

# THE USE OF REPAIR STRATEGIES IN THE COMPLEX ONSET CONSTITUENT: NORMAL PHONOLOGICAL DEVELOPMENT AND PHONOLOGICAL DISORDER

## *O uso de estratégias de reparo no constituinte onset complexo: desenvolvimento fonológico normal e desviante*

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### ABSTRACT

**Purpose:** to describe and to analyze the repair strategies used by children with normal phonological acquisition and phonological disorder in the complex *onset* syllable constituent, in order to examine the similarities as well as the differences in the studied groups. **Method:** the analysis included speech data from 60 children with normal acquisition, 30 male and 30 female, in addition to 84 children with deviation, 53 male and 31 female. The age in the normal group was between 1:0 and 4:0, whereas in the deviation group it was between 3:0 and 11:0. The variables age, gender, preceding and following context, obstruent of complex *onset*, kind of liquid of complex *onset*, tonicity, number of syllables and position in the word were considered. Then, the data were submitted to statistical analysis in the VARBRUL program. **Results:** the children with normal acquisition and deviation used the following resources, respectively: simplification strategies for C<sup>1</sup>V (93%; 77%), alteration of the obstruent feature (5%; 17%), alteration of the liquid feature (1%; 5%), epenthesis (1%; 0%) and metathesis (0%; 1%). The variables tonicity, preceding context and position in the word were not relevant to the study. **Conclusion:** the most frequent resource was the simplification for C<sup>1</sup>V in both groups, but other strategies were applied, mainly in the deviation group. Considering the influence of the variables, it was possible to conclude that the variables: age, gender, kind of obstruent, kind of liquid of complex *onset*, following context and number of syllables influenced the studied resources.

**KEYWORDS:** Speech; Language Development; Child Language; Speech Disorders

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### ■ INTRODUCTION

During the phonological development, children can become confused when they face the phonological system which is used in their environment. Consequently, they start using some resources in order to simplify their productions in a movement to adapt the output to their capacities.

The used “resources” are also called repair strategies, and they are related to segments children use to replace other segments and/or syllable structure which they do not know or do not command <sup>1</sup>. These strategies are observed during typical and atypical phonological acquisition, but with chronological difference. It means that the use

of strategies can be prolonged when the phonological acquisition is atypical<sup>2</sup>.

Besides, the used repair strategies can be related to the difficulties the child is facing and they can show the child's own speech awareness<sup>3</sup>. So, children with atypical phonological development have, in general, an inferior level of metalinguistic awareness when compared to children with typical phonological development<sup>4</sup>.

Regarding the type of repair strategy used by children, some studies which describe the Brazilian Portuguese phonology detect that the word and syllable position is relevant to verify the type of alteration which will happen<sup>5-7</sup>.

In relation to the complex onset syllable constituent, some researchers observed that it is the last syllable structure to be settled into the phonological system<sup>8,9</sup>. Other studies<sup>7,10-13</sup> detected that the complex onset simplification is the most adopted strategy for this constituent. However, other resources are also observed, such as alteration of the obstruent feature, metathesis, epenthesis, etc. When the acoustic analysis was used, the use of compensatory lengthening, which is the prolonged time in the production of a segment when compared to the adult target, is evidenced<sup>8</sup>.

Some authors<sup>7,11,13,14</sup> perceived that there is a tendency of children with atypical phonological development to use the same repair strategies as younger children with typical phonological development.

The typical phonological acquisition can be defined as the one with spontaneous phonological control, into an age group which is common for most children. So, there is the settlement of a phonological system which coincides with the adult phonological system<sup>1,15</sup>. However, during the phonological acquisition process there are some regressions of use, as for typical as for atypical phonological development<sup>16</sup>.

When the child's phonological performance is lower than what is expected, it can be a case of atypical phonological development, which is disorganization, inadaptation or abnormality of the children's phonological system in relation to their linguistic community target, when there are no organic dysfunctions<sup>17,18</sup>. There is difficulty of mental organization and adaptation to the received input<sup>1,15</sup>. Although the atypical phonological development cause is not clearly defined, it is described as sounds production alterations and improper use of the language phonological rules<sup>19</sup>.

The phonological disorders can be distinguished in terms of severity, according to the used repair strategies, observing if the resource presents or not

some type of phonological knowledge regarding the target phoneme<sup>6</sup>.

In this context, the purpose of this study is to describe and to analyze the use of repair strategies by children with typical and atypical phonological development, regarding the complex onset syllable constituent, in order to verify similarities and differences in the use of the resources by children of different groups.

## ■ METHOD

This study is speech data analysis, cross-sectional, qualitative-quantitative.

Speech data of 60 children with typical phonological development, 30 male and 30 female, and 84 subjects with atypical phonological development, 53 male and 31 female were used. The ages of the children with typical phonological development varied between 1:0 and 4:0, and atypical, between 3:0 and 11:0.

The selection criterion to define the minimal age for children with typical phonological development was based on studies about language acquisition, which show that children with one year old start their first productions. So, it was adopted this age aiming at investigating the use of repair strategies since their emergence.

Regarding the highest age, previous researches mention that the age of 4:0 is the phonological development peak, because during this period it is clear to observe the consonant domain which the children possess related to their native language.

Related to the children with atypical phonological development, the minimal established age was three years old, because in this period it is possible to observe that the child's phonological development is not the normal for his/her age, what characterizes the atypical phonological development. The ceiling set was 11 years old, because it was used the higher number of subjects which was possible from the atypical phonological development data basis.

It is important to mention that the children with atypical phonological development aged above nine years old were evaluated, in order to reject cases of speech alterations called "residual speech sound errors". According to some studies about American English acquisition<sup>20,21</sup>, children who are not able to produce all the phonological inventory of their language when they are nine years old present "residual speech sound errors". These children misarticulate some phonemes, such as /s, z, r, l/. The errors are usually related to phonemes distortion, but they can also involve substitutions and omissions.

