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**MORPHOSYNTACTIC ABILITIES IN HUNGARIAN CHILDREN
WITH AND WITHOUT SPECIFIC LANGUAGE IMPAIRMENT**

PhD thesis summary

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1. Introduction

The term *specific language impairment* (SLI) refers to a group of children who face difficulties during the acquisition of their native language in spite of normal senses, nervous system, generally typical cognitive and social abilities. Although this developmental disorder has long been known, exhaustive research on SLI started only in the 90s. The main research directions focus on (i) subsystems of grammar that pose difficulties for these children, (ii) differences and similarities of linguistic symptoms across languages, (iii) quantitative and qualitative differences from patterns of typical language acquisition, (iv) the relationship between acquisition of linguistic structures and cognitive and perceptual abilities external to grammar, and (v) theoretical explanations of SLI.

Theoretical explanations of SLI can be categorized in two broad classes. One of these consists of theories based on the nativist view of language development. These grammatical representational accounts claim that the underlying reason for SLI is a selective impairment of one of the parameters or principles of universal grammar (e.g. Gopnik & Crago, 1991; van der Lely & Stollwerck, 1997; Clahsen, 1999; Rice et al., 1995). Theories belonging to the other group base their claims on a constructivist view of language acquisition which hypothesises an experience-based language learning process with several perceptual and cognitive systems involved. The input-processing accounts of SLI claim that weaknesses of necessary perceptual and cognitive abilities such as processing capacity and speed (e.g. Marchman & Bates, 1994; Leonard, 1998), auditory perception (Tallal & Piercy, 1973) or phonological working memory (Gathercole & Baddeley, 1990) hamper language development and lead to language impairment.

2. Aims

The main aims of the studies in the present dissertation were (i) to discover the morphosyntactic symptoms of SLI in Hungarian, (ii) to identify any qualitative differences from typical language development, (iii) to compare the Hungarian language profile of SLI with earlier crosslinguistic data, (iv) to discover the correspondences between morphosyntactic difficulties and factors of language processing external to grammar, (v) and to evaluate theories of SLI. To this end, we conducted off-line language processing and elicited production experiments with children with SLI selected by internationally accepted

standard criteria and with control children matched individually on receptive vocabulary scores. We chose morphosyntactic structures that are comparable with structures of other languages studied earlier in SLI, but differ from those structures in a psycholinguistically relevant way, and are suitable to test theoretical accounts of SLI. Such morphosyntactic structures are verb agreement and tense marking, case marking, main clause word order and focus interpretation and complex sentences with relative clauses. Studying the processing of these structures allows for the investigation of correspondences between effects of morphological and syntactic structure, perceptual and memory factors in groups with and without SLI.

3. New scientific results

In the following sections I present the main results of the studies included in the dissertation in thesis points grouped by grammatical domains.

3.1. Tense and agreement morphology (Studies 1-2)

Thesis 1. Hungarian children with SLI show a significant weakness in verb agreement and tense marking compared to their general language level, however, their verb agreement performance is largely correct and the patterns of their performance does not differ qualitatively from those of typically developing children.

In an implicit verbal inflection restoration task, children with SLI produced significantly less correct verb forms than typically developing children matched on receptive vocabulary. Both groups showed similar patterns across verb agreement dimensions: past tense, plural, second person were more difficult than present tense, singular, first and third person, respectively, the 2nd person plural verb forms being the most difficult. The definiteness of the object did not influence performance in neither group. Children with SLI produced more errors in person and definiteness marking, while there weren't such differences in number and tense marking. However, the relative proportions of different error types were similar across groups. Children with SLI did not show any tendency to use default forms without suffix, as this type of error was occurred in only 5.2% of all errors. Groups did not differ in the amount of morphophonological errors, so children with SLI do not seem to be impaired in the use of

vowel harmony. In general, most of their errors were near-misses where the produced verb form differed from the target form in a single grammatical dimension.

In a grammaticality judgment task, children with SLI showed comparable performance to typically developing children matched in receptive vocabulary in the recognition of agreement and morphophonological errors. Both groups recognized agreement errors more successfully than tense and morphophonological errors. Among agreement errors, recognition of person errors was easier than number errors that were in turn easier than definiteness errors for all children. Taken together these results, verb agreement does not seem to be a domain of selective impairment in Hungarian children with SLI.

Thesis 2. The weakness of Hungarian children with SLI in verb agreement is largely explained by the frequency of verb inflections, the length of inflected verb forms and the children's poor phonological working memory.

