Story complexity and silent pauses in children with and without specific language impairment

Complexidade da história e pausas silentes em crianças com e sem distúrbio específico de linguagem

ABSTRACT

Purpose: To verify the average time of silent pauses in narratives and the influence of story complexity over the occurrence of these pauses in narratives produced by children with typical language development and children with specific language impairment (SLI), and to compare these aspects between the groups. Methods: Sixty children aged between 7 and 10 years participated in this study. Forty presented typical language development and 20 had SLI. For the purposes of data collection, each child produced 15 narratives, each one based on a four-scene sequence. These narratives showed an increasing complexity in the relations between the characters, from the absence of intentionality (mechanical and behavioral sequences) to relations between characters with the attribution of mental states (intentional sequences), which allowed the survey of the average time of silent pauses in the narratives. Results: Story complexity influenced the average time of silent pauses in the narratives of children with typical language development. However, this pattern was not observed in the children with SLI. The comparison between the groups indicates a significant difference perceived in all types of narratives, with the highest average in the group with SLI. Conclusion: Due to their linguistic impairment, the children with SLI presented longer silent pauses in their narratives. Story complexity influenced the average time of silent pauses in the narratives of children with typical language development, but this difference did not occur in the narratives of children with SLI.

RESUMO

Objetivo: Verificar o tempo médio das pausas silentes em narrativas e a influência da complexidade da história na produção destas pausas nas narrativas de crianças em desenvolvimento típico de linguagem e em crianças com DEL; além de comparar estes aspectos nos dois grupos. Métodos: Participaram do estudo 60 crianças, entre sete e dez anos, sendo 40 em desenvolvimento típico de linguagem e 20 com DEL. Para a coleta de dados foi utilizada uma série de 15 histórias, representadas por figuras, compostas por quatro cenas cada. As histórias apresentam complexidade crescente a partir das relações entre os personagens, desde ausência de intencionalidade (sequências mecânicas e comportamentais) até relações entre os personagens com atribuição de estados mentais (seqüências intencionais), possibilitando o registro do tempo médio das pausas silentes produzidas nas narrativas. Resultados: A complexidade da história influiu no tempo médio de pausas silentes nas narrativas das crianças em desenvolvimento típico de linguagem, porém, para as crianças com DEL não foi observado tal padrão. A comparação entre os grupos indica diferença significativa em todos os tipos de narrativas, com maior média no grupo com DEL. Conclusão: As crianças com DEL, devido ao seu comprometimento linguístico, apresentaram pausas silentes mais longas em suas narrativas. A complexidade da história influenciou o tempo médio da pausa silente durante a produção das narrativas das crianças em desenvolvimento típico de linguagem, porém esta influência não ocorreu nas narrativas das crianças com DEL.
INTRODUCTION

Narrative production requires coordination between morphosyntactic and semantic abilities within a system that encompasses pragmatic aspects and cultural convention, which, in turn, influence how information is presented to the listener\(^{(4)}\).

In order to produce speech fluently, semantic, phonological, and syntactic information must be accessed in harmony with contextual information\(^{(2)}\), and several vocal tract parts must be activated in a smooth and precise manner\(^{(3)}\). Therefore, when flaws occur in this process, production fluency is interrupted, which then causes ruptures in speech\(^{(4)}\).

In typical language development, the occurrence of speech ruptures may be related to an imbalance between syntactic and lexical abilities during specific periods of development\(^{(6)}\), and the appearance of more complex structures on the course of grammar acquisition, especially in relation to structures that have not been fully comprehended by the child\(^{(7)}\). These structures are then used as processing strategies with the purpose of gaining time or correcting mistakes during the production of sentences\(^{(4,7,8)}\).

During lexical development, the initial representation of semantic and phonological aspects of unknown words is incomplete and limited, and it requires further experiences to be strengthened\(^{(9,10)}\). However, the more experience a child has with an unknown word, the stronger its phonological and semantic representations become. This child will employ less effort to access the word in his/her memory, consequently producing less speech ruptures\(^{(5,10,11)}\).