All sample subjects are monolingual Brazilian Portuguese speakers.

The data from the atypical phonological development group was obtained through cross-sectional attendance, and monthly interviews with 15 to 45 minutes, depending on each child's tolerance.

The data collection had the purpose to elicit speech and spontaneous naming from the children and/or, eventually, the delayed imitation. To do this, some toys which represent the word list from the *Phonological Assessment of Child Speech*<sup>22</sup> were used. They also represent list of words which oppose the syllable structures CCV X CV e CVC X CV.

The speech samples of the children with atypical phonological development were cross-sectionally obtained. Only each child's initial evaluation was used. For the data collection, the *Phonological Assessment of Child Speech* with all five thematic pictures was used.

Besides, the subjects with atypical phonological development were submitted to speech language hearing evaluations, including the expressive and comprehensive language, stomatognathic system, hearing discrimination, voice, phonology and auditory evaluations. The children were also submitted to complementary evaluations such as otorhinolaryngologic and neurologic.

After the recordings, the speech data of the children with typical and atypical phonological development were transcribed and reviewed by two professionals with experience in phonetic transcription. When there was no agreement about the transcribed words, these words were rejected, so the data were more reliable.

It is important to emphasize that the people who transcribed the speech data from the children with typical phonological development were experienced in acoustic analysis, and, possibly, they have more refined auditory perception than people without this experience.

The inclusion criteria for the group with typical phonological development were: to present typical phonological development; to be aged between 1:0 and 4:0, male and female. The subjects who were submitted to speech language hearing treatment before the data collection; with auditory alterations; and with neurologic, psychological, and cognitive alterations were excluded.

Regarding the children with atypical phonological development, the inclusion criteria were: to be diagnosed with atypical phonological development; to be aged between 3:0 and 11:0, male and female. As for the subjects with typical phonological development, the children submitted to speech language hearing treatment before the collection data; with

auditory alterations; and with neurologic, psychological, and cognitive alterations were excluded.

After the speech sample selection, the used repair strategies with the coda syllable constituent by children with typical and atypical phonological development were observed.

The observed repair strategies were called **dependent linguistic variables**, and the following possibilities were considered: *simplification for C<sup>1</sup>V*, *simplification for C<sup>2</sup>V*, *simplification for V*, *target syllable omission*, *alteration of the obstruent feature*, *alteration of the liquid feature*, *compensatory lengthening*, *metathesis*, *epenthesis*, etc.

As intervening factors during the use of resources, the considered **independent extra-linguistic variables** were *age* and *sex*; and the **independent linguistic variables** were *preceding and following context*, *complex onset obstruent*, *complex onset liquid*, *tonicity*, *number of syllables* and *word position*. These factors were considered because previous researches<sup>6,10,12,13,15</sup> verified the relevance of these variables in studies about phonological acquisition.

Specifically regarding the linguistic variable word position, the different positions of complex onset were considered: initial (ex.: **pr**ato), medial (ex.: **estr**ada) and final (ex.: **cob**ra).

After the survey of the repair strategies in coda position, these were codified in specific forms for each group, one for children with typical phonological development and another for children with atypical phonological development, through *Microsoft Access 2003*.

Through the codification it was observed that there were 883 repair strategies for the group with typical phonological development and 2529 for the group with atypical phonological development, a total of 3412 resources. Each resource was registered separately and it was equivalent to one entrance. It means that if in the same word there were two repair strategies, two entrances were considered. For example: *brabo* → *papu*, in this case the resources *simplification for C<sup>1</sup>V* and *alteration of the obstruent feature* were registered – two entrances. It is important to mention that the correct productions were not considered.

The research was accomplished after a repair strategies survey from two data basis. The data basis which contains the speech data of children with typical phonological development was created from a project which was approved by the Research Ethics Committee of a University, number 064/2004. Regarding the children with atypical phonological development, the data basis comes from speech recordings obtained from another project which was

also approved by the Research Ethics Committee of a University, number 6331.

