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Word class and silent pauses in spoken narratives of children with specific language impairment

Relação entre pausas silentes e classe gramatical em narrativas de crianças com distúrbio específico de linguagem

ABSTRACT

Purpose: To determine whether word class has any influence on the mean duration of silent pauses in the spoken narratives of children with specific language impairment (SLI) and in those with typical language development (TLD). **Methods:** The study sample consisted of 60 children in the age range from 7 to 10 years: 20 with SLI; and 40 with TLD. Each child produced 15 narratives, each based on a set of four pictures (scenes) and each set of pictures being more complex than the last. The narratives were analyzed, and nouns, adjectives, verbs, conjunctions, prepositions, and pronouns were identified. A computer program was used in order to determine the duration (in milliseconds) of the silent pauses preceding words of each class. **Results:** In both groups, silent pauses were shortest before nouns and longest before conjunctions. For all word classes, the mean duration of silent pauses was longer in the SLI group than in the TLD group. **Conclusion:** Word class influences the duration of silent pauses, which are shorter before nouns and longer before conjunctions. Children with SLI produce longer silent pauses, possibly because of their language processing difficulties.

RESUMO

Objetivo: Verificar se há influência das classes gramaticais no tempo médio de pausas silentes durante a produção de narrativas em crianças em desenvolvimento típico de linguagem e em crianças com distúrbio específico de linguagem (DEL). **Métodos:** Participaram da pesquisa 20 crianças com DEL e 40 em desenvolvimento típico de linguagem com idade variando entre 7 e 10 anos. Cada sujeito elaborou 15 narrativas, baseadas em uma sequência de quatro cenas cada, com aumento gradual de complexidade. Após as análises das amostras foram identificados os substantivos, adjetivos, verbos, conjunções, preposições e pronomes. Num segundo momento, as amostras foram submetidas a um software para análise das pausas silentes (tempo em milissegundos), que permitiu o levantamento do tempo das pausas imediatamente anteriores a cada uma dessas categorias gramaticais. **Resultados:** Ambos os grupos apresentaram menor duração da pausa silente quando esta precedia os substantivos e maior quando esta precedia as conjunções. A análise estatística evidenciou que os grupos diferem em todas as classes de palavras, com média de pausas silentes maiores nas crianças com DEL. **Conclusão:** A classe gramatical influencia a duração da pausa silente, sendo esta menor quando precede substantivos e maior quando precede conjunções. Além disso, os indivíduos com DEL possuem pausas silentes mais longas possivelmente em decorrência de suas dificuldades com o processamento da linguagem.

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INTRODUCTION

Language acquisition is a complex process that occurs gradually and involves numerous skills, which range from the choice of words to be used and their correct linguistic formulation to the correct execution of motor acts leading to speech. Fluent speech depends on the activation of semantic, phonological, and syntactic information and is influenced by contextual information⁽¹⁾.

Speech disruptions can occur as a result of glitches occurring at any of the stages of language production. Speech disruptions are acceptable during language development, constituting a strategy used by speakers in order to gain more time for reformulating the phrase and planning the sentence⁽²⁾. In typically developing children, speech tends to become more fluent as linguistic structures are mastered, whereas in children with specific language impairment (SLI), this does not usually occur⁽³⁾.

Children with SLI show significant changes in the process of language acquisition and development when compared to other cognitive abilities. Therefore, linguistic deficits that cannot be attributed to hearing loss, motor neuron disease, mental disorders, or pervasive developmental disorders are suggestive of SLI^(4,5).

In children with SLI, there are significant changes in the process of language acquisition and development, the clinical manifestations of which include difficulty in learning new words, the use of simplistic, rote grammatical structures, and unorthodox word ordering⁽⁶⁾. Therefore, children with SLI have greater difficulty planning and organising their sentences; consequently, they produce more disfluencies than do typically developing children and continue to do so for longer as a result of their delayed and incomplete mastery of linguistic structures⁽³⁾.

