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Abstract

The purpose of the present study is to investigate the relationship between perception and production of metrical patterns in Swedish children with LI, in order to add to the knowledge on underlying explanations of LI. A further aim was to explore whether omissions are mainly related to prosodic aspects or to linguistic function. Children with LI omitted significantly more unstressed syllables than children with typical language development. Exploration of the relationship between perception and production of phrasal stress patterns demonstrated that children with LI might be divided into three sub-groups: a) children who perform better on perception than production, b) children who perform better on production than perception and c) children with rather poor results on both perception and production.

Key words: Perception and production of stress patterns, linguistic function, omissions, prosody

Introduction

Children's productions of different metrical patterns have been explored in previous research; it has been shown that children early in their language development tend to omit unstressed syllables, especially in pre-stressed position (1). This phenomenon is not universal, however, but seems to be dependent on the ambient language of the children (2). It has also been demonstrated that Swedish children with language impairment (LI) omit indefinite articles, placed in an unstressed position of the utterance, to a greater extent than children with typically developing language and they continue to omit these at later ages (3). In the present study, production and perception of metrical patterns are further explored. The overall aim is to investigate the relationship between perception and production of metrical patterns in Swedish children with language impairment and to explore whether omissions are mainly related to stress or to linguistic function.

Development of stress and prominence

It is known that both English-speaking and Swedish-speaking children early in their development omit weak syllables, especially in pre-stressed positions (4,5,6,7). Such omissions are explained by the metrical hypothesis, originally proposed by Gerken (1). According to the metrical hypothesis young children's utterances are organized in patterns of strong-weak syllables, such as trochaic rhythmic patterns. These patterns operate as templates for early child language development, and it is more likely that the iambic word pattern in "guitar" is reduced to "tar" than the trochaic pattern "trumpet" to "trum". The metrical account also explains reductions within the phrase. Young children are more likely to omit an article than an inflection. In a target phrase like "He plays the flute" the child may say "plays flute". According to the metrical hypothesis, the omission of the determinate article /the/ is

explained by the unstressed position in the phrase held by the article. In a study exploring the use of indefinite articles and definite suffixes in Swedish-speaking children with impaired and typical language development, it was shown that children tend to omit unstressed elements also in Swedish (8). A perceptually based model for similar reductions was proposed by Echols (9), where perceptual salience was incorporated into a framework provided by autosegmental phonology. It was shown that children relied on prosody more than adults, suggesting that the prosodic component, the stress pattern, may be important in a child's representation of a word. The tendency for young children to prefer a strong-weak rhythmic pattern is not universal, but seems to be related to the ambient language (2). Vihman et al. showed that typically developing French-speaking children showed a preference for iambic patterns. This can be explained by the fact that the predominant pattern of French is iambic. Theories of prosodic bootstrapping constitute another important psycholinguistic framework (10). According to this view, the prosodic processing of spoken language input is a key factor in enabling children to identify grammatical structures and provides a basis for the acquisition of those structures.

As with all features of language acquisition, however, there is great variability between individual children. In a case study description of the expressive phonology of a 2-year-old boy, Klein (11) showed that no general rule for stress application emerged. Instead, there was great variability and the results indicated that stress at this age is mainly lexically learnt. This conclusion gets further support by Vogel and Raimy (12), who demonstrated that young children have difficulties in using prosodic information instead of the strong lexical representations of words when they are only separated by e.g. stress, like *pre*sent and pres*ent*. When asked to choose the picture matching each word, the participants chose the picture for which they had the strongest lexical representation. Another case study focused on the

relationship between prosodic and syntactic organization in German early multiword child speech (13). The results showed that different types of two-word utterances undergo different developmental trajectories. For determiner + noun combinations the child omitted the unstressed determiner in the beginning of the study, e.g. ‘n ´tisch/a table’ and when the determiner was produced in full phonetic form at around 2;1, it was stressed, e.g. ‘éin socken/ a sock’ . At the age of 2;3 the child produced the unmarked adult pattern with an unstressed determiner and a stressed noun, e.g. ‘ein ´kekse/a cookie’.