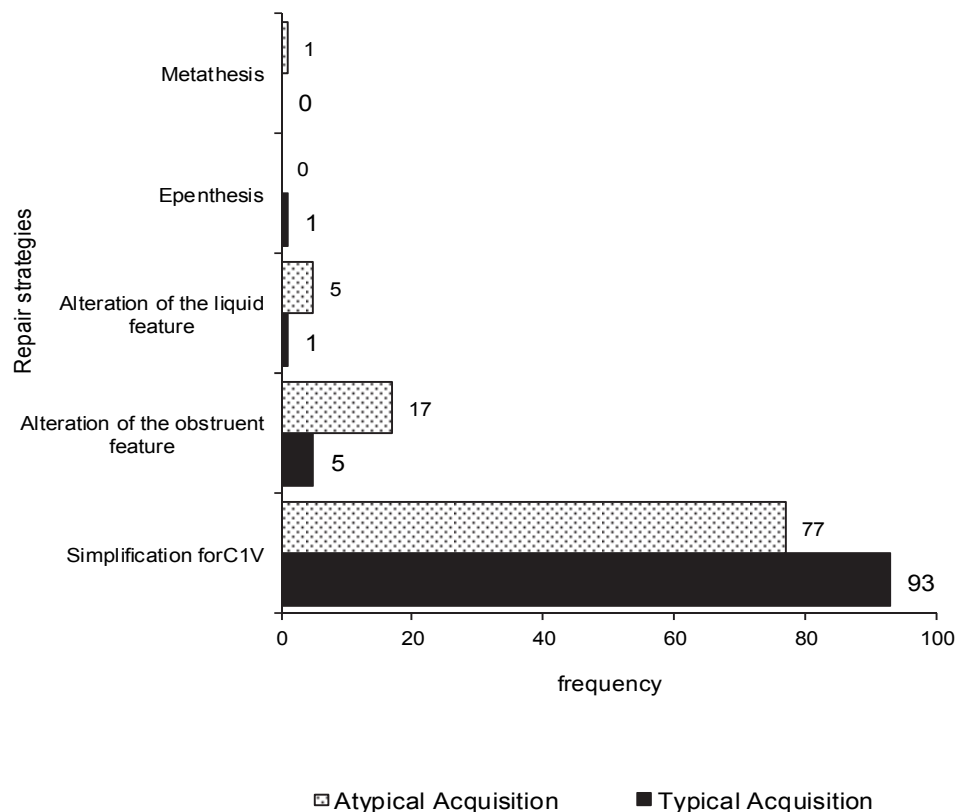
After the codification, the data were statistically analyzed through the statistical program VARBRUL<sup>23</sup>. This group of programs are widely used in variationist linguistic analyzes<sup>24</sup>. However, although this is a program which is specific for linguistic variation, several studies<sup>5,7,10-12,13</sup> approved its effectiveness to analyze linguistic data in large quantities, providing frequencies and probabilities, and also selecting relevant variables during language acquisition. The program makes probabilistic analysis in binary form, assigning relative weights to the variants of the independent variables, regarding the dependent variable. Besides, the statistical program VARBRUL works with error of 5%, what shows that any factor with significance below this value was not statistically expressive. The probabilistic values come from an interaction which contains all variables selected by the program. These factors are statistically significant and play a role in the studied phenomena. So, the probabilistic values between .50 and .59 were considered

as neutral; while the values equal or higher than .60 were favorable; and the values lower than .50 were unfavorable.

## RESULTS

After the analysis of the results, it was observed that the quantity of repair strategies used by the groups with typical and atypical phonological development was the same; both groups used four different repair strategies.

Through Figure 1, it was possible to observe that the strategies simplification for C'V (ex.: preto → [ˈpetu]), alteration of the obstruent feature (ex.: brabo → [ˈprabu]) and alteration of the liquid feature (ex.: prato → [ˈplatu]) were used by both groups. The difference was related to the fact that the children with typical phonological development used the strategy epenthesis (ex.: livro → [ˈlivuru]) while the subjects with atypical phonological development used the strategy metathesis (ex.: primo → [ˈpirmu]).



**Figure 1 – Frequency and type of repair strategies used by children with typical and atypical phonological development in complex onset**

The strategy simplification for C<sup>1</sup>V was the most used resource by both groups, with 93% of frequency for the children with typical phonological development and 77% for the children with atypical phonological development.

It was perceived the resource alteration of the obstruent feature in 5% of the children with typical phonological development and in 17% of the children with atypical phonological development, being the second most used resource when counting the realizations of both groups.

The repair strategy alteration of the liquid feature presented low frequency, 1% for the group with typical phonological development and 5% for the group with atypical phonological development. Regarding the resources of syllable structure, the metathesis (atypical phonological development) and the epenthesis (typical phonological development) occurred in only 1% of the samples.

Because of the occurrence frequency of each repair strategy, the resources which allowed the

accomplishment of statistical analysis were: simplification for C<sup>1</sup>V and alteration of the obstruent feature (typical and atypical phonological development), and alteration of the liquid feature and metathesis (atypical phonological development).

Next, it will be possible to observe tables with the variables selected as relevant for the use of the studied repair strategies, as well as the role of the variants.

### Simplification for C<sup>1</sup>V

The common variables selected as significant in the use of simplification for C<sup>1</sup>V (ex.: brabo → [ˈbabu]) for both groups were *obstruent of the complex onset* and *age*. Regarding the first variable, the *voiced plosive obstruent* (ex.: preto → [ˈpetu]) was the only favorable variant for the use of the resource for the children with typical (Table 1) and atypical (Table 2) phonological development.

**Table 1 – Variables selected as statistically significant in the use of complex onset simplification by the group with typical phonological development**

Simplification for C <sup>1</sup> V		Frequency	%	Relative Weigh
Complex onset obstruent	Voiced coronal plosive	0/36	0	.00
	Voiced labial fricative	0/50	0	.00
	Voiced labial fricative	30/36	83	.15
	Voiced dorsal plosive	61/79	77	.21
	Voiced dorsal plosive	12/13	92	.22
	Voiced labial plosive	205/230	89	.35
	Voiced coronal plosive	273/290	94	.56
	Voiced labial plosive	88/89	99	.94
Age	3:6;0 – 3:8;29	0/43	0	.00
	3:9;0 – 3:11;29	0/26	0	.00
	1:6;0 – 1:8;29	69/83	83	.12
	1:9;0 – 1:11;29	41/50	82	.17
	2:9;0 – 2:11;29	87/98	89	.34
	3:0;0 – 3:2;29	66/79	84	.35
	2:3;0 – 2:5;29	100/110	91	.46
	2:0;0 – 2:2;29	113/120	94	.82
	2:6;0 – 2:8;29	109/111	98	.82
3:3;0 – 3:5;29	84/86	98	.84	
Following context	Dorsal vowel	205/238	86	.31
	Labial/dorsal vowel	286/308	93	.55
	Coronal vowel	178/191	93	.66

\* p value = 0.05



In relation to the variable age, it is possible to perceive that the strategy was used during the acquisition process randomly. It means that some initial age groups were favorable for the use of the resource, at the same time as the older children also used the resource significantly, for both groups.

The groups presented singular variables, such as following context for children with typical phonological development (Table 1), and number of syllables and liquid of the complex onset for the children with atypical phonological development (Table 2).

