SUBTYPES OF SLI: SYSLI, PHOSLI, LESLI, AND PRASLI

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1. Introduction

In this study we explore how specific Specific Language Impairment (SLI) is. Does the term SLI refer to a homogeneous group? When a child is diagnosed with SLI – can we predict what her difficulties will be, and in what way she should be treated? Are all children with SLI impaired in syntax?

Because syntax, phonology, pragmatics, and the lexicon are distinct modules in the language system, we examine in this article whether these modules can be selectively impaired, creating different types of SLI. A claim of this sort is widely assumed in the study of adult aphasia. The question, thus, is whether it holds for developmental language disorders as well. The SLI literature indeed describes SLI as a heterogeneous deficit, which causes difficulties in various aspects of language: word finding, phonology, morphology, syntax, semantics, and pragmatics (e.g., Bishop, 1997, 2006; Bishop & Rosenbloom, 1987; Clahsen, 1989; Leonard, 1998; Rice & Wexler, 1995; van der Lely, 1996, 1997; van der Lely & Battell, 2003; van der Lely & Christian, 2000). Some researchers suggested that different children show different patterns, and that SLI can be further classified into subgroups according to the language component that is impaired (Bishop, 2006; Conti-Ramsden & Botting, 1999, 2006; Conti-Ramsden, Crutchley, & Botting, 1997; Conti-Ramsden et al., 2001; Dockrell, Messer, & Murphy, 2005; Friedmann & Novogrodsky, 2007; Korkman & Hakkinen-Rihu, 1994; Rapin & Allen, 1983; van Daal, Verhoeven, & van Balkom, 2004; van der Lely, 2005).

In this study we explore the possibility that a selective impairment of one of the language components can exist without a deficit in other language abilities. We investigate this question through the looking glass

of syntax, and specifically, of syntactic movement. We will first test children with Syntactic SLI (SySLI), who have a deficit in the comprehension and production of movement-derived sentences, and assess their lexical retrieval and phonological abilities. We then explore the other direction of the dissociation – testing syntactic-movement abilities of 3 groups of children, children with lexical retrieval impairments, children with phonological deficits, and children with pragmatic deficits.

There are already some indications for a double dissociation between lexical retrieval and syntactic deficits in SLI. Dockrell, Messer, and Murphy (2005) described a group of children with SLI with difficulties in word finding, whose syntactic abilities were preserved. The other direction of dissociation between syntax and lexical retrieval was also reported. Van der Lely (2005) described a group of children who had a selective impairment in grammar (syntactic and phonological abilities), whose vocabulary[1] was also impaired but to a lesser extent than their grammar. Friedmann and Novogrodsky (2004, 2007; Novogrodsky & Friedmann, 2006) reported a group of school-age children with SLI who had a syntactic deficit, but whose lexical retrieval and phonological abilities were within the normal range. There are also indications for dissociations between phonological and syntactic impairments: Impaired phonology with intact syntax (Bishop, 2006; Gathercole et al., 2005; Hansson, Nettelbladt, & Nilholm, 2000) and impaired syntax with intact phonology (Stokes et al., 2006).

2. Method

2.1 Syntactic tests

The syntactic tests included syntactic structures and tasks that proved to be the most sensitive for the detection of syntactic SLI in previous studies. These tasks included: a) A binary task of *matching a picture to a relative clause*, in which each participant heard 40 right branching subject and object relatives and was asked to choose which of the two presented pictures matched the sentence (in the non-matching picture the theta roles were reversed, Friedmann & Shapiro, 2003; Friedmann & Novogrodsky, 2004); b) A task of comprehension questions on assorted relative clauses, in which each participant heard 90 subject and object center-embedded or right-branching relatives, and answered comprehension questions about the thematic roles in the relative clauses – regarding the agent and theme of the embedded and matrix clauses; c) Another task of comprehension questions, in which each participant heard 40 right-branching subject and

