THE COMPREHENSION OF INDIRECT DIRECTIVES BY CHILDREN WITH SLI

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SUMMARY

Background: Specific Language Impairment (SLI) is a dysfunction in which, apart from abnormalities in the acquisition of language, there are no serious disturbances in psychomotor development. There is a great deal of literature on the active speech skills of children with SLI, but much less is known about their competence in reception. The primary goal of the present study was to find out how children with SLI understand indirect directives addressed to them by asking them if the action was possible.

Material/ Methods: The study was conducted using the authors' own method for studying indirect directives. The clinical group consisted of 76 children with SLI, ranging in age from 4;0 to 6;11. A group of 136 children of the same age served as controls.

Results: The mean between-group results did not differ significantly in terms of reacting to indirect directives in a manner responsive to the speaker's intention. In all age groups, however, the children with SLI had significantly lower scores than the controls in terms of interpreting the indirect directives as questions about the possibility of performing the action. The SLI group also displayed significantly more passive behaviors than did the controls.

Conclusions: Although these children with SLI did not differ from controls with normal language development in terms of understanding indirect directives in accordance with the speaker's intentions, the failure to consider alternative interpretations was significantly greater among the SLI children, although the difference becomes smaller with age.

Key words: intention, communication, pragmatics

INTRODUCTION

Specific language impairment (SLI) is a dysfunction defined by specific difficulties in acquiring the native language, which appear to be primary, i.e. not caused by other, greater or universal disturbances. In these cases the children present with at least average intelligence, relatively good comprehension, and no neurological or serious somatic disorders. These children are not raised in circumstances of extreme deprivation, and are not ill more often than their contemporaries. They sometimes have siblings in whom speech develops normally, but not infrequently difficulties in acquiring the native language occur or have occurred to a greater or lesser extent in several family members (Leonard, 2000, 2006; Bishop, 2008).

To date it has not proven possible to establish the etiology of SLI beyond all doubts. In spite of the fact that the absence of serious neurological damage or dysfunction is generally considered a necessary condition for a diagnosis of SLI, it is not difficult to find reports in the literature indicating certain other abnormalities occurring in some persons with this disorder (Pąchalska et al., 2007; Pąchalska et al., 2010). For instance, Duvelleroy-Hommet et al. (1995) found anomalies of normal hemisphere asymmetry in children with SLI, mainly in the parieto-occipital and temporo-parietal regions. Ullman and Pierpont (2005) found abnormalities in the frontal cortex (in Broca's area) and in the basal ganglia. Clark and Plante (1995) examined the parents of children with SLI, who had also been diagnosed with limited linguistic competence, and found an additional sulcus in the inferior frontal gyrus, where Broca's area is located. Plante (1991), using MRI, discovered atypical symmetry of the Sylvian fissure in some children with SLI. However, a similar atypicality was also found in some of the parents and siblings of SLI children, but the former did not have any language disturbances.

An atypically large Sylvian region has also been noted in children who have SLI and accompanying disorders, e.g. dyslexia, more often than in the population of persons with normal development (Bishop & Snowling, 2004). Some experts believe that this may have some connection with polymicrogyria (de Vasconcelos Hage et al., 2006; Pąchalska et al., 2007), an anomaly in the growth of the cerebral cortex, in which neurons from deeper layers of the brain reach the level of the cortex, but are abnormally distributed, which produces numerous small gyri in the cortex. Guerreiro et al. (2000) and de Vasconcelos Hage et al. (2006) have pointed out a connection between the presence of polymicrogyria in the perisylvian region and the occurrence of SLI, accompanied by cognitive deficits or pseudobulbar syndrome (i.e. dysarthria with nasalized speech, difficulties in swallowing, sometimes uncontrollable weeping or laughter, or both). On the other hand, in a study by Trauner, Wulfeck, Tallal and Hesselink (1995), neuroanatomical anomalies were found in only 10 of 34 children with SLI, and as many as 6 different kinds of anomalies were present in these 10 individuals.

It would be safe to say, then, that the data on neuroanatomical changes in children with SLI are far from unambiguous, and it would be hasty to draw any far-reaching conclusions from them at this point.