Effects of inflection frequency, length of inflected verb forms and phonological working memory were analyzed in the above presented implicit verbal inflection restoration task. The frequency of verb inflections and the length of verb forms measured by the number of phonemes explained a greater proportion of variance in the SLI group than in the control group. These two factors together accounted for 41% and 27% of the variance in the SLI and the control group, respectively. Controlling for phonological working memory by including nonword span as a covariate eliminated general group differences in verb agreement. These results suggest that the group difference in verb agreement is caused mainly by the greater burden of lengthier inflected verb forms on the relatively poor phonological working memory of children with SLI regardless of grammatical dimensions. Thus, agreement errors are largely explained by the frequency of verb inflections, the length of inflected verb forms and their interaction with the children's poor phonological working memory.

In the grammaticality judgment task, different significant factors accounted for the performance of the groups according to regression models: nonword span accounted for 34.3% of the variance, while general grammatical comprehension explained 38.5% of the variance in the vocabulary control group.

3.2. Case marking morphology (Study 3)

Thesis 3. Case marking abilities of Hungarian children with SLI are at their general language level in narrative language samples.

Children with SLI produced significantly less case marked nouns and less types of case marking inflections in narrative language samples than age-equivalent peers but did not differ from younger typically developing children matched on receptive vocabulary. All groups produced very few case marking errors. Thus, Hungarian children with SLI used case marking at the level of complexity and correctness expected by their general language ability in narrative language samples. However, the case markers used in the narrative samples were mostly transparent ones expressing spatial relations rather than lexically determined nontransparent ones.

Thesis 4. Hungarian children with SLI show significant weaknesses in the use of lexical case marking inflections compared to their general language level. The difference is milder in the use of semantically transparent inflections marking spatial relations, while there is a more pronounced lag in the use of nontransparent inflections marking lexically determined argument relations.

Children with SLI lag behind the vocabulary control group in a sentence repetition task requiring implicit restoration of masked case marking inflections. Semantically nontransparent uses of the very case markers were much more difficult than transparent (spatial) ones for younger children with SLI while this difference was not similarly pronounced in the control group. For both groups, the patterns of difficulty with certain case marker inflections were different in their semantically transparent versus nontransparent uses. All children produced predominantly near-miss errors, that is, case markers differing from the target morpheme in either the type of spatial relation or the direction. The particular weakness in the use nontransparent, lexically determined case markers might reveal difficulties with the acquisition of verb-related argument frames in SLI.

3.3. Identification of argument roles in transitive sentences (Study 4)

Thesis 5. Word order highly influences the identification of arguments in simple transitive sentences in children with and without SLI. The effect of word order mirrors the frequency distribution of word order patterns in corpus data.

In a picture selection task requiring the identification of arguments in spoken sentences, the order of relative difficulty for six different word order types reflects their frequency distribution in corpus analyses. The two most prominent word orders were the SVO and SOV types both in corpus frequency analyses and sentence comprehension in all children. Corpus analyses showed that subjects predominantly precede objects in simple transitive sentences across word order types which pattern also showed up in the sentence processing with the S-O order of arguments being easier than the reversed pattern.

Thesis 6. Hungarian children with SLI show significant weakness in the identification of arguments in simple transitive sentences. Although their pattern of performance is generally similar to younger typically developing children's patterns, sentences with the object preceding the subject pose particular difficulties for them.

Hungarian children with SLI lag behind control groups matched in receptive vocabulary in the identification of arguments in simple transitive sentences. The six word orders showed the SVO=SOV=VSO<OVS<VOS=OSV order of difficulty in all groups of children. The perceivability of the accusative case marker also affected performance: sentences with hardly perceivable allomorphs, e.g. those without linking vowel or stem alternation, were significantly more difficult to parse. A more detailed analysis of word order patterns revealed that sentential position of the verb had an effect showing a V2<V1<V3 order, and that O-S order of arguments is more difficult than the S-O order. This latter difference was more pronounced in children with SLI marking a particular difficulty, marking the use of a first NP is agent strategy in the identification of argument roles.

Thesis 7. The particular difficulty in processing sentences with O-S order of arguments in children with SLI corresponds to their relatively poor phonological working memory, while their overall weakness in sentence comprehension is not explained by this factor alone.

A statistical analysis that controls for phonological working memory by including nonword span as a covariate eliminated the specific structure*group interaction but still showed general group differences in sentence comprehension. A possible interpretation of this analysis is that the particular difficulty in processing sentences with the infrequent O-S order of arguments in children with SLI is caused by their poor phonological working memory, while their overall weakness in sentence comprehension can not explained by this factor alone.