object relatives and answered comprehension questions about the (verb or adjective) predicate of the main clause; d) Question-picture matching task, in which each participant heard 40 subject and object referential Wh-questions ("which" questions), and was asked to choose the picture that answered the question, between two pictures, again one matching and one with reversed roles (Friedmann & Novogrodsky, 2007); e) A relative clause production task that required a preference selection (BAMBI ADIF, Friedmann & Szterman, 2006; Novogrodsky & Friedmann, 2006). The children were presented with two options and had to say what they preferred. The task was constructed in such a way that the choice would have to be formulated either as a subject relative or as an object relative. f) A relative clause elicitation task that used two pictures (BAMBI ZIBUV, Friedmann & Szterman, 2006; Novogrodsky & Friedmann, 2006). The participants were requested to describe a figure in a picture, in a way that required a subject or object relative. In the following sections we report only the most sensitive structures in each task, which were the noncanonical sentences: object relatives and referential object questions.

2.2 Lexical retrieval tests

The lexical retrieval tests included the SHEMESH *naming test* (Biran & Friedmann, 2005), which contains 100 color pictures for naming; The MAASE test (Rom & Morag, 1999), a norm-referenced *test of vocabulary* and lexical processing; A task of naming 20 *words to definition* (Cohen-Mashiah, 1990); and two *verbal fluency* tasks – a semantic fluency task in which the participants were asked to name as many animals as they can in one minute, and a phonological fluency task, in which the participants are asked to name words that start with a given letter for 3 letters, with 30 seconds allotted to each letter. Children who failed on the SHEMESH naming test and on at least one other lexical test were classified as having a lexical retrieval deficit.

2.3 Phonological tests

Four tests assessed 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, Friedmann, 2003), which included 29 words and 26 nonwords, with various types of phonological complexity (initial and medial cluster, no onset, feature similarity, etc.); a test of *nonword judgment* (BLIP SHIPUX, Friedmann,

2003) in which 38 pairs of nonwords were given, one of which was phonologically plausible, and the other violated universal phonological constrains such as sonority (slanim-lsanim; droz-rdoz) or Hebrew-specific phonological rules. The participants were asked to choose which of the nonwords "sounds more like a word in Hebrew"; *LAC test* (Lindamood & Lindamood, 1979), which assesses phonemic awareness on tasks of analysis and synthesis using colored blocks representing phonological sequences; and the *working memory* subtest from the Wechsler Intelligence Scale for Children (WISC-R95) that requires forward and backward recall of digit sequence. The children with PhoSLI (Phonological SLI) were tested for *phonological awareness* using an additional task of same-different judgment for first and last phoneme and syllable of word pairs presented aurally. The participants were asked to determine whether the words start or end with the same sound (syllable or phoneme). There were 54 word pairs at the syllable level and 53 at the phoneme level.

For all tests, failure on a test was defined as a significantly poorer performance than the control group using Crawford & Howell's (1998) t-test.

2.4 Participants with SLI – exclusionary and inclusionary criteria

All the participants with SLI in the current study met 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 their score on the Raven's Matrices (Raven, 1965), in which they performed within 1 SD from the average of their age (these data are available for all but five of the PhoSLI participants). Ten of the participants were also tested using the Wechsler Intelligence Scale for Children (WISC-R95, Hebrew adaptation), with scores of 93-106. All of the SLI participants were attending regular classes in regular schools.

With respect to the inclusion criterion, all the participants in the SLI groups were diagnosed with SLI prior to the study through clinical tests, by speech-language pathologists and educational specialists, based on reading comprehension assessment and non-standardized tests used in the

clinics. We included them in the various SLI groups according to deficits in specific abilities – the inclusion in the SySLI group was based on failure in tests that assessed syntactic movement comprehension and production; the inclusion in the LeSLI group was based on failure in lexical retrieval; the inclusion in the PhoSLI was based on failure in tasks that tested various phonological abilities, and the inclusion in the PraSLI group was based on impaired discourse-pragmatic abilities including relevance, quantity, and reference.

The participants in the control group for the syntactic tests were 50 typically developing children in fourth and sixth grade (mean ages = 9;8, 11;8, respectively). The control group for the phonological and lexical retrieval tests included 36 participants. The scores of the younger PhoSLI children (second graders) were compared to a control group of 10 children without language impairments with mean age of 7;2.