Speech disruptions include silent pauses⁽²⁾, which are defined as stuttering-like disfluencies characterised by silent intervals that are ≥ 250 ms in duration. Speakers use silent pauses as a strategy to gain time for formulating their utterance without having to add unnecessary words or word fragments. Studies have shown that silent pauses are used when there is an overload of information related to linguistic processing, as well as that silent pauses can be used in order to maintain the prosody of the utterance^(7,8).

A recent study evaluated the types of silent pauses in 20 children with SLI and in 20 typically developing children, all of whom were fourth-grade students. The authors of the study reported that the children with SLI produced more such pauses than did their age-matched peers without SLI. However, when the children were paired by the level of linguistic development, the authors found no differences between those with and without SLI, demonstrating that a higher level of linguistic development translates to fewer silent pauses in speech⁽²⁾.

One longitudinal study of children with SLI at 8, 9, and 10 years of age⁽⁹⁾ showed that, between 8 and 9 years of age, there was a decrease in the mean number of long silent pauses (in both of two categories: 1,000-2,000 ms; and > 2,000 ms), whereas there was an increase in the mean number of

short silent pauses (250-500 ms). Qualitative analysis of speech disruptions showed that the use of filled pauses and interjections increased as the use of long pauses decreased, filled pauses and interjections being speech disruptions that are more socially acceptable⁽⁹⁾.

Recent studies have examined the relationships between the different word classes and speech disruptions, and there is evidence that such relationships are significant⁽¹⁰⁾. Children initially acquire open-class words (also known as content words), such as nouns, verbs, and adjectives. Subsequently, children master closed-class words (also known as function words), such as articles, prepositions, and pronouns. This is due to the fact that content words carry meanings that are more concrete and are more easily related to the context, whereas function words connect and establish relationships among words within a sentence and between sentences, being therefore more abstract⁽¹¹⁻¹⁵⁾.

Considering the differences between children with SLI and typically developing children in terms of lexical acquisition, we conducted the present study in order to determine whether open- or closed-class words (nouns, adjectives, verbs, conjunctions, prepositions, and pronouns) had any influence on the mean duration of silent pauses in the spoken narratives of such children.

METHODS

The study was approved by the Research Ethics Committee of the School of Medicine, Universidade de São Paulo (Protocol no. 1150/09), located in the city of São Paulo, Brazil. Written informed consent was obtained from the legal guardians of all children who met the criteria for inclusion in the study.

Study sample

The study sample consisted of 60 children (28 females and 32 males) in the age range between 7 and 10 years, who were divided into two groups: typical language development (TLD, $n=40$); and SLI ($n=20$). The groups were matched for age, and there were two children in the TLD group for every child in the SLI group.

The TLD group children were selected from among those studying at a state school located in the western region of the city of São Paulo, Brazil. The criteria for inclusion in the TLD group were as follows: being a native speaker of Brazilian Portuguese; performing within the expected range on imitation and picture naming tests⁽¹⁶⁾; testing within the expected range for phonological awareness, reading, and writing⁽¹⁷⁾; and showing age- and grade-appropriate academic performance, as confirmed by transcript analysis.

The criteria for inclusion in the SLI group were as follows: being a native speaker of Brazilian Portuguese; testing normal for non-verbal intelligence; being able to produce intelligible speech; and having been diagnosed with SLI. The diagnosis of SLI was based on scores below the expected range on at least two of the following: a vocabulary test⁽¹⁸⁾; a phonological test⁽¹⁶⁾; a pragmatic test⁽¹⁹⁾; and a mean length of utterance test⁽²⁰⁾.

Procedures

To collect the necessary data, we used 15 sets of four pictures (scenes), each set constituting a complete story⁽²¹⁾. The stories depicted gradually increased in complexity, from one picture set to the next, and were classified as mechanical, behavioural, or intentional, depending on the relationships among the characters.