3.4. Focus interpretation (Studies 5-6)

Thesis 8. Adults show a remarkable tendency to distinguish between neutral and focus sentences in their interpretation, however, this tendency is far from a categorical level predicted by the syntactic-semantic operator hypothesis within the generativist framework.

Adults tend to interpret subject and object focus sentences exhaustively compared to neutral sentences in a picture-sentence verification task as participants accepted significantly less focus sentences than neutral sentences for pictures representing non-exhaustive events. However, the acceptance rates for focus sentences in non-exhaustive contexts are still relatively high: approximately 40% and 60% for subject and object focus sentences with their appropriate non-exhaustive context (two agents and two patients), respectively.

Thesis 9. Neither typically developing children, nor children with SLI showed any signs of exhaustive interpretation of subject or object focus compared to neutral sentences.

The adult-like tendency for focus sensitivity was not present in the performance of neither group of children, that is, neither typically developing 5-10 year old children, nor children with SLI as groups distinguished between neutral and focus sentences in the same picture-sentence verification task. However, a considerable amount of inter-individual variation was observable which revealed that a small minority of the children in both groups quite consistently interpret subject focus and neutral sentences differently. These children's performance shows adult-like patterns in that they reject subject focus sentences in non-exhaustive contexts (with two agents performing a joint action). The results suggest that the recognition of focus which is based only on syntactic (position) and phonological (stress) cues develops later than 8-10 years of age in typical development and even later in SLI but already present earlier in some children.

3.5. Processing of sentences with relative clauses (Studies 7-8)

***Thesis 10.* In typically developing Hungarian children, processing relative clauses (RCs) are influenced by several structural factors: interrupted main clauses (center-embedded RCs), greater distances between verbs and their arguments, accusative case relative pronouns and SO sentence types caused difficulties in processing.**

Typically developing children's performance in an act-out task showed OS = SS = OO < SO order of difficulty across sentence types, that is, OS, SS, OO types were similarly less difficult than the SO type. Structural factors such as word order and argument roles significantly influenced comprehension performance: RCs attached to the main clause subject, accusative case relative pronouns, interrupted main clause and stacking arguments at the beginning of the sentence made processing more difficult. The latter effects were due to their interaction, that is, stacking main clause arguments caused difficulties only when the relative clause separated them from the main clause verb, so only the NN-RC-V word order was significantly more difficult than the other types (NNV-RC, NVN-RC, N-RC-VN). When arguments stacked up at the beginning of the sentence, the object preceding the subject caused additional processing errors compared to the reversed pattern.

***Thesis 11.* Hungarian children with SLI show significant weaknesses in the processing of complex sentences with relative clauses compared to their general language level; the pattern of their performance is highly similar to typically developing children's pattern but the cumulative effect of some structural factors cause particular difficulties with certain structures.**

Hungarian children with SLI showed significantly weaker performance in the comprehension of complex sentences with RCs than typically developing children matched in receptive vocabulary. Both groups' performance showed similar patterns across different sentence types: the order of difficulty of sentence types was OS < SS < OO < SO. This pattern was seen because RCs attached to the main clause object were easier than those attached to the subject and accusative case relative pronouns were easier than nominative ones. Interrupted main clause and two stacking arguments at the beginning of the sentence were more difficult than conjoined relative clauses and those that followed only one main clause argument. The most difficult word order was the NN-RC-V type for both groups where two main clause arguments stacked up and were interrupted from the main verb. Argument roles and word order showed interaction in that the S-O order of arguments was preferred in the most difficult

NN-RC-V word order compared to the O-S order. A specific structure featuring some of the factors that burden sentence processing turned out to be especially difficult for children with SLI: sentences with N-RC-VN word order with accusative case relative pronoun were particularly difficult for them. These factors influenced the typically developing children as well, but their cumulative effect might have overloaded the processing capacity of children with SLI.

Thesis 12. The groups of typically developing children and those with SLI showed great individual variability in the processing of sentences with RCs, however, this variability and the processing difficulties of certain structural factors correspond to the inter-individual variability in working memory abilities that contribute to sentence processing.