The research results on the genetic conditions for SLI are equally indecisive. Much of the available data indicates that children with SLI come from families with various kinds of problems in language development, which is true of anywhere from 20% to 75% of cases in this group (Bishop et al., 2003). The family members found to have language disturbances are typically parents or siblings, or both. As a general rule these are fathers and brothers more often than mothers and sisters, which is consistent with the proportions of males to females among persons with SLI.

Bishop et al. (2003) reported that disturbances occurred in the families of 46% of their subjects with SLI, as opposed to 18% in the control group. By contrast, however, there have also been studies reported in which there was no SLI in members of the same families. Tallal, Townsend, Curtiss and Wulfeck, (1991) found no language disturbances in 23 families out of 65 subjects with SLI. These contradictory results may be an indication that SLI is conditioned polygenically, or that a single gene may cause only the risk of SLI, which will develop only under particular environmental conditions (Rutter, 2008). Each of the individual internal or environmental components probably produces only a small effect. It is only when combined that they produce the symptoms of SLI.

In terms of symptomatology children with SLI do not constitute a homogeneous group. We can find very different information in the literature on the subject of their competence in the expression and reception of speech.

In linguistic production, most of the research done to date basically shows that, with the exception of a few areas causing greater difficulties, the phonological production of children with SLI in many respects resembles that of younger children with normal language development, and this pertains to both consonants and vowels (Leonard, 2001), though some research indicates that particular problems occur with consonants (Bartolini & Leonard, 2000). While most six-year-olds with normal speech development correctly pronounce phonemes, both in isolation and in spontaneous speech, children with SLI still show various kinds of abnormalities in this respect at the age of six or seven.

What especially differentiates children with SLI from those with normal speech development is the presence of various peculiarities in the area of phonetics, not seen in normal development. The lack of error consistency in SLI has been particular emphasized (e.g. Betz & Stoel-Gammon, 2005). Some researchers have listed yet other peculiarities in children with SLI, such as the addition of nasal phonemes at onset, or the addition of certain sounds when the correct form of the word begins with some particular phoneme (Leonard & Leonard, 1985).

As for competence in syntax, although Leonard et al. (2003) found that the primary syntactical forms occur in the spontaneous speech of children with SLI. Johnson and Kamhi (1984) noticed that the utterances of 5-year-old children with SLI, when compared to a control group matched for mean length of utterance (MLU), contained a smaller number of constituent clauses.

Most recent publications have called attention to the difficulties experienced by English-speaking children with SLI in forming the "wh-" questions (e.g. van

der Lely & Battell, 2003). Also especially difficult for English-speaking children with SLI is the construction (and comprehension) of the passive voice (Bishop et al., 2006).

One feature that particularly distinguishes children with SLI from younger children with the same MLU is an exceptional large number of problems with morphology (Karmiloff & Karmiloff-Smith, 2001; Leonard et al., 2003; Ebbels, 2007). It turns out that children with SLI must attain a MLU much higher than expected before their speech begins to reflect the proper use of grammatical morphemes. In English, problems with the correct inflection of verbs constitute an especially characteristic sign (Rice, 2000; Leonard, 2001). Data gathered from various publications shows that problems with verb morphology can constitute the basis for a diagnosis of SLI (this, of course, pertains to children who already have a sufficient active vocabulary, so it does not pertain to three- or four-year-olds with SLI). These deficits often persist into school age, and even longer. Data on children with SLI in other languages, such as Italian, Spanish, or Hebrew (Leonard, 2000), suggest that difficulties in verb inflection are virtually pathognomonic for this disorder.

Research has shown that children with SLI have problems with both encoding words and accessing them in their personal lexicon (Oetting et al., 1995). Their particular lexical difficulties consist above all in problems with extracting the target word from the mental lexicon in a phonologically correct form. These problems may be caused by either insufficiently coalesced word representations or difficulties with access to the internal lexical network.

Word representations that have not coalesced may be the reason for the previously mentioned phenomenon of inconsistent phonological errors, when the chid pronounces a certain phoneme sometimes correctly, sometimes incorrectly. It is hard to find any general rules for this.

There can be many possible barriers interfering with access to the mental lexicon. Such factors as memory or attention may be of considerable importance in this context (cf. Lipowska, 2012). Researchers have emphasized that children with SLI perform at a worse level than controls in combining words with their referents, while school children with SLI have more difficulties than their contemporaries in remembering a list of known words, and experience considerable problems in recalling them (Leonard, 2001).