3. Results

3.1 SySLI: Syntactic impairment with intact lexicon and phonology

SySLI – syntactic SLI

The children with SySLI were 20 school-age children; 14 boys and 6 girls, in 4th to 8th grade, aged 9;4 to 14;6 years (mean age 11;2). Children were included in the SySLI group if they failed in at least 3 of 4 syntactic comprehension tests and in at least one of the two relative clause production tests (failure defined as performance significantly poorer than the control group using Crawford & Howell's, 1998 t-test).

As can be seen in Table 1, the children in the SySLI group showed a marked deficit in the comprehension and production of non-canonical sentences derived by Wh-movement. They failed to understand object relatives in the sentence-picture matching task and in the comprehension questions tasks, and failed to understand object *which*-questions in the question-picture matching task. They also had significant difficulties in the production of object relatives in the relative clause elicitation task. Their performance was significantly poorer than that of the control group on all tasks.

***Table 1*. Performance of the SySLI group in the syntactic tasks (%correct).**

	SySLI	Control
Object relatives: Sentence picture matching	67	94
Assorted object relatives: Comprehension questions	62	92
Object relatives: Comprehension questions	64	90
Object *which* questions: Sentence picture matching	69	90
Object relatives: Elicited production - pictures	55	94
Object relatives: Elicited production - preference	66	94

What about the lexical and phonological abilities of the children with SySLI? As seen in Figure 1, the series of lexical and phonological tests that were run on the participants with SySLI indicated that eleven of the participants had a selective SySLI, without lexical or phonological deficits; three of them had, in addition to SySLI, a phonological impairment, three had, in addition to SySLI, also a lexical retrieval impairment, and three had phonological impairment and a lexical retrieval deficit in addition to the syntactic deficit.

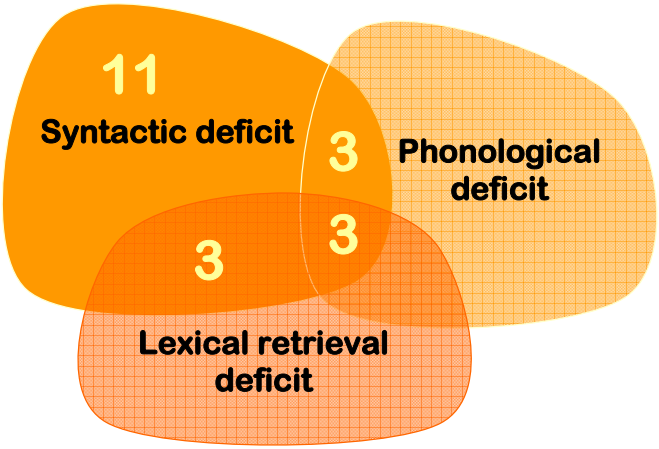

***Figure 1*. Distribution of impairments within the group of children with SySLI.**

3.2 LeSLI and PhoSLI: Lexical or phonological impairment with intact syntactic abilities

3.2.1 LeSLI – lexical SLI

The LeSLI group included 10 Hebrew-speaking children aged 9;3 to 13;6 years (with a mean of 11;1), 7 boys and 3 girls.

The lexical tests indicated that all ten participants had a significant difficulty in the SHEMESH naming task, and on at least one additional lexical task. Their performance on the SHEMESH was 85% correct (84%-89%), significantly poorer than the average of control participants in 4^{th}-6^{th} grade (M = 95%, SD = 2%, $p < .05$, Crawford & Howell, 1998 t-test). Their naming difficulty was manifested in failure to name, in naming errors, and in response times longer than 5 seconds, hesitations, circumlocutions, providing a description instead of naming, and use of gestures. The lexical difficulty was evident also in their spontaneous speech during the assessment.

In marked contrast to their poor performance on the lexical tasks, and in marked contrast to the performance of the children with SySLI, the children with LeSLI had no difficulties in any type of relative clause, or in any type of Wh-question, either in comprehension or in production, as shown in Table 2.

***Table 2*. The performance of the LeSLI participants on the syntactic tests in comparison to the SySLI and control participants (%correct)**.