During data collection, the participants were informed that each four-picture set constituted a complete story. Each child was asked to arrange the four pictures in a logical order and provide a narration, which was recorded with a digital recorder. Because short-term memory deficit could act as a confounder, skewing the results, the pictures remained visible to the children throughout their narratives.

The spoken narratives were transcribed. Subsequently, the recordings were visualised and acoustically analysed with Audacity software, version 1.3 Beta (Anderson Language Technology Center, University of Colorado, Boulder, CO, USA), which allowed us to measure the duration of each word uttered by the children and, consequently, the intervals (pauses) between words. This also allowed us to determine the word classes.

The resulting file was processed with a computer program developed specifically for a larger project of which the present study is part. The program calculates the duration (in milliseconds) of silent pauses preceding each word. The program generated a report for each of the 15 spoken narratives produced by each child in the study sample, showing the duration (in milliseconds) of the silent pauses preceding nouns, adjectives, verbs, conjunctions, prepositions, and pronouns.

Data analysis

We used descriptive and inferential statistics. Statistical analyses were performed with the Statistical Product and Service Solutions program, version 18.0 (SPSS Inc., Chicago, IL, USA), and the initial level of significance was set at 5%.

RESULTS

Typical language development

Our descriptive analysis revealed that, in the TLD group, the mean duration of silent pauses was shortest before nouns and longest before conjunctions (Table 1).

Friedman's ANOVA showed that word class had a significant influence on the mean duration of pauses ($\chi^2(5)=124.3$; $p<0.001$). In order to explore those findings, we used the Wilcoxon signed rank test with Bonferroni correction, eight designed effects being tested at a significance level of 0.006.

As can be seen in Table 2, Friedman's ANOVA ranked the word classes, in ascending order by the mean duration of silent pauses, as follows: nouns; adjectives; prepositions; verbs; pronouns; and conjunctions. We found that word class influenced the mean duration of silent pauses in the spoken narratives of the children in the TLD group.

Specific language impairment

Our descriptive analysis revealed that, in the SLI group, the mean duration of silent pauses was shortest before nouns and longest before conjunctions (Table 1). Friedman's ANOVA showed that word class had a significant influence on the mean duration of pauses ($\chi^2(5)=45.94$; $p<0.001$). In order to explore those findings, we used the Wilcoxon signed rank test with Bonferroni correction, 15 designed effects being tested at a significance level of 0.003.

As can be seen in Table 3, Friedman's ANOVA ranked the word classes, in ascending order by mean duration of silent pauses, as follows: nouns; adjectives; prepositions and verbs (equal ranking); pronouns; and conjunctions. We found that nouns and conjunctions were the only word classes that had a significant influence on the mean duration of silent pauses in the spoken narratives of the children in the SLI group.

Table 1. Descriptive analysis of the mean duration of silent pauses in children with and without specific language impairment, by word class

Word class	Group	Mean	Minimum	Maximum	SD	1st quartile	Median	3rd quartile
Noun	TLD	25.70	5.40	104.12	19.25	14.34	21.69	29.72
	SLI	67.22	29.28	163.85	37.22	44.27	55.90	72.89
Adjective	TLD	52.76	0.00	384.37	85.44	2.88	20.83	54.60
	SLI	190.74	0.00	1268.26	301.31	17.01	112.60	204.61
Verb	TLD	89.05	24.39	204.24	45.91	50.88	76.06	117.45
	SLI	185.71	65.06	387.64	94.90	104.79	172.95	273.78
Conjunction	TLD	309.45	21.35	1179.96	213.52	168.27	261.41	371.45
	SLI	478.10	58.22	1088.65	269.54	274.00	425.84	630.29
Preposition	TLD	75.76	2.91	341.86	72.26	28.53	56.95	84.12
	SLI	169.40	66.00	451.63	100.37	96.59	136.73	211.85
Pronoun	TLD	179.49	8.45	1493.95	245.50	50.39	94.88	219.28
	SLI	283.29	7.97	1106.25	271.01	101.18	214.75	363.53