Swedish prosody

Compared to English, Swedish has a relatively complex prosodic system and is often referred to as a pitch accent language (14). In addition to the contrasts of word stress, there are contrasts of tonal word accents, i.e. Accent I (´) and Accent II (`) (15). According to Bruce (16) and Gårding (17) Swedish has two distinctive tones: accent I and accent II (15). As opposed to accent I, accent II has a connective function at the word level; it shows that a sequence of morphemes belongs to the same word. In contrast to accent I, accent II requires a series of at least two syllables and consequently the contrast between accent I and II never occurs in monosyllabic words (18). About three hundred and fifty minimal pairs distinguished by tone alone can be found in Swedish, e.g.

/tˊɔmtɛn/=“the garden”−/tˋɔmtɛn/=“Santa Claus”.

Vowel quantity mainly concerns length relations within a syllable. Many languages in the world do not use vowel quantity distinctively, and its use varies in the languages that do (15, 19). In Swedish, quantity contrasts are limited to stressed syllables and it reaches over a vowel and/or a consonant, i.e. the rhyme of the syllable (15). In stressed syllables there is a

combination of either a long vowel and a short consonant (V:C), or a short vowel and a long consonant (VC:), e.g /glɑ:s/="glass"−/glas:/="ice-cream".

The predominant stress-pattern in Swedish polysyllabic words is trochaic (strong-weak), but there are also polysyllabic words with other metrical patterns, e.g. iambic patterns (weak-strong). In Swedish, stress is usually morphologically determined, i.e. the stress placement marks the root or the stem of the word. The placement of stress in Swedish words is also sensitive to quantity. This means that the weight and the quantity of the syllable are important factors in stress regulation. A closed syllable is a potential carrier of word stress. In Swedish, a number of pairs can be found where the placement of stress is distinctive, e.g. /tr`ɵmpɛt/="sullen"−/trɵmp´e:t/="trumpet". The quality of both consonants and vowels is, however, affected by stress (15, 14), hence the placement of stress is not the only difference between these words.

Swedish morphology

In Swedish morphology, inflections are word-final. Nouns, verbs and adjectives can appear as bare stems. For nouns there are two genders and adjectives agree with the noun with respect to gender, definiteness and number. For nouns there are indefinite articles, usually in unstressed position, and definite articles, which appear in combination with an obligatory inflection. Swedish has two cases; the nominative and the genitive. Verb inflection is rather simple since there is no gender or number agreement. The verbs have both weak and strong or irregular conjugations. There is no marking of aspects (20, 3:62). Furthermore, in Swedish, homophone morphemes appear as either a verb particle or a preposition in a prepositional phrase. In both cases, the morpheme appears in the same sentence position but with or without

stress, e.g. ’han KÖR på bron/he DRIVES on the bridge’ vs. ’han kör PÅ bron/he drives ON (drives into) the bridge’.

Definitions and systems of classification

The identification of children with specific language impairment (SLI) is a challenging task for both researchers and clinicians (21). SLI is a heterogeneous disorder, currently used to describe children with otherwise normal development and normal hearing, exhibiting a significant deficit in the production and/or comprehension of language (6). In Swedish clinical practice, different subgroups of LI are categorized mainly according to ICD-10, which is the contemporary International Classification of Diseases published by the World Health Organization. In ICD-10, the different sub-diagnoses of LI are categorized under the main heading of disorders of psychological development. The system is descriptive, based on linguistic symptoms. The subgroups included in the classification are: Specific developmental disorders of speech and language, Specific speech articulation disorder, Expressive language disorder, Receptive language disorder, Acquired aphasia with epilepsy [Landau Kleffner syndrome], Other developmental disorders of speech and language and Developmental disorder of speech and language, unspecified.

Theories to Explain Underlying Factors of Language Impairment in Children

Several theoretical accounts have been formulated to explain the origin of language impairment in children. There are two major views of theories of underlying factors of LI (for an overview, see 3, 6, 5). Within one of the views, it is assumed that there is a *deficit of linguistic knowledge.* Most such theories spring from early Chomskyan linguistic theory, in which it is claimed that children have problems with functional categories, or that their language grammar lacks the features necessary for rule construction.