Among these ruptures, the silent pause, a stuttering rupture characterized by a silence period that lasts 250 ms or longer, is pointed in the literature as a strategy to gain time during the formulation of enunciation without resorting to the addition of more words to the speech. It usually occurs when there is an overload of information related to linguistic processing or when the speaker encounters difficulties to formulate concepts, and to activate and retrieve syntactic, semantic, and lexical patterns\(^{(4)}\).

Children with specific language impairment (SLI) produce shorter enunciations than individuals in typical development, which indicates that they utilize simpler structures in order to communicate. These children have a linguistic impairment that cannot be attributed to hearing deficiencies, neuromotor dysfunction, mental deficiencies, or invasive developmental disorders\(^{(12,13)}\).

The analysis of narrative components produced by children with SLI confirms that they are deficient in linguistic aspects that precede expressive elaboration. They also take longer to learn their mother tongue, and also face difficulties in literacy\(^{(14)}\).

In general, these children suffer a significant overload on linguistic information processing when submitted to tasks that require more complex and extensive production. This overload is explained by the important early lexical deficits that linger throughout development, especially in relation to closed words, flaws in the formation of grammatical rules, and derailments in phonetic and phonological systems during the formation of morphological rules\(^{(15)}\).

Thus, children with SLI present deficits in speech elaboration due to a limited knowledge of language structure, difficulties with textual organization, comprehension of temporality and cause-effect relations, and limited structural knowledge. Therefore, they produce narratives that are more rudimentary in comparison to children of the same age undergoing typical language development, regardless of the type of story provided\(^{(16)}\).

In light of this, the present study aimed at verifying the average time of silent pauses in narratives, and the influence of story complexity over the production of these pauses in the narratives of children with typical language development and children with SLI, in addition to comparing these aspects between both groups.

METHODS

This project was approved by the Ethics Committee of the Universidade de Sao Paulo (USP)’s School of Medicine, protocol 1150/09. The children’s legal guardians signed the Informed Consent.

Forty children undergoing typical language development (18 boys) and 20 with SLI (14 boys), aged between 7 and 10 years, participated in this study. The individuals were paired based on their age. Each participant in the SLI group was allocated with two participants in the typical development group. All individuals resided in the city of Sao Paulo and attended public school.

The selection of individuals undergoing typical language development was conducted at a public school located in the western portion of the city of Sao Paulo. Initially, all of them were individually triaged during regular class periods and in a room reserved for this study.

The inclusion criteria for the typical development group were: absence of complaints related to language development, attending classes in a regular group compatible with the child’s age, absence of productive phonological processes or idiosyncratic errors in the imitation and nomination phonological test\(^{(17)}\), and performance in tasks that involve phonological awareness, reading, and writing that correspond to what is expected for the age range\(^{(18)}\).

The individuals in the SLI group were attending weekly appointments with speech-language pathologists and audiologists, and had been previously diagnosed based on international criteria as presenting exclusively linguistic deficit and normal intellectual quotient\(^{(12)}\). In order to receive this diagnosis, the children needed to present preserved hearing and results lower than expected in at least two standardized language tests, in the ABFW children’s language evaluation protocol\(^{(19)}\), and in the evaluation of average length of enunciation\(^{(15)}\). The shortest time of speech therapy for these individuals was 6 months and the average was 3 years.

For data collection, we used a series of 15 stories, represented through images and composed of four scenes each. They
were classified according to the relations among the characters, and their complexity was increased gradually\textsuperscript{(20,21)};

- Mechanical 1: objects interacting casually with one another;
- Mechanical 2: people and objects interacting casually with one another;
- Behavioral 1: a person acting in routinely situations that do not require the involvement of mental states;
- Behavioral 2: a person acting in routinely social situations involving more than one person, and that do not require the involvement of mental states;
- Intentional: a person acting in daily activities that require the involvement of mental states.

During data collection, we explained to the participants that the sequence of four pictures composed a story. The first image was presented to the child and he/she was required to organize the others and narrate the ensuing story. In case the pictures were not sorted in the usual manner, the researcher wrote down the order that was used, given that all the children would then elaborate stories that were compatible with their understanding of the sequence. In order to eliminate possible variables, the images were visible to the child during the entire time he/she needed to compose the narrative. Data related to the organization of the scenes were not considered in this stage of the study.