Note: TLD = typical language development (n=40); SLI = specific language impairment (n=20); SD = standard deviation

Table 2. Analysis of the duration of silent pauses, comparing word classes, in the group of children with typical language development (n=40)

Word class	T	Z	p-value
Adjective vs. noun	281.00	-1.734	0.084
Preposition vs. adjective	259.00	-2.030	0.042
Preposition vs. verb	261.00	-2.003	0.045
Pronoun vs. verb	186.00	-3.011	0.002*
Pronoun vs. conjunction	77.00	-4.476	<0.001*
Preposition vs. noun	76.00	-4.489	<0.001*
Verb vs. noun	15.00	-5.309	<0.001*
Adjective vs. verb	181.00	-3.078	0.002*

* Significant values ($p \leq 0.006$) after Wilcoxon signed rank test with Bonferroni correction

Table 3. Analysis of the duration of silent pauses, comparing word classes, in the group of children with specific language impairment (n=20)

Word class	T	Z	p-value
Adjective vs. noun	55.0	-1.867	0.064
Adjective vs. verb	63.0	-1.568	0.123
Preposition vs. verb	90.0	-0.560	0.596
Pronoun vs. preposition	55.0	-1.867	0.064
Pronoun vs. conjunction	33.0	-2.688	0.006
Verb vs. noun	0.0	-3.920	<0.001*
Preposition vs. noun	7.0	-3.659	<0.001*
Pronoun vs. noun	8.0	-3.621	<0.001*
Preposition vs. adjective	76.0	-1.083	0.294
Pronoun vs. adjective	69.0	-1.344	0.189
Pronoun vs. verb	60.0	-1.680	0.097
Conjunction vs. noun	1.0	-3.883	<0.001*
Conjunction vs. adjective	25.0	-2.987	0.002*
Conjunction vs. verb	1.0	-3.883	<0.001*
Preposition vs. conjunction	6.0	-3.696	<0.001*

* Significant values ($p \leq 0.003$) after Wilcoxon signed rank test with Bonferroni correction

Comparison between the TLD and SLI groups

We used the Mann-Whitney test in order to compare the TLD and SLI groups in terms of the mean duration of silent pauses. We found that such pauses were, on average, longer in the SLI group than in the TLD group, for all word classes (Table 4).

DISCUSSION

In our study sample as a whole, the mean duration of silent pauses was shortest before nouns and longest before conjunctions. This finding might be due to the fact that open-class words, including nouns, are acquired earlier than are closed-class words, including conjunctions⁽²²⁾. Therefore, open-class

Table 4. Comparison between children with and without specific language impairment in terms of the mean duration of silent pauses, by word class (n=60)

Word class	Group	Mean	U	Z	p-value
All	TLD	23.51	120.5	-5.159	<0.001*
	SLI	44.48			
Noun	TLD	22.28	71.0	-4.383	<0.001*
	SLI	46.95			
Adjective	TLD	26.89	255.5	-2.267	0.023*
	SLI	37.73			
Verb	TLD	24.10	144.0	-4.014	<0.001*
	SLI	43.30			
Conjunction	TLD	26.30	232.0	-2.634	0.008*
	SLI	38.90			
Preposition	TLD	23.60	124.0	-4.328	<0.001*
	SLI	44.30			
Pronoun	TLD	27.28	271.0	-2.023	0.043*
	SLI	36.95			

* Significant values ($p \leq 0.05$) – Mann-Whitney test

Note: TLD = typical language development (n=40); SLI= specific language impairment (n=20)

words become consolidated in the lexical inventory of children before closed-class words do, and better established linguistic structures translate to a lower chance of producing speech disruptions^(2,23-26).

Because nouns constitute the most common word class in maternal speech, infants are exposed to nouns more than they are to other word classes^(14,27,28). This early and constant exposure to nouns strengthens the concept, phonology, and semantics of such words and therefore increases the ability of children to retrieve lexical items more easily and efficiently^(2,23,24).