In the other view, it is claimed that children with LI have *general information processing limitations.* Within this view, it is assumed that children with LI have limitations in their verbal as well as in their nonverbal general processing capacity (22). There are also different perspectives within this view. One model assuming processing limitations is *the surface hypothesis*. It postulates that problems of children with LI are due to perceptual limitations affecting linguistic processing, and that these limitations are related to the speed of processing (23). According to this model, omissions should be more frequent in unstressed syllables since they are less salient, have shorter duration and less phonetic substance. The Surface Hypothesis further postulates, that the general pattern of poor grammatical morphology, seen in English-speaking children with Specific Language Impairment, (SLI) may be explained by metrical patterns. English grammatical morphemes usually appear in non-stressed position in sentences and are thus vulnerable to omission due to weak perceptual salience. According to the Surface Hypothesis, the combined features of low perceptual salience and grammatical information tax the limited processing capacity of children with language impairment beyond their capabilities.

The metrical hypothesis has also been used to explain LI in children since it has been shown that children with LI omit unstressed syllables to a much greater extent than children with typical language impairment (24, 3). Hansson (3) showed that a subgroup of Swedish-speaking children with severe language impairment make a large number of omissions of grammatical morphemes. It has also been demonstrated that Swedish-speaking children with LI produce unstressed definite suffixes at the same level of accuracy as children with typical language development (TL), but that children with LI omitted unstressed indefinite articles in pre-stressed position more frequently than children with TL.

The influence of metrical patterns on non-word repetition in children with LI was investigated by Sahlén, Reuterskiöld-Wagner, Nettelbladt and Radeborg (25). It was shown that unstressed syllables were omitted six times more often in pre-stressed than in post-stressed positions of non-words constructed according to Swedish phonotactic rules. It was concluded that it is important to consider metrical patterns when constructing a non-word repetition task, since the stress-pattern clearly has an impact on children's ability to correctly repeat such structures (25, 26). Metrical patterns have also been studied in children with speech disorders. Velleman & Shriberg (27) compared the lexical metrical patterns of children with suspected developmental apraxia of speech with the patterns of children with a speech delay. The lexical stress errors of both groups were similar to patterns identified by metrical analysis of younger typically developing children. Lexical metrical error patterns did not differentiate the groups from each other regarding number of omissions. However, syllable omissions persisted to later ages in children with suspected developmental apraxia of speech.

In sum, typically developing children have been found to omit unstressed syllables, especially in pre-stressed positions. This is also true for children with LI, even to a greater extent and at later ages than children with TL. The classification of LI into expressive or receptive LI has not been investigated in relation to prosodically based theories.

The main purpose of the present study is to investigate the relationship between perception and production of metrical patterns in Swedish children with LI, in order to add to the knowledge on underlying explanations of LI. A further aim was to explore whether omissions are mainly related to prosodic aspects (e.g. stress) or to linguistic function as for example if omissions of grammatical morphemes is more related to stress or to grammatical function.

Method and materials

Twenty-seven children with LI and 25 children with TL participated in the study. Children with typical language development were recruited through preschool programs in the south of Sweden. Preschool teachers were asked to identify children with normal development and no previous contact with a Speech and Language Pathologist. Parents gave their written consent for their child to participate in the study. Twenty-seven children aged 4;0-5;8 (mean age 4;10) were included. The children with LI were 10 girls and 18 boys, aged 4;11-5;9 (mean age 5;4). These children were recruited through speech and language pathologists in clinics in southern Sweden. Pre-testing included language comprehension, assessed with The Swedish Test of Language Comprehension (28) and T.R.O.G. (29). Expressive grammar was assessed with The Lund Test of phonology and Grammar (30) and oral motor skills were assessed with ORIS (31). Pre-testing showed that 50 % of the children included in the study had a severe LI comprising all linguistic domains, 25% of the children had a moderate LI comprising expressive language (grammar and phonology) and 25% had a mild LI comprising manly phonology. All of them were diagnosed with LI by their clinician according to Swedish clinical practise. Apart from the expressive criteria, a nonverbal IQ of at least 78 was required for inclusion. All children passed a pure tone audiometric screening test at 25 dB bilaterally for 500, 1000, 2000 and 4000 Hz at the time of the language assessment.