	LeSLI	SySLI	SySLI-LeSLI comparison	Control (SD)
Object relatives: Sentence picture matching	93	67	U = 139, $p = .0005$	94 (7)
Assorted object relatives: Comprehension questions	94	62	U = 64.5, $p = .002$	92 (7)
Object relatives: Matrix comprehension questions	94	64	U = 75.5, $p = .005$	89 (13)
Object *which* questions: Sentence picture matching	98	69	U = 136, $p = .0002$	89 (10)
Object relatives: Elicited production - pictures	87	55	U = 136, $p = .0002$	94 (15)
Object relatives: Elicited production - preference	88	66	U = 80, $p = .01$	94 (8)

The children with LeSLI performed significantly better than the children with SySLI on all 4 comprehension tests of object relatives and object questions, as well as in the two tasks of relative clause elicitation. Each of the individuals with LeSLI performed significantly above chance on all

question types, and none of them performed poorer than the control group on any question type or on any relative clause task (Crawford & Howell, 1998 t-test, $p > .22$).

3.2.2 PhoSLI – Phonological SLI

The participants in the PhoSLI group were 8 Hebrew-speaking children aged 7;3-12;3 (M = 9;3). They showed clear difficulties in repetition of phonologically complex nonwords, which they repeated only 74% correct, in contrast to the control participants, who were 97% correct in this task; they repeated only 88% of the phonologically complex words correctly, whereas the control participants repeated 99% of the words correctly. They had difficulties in the LAC test and in the other phonological awareness test, in which they were asked to judge whether the opening or closing syllables and phonemes of two words were the same, with 71% correct on syllables and 47% correct on opening phonemes (controls performed 96% and 93% respectively). Two of the participants also had lexical retrieval deficits.

Their syntactic abilities, however, were normal. As can be seen in Figure 2, they performed well on the comprehension and production of object relatives, and comprehended referential Wh-questions well. They performed significantly better than the SySLI participants, although they were 2 years younger.

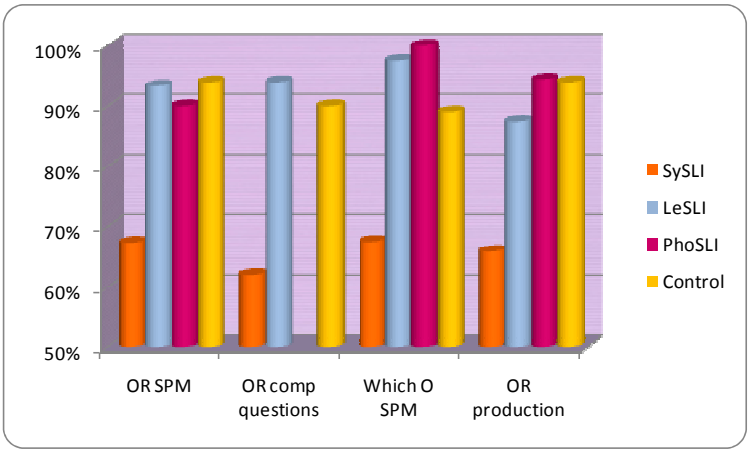

***Figure 2*. Percentage of correct performance in 4 tests of Wh-movement in the SySLI, LeSLI, PhoSLI, and control groups. The tasks from left to right: object relative sentence-picture matching, comprehension questions on assorted object relatives, *which* object questions in sentence-picture matching, object relative clause elicitation - preference task.**

3.2.3 A short note on PraSLI

Due to space limitations, we only report briefly another group of 7 children aged 9;2-14;2 with linguistic-pragmatic impairments, manifested in highly disturbed discourse in terms of relevance and quantity. This was indicated in narrative analysis, as well as in structured tests targeted at examining various aspects of linguistic-pragmatic abilities such as reference setting and provision of relevant information. Their CCC questionnaires (Children's Communication Checklist, Bishop, 1998) yielded very low scores (between 108 and 148, with an average of 129), indicating a pragmatic deficit in various aspects of language and communication. They also showed impaired theory of mind, as indicated by failure in false belief tasks and tasks examining gaps in knowledge, and provided unconventional responses in the naming task. Interestingly, they still performed very well on the syntactic tasks reported here, showing good comprehension and production of sentences derived by Wh-movement.