While the available literature contains a great deal of data about language production, there is much less data pertaining to the comprehension of language by children with SLI. As a general rule it is assumed that the reception of speech remains within normal limits for most persons with this disorder (Reed, 2012). On the other hand, in research work done in English (e.g. Bishop, 1999; Tallal, 2000) we frequently encounter reports of major difficulties in SLI with auditory perception. According to Tallal (2000), the particular symptoms experienced by children with SLI in the perception of speech sounds arise from problems with temporal processing, that is, the processing of stimuli that change very quickly over time. Particular phonemes have a fixed time structure. The basis for correct

identification of phonemes is a specific neuronal mechanism that operates in the range of several dozen milliseconds. Stop consonants last an average of 30–40 milliseconds, while vowels and fricatives last two or even three times longer (Tallal, 2000). The inability to recognize paronyms or syllables differing by only one phoneme may result from disturbances in the functioning of the brain clock, rendering it impossible to grasp the changes in phonemic formants succeeding one another in a specific time frame. Bishop (1999) argues that many children with SLI show greater or smaller deficits in the perception of speech. The information provided primarily by specialists in the diagnosis and treatment of specific difficulties in writing and reading, that dyslexia in school age is often preceded by disturbances in the development of speech (Bogdanowicz, 2001; Krasowicz-Kupis, 2008), suggest that, despite the apparent therapeutic success in making up for deficits in speech expression, children with SLI are often beset with long-term problems in comprehending longer or more complicated texts. There is no information regarding the comprehension of ambiguous sentences or metaphors.

The basic goal of our research was to find answers to this question: Does the process of understanding indirect directives, understood as questions regarding the possibility of performing an action, follow the same course in children with SLI in the age bracket 4;0 to 6;11 as in their contemporaries with normal speech development?

MATERIAL AND METHODS

For purposes of this research we used a method of our own devising to test the understanding of directives, called "Spaceman" (Czaplewska, 2005, 2012). During the test, the child and the experimenter sat opposite each other at a table, on which the following toys had been placed (in a specific order so as to resemble the normal arrangement of a room):
- a bed with bedclothes;
- a wardrobe with clothing;
- blocks;
- food and drink;
- a ball;
- a book;
- a spaceman doll.

The child was informed that the experimenter is writing a book about spacemen and wants to know how children would behave if a spaceman came to them. The child's task was to respond appropriately (verbally or nonverbally) to the spaceman's questions. All the sentences directed by the spaceman to the child were indirect directives, phrased as questions regarding the possibility of performing a certain action. The six questions were as follows:
1. Can you give me your hand?
2. Can you wave your hand?
3. Could you stand on your head?

4. Can you wiggle your ears?
5. Could you give me something to drink?
6. Can you tell me a story?

All the children's responses were recorded, and then grouped into the appropriate categories (see below).

We tested 76 children with SLI. Inclusion in the final SLI group required the establishment of the necessary qualifying criteria. The inclusion criteria were as follows:

- parental consent for the child to participate in the research;
- a below-average level of speech development;
- an at least average level of intellectual development;
- normal hearing;
- no neurological or somatic disorders that could have contributed to abnormalities in the development of speech;
- a family environment that was sufficiently supportive of the child's development.

The exclusion criteria included the following:

- retarded speech development only in respect to phonology;
- failure to make contact with the child within two meetings to a degree sufficient to allow the research to proceed;
- below-average intelligence;
- too low a level of speech comprehension;
- a pathological family environment;
- otitis media with effusion within two years of the research;
- frequent administration of antibiotics;
- a disease or drugs administered during the research that could interfere with its progress.

In the events of any doubts as to whether something might have occurred during the test that would have an uncontrolled effect on its course, the test was halted. Ultimately, from among all the children with SLI qualified for the research, we recruited 57 boys and 19 girls, a proportion which represents the typical male:female distribution in this disorder. Our clinical group, then, consisted of:

- 33 children in the age bracket 4;0 to 4;11;
- 24 children in the age bracket 5;0 to 5;11;
- 19 children in the age bracket 6;0 to 6;11.

All these children had below-average scores on the Logopedic Screening Test (Tarkowski, 2002), while 66 children had average intelligence and 10 had above-average intelligence, as measured by the Polish version (Jaworska & Szustrowa, 2003) of Raven's Colored Matrices.