Procedure

For an overview of the test procedure see Appendix. For this study the participants were exposed to three different tasks using two kinds of materials (see Appendix). First they were shown four pairs of pictures representing target phrases with contrasting stress patterns depending on whether the phrase contained a stressed verb particle (mannen skjuter PÅ en

bil/The man shoots ON (pushes) a car) or an unstressed preposition (mannen SKJUTER pa en bil/The man SHOOTS on the car) (32**)**.

This task was divided into two parts: the first was a sentence repetition task (A) with picture support, where the children were asked to imitate the phrase spoken by the test administrator; the other part was administered as a receptive task (B) with matching pictures (one correct, one depicting the phrase with contrasting stress and one foil).

The participants were also exposed to a sentence repetition task with ten target phrases with various metrical patterns, some of them containing the copula, appearing in an unstressed position (task C). The task was accompanied by a set of pictures illustrating each phrase (for a detailed description and examples see Appendix).

Omission of unstressed syllables with different linguistic function (part of content words vs. free morphemes) was assessed by calculating omissions in content words as well as unstressed copulas for all the tasks. Total number of pre-stressed syllables in content words was ten. Total number of un-stressed freestanding morphemes was 13.

The material was audio-recorded and transcribed phonetically by the first author (CS) according to the International Phonetic Association (IPA) conventions. The tasks were scored as correct or incorrect production in obligatory contexts. The scoring was made by the fourth author (BS) and all the productive tasks were also scored by the first author. Inter-rater agreement was 95%. In the few cases where the scoring differed, the first and the second author listened a second time and consensus was reached through discussion.

Statistical analysis

Statistical group comparisons were conducted with a Mann-Whitney U-test if there were two groups and with a Kruskal-Wallis test if there were more than two groups. Correlations were calculated by means of Spearman's rho. All statistical calculations were made using the software program SPSS 15.0. The level of significance was set to $p<.05$. The post hoc procedure for the Kruskal-Wallis test was made according to Siegel and Castellan (33). This procedure involves taking the difference between the mean ranks of the different groups and comparing this to a value based on the value of *z* (corrected for the number of comparisons being done) and a constant based on the total sample size and the sample size in the two groups being compared.

Results

Children with LI scored below the children with TL on all of the tasks. Children with typically developing language (TL) performed almost at ceiling on all of the tasks (Figure 1), therefore it was not meaningful to conduct any statistical calculations on their results.

Children with LI omitted significantly more unstressed syllables across tasks, regardless of position, than children with typically developing language (TL) as measured with Mann-Whitney U test. For verb phrase, copula, copula+ indefinite article and the total number of unstressed syllables the difference was significant at the $p<.01$-level and for prepositional phrase, indefinite articles it was significant at the $p<.05$-level. The difference was not significant regarding pre-stressed syllables.

To explore the relationship between metrical pattern and linguistic function the proportion of pre-stressed syllables omitted in content words and the proportion of omitted copulas was

computed (task C). There was no difference in number of omissions of pre-stressed syllables whether these syllables were free-standing copulas or part of a content word (p=.546).