In Study 7, two age groups consisting of six and nine year old typically developing children did not differ in processing sentence with RCs and the same structural factors posed difficulties for both age groups. However, there was considerable inter-individual variability in comprehension performance as well as working memory abilities. Subsequent covariate analyses controlling for components of working memory eliminated some effects of structural factors allowing us to correspond difficulties of certain structures to working memory abilities. Controlling for verbal short term storage capacity using digit span scores as a covariate variable, the difficulty of interrupted main clauses with OSV main clauses are no longer present in the statistical analysis which indicates that this type of structure affects processing through charging the ability to store sentential arguments. Controlling for the capacity of verbal short term storage and phonological discrimination using nonword repetition span as a covariate, the difficulties with processing of accusative case pronouns are also eliminated suggesting a relationship between phonological discrimination ability and the processing of the accusative case marker in a difficult phonetic context. Controlling for the capacity of verbal short term storage and transformation using backward digit span as a covariate, all of the structural factors lose their significance. In Study 8, the nonword span covariate analysis eliminated the significance of the word order effects, the effect of case marking of the relative pronoun and the group difference between children with SLI and the vocabulary control group. Thus, it seems that the difficulties of the NN-RC-V word order and the accusative case relative pronoun manifested themselves in a greater burden on phonological working memory, limiting the performance of children with lower working memory capacity. The elimination of the group difference suggests that the weaker

comprehension performance of children with SLI corresponds to their poorer phonological working memory.

4. Summary and further research directions

Morphosyntactic symptoms of Hungarian children with SLI. Our results revealed that Hungarian children with SLI showed weaknesses relative to their general language ability in verb agreement, lexical case marking, comprehension of simple transitive sentences and complex sentences with relative clauses, while they performed at their general language level in grammaticality judgments of agreement errors and comprehension of focus sentences. In spite of their deficits, children with SLI attested remarkable morphosyntactic abilities and the qualitative patterns of their performance resembled those of typically developing children. Children with SLI showed extraordinary difficulties in three domains: semantically opaque case markers, transitive sentences with the object preceding the subject, and complex sentences featuring an accusative case marked relative pronoun and N-RC-VN word order. Overall, children with SLI showed significant abilities in using grammatical morphemes and processing morphosyntax with mainly quantitative differences compared to typical development and with only a few particular weaknesses in certain domains.

Correspondences between morphosyntactic deficits and factors external to grammar. Morphosyntactic difficulties of children with SLI are related to processing factors external to grammar, that is, token and type frequency of morphologically complex word forms, inflections and word order patterns, length of word forms and distances between dependent constituents and these children's poor phonological discrimination and working memory abilities. Type frequency effects are present in the processing of different word orders and the expressive use of verb inflections, while frequency of occurrence might have influenced the processing of case marked relative pronoun. Effects of phonological working memory charge are present in various results. Length of verb forms influenced inflection performance of children with SLI, and their lower phonological working memory levels explained group differences in verb inflection, relative clause processing and the processing of transitive sentences with atypical word orders.

Morphosyntax in Hungarian children with SLI in crosslinguistic context. Our results are in concert with previous findings showing that tense and agreement marking is a relative strength in children with SLI in languages with rich inflectional morphology. Difficulties in

lexical case marking are evidenced in Hungarian as well as Turkish and German. The word order based \neq first NP is agent \emptyset strategy in processing sentences with less frequent word order patterns (with the object preceding the subject) marks a strategy that has been observed in younger typically developing children in Hungarian and that is characteristic of early language development in English and children with SLI. Patterns of relative clause processing in Hungarian children with SLI are congruent with English, German and Hebrew results as the interruption of the main clause and object relatives were shown to pose difficulties. The latter concurrence is especially interesting as object relatives are analyzed as structures with gaps in object position in English and Hebrew but characterized by accusative case marked relative pronouns in German and Hungarian. The relative difficulty of accusative case relative pronouns in Hungarian is better explained in terms of lower frequency of accusative pronoun compared to the nominative and the difficult perceivability of the accusative marker.

Evaluation of theoretical accounts of SLI. For verb inflections, selective verb agreement deficits were predicted by the agreement deficit hypothesis (Clahsen, 1999). In contrast, although Hungarian children with SLI produced more agreement errors than typically developing children, they used verb inflections correctly in general, did not show evidence for a selectively impaired grammatical dimension, produced mostly near-miss errors and their weakness is better explained by effects of inflection frequency, word length and poor phonological working memory. These results are much more compatible with the morphological richness account (Leonard, 2007). This account together with the critical mass hypothesis (Conti-Ramsden & Jones, 1997; Windfuhr et al., 2002; Conti-Ramsden, 2003) was also predicted correctly the difficulties with less transparent uses of lexical case markers in Hungarian children with SLI. Contrary to inflections with spatial meaning, non-transparent uses of case marking inflections are not supported by the meaning of the verb and the verbal prefix, their meaning are more abstract and depend on the acquisition of the corresponding verb and its argument frame. Since lexical acquisition is known to be impaired in SLI, the weakness in the use of non-transparent case marking inflections might be explained by their poor lexical abilities and the semantic properties of the inflections.