Each story narrated was transcribed and submitted to an analysis of silent pauses with the use of software that was specifically devised for this purpose. It generated a report with the value of each silent pause (in ms). As a result, we obtained a survey of the time length (in ms) of the pauses that immediately preceded each word of each narrative.

In order to achieve the aim of this study, we conducted a statistically descriptive and inferential analysis through the software SPSS version 18. Friedman’s ANOVA and Wilcoxon’s signed-rank test were used to verify the influence of story complexity over the average time of silent pauses. The test of Mann-Whitney was utilized to compare the average time of silent pauses between the groups. The initial significance level adopted was 5%.

RESULTS

To facilitate the comprehension of the results, we will first present the performance of each group followed by the comparison between them.

### Typical language development

The descriptive analysis obtained based on the average time of silent pauses in each story reveals that the lowest average occurred in the intentional stories, and the highest occurred in the mechanical 1 type (Table 1).

Friedman’s ANOVA indicated that the type of story significantly influences the average pause time ($\chi^2(4)=21.58$, $p<0.001$).

In order to ascertain these findings, we utilized Wilcoxon’s tests with the application of Bonferroni’s correction, and tested 10 planned effects with a significance level of 0.005.

The ranking resultant from Friedman’s ANOVA organized the types of story according to the average time of silent pauses, from the shortest to the longest, as follows: intentional–mechanical 2, behavioral 2, mechanical 1, and behavioral 1 (Table 2).

These results indicate that there is no statistical difference between the story types mechanical 1 and behavioral 1; mechanical 2 and behavioral 2; and mechanical 2 and intentional. Therefore, it was possible to verify that the type of story influences the average time of silent pauses during the production of narratives by children undergoing typical language development.

### Specific language impairment

In order to verify the influence of story types, the descriptive analysis obtained from the average time of silent pauses reveals that the lowest average occurred in the stories of intentional type, and the highest in the stories of behavioral type 1 (Table 3).

Friedman’s ANOVA indicated that the type of story does not interfere significantly with the average pause time ($\chi^2(4)=14.24$, $p=0.007$). The ranking organized the types of story from the shortest to the longest average time of silent pauses as follows: mechanical 1, behavioral 2, intentional, mechanical 2, and behavioral 1.

It was possible to verify that the type of story does not influence the average time of silent pause significantly during the production of narratives by children with SLI.

### Comparison between the average performances of the groups

The comparison between the groups indicates differences in all types of narratives with the highest average in the SLI group (Table 4).

#### Table 1. Descriptive analysis of the average pause time for each story type in the typical language development group

<table>
<thead>
<tr>
<th>Story type</th>
<th>Mean</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Standard deviation</th>
<th>25th percentile</th>
<th>Median</th>
<th>75th percentile</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mechanical 1</td>
<td>125.43</td>
<td>18.58</td>
<td>589.05</td>
<td>108.49</td>
<td>67.72</td>
<td>92.43</td>
<td>163.20</td>
</tr>
<tr>
<td>Mechanical 2</td>
<td>94.73</td>
<td>15.62</td>
<td>443.76</td>
<td>73.65</td>
<td>48.74</td>
<td>78.35</td>
<td>112.13</td>
</tr>
<tr>
<td>Behavioral 1</td>
<td>115.80</td>
<td>23.04</td>
<td>358.68</td>
<td>65.93</td>
<td>73.61</td>
<td>101.11</td>
<td>151.17</td>
</tr>
<tr>
<td>Behavioral 2</td>
<td>90.73</td>
<td>12.77</td>
<td>272.63</td>
<td>47.93</td>
<td>57.18</td>
<td>88.43</td>
<td>106.89</td>
</tr>
<tr>
<td>Intentional</td>
<td>89.23</td>
<td>25.73</td>
<td>286.99</td>
<td>48.91</td>
<td>56.84</td>
<td>87.42</td>
<td>104.44</td>
</tr>
</tbody>
</table>
Table 2. Comparison between the story types in the typical language development group