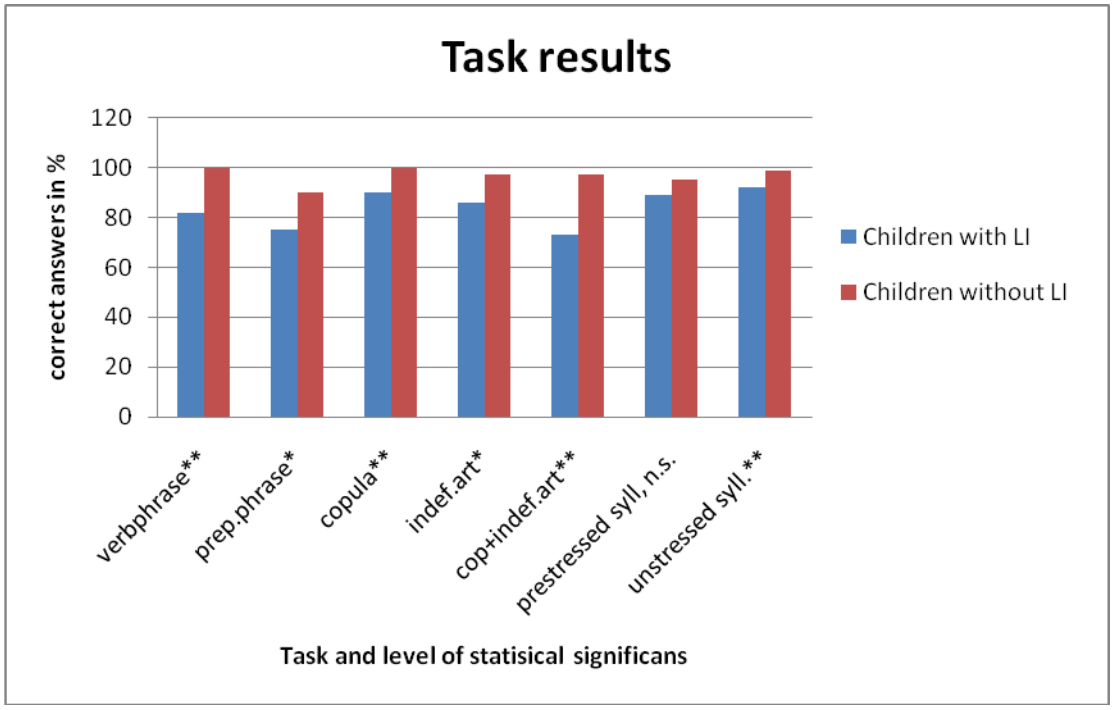

Figure 1. Results from the assessment procedure in percent. (*=p<.05; **=p<.01)

The ability to produce phrases with contrasting stress patterns was explored by comparing the difference in production of the same morpheme appearing in different positions in the phrase (stressed vs unstressed) and with different functions (preposition vs verb particle) (task A). The same morpheme from phrases with contrastive stress was not omitted significantly more often as an unstressed preposition versus as a stressed verb particle, as measured with Mann-Whitney U-test (p=.43).

The comparison between results on perception versus production of phrasal stress revealed that children with LI may be divided into three groups; a) children who perform better on perception than production, b) children who perform better on production than perception and c) children with rather poor results on both perception and production. As cut-off score for group a, two points better on perception than production was chosen; as cut-off score for

group b, two points better on production than perception was chosen and as cut-off score for group c, the same results or only one points difference between perception and production was chosen. In order to analyze data in further detail and also to determine statistic significance, a statistical analysis with Kruskal-Wallis H was performed. The tested abilities were chosen as analytic variables and the grouping variables were chosen from the distribution of test-results as described above. Post hoc analysis according to Siegel and Castellan (1988) was performed. These analyses showed that the difference between the three groups is statistically significant as regards production of unstressed syllables in total, perception of unstressed syllables in total and production of pre-stressed syllables. This means that group a) showed significantly poorer results than the other groups regarding production of unstressed syllables in total (H(2)9,34) and regarding production of pre-stressed syllables (H(2)8,81). This group also seemed to perform poorer than the other groups regarding production of copulas and indefinite articles, but this difference was not significant (Table 1a and b).

Group b) performed poorer than the other groups regarding perception of unstressed syllables (H(2)9,46). The children in this group also performed better than the other groups on all the productive measures except for production of copula, but this difference was not statistically significant. The results in group c) fell in between the other groups regarding all measures except for perception of phrasal stress in total and production of copulas, where the results were better than for the other groups (Table 1), however not to a level of significance.