Although language acquisition is atypical in children with SLI, it follows a certain hierarchy. Therefore, despite being acquired more slowly, nouns are the word class that is most easily used, given that they have quite concrete meanings⁽²⁰⁾. This delayed acquisition of nouns can be due to impaired symbolic functioning – which influences the categorization of the semantics of such words – or to deficits in phonological processing – which could hinder the phonological representation of such words and, consequently, their retrieval from the working memory⁽¹⁴⁾. Therefore, children with SLI require intense, constant exposure to nouns so that such words become satisfactorily consolidated in their lexical inventories⁽²⁰⁾, and it is understandable that, in the present study, the mean duration of silent pauses was shortest before nouns.

Conjunctions connect words and clauses through relationships of dependence and interdependence. Conjunctions can be coordinating or subordinating, depending on the syntactic relationship between terms, and speakers must master the morphosyntactic features of a given language in order to be able to use conjunctions correctly⁽²⁹⁾. Conjunctions are therefore more complex than are nouns⁽²⁹⁾. In the present study, the children in both groups had more difficulty using conjunctions than they

did using nouns, as evidenced by longer silent pauses before conjunctions.

Children with SLI have other language processing deficits and therefore have even more difficulty than do typically developing children in understanding how and why conjunctions are used. Consequently, children with SLI seldom use conjunctions in their speech, and, when they do, they tend to use those that are simpler, such as “and”⁽²⁹⁾. Because conjunctions require more language processing than do nouns, the pauses preceding conjunctions are far longer than are those preceding nouns.

In the present study, the mean duration of the silent pauses preceding verbs was found to be similar to that of those preceding prepositions. This is probably due to the peculiarity of verbs, which, despite being open-class words, have complex and dynamic lexical features. Because verbs carry less concrete meanings than do nouns (therefore being more difficult to understand) and require conjugation, they are acquired more slowly and gradually than are nouns, especially by children with SLI, who have numerous language processing difficulties. It is therefore understandable that pauses preceding verbs are relatively longer than are those preceding other open-class words; verbs need to be adjusted to the context and syntax in question and therefore require greater planning before being uttered^(14,27,28,30).

For all of the word classes under study, silent pauses were longer in the SLI group than in the TLD group because children with SLI have difficulty retrieving lexical items and require greater exposure to words in order to be able to acquire them. This clearly shows that children with SLI have difficulties with linguistic formulation in narrative tasks⁽²⁰⁾.

The results of the present study show an intrinsic relationship between the acquisition and use of word classes and their impact on fluent speech in children, with and without SLI. Our results also show the differences between the two groups of children in terms of the linguistic processing of word classes.

In addition, our results allow us to gain a deeper understanding of silent pauses in the narratives of children with and without SLI, silent pauses being always longer in the narratives of the children in the former group. This shows why, despite therapeutic interventions aimed at increasing their knowledge of the language, language difficulties persist in children with SLI, who are consequently less effective communicators than are their age-matched peers. Our results can help guide the diagnostic evaluation of children with language development disorders, as well as furthering the development of therapeutic interventions for language development disorders.

Although only a few word classes were investigated, the present study represents a first step toward a deeper understanding of silent pauses in the speech of children with SLI in Brazil. Further studies are needed in order to investigate children with and without SLI in terms of their mastery of the remaining word classes in Brazilian Portuguese.

CONCLUSION

Word class influences the duration of silent pauses in typically developing children and in children with SLI, the

latter producing longer silent pauses, possibly because of their language processing difficulties. In children with and without SLI, silent pauses preceding nouns are shorter than are those preceding conjunctions. Therefore, linguistic elements clearly have a direct influence on fluent speech.

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** LBB and PRP were responsible for data tabulation and analysis; AMC was responsible for the statistical analysis and contributed with the interpretation of the findings. DMBL was responsible for supervising, reviewing and adjusting the final project. All authors participated in the discussion of all stages and findings of the study, as well as in the manuscript elaboration.*

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