Figure 3 summarizes the distribution of the various impairments in the children with SLI presented in this article.

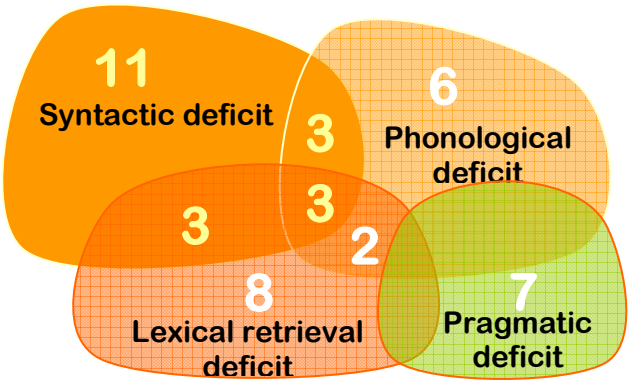

***Figure* 3. Distribution of impairments within the four groups of children with SLI.**

4. Discussion

This study thus describes several specific Specific Language Impairments. We presented four groups of children – all of them had SLI, but their pattern of performance differed greatly. One group, that of the children with SySLI, syntactic SLI, showed a severe impairment in the comprehension of noncanonical sentences derived by Wh-movement,

including object relatives and referential object questions, and had difficulties producing object relatives. Interestingly, 11 of these 20 children with SySLI showed good lexical and phonological abilities. Another group presented here was a group of children with LeSLI, a lexical retrieval deficit. Their deficit related to the retrieval of words, but their syntactic abilities, and specifically their comprehension and production of sentences derived by syntactic movement, were intact. A similar picture was described with respect to children with PhoSLI. These are children whose phonological abilities are impaired – they cannot repeat phonologically complex words and nonwords, and have difficulties judging phonological aspects of words and segmenting words. Still, these children performed well in the syntactic tests. A fourth group, which we only mentioned briefly, is a group of children with linguistic-pragmatic impairment, PraSLI, whose discourse ability and theory of mind were impaired but whose performance in purely syntactic tasks was normal. These findings support the idea of subtypes in SLI (Conti-Ramsden & Botting, 1999, 2006; Conti-Ramsden et al., 1997, 2001; Korkman & Hakkinen-Rihu, 1994; Rapin & Allen, 1983; van Daal, Verhoeven, & van Balkom, 2004). The dissociations found between lexical and syntactic abilities are in line with studies by van der Lely (2005) and Dockrell, Messer, and Murphy (2005). The results of the participants with PraSLI are in line with studies that reported dissociation between pragmatic impairment and intact abilities in other language domains (Bishop, 1998; Conti-Ramsden et al., 1997, 2001).

Thus, in our study there were children with SySLI who showed unimpaired lexical and phonological abilities, whereas the children with LeSLI, PhoSLI, and PraSLI showed the other direction of dissociation: they showed impaired lexical, phonological, or pragmatic abilities, with unimpaired syntactic abilities. This is not to say that every child who has a syntactic deficit will not have lexical, phonological, or pragmatic deficits. This also does not mean that no child with a lexical, phonological, or pragmatic impairment can have a syntactic impairment as well. The claim here is existential: *there are* children who have purely syntactic impairments, and there are children who have pure lexical, phonological, or pragmatic impairments, without syntactic deficits. Namely, selective impairments in one module of language, and not in the others, do exist, and it is possible to identify subgroups within SLI with selective deficits in various language modules: syntax, lexicon, phonology, and pragmatics.

These results suggest that it is important to assess different linguistic modules to identify the exact locus of deficit each child with SLI has, in order to apply specific intervention programs for children with specific

language needs. These findings also speak against a phonological or lexical basis for the syntactic deficit in SLI (Joanisse & Seidenberg, 1998), as some children had a clear syntactic impairment without a phonological impairment, and some had a phonological impairment which did not lead to a syntactic deficit. The results also suggest corroboration for modularity within the language system.

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Notes

[1] In our 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 & Friedmann, 2005; Ellis & Young, 1996; Howard and Gatehouse, 2006; Nickels & Howard, 2000).

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