterman, & Preminger, 2005).[8] This difference might indicate that OTCHI, unlike S-SLI children, cannot even construct the trace of movement, and therefore use an overt noun phrase in its position, whereas in the S-SLI group it is not the construction of the trace that is impaired but rather the transfer of thematic roles (across another argument of the verb).

This conclusion converges with similar results from a comprehension study that we recently conducted (Friedmann, Gvion, & Novogrodsky, 2006; Friedmann & Novogrodsky, in press). This study tested reading and interpretation of relative clauses, in a way that allowed teasing apart the construction of the trace and the assignment of thematic roles. It used reading aloud of object relatives that contain homographs after the trace position. The reading of the homographs as a noun or as the main verb crucially depended on the ability to assume a trace in the correct position and assign the homograph its correct syntactic position as the main verb. The children with S-SLI read the homographs correctly, but failed to interpret the sentence, making thematic role errors when they paraphrased the object relatives. This indicated that they were able to construct the trace but could not use it to assign a thematic role to the moved constituent.

This deficit can be related to either impaired representation of thematic role assignment and movement or to impaired processing of thematic roles, and the current results can be interpreted either way (see Deevy & Leonard, 2004, for a discussion of the subject-object asymmetry in comprehension as an indication of impaired processing in SLI). Note, however, that if a processing account is adopted, it should still be captured in syntactic-

thematic terms, rather than in general memory terms, both because the working memory of 16 of the participants, as measured by span tasks, was normal and because memory limitation in other populations did not seem to yield subject-object asymmetry or the impairment in object relative witnessed in the current study (see Friedmann & Gvion, 2003).

To conclude, the results of the current elicitation tasks converge with data from previous comprehension studies to suggest that the deficit in relative clauses in school-age S-SLI relates to an inability to transfer thematic roles to moved constituents, at least in non-canonical sentences that include wh-movement.

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Notes

1 According to some linguistic analyses of relative clause derivation, the relative head itself moves from within the embedded clause to CP (Kayne, 1994; Vergnaud, 1974). Other theories take the movement in relative clauses to be a movement of a relative operator (Chomsky, 1986, 1995). According to them an empty operator or the relativizer *who* or *which* moves from within the embedded clause to the specifier position of the embedded CP, where it is co-indexed with the head of the relative clause (see Sauerland, 2000, for a discussion of the two analyses).

2 Hebrew also allows topicalization and verb movement within the relative clause, but these occur in a more formal language and none of the children in the control group used these options, so it is not relevant here.

3 All the analyses presented below were done both with t-tests and with nonparametric tests—Wilcoxon signed rank for comparisons within the group of SLI, and Mann-Whitney for the comparison between groups. The results of the t-tests and the nonparametric tests were very similar, every result that was significant with the t-test was also significant with the nonparametric tests, and every non-significant result was non-significant in both tests. In the text we present the results of the t-tests.

4 Note that according to Reinhart and Siloni (2005) some languages express the impersonal meaning by an arbitrary *pro*, whereas other languages use a lexical operation of saturation or arbitrarization of the agent role. Unimpaired speakers of Hebrew are thought to use the arbitrary *pro* in this context, but it is possible that the children with S-SLI, who showed mismatches between lexical operations, verbal morphology, and thematic roles, incorrectly reduce the external theta role in this construction too.

5 Another possibility is that there is actually more than one type of S-SLI, one that is related to movement and thematic roles, as described in the current study, and another that involves impairment in the syntactic tree.

6 Why are Hebrew-speaking children treated on passives is yet another question. This might be because treatment and diagnostic tools are many times translated from English without the necessary adaptations to Hebrew.

7 This is also consistent with the errors they made in which the verb morphology, and hence the verb thematic grid—the number of thematic roles it can assign—did not match the number of noun phrases in the sentence. Because it might be that the instances in which they used full passives could also be instances of adjectival passives with two NPs. Interestingly, of the six participants with SLI who used passives in the picture task, four were the four participants who made the errors of morphology not matching the thematic structure.

8 Whereas most of the children with hearing impairment in Friedmann and Szterman (2006) produced doublings in relative clauses like ''The girl bought the boots that she wanted the boots'', most of the doubling errors in the S-SLI group came from one participant. Interestingly, his files include recurring hearing infections at the first 2 years of life, possibly pointing to a hearing impairment (and hence insufficient exposure to linguistic input) source for his S-SLI.

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