The control group consisted of 136 children with normal speech development, including:

- 31 children in the age bracket 4;0 to 4;11;
- 61 children in the age bracket 5;0 to 5;11;
- 44 children in the age bracket 6;0 to 6;11.

The tests were performed with each child individually in a closed room set aside for this purpose.

In order to compare the competence of the clinical group with that of the controls in terms of the comprehension of directives, the answers to each of the spaceman's questions were analyzed in both groups. This made it possible to categorize the subjects' behaviors in each of the six sentences. The categories were based on behaviors that recurred several times (Pąchalska et al., 2012).

To the first category, that is, behaviors consistent with the speaker's intentions, we assigned those responses that indicated the spaceman doll's question had been received as a directive. The first-category responses for each of the six sentences were as follows:

1. *Can you give me your hand?* child's response: offers their hand to the spaceman; says "I would give him my hand," or "I will give him my hand";
2. *Can you wave your hand?* child's response: waves their hand; says, "I would wave," or "I will wave";
3. *Could you stand on your head?* child's response: says, "I would stand on my head" or "I will stand on my head"; tries to stand on their head;
4. *Can you wiggle your ears?* child's response: wiggles their ears; says, "I would wiggle them" or "I will wiggle them."
5. *Could you give me something to drink?* child's response: gives the spaceman something to drink; says, "I would give him something to drink" or "I will give him something to drink."
6. *Can you tell me a story?* child's response: tells a story; says, "I would tell him a story"; picks up the book.

The behaviors qualified to the second category indicated that the spaceman's utterance had been regarded as a question regarding the possibility of performing an action; these responses most often took the form of saying "Yes," "No," or "I can't," or making affirmative or negative gestures.

The third and final behavioral category consisted of reactions that were entirely inadequate: most often complete passivity, sometimes shrugging the shoulders or saying, "I don't know."

In each of these categories, the subject could obtain a maximum score of 6 points, 1 for each question.

Statistical analysis was performed using ANOVA.

RESULTS

Fig. 1 shows the average scores obtained by the subjects from both the experimental and control groups, by age bracket, for the first category of responses: that is, when they responded to the speaker's intentions, as a directive.

An analysis of variance indicates that the differences between the mean scores of the two group are not statistically significant. A similar number of children from both groups, when asked questions like "Can you give me your hand?", replied in a manner responsive to the speaker's intention, i.e. held out their hands.
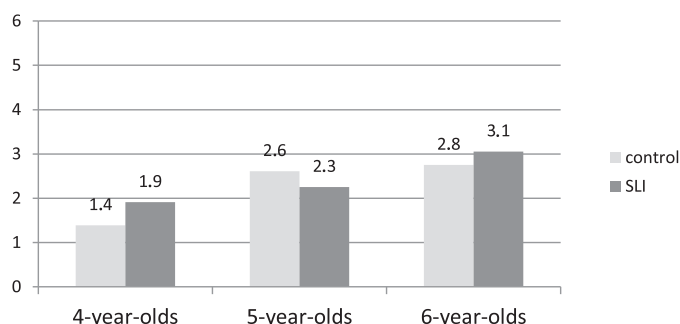
Figure 1. Average number of points scored by the subjects for treating all six sentences as directives

It can be assumed, then, that the comprehension of indirect directives formulated as questions regarding the possibility of performing an action in a manner responsive to the speaker's intentions followed a similar course in the children with SLI and the controls. This competence increased with age. The difference between the scores of the four- and five-year olds (from both groups together) is significant at the level of p=0.000. The difference between the scores of the five- and six-year-olds is not significant.

Fig. 2 shows the average scores obtained by the children from both groups for understanding all six questions literally, i.e. as questions regarding the possibility of performing the given activity.