**Table 2 – Variables selected as statistically significant in the use of complex onset simplification by the group with atypical phonological development**

Simplification for C <sup>1</sup> V		Frequency	%	Relative Weigh
Complex onset obstruent	Voiced coronal plosive	0/36	0	.00
	Voiced labial fricative	0/50	0	.00
	Voiceless labial fricative	30/36	83	.15
	Voiced dorsal plosive	61/79	77	.21
	Voiceless dorsal plosive	12/13	92	.22
	Voiced labial plosive	205/230	89	.35
	Voiceless coronal plosive	273/290	94	.56
	Voiceless labial plosive	88/89	99	.94
Age	3:6;0 – 3:8;29	0/43	0	.00
	3:9;0 – 3:11;29	0/26	0	.00
	1:6;0 – 1:8;29	69/83	83	.12
	1:9;0 – 1:11;29	41/50	82	.17
	2:9;0 – 2:11;29	87/98	89	.34
	3:0;0 – 3:2;29	66/79	84	.35
	2:3;0 – 2:5;29	100/110	91	.46
	2:0;0 – 2:2;29	113/120	94	.82
	2:6;0 – 2:8;29	109/111	98	.82
	3:3;0 – 3:5;29	84/86	98	.84
Following context	Dorsal vowel	205/238	86	.31
	Labial/dorsal vowel	286/308	93	.55
	Coronal vowel	178/191	93	.66

\* p value = 0.05

Regarding the group with typical phonological development, the following context coronal vowel (ex.: *primo* → [*ˈpimu*]) was favorable for the use of the repair strategy (Table 1). In relation to the vowels seen as significant for the group with atypical phonological development, it was possible to conclude that all possibilities presented neutral or unfavorable role for the use of the strategy. The monosyllable (ex.: *flor* → [*ˈfor*]) and disyllable (ex.: *prato* → [*ˈpatu*]) words, and complex onset formed by lateral liquid (ex.: *pluto* → [*ˈputo*]) were unfavorable for the use of the resource. However, the trisyllable (ex.: *brinquedo* → [*ˈbinˈkedu*]) and polysyllable (ex.: *bicicleta* → [*bisiˈklɛta*]) words and complex onset formed by non lateral liquid (ex.: *livro* → [*ˈlivu*]) were considered as neutral (Table 2).

#### Alteration of the obstruent feature

The statistical results related to the strategy alteration of the complex onset obstruent feature (ex.: *branco* → [*ˈpãngu*], *livro* → [*ˈlifru*]) pointed the variables type of complex onset obstruent, age and sex as statistically significant for both groups. Regarding the variable age, children with typical phonological development aged 1:6;0 – 1:8;29 and 1:9;0 – 1:11;29 (Table 3) presented higher probability of using the strategy alteration of the obstruent feature, and for the subjects with atypical phonological development, the medial age groups acted in a neutral way, while the adjacent age groups, more precocious from 3:0 to 5: and later from 9: to 11:0 (Table 4) were unfavorable for the use of the mentioned strategy.

**Table 3 – Variable selected as statistically significant in the use of resources that involve complex onset feature alteration – group with typical phonological development**

Alteration of the obstruent feature		Frequency	%	Relative weigh
Age	3:6;0 – 3:8;29	0/43	0	.00
	3:9;0 – 3:11;29	0/26	0	.00
	3:3;0 – 3:5;29	2/73	3	.19
	2:9;0 – 2:11;29	1/71	1	.19
	2:6;0 – 2:8;29	2/88	2	.33
	2:3;0 – 2:5;29	4/97	4	.40
	2:0;0 – 2:2;29	6/108	6	.49
	3:0;0 – 3:2;29	13/63	21	.66
	1:9;0 – 1:11;29	4/34	12	.76
1:6;0 – 1:8;29	14/72	19	.96	
Complex onset obstruent	Voiced labial fricative	0/36	0	.00
	Voiceless labial plosive	0/50	0	.00
	Voiced coronal plosive	0/28	0	.00
	Voiceless coronal plosive	11/259	4	.29
	Voiced labial plosive	16/230	7	.55
	Voiceless labial fricative	1/25	4	.68
	Voiced dorsal plosive	17/79	22	.84
	Voiceless dorsal plosive	1/13	8	.93
Sex	Female	12/275	4	.31
	Male	34/331	10	.66
Following context	Coronal vowel	8/135	6	.23
	Labial/dorsal vowel	15/290	5	.56
	Dorsal vowel	23/181	13	.63
* p value = .015				

Regarding the variable type of complex onset obstruent for the children with typical phonological development, the voiceless dorsal plosives (ex.: *creme* → [ˈtɛmi]), voiced dorsal plosives (ex.: *grilo* → [ˈkrilu]) and the voiceless labial fricative (ex.: *fraco* → [ˈsaku]) (Table 3) acted in a favorable way for this resource. For the group with atypical phonological development, the contexts voiced dorsal plosive (ex.: *grama* → [ˈkãma]), voiced labial fricative (ex.: *livro* → [ˈlifu]) and voiced coronal plosive (ex.: *dragão* → [traˈgãw]) (Table 4) played a favorable role to the use of this strategy.

The variable sex revealed that for the children with typical phonological development, the male sex was favorable, while the female sex was unfavorable for the use of the strategy (Table 3). For the group with atypical phonological development, the boys presented neutral probability in the use of the strategy, while the girls presented unfavorable role (Table 4).

For the group with typical phonological development the variable following context was also selected and the dorsal vowel (ex.: *brabo* → [ˈpabu])

was favorable and the *coronal* vowel (ex.: *primo* → [ˈtĩmu]) was unfavorable for the use of this resource (Table 3).

For the children with atypical phonological development, the variable number of syllables was selected as significant, with neutral role (monosyllable, disyllable e polysyllables; *flor* → [ˈpor], *livro* → [ˈlifru], *bicicleta* → [bisiˈtɛta]) or unfavorable (trisyllables (ex.: *brinquedo* → [priˈkɛdu]) for the use of the strategy (Table 4).

#### Alteration of the liquid feature

The variables selected by the statistical program as significant for the use of the strategy alteration of the liquid feature (ex.: *branco* → [blãŋku]) for the group with atypical phonological development were sex, age, type of complex onset obstruent and number of syllables (Table 4).

So, the results revealed that boys, complex onset obstruent with voiced and voiceless labial plosive (ex.: *brabo* → [ˈblabu], *praça* → [ˈplasa]), and voiceless dorsal plosive (ex.: *cravo* → [ˈklavu]), and monosyllable words (ex.: *três* → [ˈtɛs]) were

**Table 4 – Variable selected as statistically significant in the use of resources which involve feature value or complex onset syllable structure alterations – group with atypical phonological development**

<b>Alteration of the obstruent feature</b>		<b>Frequency</b>	<b>%</b>	<b>Relative weigh</b>
Complex onset obstruent	Voiceless labial plosive	9/281	3	.14
	Voiceless coronal plosive	46/503	9	.37
	Voiced labial plosive	92/532	17	.55
	Voiceless labial fricative	46/284	16	.55
	Voiceless dorsal plosive	43/232	19	.56
	Voiced coronal plosive	58/284	23	.63
	Voiced labial fricative	54/192	28	.69
	Voiced dorsal plosive	75/257	29	.73
Age	3-5	60/529	11	.35
	9-11	1/19	5	.36
	7-9	70/457	15	.53
	5-7	292/1524	19	.54
Sex	Female	242/1532	16	.47
	Male	181/997	18	.55
Number of syllables	Trissyllable	53/466	11	.40
	Monosyllable	44/302	15	.52
	Polysyllable	35/205	17	.52
	Disyllable	291/1556	19	.52
*p value = .034				
<b>Alteration of the liquid feature</b>				
Sex	Female	23/298	2	.36
	Male	94/1411	7	.60
Age	3-5	5/454	1	.20
	9-11	1/19	5	.47
	7-9	14/457	3	.55
	5-7	97/1409	7	.59
Complex onset obstruent	Voiced coronal plosive	3/233	1	.22
	Voiced labial fricative	3/185	2	.25
	Voiceless labial fricative	12/273	4	.40
	Voiced dorsal plosive	9/234	4	.47
	Voiceless coronal plosive	28/463	6	.56
	Voiceless dorsal plosive	10/204	5	.63
	Voiceless labial plosive	16/249	6	.63
	Voiced labial plosive	36/498	7	.64
Number of syllables	Polysyllable	4/188	2	.25
	Trissyllable	22/437	5	.46
	Disyllable	69/1431	5	.52
	Monosyllable	22/283	8	.64
*p value = .015				
<b>Metathesis</b>				
Complex onset obstruent	Voiceless labial fricative	0/284	0	.00
	Voiceless dorsal plosive	1/193	1	.19
	Voiceless labial fricative	1/252	0	.28
	Voiceless labial fricative	2/438	0	.36
	Voiceless labial plosive	2/281	1	.39
	Voiceless coronal plosive	4/352	1	.68
	Voiced labial fricative	4/191	2	
	Voiced coronal plosive	9/245	4	
*p value = .048				



favorable for the use of the presented strategy (Table 4).

Regarding the variable age, it was possible to notice that the *medial age groups* were neutral, while the *adjacent age groups*, from 3:0 to 5:0 and from 9:0 to 11:0 were unfavorable (Table 4).

### Metathesis

The only variable selected as statistically significant in the analysis of the strategy metathesis (ex.: febre → [ˈfeber]) was the type of complex onset obstruent, and the voiced coronal plosive (ex.: dragão → [daˈgrāw]), voiceless coronal plosive (ex.: letra → [ˈletar]) and the voiced labial fricative (ex.: livre → [ˈliver]) were favorable for the use of this resource (Table 4).

## ■ DISCUSSION

### Type and frequency of repair strategies used in the complex onset constituent

Several authors have observed that the most frequent repair strategy during the complex onset acquisition by children with typical phonological development<sup>8,25</sup>, and atypical phonological development<sup>7,9,26,27</sup> is the **simplification for C<sup>1</sup>V**. A study detected that omissions are more frequent than substitutions in complex onset acquisition<sup>28</sup>. There is another study in which the consonant cluster reduction (or simplification for C<sup>1</sup>V) is the second most frequent phonological process used by children with typical phonological development, and it appears right after liquid substitution<sup>29</sup>.

The results of the present study agree with the mentioned studies, because the strategy simplification for C<sup>1</sup>V presented frequency of 93% for the group with typical phonological development and 77% for the group with atypical phonological development.

A study which was specifically about complex onset<sup>9</sup> compared its results with the results from a previous work performed with children with typical phonological development<sup>8</sup>, and it detected that the subjects with atypical phonological development use the strategy simplification for C<sup>1</sup>V more often than subjects with typical phonological development. This finding was not observed in the present study, but the divergence of results can be justified by the fact that the first research<sup>8</sup> studied the complex onset acquisition process until its complete control, including children up to 5:3 years old. So, the children with typical phonological development from the previous study<sup>8</sup> decreased the use of simplification for C<sup>1</sup>V as the acquisition of the complex structure was complete, what did not occur in the present study, because the higher age group considered

was 3:11, age in which the complex onset is still unstable, and the mentioned resource is still being used.

Besides, the input evidence and the articulatory and cognitive abilities are developed during the phonological trajectory, and the child specifies the features which were not present in the initial representations, the marked features<sup>30</sup>. Considering this statement, it is possible to hypothesize that children with typical phonological development, because they are younger, prefer to use a simple and primary resource when facing the CCV complex structure, while children with atypical phonological development, because they are older, have better input evidence and better cognitive and articulatory abilities, which allow them to use more elaborate resources, such as alteration of the liquid feature and metathesis.

The repair strategy **alteration of the obstruent feature** was used more frequently by the group with atypical phonological development, with frequency of 17%, while the typical group presented a frequency of 5%.

The typical data regarding the strategy alteration of the obstruent feature were similar in a study about the complex structure CCV<sup>8</sup>, which obtained lower results than the present research. The strategy alteration of the obstruent feature represented only 1% of the typical phonological development corpus.

In contrast, regarding the atypical phonological development, another study<sup>9</sup> detected that the studied children did not use the resource alteration of the obstruent feature. It can be justified by the different corpus, because this study<sup>9</sup> was performed with a small number of subjects.

The resource **alteration of the obstruent feature** was used by the children with typical and atypical phonological development, with frequencies of 1% and 5%, respectively.

Specific studies about complex onset acquisition<sup>8,9</sup> verified that the resource alteration of the liquid feature was used by 5% of the corpus with typical phonological development and by 9% of the corpus with atypical phonological development.

The present study is supported by the mentioned researches in a sense that the children with atypical phonological development used the strategy alteration of the liquid feature in a more productive way than the subjects with typical phonological development.

After this finding, it is possible to assume that the children with atypical phonological development, because they are older, have higher input evidence and more developed articulatory and cognitive abilities<sup>30,31</sup>, what allows them to try to perform the

target segment, through C<sup>2</sup> substitutions, instead of omissions.

The previous statements can justify the fact that only children with atypical phonological development use **metathesis** when they face the complex structure CCV.

The findings of the present study partially agree with a previous research<sup>9</sup>, which also observed low use of metathesis, corresponding to 0.3% of the resources used by children with atypical phonological development. However, another research<sup>8</sup> verified that children with typical phonological development also use metathesis, in a more productive way than the subjects with atypical phonological development, with frequency of 1.5%, what was not detected in the present study.

The analysis of the repair strategies used by the children with typical and atypical phonological development in complex onset allowed the researchers to verify similarities and differences regarding type and frequency of resources which were used by the groups, as well as variables which were favorable and unfavorable in the use of these strategies.

Next, there will be some comments about the role of the linguistic and extralinguistic variables in the use of repair strategies for the complex onset syllable constituent. The variables tonicity, word position and preceding context were not selected as relevant for any used strategy. However, in a study about the effects of word position and tonicity in words containing complex onset, the accuracy of the consonant clusters was higher in initial tonic syllables<sup>32</sup>.

It is important to emphasize that the comments regarding the not frequent repair strategies should not be seen as generalization for the use of complex onset resources, because they are related to less than 20% of the analyzed data.

### **Repair strategies versus linguistic and extralinguistic variables**

#### *Extralinguistic variable age*

The extralinguistic variable age was important for the use of complex onset repair strategies. It was selected as relevant for the strategy simplification for C<sup>1</sup>V, alteration of the obstruent feature and alteration of the liquid feature.

In relation to the most productive repair strategy, the simplification for C<sup>1</sup>V, there was higher probability of the children with typical phonological development from early age groups (2:0-2:2), and also more advanced age groups (3:3-3:5) to use this resource. These results agree with a previous research<sup>8</sup>, which observed the use of simplification for C<sup>1</sup>V during the acquisition process, with no differences

regarding the resource frequency in different age groups.

In contrast, another study<sup>10</sup> detected that younger children use the strategy simplification for C<sup>1</sup>V more often than older children.

Regarding the not frequent repair strategies, such as the ones which involve the obstruent feature, a study about complex onset acquisition by children with typical phonological development mentioned that these resources were used more often by younger children<sup>8</sup>.

In the present study, the strategy alteration of the obstruent feature was used more significantly by younger children (1:6-1:11). However, although with lower probability, this strategy was also used by older children (3:0-3:2). It is possible to think that the predominance of the resource in early age occurred because younger children use several repair strategies in all syllable positions, because their phonological system is still unstable.

Regarding children with atypical phonological development, the resource simplification for C<sup>1</sup>V was used more significantly by children from adjacent age groups (3:0 to 5:0 and 9:0 to 11:0), while for the resources alteration of obstruent and liquid features, the children from intermediate age groups used the resources the most. Because these children present atypical phonological development, although the severity of the phonological disorder was not analyzed, it is possible to consider the possibility of severity degree interference in a higher way than the age group. It would justify the random use of the resource.

#### *Extralinguistic variable sex*

The variable sex was important for the resources alteration of the obstruent feature and alteration of the liquid feature. Boys presented higher possibility of using these strategies.

The obtained results are different from results of previous studies. When observing the relationship between the variable sex and the occurrence of repair strategies, a study about the acquisition of non lateral liquids<sup>9</sup> and other studies about the complex onset<sup>10,33</sup> verified that there are no differences between male and female sex. Agreeing with these studies, a research with high socioeconomic class children<sup>34</sup> detected that there was no difference among speech errors considering the variable sex.

In contrast, a study about coda<sup>6</sup> acquisition and other about preschool phonological development<sup>29</sup> verified higher number of repair strategies for the female sex, while the boys presented higher number of correct production. Complementing what was said, a research about rapid naming tasks observed

that girls presented higher average of errors during a test <sup>35</sup>.

Another research <sup>5</sup> observed the opposite, with results similar to the found in the present study. It concluded that girls produced the complex onset more correctly than boys.

Several authors have verified significant relationship between phonological disorders and male subjects <sup>1,13,17</sup>. These studies support the findings of the present research, because there was higher probability that boys produced the studied repair strategies.

So, it is possible to observe that there is divergence in relation to the results found in literature. It is believed that more studies are necessary regarding the use of repair strategies and the variable sex, in order to investigate the role of this variable in relation to the resources children use during the acquisition process.

#### *Obstruent linguistic variable of the complex onset*

The first consonant of the complex onset, the obstruent, can influence the correct production of the structure CCV, considering the obstruent articulation mode <sup>8</sup>. Based on this idea it is possible to consider if these favorable contexts for correct production can act in a relevant way regarding the type of repair strategy to be selected by children.

The results of the present study, related to the relevance of this variable for the use of the repair strategy simplification for C'V, pointed to the voiceless labial plosive obstruent as favorable for the use of the resource, as by children with typical as atypical phonological development. These findings do not agree with a previous study about the complex onset acquisition <sup>8</sup>, which verified that complex onsets formed by voiced and voiceless labial plosives are favorable for the correct production of the mentioned structure.

Similarly, another research <sup>36</sup> observed ease of the labial feature to the acquisition of the complex onset, describing the following acquisition order: groups with labial obstruent, followed by groups with coronal and, lastly, with dorsal.

For the strategy alteration of the obstruent feature, there was higher probability of the occurrence of this resource in complex onsets formed by voiced and voiceless dorsal plosives and voiceless labial fricative, in the group with typical phonological development. The results obtained for the group with atypical phonological development were distinct. The complex onsets formed by voiced labial fricative, voiced dorsal plosive and voiced coronal plosive presented higher relative weights and were favorable.

Although the groups presented different results, it was verified an order of complexity. The obstruents with more complex features are more susceptible to the use of the strategy alteration of the obstruent feature, what was not observed for the strategy simplification for C'V. The difficulty seemed to be related to the performance of the complex syllable and not to the complex onset obstruent.

Therefore, it is possible to think that regarding the children with typical phonological development the [dorsal] feature of the obstruent was the most difficult for the children to perform, followed by the [continual] feature. Considering the typical phonological development, this result is supported by previous studies which refer later acquisition of the dorsal plosive segments in onset <sup>1</sup>.

Regarding the difficulties observed in the group with atypical phonological development, it was possible to observe that obstruent difficulties were varied, what can be justified by the atypical phonological development. However, it is possible to hypothesize that children who presented difficulties to perform more complex features, such as [continual], [dorsal], and mainly [voiced], in this last case using the not marked feature [-voiced].

About the strategy alteration of the liquid feature, the favorable contexts were the voiced and voiceless labial plosive obstruents and the voiceless dorsal plosive. These results do not agree with the ones from another study <sup>8</sup>, which detected that complex onsets formed by obstruents with plosive mode of consonant are favorable for the constituent correct production.

For the resource metathesis, the favorable contexts are the voiced and voiceless coronal plosive obstruents (ex.: *quadrado* → [k<sup>w</sup>a'dador]; *litro* → [ˈlitur]), and voiced labial fricative (ex.: *livre* → [ˈliver]).

The results point to a possible difficulty in relation to the [coronal] feature. It can be because of the Obligatory Contour Principle (OCP) interference, which aims at avoiding a sequence of identical adjacent features. So, when using the metathesis resource, the child avoids the sequence of coronal features, preserving the segment, but altering the liquid position.

This visible children's difficulty regarding the [coronal] feature was also observed in a previous study <sup>8</sup>. The author observed that metathesis and epenthesis occur more often in words whose first consonant is coronal, what consists of a phonemes sequence with the same feature, what seems to make the CCV production even more complex.

Another study also supports the findings of the previous research, which verified that the resource metathesis involves basically the liquid segments

with late acquisition such as complex onset, especially when they are formed by two coronals<sup>37</sup>.

This phenomenon can be explained if it is considered that a child can misperceive a phonetic chain, performing several phonological analyses<sup>38</sup>. So, in complex onsets formed by fricatives, the fricative noise of these segments distracts the listener, leading to great confusion regarding the segments linear order and the occurrence of metathesis. This argument seems to justify the higher probability of metathesis in fricatives, what happens with the voiced labial fricatives of this study.

#### *Linguistic variable number of syllables*

The researches in relation to the influence of the number of syllables for the segments production are contradictory. Some studies<sup>6,31</sup> mention that the words with less syllables have tendency to be correctly produced and longer words are proper to phoneme omission.

A specific study about complex onset<sup>10</sup> mentioned that words with more syllables are favorable for tap omission, while shorter words present a reduced possibility of missing a segment. The author also mentions that polysyllable words need a more accurate rhythmic management, what makes its production even more complex.

Regarding this variable behavior by children with atypical phonological development, longer words are more complex for these children, because as more syllables a word has, it will be more difficult for this child to store and to repeat the word<sup>39</sup>.

In relation to the strategy simplification for C'V, the results of the present research agree with previous studies<sup>6,10</sup>, because longer words were more vulnerable for this repair strategy. Besides, considering that this variable was selected only for the group with atypical phonological development, the results also agree with a study about phonological memory<sup>39</sup>, because words with less syllables went through less repair strategies.

In contrast, for the resources alteration of the liquid and obstruent feature, monosyllable and dissyllable words presented higher possibility of going through the resources. So, these findings are different from the previously mentioned studies<sup>6,10,39</sup>.

#### *Linguistic variable following context*

For the strategy simplification for C'V, the variable following context was relevant only for the group with atypical phonological development, and it revealed following contexts filled by coronal vowel as favorable for the use of this resource.

The OCP refers the prohibition of identical adjacent features into a tier<sup>40</sup>. However, as the coronal feature of the liquid is connected to the point of

consonant and the coronal feature of the vowel is connected to point of vowel, there is no OCP violation. There is, on the contrary, articulatory ease. So, it would be expected that the strategy simplification for C'V was unfavorable in the presence of following context filled by coronal vowel, what was not observed in the present study.

Regarding the strategy alteration of the obstruent feature, the following context dorsal vowel presented higher probability for this resource to occur. This result would not be expected, because the vowel of the CCV syllable is dorsal, it does not matter the quality of the preceding liquid. So, a favorable environment for the complex onset production is formed<sup>8</sup>.

#### *Linguistic variable type of liquid of the complex onset*

About the second complex onset consonant, variable selected as relevant only for the strategy simplification for C'V in the group with atypical phonological development, it was verified that the non lateral liquid presented higher relative weigh; however, the value is still considered neutral to apply the strategy simplification for C'V. In contrast, the lateral liquid was considered unfavorable for the use of this strategy.

The strategy simplification for C'V is used in a productive way for both liquids, lateral and non lateral, with no difference of correct production between them<sup>8</sup>. Comparing these results with the present study, it was possible to observe that regarding the use of repair strategies, the type of liquid played an important role to the child, different from the findings about complex onset<sup>8</sup>, when the liquid quality was not relevant.

A possible explanation would be to assume that the non lateral liquid is a marked segment, with more complex properties and, however, later acquisition, what makes the simplifications for C'V more vulnerable than the lateral liquid. Besides, considering that the lateral liquid is acquired in simple onset and in coda before the non lateral liquid, it is possible to suppose that the sequence obstruent and lateral liquid is less vulnerable for repair strategies and, therefore, unfavorable for the use of the strategy simplification for C'V.

## ■ CONCLUSION

The accomplished study evidenced that the strategy simplification for C'V is the most adopted strategy by children with typical and atypical phonological development. Although they are not so frequent, the resources alteration of the obstruent feature, alteration of the liquid feature, metathesis



and epenthesis were also used in a significant way. They are important because they indicate the way children deal with the complex structure CCV.

The detailed analysis of the use of repair strategies revealed that there are more similarities than differences regarding the resources children with typical and atypical phonological development use during the complex onset acquisition, as in relation to the type of strategy used or the frequency, as in relation to the relevant variables for its use.

Regarding intervening factors, it was possible to conclude that the extralinguistic variables sex and age, and the linguistic variables type of complex onset obstruent, type of complex onset liquid, following context and number of syllables influenced the analyzed repair strategies. Certain variables act in a significant way and allowed some generalizations, because they operate in a similar or complementary way. Summarizing the results of this study, the conclusions were:

- the variable sex, when selected as statistically significant, showed that the male sex is favorable for the use of repair strategies, as for typical as for atypical phonological development;
- the variable age evidenced that, in general, the repair strategies used in complex onset are used randomly, by children with all ages;
- the variable type of obstruent of the complex onset was selected as relevant for all the analyzed strategies, as for typical as for atypical

phonological development; it is possible to observe different behaviors of the variable according to the analyzed group and according to the adopted strategy;

- the variable number of syllables was only important for the children with atypical phonological development, because for the resource alteration of the liquid feature the shorter words were favorable, and for the strategy simplification for C'V there was higher probability of occurrence of the strategy in longer words;
- the variable following context was relevant only for the children with typical phonological development; however, there was no standard behavior regarding the analyzed strategies, with higher probability of occurrence of simplification for C'V in following context with coronal vowel, and higher probability of occurrence of alteration of the obstruent feature in contexts formed by dorsal vowel.

Besides, the children with typical phonological development used the resource simplification for C'V more often, with restrict occurrence of other strategies. For the subjects with atypical phonological development, it was verified that although the strategy simplification for C'V occurs more often, the children also used the other observed resources in a productive way, such as the alteration of the liquid and obstruent feature

## RESUMO

**Objetivo:** descrever e analisar o uso das estratégias de reparo empregadas por crianças com aquisição fonológica normal e desviante, no constituinte silábico *onset* complexo, a fim de verificar as semelhanças e as diferenças existentes entre os grupos em estudo. **Método:** foram utilizados dados de fala de 60 crianças com aquisição normal, 30 meninos e 30 meninas, e 84 crianças com aquisição desviante, 53 meninos e 31 meninas. A idade do grupo normal variou de 1:0 a 4:0, enquanto que a do grupo desviante variou de 3:0 a 11:0 anos. Foram consideradas as variáveis: idade, sexo, contexto precedente e seguinte, obstruente do *onset* complexo, tipo de líquida do *onset* complexo, tonicidade, número de sílabas e posição na palavra. Posteriormente, os dados foram submetidos à análise estatística por meio do programa VARBRUL. **Resultados:** as crianças com desenvolvimento fonológico normal e desviante utilizaram os seguintes recursos, respectivamente: simplificação para C'V (93%; 77%), alteração do traço da obstruente (5%; 17%), alteração do traço da líquida (1%; 5%), epêntese (1%; 0%) e metátese (0%; 1%). As variáveis tonicidade, contexto precedente e posição na palavra não foram relevantes no estudo. **Conclusão:** o recurso mais frequente foi o de simplificação para C'V em ambos os grupos, contudo, outras estratégias foram aplicadas, principalmente, pelo grupo desviante. Quanto à influência das variáveis, concluiu-se que as variáveis idade, sexo, tipo de obstruente e tipo de líquida do *onset* complexo, contexto seguinte e número de sílabas influenciaram de alguma forma os recursos estudados.

**DESCRITORES:** Fala; Desenvolvimento de Linguagem; Linguagem Infantil; Distúrbios da Fala



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