In order to relate the results on the measurements of perception and production of stress to other linguistic measures and to non verbal IQ, Kruskal-Wallis analysis was made with linguistic measures and non-verbal IQ as analysis variables and the three groups as grouping

Table 1a. Number, mean, standard deviation and mean rank for each prosodic measure divided on subgroups of children with LI.

Prosodic Measure		N	M	Sd	Mean rank
Production of unstressed syllables in total	a	8	2,00	2,14	5,25
	b	10	7,00	1,49	19,55
	c	10	6,50	1,58	16,85
Perception of unstressed syllables in total	a	8	5,75	1,75	16,38
	b	10	3,70	2,26	9,10
	c	10	6,00	1,15	18,40
Production of copula	a	6	5,00	1,55	12,17
	b	10	5,40	0,84	13,40
	c	10	5,60	0,52	14,40
Production of indefinite article	a	6	2,50	0,55	11,25
	b	10	2,90	0,32	16,25
	c	10	2,50	0,70	12,10
Production of prestressed syllables	a	6	7,00	2,36	6,50
	b	10	10,00	0,00	17,00
	c	10	8,90	2,60	14,20

Table 1b. Statistics for Kruskal-Wallis H for each prosodic measure showing approximative chi-square, degrees of freedom and significance.

	Production of unstressed syllables in total	Perception of unstressed syllables in total	Production of copula	Production of indefinite article	Production of prestressed syllables
Chi-Square	15,584	7,381	,414	3,305	11,804
df	2	2	2	2	2
Asymp. Sig.	,000	,025	,813	,192	,003

variable. This analysis showed no statistically significant differences regarding these measures. However, there is a tendency towards group a) performing better regarding non-verbal IQ but worse regarding all the other measures, especially expressive grammar (Lumat) than the other groups (Table 2).

Table 2a. Number, mean, standard deviation and mean rank for each linguistic measure and non-verbal IQ, divided on subgroups of children with LI.

Measure		N	M	Sd	Mean rank
NVIQ	a	8	102,50	9,94	16,63
	b	10	97,70	11,14	13,70
	c	10	98,00	13,72	13,60
PPVT	a	8	62,50	7,17	12,06
	b	10	64,90	8,64	14,45
	c	10	66,70	7,973	16,50
Expressiv grammar (Lumat)	a	8	24,88	7,88	10,25
	b	10	31,80	10,40	16,55
	c	10	31,00	5,696	15,85
Language comprehension (SIT)	a	8	11,88	5,24	18,31
	b	10	8,80	6,90	12,60
	c	10	9,00	6,07	13,35
Phonology	a	8	2,50	1,06	15,50
	b	10	2,60	0,69	16,15
	c	10	2,10	0,99	12,05

Table 2b. Statistics for Kruskal-Wallis H for each measure showing approximative chi-square, degrees of freedom and significance.

	NVIQ	PPVT	Lumat	SIT	Phon
Chi-Square	,751	1,300	3,033	2,470	1,699
df	2	2	2	2	2
Asymp. Sig.	,687	,522	,219	,291	,428

a. Kruskal Wallis Test

b. Grouping Variable: Group

For group a,b and c together, i.e. all participants with LI, there was no significant correlation between production and perception of stress patterns. This was also the case for group a) and b) were there was no significant correlation (r=0.21, p=0.26). However, for group c) there was a significant correlation (r=0.85, p=.002). This means that for the subgroup of children with LI who perform at the same level regarding perception and production of stress patterns, there

is a relationship between perception and production of phrasal stress, but for the other two subgroups this relationship could not be demonstrated.

For the group of children with LI as a whole, there was no significant correlation between number of produced unstressed free morphemes and oral motor skills ($r = .196$, $p>.05$) as measured with ORIS. There was, however, a significant correlation between number of produced unstressed free morphemes and receptive grammar measured with a Swedish version of the T.R.O.G ($r = .37$, $p< .05$).