In this case, the children with SLI in all age brackets achieved means scores that were significantly less than those of the controls. The highest average score was found in the youngest children from the control group; the lowest score, in the youngest children with SLI. These differences are statistically significant: for the four- and five-year-olds, p=0.000, while for the six-year-olds, p=0.015.
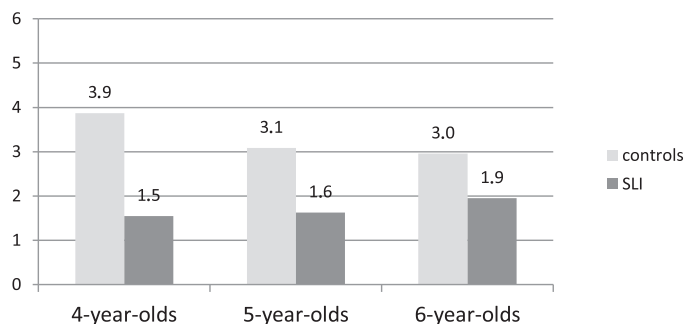
Figure 2. Average scores obtained by the controls and the SLI group broken down by age brackets for treating all six sentences as questions regarding the possibility of performance

An analysis of variance also shows that among the control children the treatment of directives as questions became significantly less frequent with age. The difference between the four-year-olds and the five-year-olds is statistically significant at the level of p=0.018; the difference between the four-year-olds and the five-year-olds is significant at the level of p=0.01; the difference between the five-year-olds and the six-year-olds is not significant. In the SLI group, on the other hand, the differences between all the age groups are statistically non-significant.

To interpret these results we can basically point out that insofar as the children with SLI did not differ significantly from the controls in terms of taking the indirect directives responsive to the speaker's intention when formulated as questions regarding the performance of the specified action, still, there is a greater tendency to comprehend these questions literally in the non-SLI controls, though it diminishes with age.

Fig. 3 illustrates the average scores for inadequate responses, qualified to the third category.

As the results indicate, the children from the SLI group, much more often than the controls, made no effort at all to respond. The difference between the results for the four-year-olds is significant at the level of p= 0.000, as is the difference between the scores of the five-year-olds. In the six-year-olds the difference between groups is not significant.

No statistically significant differences were observed within the control group between the respective age brackets. Among the children with SLI the difference between the 4-year-olds and the 6-year-olds was significant at the level of p=0.000.

Comparing the scores achieved in all three categories (responsive to the speaker's intention, not responsive to the speaker's intention, inadequate for the communicative situation), we can observe that the controls seem to have developed primarily in the direction of reducing the number of reactions that were not
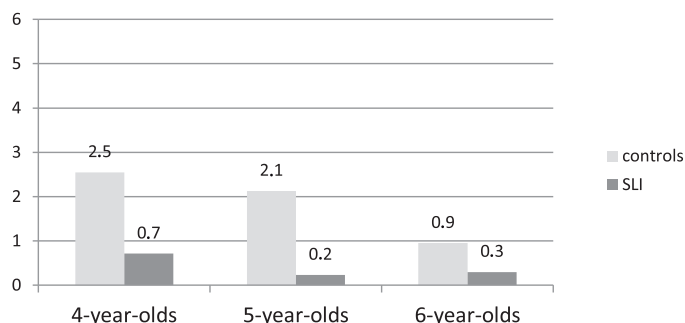

Figure 3. Average scores in the third category (see text) by the control subjects and the SLI group, broken down by age

responsive to the speaker's intentions, while increasing the number of reactions that were responsive to the speaker's intentions. The number of passive reactions remained at a similar level in every age group. In the SLI group, on the other hand, the number of reactions that were responsive to the speaker's intentions increased with age, but the number of reactions that were not responsive to the speaker's intentions remained at the same level. The number of passive reactions decreased significantly with age in the SLI group.

DISCUSSION

Our observation that children with SLI did not offer any sort of response to verbal messages directed to them significantly more often than did normal controls is consistent with the research results of Rice et al. (1991), who reported that children with language disturbances, when prompted to converse, are not eager to reply. To be sure, in research conducted under the supervision of the first author of the present study (Kluj, 2010), it was found that 3-year-olds with SLI did not yet display any serious interference in social functioning in contact with adults, whereas it was only at the age of 5 that they tended to be withdrawn and passive; still, other factors also influenced the behavior of the children in our research.

It would appear that our control children, in deciding what kind of response to make, mostly chose between a reaction that was responsive to the speaker's directive or was simply an answer to the question. The children with SLI either reacted in response to the directive or did not react at all. Since this does not seem to be caused only by difficulties in expressive speech, it would appear that our subjects with SLI had a smaller repertoire of behaviors to choose from. This may be caused by a less complicated form of cognitive representation, and/or worse functioning of working memory and/or poorer operation of processes associated with attention.