<table>
<thead>
<tr>
<th>Comparisons</th>
<th>T</th>
<th>z</th>
<th>R</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mechanical 2 x Mechanical 1</td>
<td>165.00</td>
<td>-3.293</td>
<td>-0.37</td>
<td>0.001*</td>
</tr>
<tr>
<td>Behavioral 1 x Mechanical 1</td>
<td>399.00</td>
<td>-0.148</td>
<td>-0.02</td>
<td>0.889</td>
</tr>
<tr>
<td>Behavioral 2 x Mechanical 1</td>
<td>202.00</td>
<td>-2.796</td>
<td>-0.31</td>
<td>0.004*</td>
</tr>
<tr>
<td>Intentional x Mechanical 1</td>
<td>206.00</td>
<td>-2.742</td>
<td>-0.31</td>
<td>0.005*</td>
</tr>
<tr>
<td>Behavioral 1 x Mechanical 2</td>
<td>172.00</td>
<td>-3.199</td>
<td>-0.36</td>
<td>0.001*</td>
</tr>
<tr>
<td>Behavioral 2 x Mechanical 2</td>
<td>377.00</td>
<td>-0.444</td>
<td>-0.05</td>
<td>0.666</td>
</tr>
<tr>
<td>Intentional x Mechanical 2</td>
<td>366.00</td>
<td>-0.591</td>
<td>-0.07</td>
<td>0.563</td>
</tr>
<tr>
<td>Behavioral 1 x Behavioral 1</td>
<td>171.00</td>
<td>-3.212</td>
<td>-0.36</td>
<td>0.001*</td>
</tr>
<tr>
<td>Behavioral 1 x Behavioral 2</td>
<td>136.00</td>
<td>-3.683</td>
<td>-0.41</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td>Intentional x Behavioral 2</td>
<td>379.00</td>
<td>-0.417</td>
<td>-0.05</td>
<td>0.685</td>
</tr>
</tbody>
</table>

*Significant values (p≤0.05) – Wilcoxon’s signed-rank test

Caption: T = statistic for Wilcoxon’s signed-rank test; z = data point expressed in standard deviation units; R = effect size

Table 3. Descriptive analysis of average pause time by story type in the group with specific language impairment

<table>
<thead>
<tr>
<th>Story type</th>
<th>Mean</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Standard deviation</th>
<th>25th percentile</th>
<th>Median</th>
<th>75th percentile</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mechanical 1</td>
<td>209.65</td>
<td>37.39</td>
<td>525.06</td>
<td>128.27</td>
<td>97.55</td>
<td>174.08</td>
<td>318.69</td>
</tr>
<tr>
<td>Mechanical 2</td>
<td>197.54</td>
<td>55.94</td>
<td>474.50</td>
<td>101.01</td>
<td>116.39</td>
<td>174.02</td>
<td>244.48</td>
</tr>
<tr>
<td>Behavioral 1</td>
<td>247.83</td>
<td>102.56</td>
<td>754.97</td>
<td>147.46</td>
<td>154.88</td>
<td>201.52</td>
<td>307.41</td>
</tr>
<tr>
<td>Behavioral 2</td>
<td>199.91</td>
<td>62.52</td>
<td>503.94</td>
<td>103.27</td>
<td>119.04</td>
<td>198.88</td>
<td>239.08</td>
</tr>
<tr>
<td>Intentional</td>
<td>194.74</td>
<td>42.12</td>
<td>408.43</td>
<td>88.23</td>
<td>116.48</td>
<td>194.64</td>
<td>251.00</td>
</tr>
</tbody>
</table>

Table 4. Comparison of average pause time between the groups by story type

<table>
<thead>
<tr>
<th>Story type</th>
<th>Group</th>
<th>Average</th>
<th>z</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mechanical 1</td>
<td>Control</td>
<td>25.88</td>
<td>-2.901</td>
<td>0.004*</td>
</tr>
<tr>
<td></td>
<td>Research</td>
<td>39.75</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mechanical 2</td>
<td>Control</td>
<td>23.33</td>
<td>-4.548</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td></td>
<td>Research</td>
<td>45.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Behavioral 1</td>
<td>Control</td>
<td>23.33</td>
<td>-4.501</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td></td>
<td>Research</td>
<td>44.85</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Behavioral 2</td>
<td>Control</td>
<td>23.38</td>
<td>-4.469</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td></td>
<td>Research</td>
<td>44.75</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intentional</td>
<td>Control</td>
<td>23.00</td>
<td>-4.704</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td></td>
<td>Research</td>
<td>45.50</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Significant values (p≤0.05) – Mann-Whitney’s test

Caption: z = data point expressed in standard deviation units

DISCUSSION

After comparing the performance of children with typical language development to children with SLI, we perceived that the average of silent pauses was higher in the second group.