Discussion

The results from the present study showed that children with LI omitted unstressed syllables to a higher degree than children with typically developing language of the same age. No omissions of stressed syllables occurred. This is in accordance with previous research, both in Swedish and other languages (9, 3, 7, 25). The results of the present study also showed that unstressed syllables were omitted mainly in pre-stressed position, which also is in accordance with previous research (1, 3, 23).

The fact that there was no difference between the number of omissions of free-standing copulas on one hand, and pre-stressed syllables in content words on the other hand, suggest that omissions are governed by prosodic factors, rather than by linguistic content or complexity. This supports previous studies from Swedish-speaking children with LI (8), in which it was concluded that prosody was the main factor in omission of articles even though the authors also pointed out that lexical and grammatical factors also contributed to the likelihood of omission.

In the task containing contrastive stress (task A) it was revealed that neither stress nor position of morpheme had a significant influence on number of omissions. This finding may indicate that the children's difficulties regarding production of these phrases was not affected by stress pattern. The relationship between perception and production of phrases with different linguistic content depending on stress only (mannen skjuter PÅ en bil/the man shoots ON (pushes) a car vs. Mannen SKJUTER på en bil/ the man SHOOTS on a car) revealed three different subgroups of children with LI. The first, and the smallest, group had significant problems with production at all levels. However, they performed better (although non-significant) than the other children with LI regarding language comprehension as measured with SIT, and regarding non-verbal IQ. The results of this group contradict a close link between perception and production of stress proposed by Echols (9), but it also shows that significant constraints regarding language production inhibits correct repetition of phrasal stress in spite of having perceived the phrase correctly. This result also indicates that children with LI may not be able to make full use of prosodic bootstrapping (10).

The second group (b) had lower results than the other groups on perception than on production of stress patterns. This group also had lower results regarding language comprehension as measured with SIT, but somewhat better results than the other children with LI regarding expressive grammar and phonology. The fact that the production part of the test was a repetition task may have affected the results, since the examiner provided a rhythmical model that might have supported speech production. In addition, the reception task gives greater opportunities for guessing, since the children choose between three pictures. The latter problem is, however, always a dilemma when comparing receptive and expressive language tasks. Production permits more direct assessment than receptive tasks, which must be tested indirectly and in this case in a different mode. Nevertheless, the children in group b)

showed better results than the children in group a) regarding all expressive language measures (grammar, phonology and vocabulary), which indicates that these children really have perception of language as their predominant problem. For the first two groups (a and b) there was no significant correlation between the ability to repeat contrastive stress patterns and the ability to comprehend the different semantic content reflected by these patterns. This finding may indicate that other linguistic operations are involved in the production of contrastive phrasal stress than what is required for the ability to distinguish between phrases produced with contrasting stress patterns. However, it may also be that there are differences in ability, but that there were too few participants to detect these differences.

For the third group there was a significant correlation between perception and production of stress. These children also have limitations regarding grammar, language comprehension and phonology. This group also demonstrated the lowest results on non-verbal IQ, although all of them scored above 78. The results in this group fits nicely with the theories of a linkage between perception and production of prosody (9, 2) and also the models of general language processing limitations as an underlying factor of LI (22). For the children with LI as a whole group, i.e. all three subgroups together, there are significant correlations between the production of unstressed syllables and other language abilities, e.g. language comprehension, expressive grammar and phonology, which provides additional support for the notion of limited language processing capacities in children with LI. The fact that the participants in the present study had problems regarding expressive grammar and unstressed syllables, also give some support to the surface hypothesis which suggests that it is the combination of grammatical information and low perceptual salience of English verb morphemes that is particularly problematic for children with SLI to process.

The three sub-groups that emerged within the present study, fit well into the current classification ICD-10, i.e. expressive LI (group a), receptive LI (group b). Group c corresponds to general LI, which is a subgroup to receptive LI according to ICD-10. However, the results also points to the fact that these subgroups are interrelated. Classification of language impairment is always problematic, and Law (34:401) states "There is something so intrinsically appealing about the concept of a discrete language difficulty that many authors have overlooked that the defining of language impairment is at best an imprecise art that is still highly dependent on measurement of constructs about which we know so little". According to Bishop (35:322), "The pure, clear-cut categories described in textbooks bear little relation to clinical reality". The results of the present paper demonstrating the variability within the group of children with LI underlines the complexity of LI and its underlying factors. The results from the current paper contribute to the knowledge base necessary for the formulation of explanatory models and definitions of LI.