It may be that children with normal language competence, having more skills in their possession, have a cognitive system that offers a choice between two (or more) rival options for interpretation. With maturation, having gone through something like training in social situations, they learn to make more and more apt choices in a given situation. Children with SLI, rather than search for another possible interpretation, simply fail to react. With age, the number of appropriate reactions leveled out in both groups. A detailed analysis of the behavior of children in every test (Czaplewska, 2005, 2012) indicates that in response to requests that are essentially impossible to perform ("stand on your head," "wiggle your ears"), children with SLI try to perform the task significantly more often than do normal controls. The latter more often reply truthfully that they cannot perform the task. It is as though the children with SLI do not take into consideration the purely linguistic aspect of the utterance. They choose to react to the intention, or, if another interpretation is possible, they do not react at all.

According to Nelson (2002), human intelligence for the first two years of life is supported by language, but knowledge is not yet represented in language.

The years from 3 to 6 are a critical period, during which language becomes for the human child a system of representation, transferring thinking from a purely practical intelligence to a level where symbolic representation is engaged in mental processes. According to the premises of Donald (1993), the representational level means that language reveals itself in the form of specific meanings, which are evident in given social situations, games, meetings, in which the child participates. In this way, during development, by taking part many times in different situations and associating with them certain spoken behaviors, the child forms certain cognitive categories, called "schemata" or "scripts" (Piaget, 2001; Rice, 2007). Schemata are typically organized in the cognitive system as a sequence of events (e.g. a visit to the doctor, a meal in a restaurant) or on the basis of spatial organization (e.g. knowledge of the appearance of the home). In the course of development, as new information is assimilated, schemata are continually reorganized and processed. In the course of normal development, we observe a script-like form of the organization of knowledge already in four-year-olds (Karmiloff & Karmiloff-Smith, 2001). With age, certain changes take place in this representation: the generated sequence of events is prolonged, the order in which events take place is established, there are fewer episodic elements irrelevant to the situation, and alternative connections are formed, which provide a basis for the creation of alternate pathways within the script.

Perhaps in children with SLI there are fewer of these alternative pathways. Just as the words in their mental lexicon have weaker associations, so their scripts may contain fewer situations that are partially divergent. Children with SLI, having fewer options to choose from, give priority to the most obvious ones. In the case of our research, this was understanding the situation irrespective of the linguistic content of the message.

The differences we observed between the results attained by our subjects can confirm the reports in the literature indicating that children with SLI may have problems in the normal development of some executive functions. Archibald and Gathercole (2006), for example, observed in their research that children with language difficulties display poorer functioning in working memory, which can hinder the organization of processing of verbal information. Perhaps the reactions of our subjects with SLI oscillated primarily between one type of response and no response at all precisely because, in contrast to normally developing children, they have difficulties using working memory to process two possible interpretations of a message addressed to them. It may be, also, that the attention deficits indicated by some researchers (e.g. Nickols et al., 1995), for example, cause children with SLI not to able to process the entire verbal contents in a message, so that they react primarily to the most salient signals or words in the sentence. For instance, in the question, "Could you stand on your head?", they focus only on the words "stand on your head," passing over the modal verb, "could you."

CONCLUSIONS

An analysis of the results obtained in our research entitles us to conclude that the comprehension of indirect directives formulated as questions regarding the possibility of performing an action is available to children with SLI to the same extent as to children of the same age in whom language has developed normally. It turned out, however, that our subjects with SLI take other possible interpretations into account to a significantly lesser extent than do their normally developing contemporaries. Since this does not seem to be caused only by difficulties in expressive speech (in some situations a possible, though less satisfactory response would be to nod or shake the head in affirmation or negation), the inference is that children with SLI have a smaller repertoire of behaviors to choose from, which may be associated with a less elaborated, and thus relatively impoverished network of cognitive representations. It is also possible that children with SLI, due to the existence of deficits of attention and working memory, are less able to consider alternative interpretations of the messages directed to them than are children with normal language development.

The abnormalities under discussion here may flow from the same source as the difficulties in retaining in memory a larger number of elements in formulating messages (Bishop & Adams, 1991), or problems in recognizing phonemes produced in an average tempo (Tallal, 2000). However, a review of the data available in the literature to date, both confirming and excluding hypotheses regarding the limited capacity to process information in children with SLI as the primary pathomechanism of this disorder, does not give enough evidence to formulate definite and final conclusions on this subject.

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