Considering that silent pauses tend to occur when the speaker encounters difficulties during the formation of concepts or in the retrieval of linguistic structures during speech production(22), this result allows us to affirm that, in the SLI cases, the occurrence of longest pauses confirms the fragility of language processing(4,5).

This group needs to put more effort into tasks that involve linguistic production than children undergoing typical language development. Therefore, the duration of silent pauses is longer in this population, which reinforces an overload upon the linguistic system(4,23).

The investigation of the average time of silent pauses indicated that the lowest average occurred in the stories of the intentional type in both groups, a finding that differs from what we initially supposed due to the fact that this story type involves the attribution of mental states.

The comparison between these groups also allowed us to verify that an increase in the complexity of the story influences the occurrence of silent pauses only in the narratives produced by children without language alterations. A possible explanation for this finding rests on the fact that the SLI population experiences difficulties to describe pictures, stick to the conversational topic, organize events in a sequence, and to formulate explanations, abilities that are intrinsically related to narrative skills(24).

Nevertheless, it is interesting to note that the children undergoing typical language development presented shorter silent pauses during the elaboration of intentional and mechanical 2 narratives. We expected the pauses to be shorter in the mechanical narratives, because they are less complex and involve simple casual interaction between people and/or objects, and longer in the intentional narratives, which are more complex because they involve the attribution of mental states to people performing daily activities(20).

This finding can be explained by the fact that the individuals in this study were between 7 and 10 years of age, a period in which important linguistic acquisitions determine the refinement of narrative skills. Therefore, although the intentional narrative is considered a complex typology, it is possible that the short duration of the pauses was influenced by the simplification of the narrative elaborated by the participants on one hand, but also by the fact that they are used to reporting daily events that involve intentionality, which supposedly eases its complexity(25,26).

In the case of children with SLI, the absence of this influence suggests that they have more encompassing difficulties that are not limited to complexity, given that the elaboration of narratives amounts to a complex task that integrates several linguistic abilities simultaneously. Indeed, it is difficult for these children to deal with pragmatic aspects related to the identification of the main topic of conversations and stories(24), and with linguistic aspects related especially to expressive elaboration. Such difficulties compromise speech significantly, since linguistic shortcomings are expressed in various ways,
from a limited vocabulary to the arduous comprehension and mastery of linguistic rules\(^{13,16}\).

In a previous study conducted with the same population, it was verified that the SLI group made more mistakes to organize the pictures chronologically, but this difference occurred only for the mechanical and intentional narratives\(^{27}\). Considering that the longest pauses in this group occurred in behavioral narratives, it is not possible to establish direct causal relations, but it is necessary to carry out a more detailed investigation with the purpose of clarifying if the organization of the pictures can interfere with speech fluency in this group.

These findings suggest, therefore, that the population in question might encounter difficulties to establish dialogues, because their impaired conversational skills, along with increased disfluencies, tend to cause interlocutors to lose interest in the message. Thus, it is important that speech-language pathologists and audiologists also take social skills into consideration during the rehabilitation process of patients with alterations in language, and seek to develop strategies that help children to become more active speakers.

Moreover, it is interesting to point out that speech fluency was an efficient aspect in distinguishing these groups, even though that was not the main objective of this study. Lastly, future studies that clarify the relation between story complexity, the occurrence and duration of silent pauses, and the characteristics of the narratives elaborated by the individuals in both groups can aid in a deeper comprehension of the absence of this influence in individuals with SLI, and also elucidate ways to intervene in this population.

**CONCLUSION**

Due to linguistic compromising, the children with SLI presented longer silent pauses in their narratives. The complexity of the stories influenced the average time of silent pauses during the production of narratives by children undergoing typical language development, but this influence did not occur in the case of children with SLI.

\*PRP and LBB were responsible for data collection and tabulation; AMCA supervised data collection and collaborated in data analysis; DMBL was responsible for the project, study outline, and overall supervision of the stages of manuscript execution and elaboration.

**REFERENCES**