The competition model (Bates & MacWhinney, 1987, 1989) and the morphological richness account (Leonard, 2007) predicted most of the results in the processing of simple transitive sentences. As it was suggested by the competition model, children mainly relied on morphological case marking in the identification of argument roles which lead to correct performance in general but also caused mistakes when the accusative case marker was hard to perceive. The predicted effect of word order type frequency also showed up in the results as

all children performed better on sentences with more frequent word order. A subgroup of the SLI group seemed to use a -first NP is agent \emptyset strategy based on word order which marks a significant lag compared their general language level. Perceivability of the accusative case marker did not influence children with SLI more than control children, which might refer to the use of a general comprehension strategy based on word order, at least in some children. This strategy might be interpreted as compensation for poor phonological discrimination and memory ability which is supported by the proved correspondence between phonological working memory and the difficulties with sentences with O-S argument order.

The exhaustive interpretation of focus was reflected only as a significant tendency in adults \emptyset performance, contrary to the predictions of the syntactic-semantic operator model (Szabolcsi, 1981; Farkas, 1986; É. Kiss, 1998, 2002; Brody, 1991, 1995; Kenesei, 1986, 2005, 2006, 2009) that suggested a categorical distinction between neutral and focus sentences. As predicted by the morphological richness account (Leonard, 2007), children with SLI did not show sensitivity to focus, however, this pattern can not be interpreted as a deficit as typically developing children did not interpret focus sentences exhaustively either. All these results might suggest that the exhaustive interpretation of focus sentences is not governed by semantic rules and these sentences might express exhaustive identification in certain contexts based on pragmatic inferences. Further research should explore the contextual factors that evoke exhaustive interpretation and the factors that impede its appearance in typical development and SLI.

Our results on relative clause processing justified most of the predictions of processing theories concerned with working memory processes (Gibson, 1998, 2000; Lewis & Vasishth, 2005, Lewis et al., 2006) and language experience (e.g. Reali & Christensen, 2007; Bates & MacWhinney, 1987, 1989). As the greater distance between the main clause verb and its arguments affected comprehension performance as a consequence of center embedded RCs and the NN-RC-V word order, the predictions of the dependency locality theory (Gibson, 1998, 2000) are clearly supported. Moreover, the correspondence between the difficulties of children with SLI with these structures and their poor phonological working memory was proven. Nevertheless, the interpretation of the preference for subject-object order in main clauses has to go beyond memory capacity limitations and include the influences of language experience. Both the preference for subject-object order in main clauses and for the nominative case relative pronoun might be related to a frequency-based strategy that automatically attributes the more frequent analysis to the input. Inhibiting and overwriting such a strong default analysis requires high-functioning working memory that children with

SLI lack. The latter fact might explain why children with SLI tend to rely more on frequency-based analyses. Further research should focus on the conditions that determine comprehension strategies in typical development and SLI and the exact timing and nature of problems that are caused by poor working memory during comprehension.

5. Publications related to the theses

Study 1

Lukács Á., Leonard, L. B., Kas B. és Pléh Cs. (2009) The use of tense and agreement by Hungarian-speaking children with language impairment. *Journal of Speech, Language, & Hearing Research*, 52 (1), 98-117.

Study 2

Lukács, Á., Kas, B. & Leonard, L. B. (2011) "The Dog Chase the Cat": Grammaticality Judgments by Hungarian-Speaking Children with Language Impairment. *Acta Linguistica Hungarica Vol. 58 (162)*, pp. 24638.

Study 3

Lukács Á., Kas B. & Leonard, L. B. (in press) Case Marking in Hungarian Children with Specific Language Impairment. *First Language*

Study 4

Kas B., Lukács Á. & Szentkúti-Kiss, K. (el készületben) Mondatbeli szerepek azonosítása specifikus nyelvi zavarban és tipikus nyelvi fejlődésben: a szórend és az esetjelölés szerepe.

Study 5

Kas B. & Lukács Á. (in press) Focus sensitivity in Hungarian children and adults. *Acta Linguistica Hungarica* 60/2

Study 6

Kas B. & Lukács Á. (kézirat) Fókuszértelmezés specifikus nyelvi zavarban és tipikus nyelvi fejlődésben.

Study 7

Kas, B. & Lukács, Á. (2012) Processing relative clauses by Hungarian typically developing children. *Language and Cognitive Processes* 27/4, 500-538.

Study 8

Kas B. és Lukács Á. (2008) A magyar vonatkozó mellékmondatok megértése tipikus és zavart nyelvi fejl désben. *Magyar Pszichológiai Szemle* 63/1, 51-85.

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