Conclusions

Swedish speaking children with LI omit more unstressed syllables at the phrase and sentence level than children with TL**.** The exploration of the relationship between perception and production of phrasal stress patterns demonstrated that the children with LI might be divided into three sub-groups: a) children who perform better on perception than production, b) children who perform better on production than perception and c) children whit rather poor results on both perception and production. Grammatical information may play an equally significant role as rhythmic information for the production of some structures. The fact that the task was a repetition task may have helped to provide a rhythmic model supporting production. Different operations or processing mechanisms may be involved in production and perception of contrasting stress patterns.

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Appendix
Assessment for metrical analysis

In this appendix the test material is directly translated from Swedish to English. Where the translation does not correspond to a correct or meaningful English phrase the closest corresponding phrase is given in parentheses.

Part A, Repetition: Verb particle vs. prepositional phrase; iambic vs. trochaic phrase patterns
Consists of 4 pairs of pictures with target phrases with contrasting stress depending on whether the phrase contains a verb particle or a prepositional phrase. The task is presented as a sentence repetition task.

Practice items:
Instructions to test administrator: say "First you just listen. Then I want you to say exactly what I do. If I didn't hear you I will ask you to repeat the phrase one more time."

1. Point and say: "Repeat after me"	a)	Mannen SKJUTER på en bil /The man SHOOTS on a car (=IS SHOOTING ON)/
2. Point and say: "Repeat after me"	b)	Flickan hoppar PÅ ett tåg /The girl jumps ON (=gets on) a train/
3. Point and say: "Repeat after me"	a)	Barnet TAR på en ryggsäck /the child TAKES (=touches) on a rucksack/

Part B, Reception: Verb particle vs. prepositional phrase; iambic vs. trochaic word patterns
Consists of 4 set of pictures with target phrases with contrasting stress and one foil. The task is presented as a receptive task

Examples:
Instructions to test administrator: say "Point to the picture I ask you to point to.

1. The test administrator points to the pictures and says: Mannen SKJUTER på en bil /The man SHOOTS on a car/
Mannen skjuter PÅ en bil /The man shoots ON (=pushes) a car
Mannen skjuter med en pil /The man shoots with an arrow/

Then the administrator says: point to	a)	The man shoots ON (=pushes) a car
Example of a set of pictures:	b)	The man SHOOTS on a car

2. The test administrator points to the pictures and says: Flickan HOPPAR på ett tåg /The girl JUMPS on a train/
Flickan hoppar PÅ ett tåg /The girl jumps ON (=gets on) a train/
Flickan hoppar av ett tåg /The girl jumps off (=gets off) a train/

Then the administrator says: point to a) The girl JUMPS on a train
b) The girl jumps ON a train

Part C: Indefinite article – definite form; iambic vs. trochaic syllable patterns
Consists of 5 pictures with one target phrase with indefinite article (pre stressed syllable) and one target phrase with definite form of the noun (post stressed syllable).The phrase with the indefinite article also comprises a copula. The task is presented as a sentence repetition task.

Examples:
Instructions to the test administrator: Name both pictures. Ask the child to repeat the second phrase. Say: "First I will talk about both pictures and you listen. Then I want you to repeat after me. If I didn't hear you I will ask you to repeat it one more time."

1. Där e en apa o där e en kaning /There is a monkey and there is a rabbit/.
Say: Där e en kanin /There is a rabbit/

2. Apan sover men kaninen äter /The monkey sleeps (=is sleeping) but the rabbit eats (=is eating)/.
Say: Kaninen äter /The rabbit eats/

3. Där e en tjuv o där e en polis /There is a thief and there is a policeman/.
Say: Där e en polis /There is a policeman/

Example of a picture: