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# Orthography of phonemes /l/ and /r/ in complex positions in children's writing: a comparative analysis

## Ortografia dos fonemas /l/ e /r/ em posições complexas na escrita infantil: uma análise comparativa

### Keywords

Handwriting  
Language  
Phonetics  
Child  
Speech Language and Hearing Sciences

### ABSTRACT

**Introduction:** Assuming that errors are actually hits attempts, and may mark the child's conflicts with the orthographic system, we investigated the orthographic record of two phonemes that refer to the class of liquids: /l/ and /r/. **Objective:** (1) to compare the orthographic accuracy, in the complex onset and coda syllable positions, of the phonemes spelling /l/ and /r/; (2) to verify, among the errors, their most frequent types. **Method:** We analyzed 53 textual productions of children of the 1st year of the cycle I of the elementary school of a public school in a city of the state of São Paulo. To respond to the objectives, initially all occurrences of the phonemes /l/ and /r/ were separated in the complex onset position and coda syllabic position. Then, the records were categorized as hits and errors. Errors were also classified as omission, transposition and substitution. **Results:** In the complex syllabic onset and syllable coda, a higher number of hits was found when compared to the number of errors. As for the types of errors, in the complex onset position, all corresponded to omissions; in the coda, omissions prevailed, followed by substitutions and transpositions. **Conclusion:** The results suggest that the child's perception of the relations between phonemes and graphemes does not depend directly on these relations, since this correspondence may be affected by other phonological aspects disregarded in these relations, such as syllable positions.

### Descritores

Escrita Manual  
Linguagem  
Fonética  
Criança  
Fonoaudiologia

### RESUMO

**Introdução:** Assumindo-se que erros são, na verdade, tentativas de acertos, podendo marcar conflitos da criança com o sistema ortográfico, investigou-se o registro ortográfico de dois dos fonemas que remetem à classe das líquidas: /l/ e /r/. **Objetivo:** (1) comparar a acurácia ortográfica, nas posições silábicas de ataque complexo e de coda, da grafia dos fonemas /l/ e /r/; (2) verificar, dentre os erros, seus tipos mais frequentes. **Método:** Foram analisadas 53 produções textuais de crianças do 1º ano do ciclo I do ensino fundamental (EF) de uma escola pública do interior de São Paulo. Para responder aos objetivos, inicialmente foram separadas todas as ocorrências dos fonemas /l/ e /r/ na posição de ataque complexo e de coda silábica. Posteriormente, os registros foram categorizados como acertos e erros. Os erros foram, ainda, classificados como omissão, transposição e substituição. **Resultados:** No ataque silábico complexo e na coda silábica, foi encontrado maior número de acertos quando comparado com o número de erros. Quanto aos tipos de erros, no ataque complexo, todos corresponderam a omissões; já na coda, as omissões prevaleceram, seguidas das substituições e das transposições. **Conclusão:** Os resultados sugerem que a percepção que a criança tem das relações entre fonemas e grafemas não depende diretamente dessas relações, já que essa correspondência pode ser afetada por outros aspectos fonológicos desconsiderados nessas relações, como as posições silábicas.

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## INTRODUCTION

When investigating orthographic conventions, and the presence of unconventional writing in children's productions, one issue is fundamental: the complexity of the relationships between phonetic-phonological characteristics of speech and orthographic characteristics of writing. There are different - and not always converging - attempts to explain these relationships.

It is pointed out that the processes characterized as acquisition and development of writing would suffer an important influence from what the literature conceptualizes as phonological awareness<sup>(1)</sup>, since such awareness would be a prerequisite for learning to read and write. Therefore, phonological awareness activities would assist this learning<sup>(2,3)</sup>. Also that, as phonological awareness skills would be necessary for the acquisition of reading and writing, these same skills would help the early identification of children at risk of dyslexia<sup>(4)</sup>, as well as contribute to the assessment and therapy of so-called phonological disorders<sup>(5)</sup>. However, although this awareness is considered fundamental for the development of reading and writing, it is alert to the fact that it would be (also) necessary to take into account the socioeconomic level of the child, since, plus other factors environmental effects, it could affect the child's neural development<sup>(6)</sup>.

On the other hand, it points to a non-direct relationship between speech and writing. It is noted in the literature that, although the characteristics of speech in writing are recovered, both would be modalities of the language<sup>(7)</sup>. Thus, depending on the context in which speech and writing are inserted, whether in the use of daily life or formal schooling, they will present greater or lesser differences. It is also observed, in this perspective, a non-direct relationship between the acquisition of phonology and the acquisition of spelling; however, there would be connections between both, since "[...] the acquisition of writing is part of the broader process of language acquisition [and] (ortho) graphic errors reveal the child's knowledge about the sound structure of their language [...]"<sup>(8)</sup>.

In this perspective, unconventional spelling can be considered part of the acquisition of writing<sup>(9)</sup> and that its appearance often results from the recovery that children make of speech characteristics<sup>(9)</sup>. Thus, in a literate society, characteristics of speech and writing would be related, however, indirectly, since writing would be the product of the insertion of the writer in oral social and literate social practices. This means that the product writing is heterogeneous as the result of this double insertion of the writer in social practices that involve language. Another noteworthy fact is that, in this view, unconventional spelling is seen as an attempt to get it right, since its presence can be considered "[...] as a mark of children's conflicts with the characteristics of the BP spelling system [Brazilian Portuguese]"<sup>(10)</sup>. Thus, spelling errors would not mean a failure, since "[...] he rarely escapes something that, in a way, is not raised by the language itself or by the rules that guide grapheme/phoneme correspondence"<sup>(11)</sup>, that is, the correspondence between the written and the spoken. Consequently, these errors would not necessarily be related to a pathological condition or to the individual's difficulties.

Assuming that characteristics of speech and characteristics of writing are related, although not directly, this work aims to investigate the orthographic record of two of the phonemes that refer to the class of liquid consonants of BP - namely, /l/ and /r/ - in textual productions of children in cycle I of elementary school (EF). In this investigation, the occurrences of /l/ and /r/ in the second syllable position of complex onset and in the syllable position of simple coda will be considered.

Although the literature has: (i) investigated children's repair strategies in the speech of the phonemes /l/ and /r/<sup>(12)</sup>; (ii) observed the relationship between phonology and spelling of phonemes of the class of the sounds, mainly of the liquids<sup>(13)</sup>, and still; (iii) described the orthographic performance of the sounding consonants in simple syllable onset position and the effect of the lexical accent on the written production of children from the 1st to the 4th grade<sup>(14)</sup>, no studies were found that specifically investigated the orthographic record of the phonemes in question. This gap draws attention, since it is a matter of phonemes whose complexity is shown not only in the acquisition of speech, but also in orthographic acquisition.

An essential aspect - but disregarded by the literature - for a better understanding of the spelling register of the sounding consonants is their distribution between errors and hits depending on the position in which these consonants can occupy in the syllable structure in BP. The question that mobilized this study arises from this aspect: how the spelling of the phonemes /l/ and /r/ would show up in the complex positions of second position of complex onset and coda position. Especially because the phonetic-phonological characteristics of the syllable may have a greater or lesser influence on the way children in the early years of their literacy register the phonemes in their spelling - the hypothesis of the present investigation.

In order to test this hypothesis, the following objectives guided the investigation:

- (1) to compare the orthographic accuracy, in the syllabic positions of complex onset and coda, of the spelling of the phonemes /l/ and /r/; and
- (2) to check, among the possible errors, their most frequent types.

## METHODS

Children's textual productions that make up a database of the Research Group on Language Studies (GPEL/CNPq) were used. The data were collected in a public state elementary school in a city in the interior of São Paulo, by GPEL researchers, during the second semester of 2016. After collecting the textual productions of all children present in the classroom, we excluded from the sample those who presented complaints related to academic learning, and those who did not receive authorization from parents or guardians to participate in the research. This authorization was given by signing an Informed Consent Form (ICF). The investigation was approved by the Research Ethics Committee (CEP) of the Institute of Biosciences, Letters and Exact Sciences - UNESP/SJRP under number 1,795,053.

Although the database includes the writing of children from the 1st to the 5th year of elementary school, the productions were selected based on the four proposals of the children who, at the

time of collection, attended the 1st year of this stage of formal schooling. This cut was adopted because children's writing still present a very unstable character in the year they begin school. This allows for a better observation of how relationships between phonology and spelling are being established, and how conflicts are showing up and are inherent to the establishment of such relations in the initial writing.

With this criteria, 80 textual productions were expected for analysis; four from each of the 20 children whose parents signed the ICF. However, due to the absence of some students on the days of the collection, and by the exclusion of those that did not have orthographic records of the phonemes / l / and / r / in the second position of complex onset and coda, 53 productions were included in the corpus. For the explanation of how the research results were analyzed, the objectives that guided it will be remembered.

As for the results related to the first objective (to compare the orthographic accuracy, in the syllabic positions of complex onset and coda, of the spelling of the phonemes / l / and / r /), we carried out a survey of all the possibilities of registering the graphemes in question in the two positions in which they were analyzed. Subsequently, regarding this total of possibilities, the presence of correct answers and errors was quantified - considering, as a correct answer, when the child registered the phoneme according to the conventional spelling of BP and, as an error, when the child stopped register or made an unconventional orthographic registration of a phoneme. This quantification was performed in each of the two syllabic positions under analysis because it allows to identify whether the orthographic accuracy depended, or not, on the position in which the grapheme appeared in the syllable structure.

However, the right/wrong bipartition does not allow detecting the gradient between two points that, at first glance, can be considered as unique in an analysis of orthographic performance<sup>(10)</sup>. In order to better detect it, the second objective of the investigation was proposed: *to verify, among the possible errors, its most frequent types*.

As for the results related to this second objective, that is, to detect the possible gradient between errors, we used the categorization proposed by GPEL. The work developed by researchers in this group<sup>(19-22)</sup> propose a categorization of misspellings in three types, which clearly indicate their gradient. They are: omissions, transpositions and substitutions. Look at the characteristics of each of these types that explain their degree of success:

- (1) **omissions** occur when a phoneme is not registered orthographically, as, for example, in the word PENTE written as PENE;
- (2) **transpositions** occur when there is a displacement of an element from its conventional position to an unconventional one, as, for example, in the word PROFESSOR written as PORFESSOR; and
- (3) **substitutions** occur when the target grapheme is exchanged for another at the time of registration, as, for example, in the word CEBOLA written as SEBOLA.

The gradient that can be detected in this distribution:

[...] it is explained, first, by the fact that, in omissions, there is not even the orthographic registration of the phoneme. In this sense, they are on a different plane, in nature, from that of transpositions and substitutions, since, in the latter, the orthographic record of the intended phoneme is already verified. However, even if this presence is verified, it is also shown in different planes, since, in transpositions, the phoneme register is oscillating as to its conventional position and, in substitutions, the grapheme, although undue, already occupies the conventionally expected position for him.<sup>(10)</sup>.

All results underwent statistical analysis. For that, data treatment was performed using the Statistica software (version 9.0). Descriptive and inferential analyzes were performed. For the descriptive analysis of the data, a measure of central tendency (mean) and a measure of dispersion (standard deviation) were used. For the inferential analysis, the Sign Test was used for dependent samples in the comparison of orthographic accuracy and Anova for repeated measures in the comparison of types of errors. The level of significance adopted was  $(\alpha) \leq 0.05$ .

## RESULTS

The results will be displayed according to the objectives of this research.

Regarding the first objective, 104 recording possibilities were found in the second complex onset position and 420 in the simple syllabic coda position. These possibilities resulted in spellings with successes and errors, whose values will be exposed in figure 1.

A higher percentage of correct answers was observed in the two syllabic positions and, still, a higher percentage of correct answers in the second complex onset position regarding the percentage of correct answers in the coda position. Table 1 shows the descriptive and inferential analysis for the comparison between the orthographic accuracy of the two syllabic positions.

**Table 1. Descriptive and inferential analysis of the distribution of hits in the second position of complex attack and coda.**

Syllabic position	Average	Standard deviation	Sign Test
2 <sup>a</sup> complex onset position	0.98	0.27	Z=2.77
Coda	0.68	0.32	p=0.00*

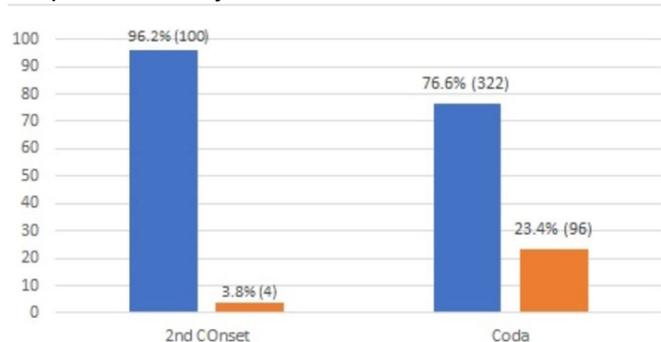
**Source:** Research data. Captions: Sign Test ( $\leq 0.05$ ). The percentage means considered for analysis were the correct answers.

As shown in Table 1, there was a statistically significant difference between the syllabic positions analyzed, since the average of correct answers in the second complex onset position was higher than the average of correct answers in the coda position.

The following are examples of correct answers taken from the analyzed productions:

- (1): quadrado (square)
- (2): inflei (I inflated)
- (3): porta (door)
- (4): silva (silva – a surname)

**Figure 1.** Distribution of hits and errors in the second position of complex onset and syllable coda.



Source. Research data. Legend. 2nd ATC = second complex onset position

In (1) and (2), conventional orthographic records of the phonemes /r/ and /l/ in the second position of complex onset are observed in the second syllable of the words <quadrado> and <inflei>, respectively. In (3) and (4), conventional records of the target phonemes are also observed, but in syllable coda position in the first syllable of the words <porta> and <silva>, respectively.

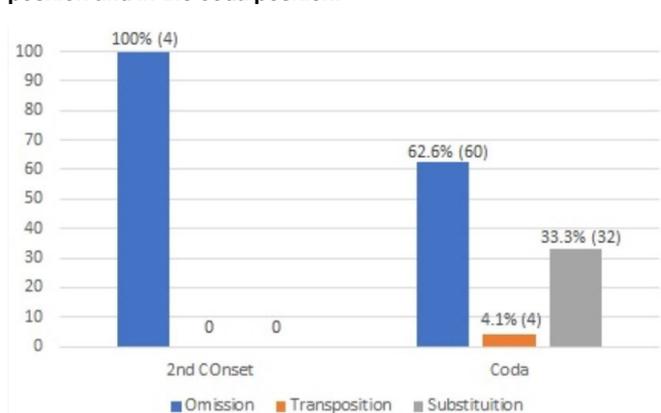
Below, examples of errors in these two syllable positions taken from the analyzed productions:

- (5): Nouto (in other)
- (6): Pota (door)
- (7): Voutei (I came)

In (5), the phoneme /r/ was omitted in the second complex onset position in the second syllable of the word <noutro> (written without R grapheme). In (6), the phoneme /r/ was omitted in the coda position in the first syllable of the word <porta> (also written without R grapheme). Finally, in (7), the conventional representation of the phoneme /l/ registered by the grapheme “u” was replaced in the coda position of the first syllable of the word <voltei> (written as “voutei”). It must be noted that there were no unconventional records involving the phoneme /l/ in the second complex onset position.

For the second objective, the errors were classified according to their typology. The results of this classification are shown in Figure 2.

**Figure 2.** Distribution of error types in the second complex onset position and in the coda position.



Source. Research data.

In the second complex onset position, there were only omissions. In the coda position, there was a predominance of omissions, followed by substitutions and, finally, transpositions. Table 2 shows the descriptive and inferential analyzes regarding the types of errors in the coda position.

**Table 2.** Descriptive and inferential analysis of types of errors in the coda position.

Error type	Average	Standard deviation	Anova Chi Square
Omission	0.79	0.31	2= 22.62
Replacement	0.13	0.22	df= 2
Transposition	0.09	0.25	p= 0.00*

Source: Research data. Captions: Anova Chi Square ( $\leq 0.05$ ). The percentage means considered for analysis were the correct answers.

The results in Table 2 show that the average of omissions was higher when compared to the average of substitutions and transpositions, being statistically significant.

Due to the absence of variance in the second complex onset position, due to the number of occurrences of errors appearing only in two subjects - three errors in one subject and one error in the other subject (which resulted in insufficient data for comparative analysis between individuals), it was not possible to carry out the descriptive and inferential analyzes of this position - a situation that suggests that, at the beginning, the functioning of orthographic rules affects children differently.

The following are examples of the types of errors taken from textual productions:

- (8): pimeiro (first)
- (9): resoveu (he resolved)
- (10): poquinho (little pig)
- (11): Siuva (Silva – a surname)
- (12): Badnapé (Barnabé – name of a man)
- (13): açúcarca (sugar)

In (8) there was omission of the phoneme /r/ in the second complex onset position in the first syllable of the word <primeiro> (written as “pimeiro”). In (9), the phoneme /l/ was omitted in the coda position in the second syllable of the word <resolveu> (written as “resoveu”). In (10), the phoneme /r/ was omitted in the coda position in the first syllable of the word <porquinho> (written as “poquinho”). In (11), there was a substitution of the conventional representation of the phoneme /l/, since it was registered by the grapheme “u”, in the coda position of the first syllable of the word <Silva> (written as “Siuva”). In (12), the conventional representation was replaced, now of the phoneme /r/ by the grapheme “d”, in the coda position of the first syllable of the word <Barnabé> (written as “Badnapé”). Finally, in (13), there was a transposition with the shift from conventional to unconventional position of the phoneme /r/ in the coda position of the word <açúcar> (written as “açurca”). It is noteworthy, once again, that unconventional records involving the phoneme /l/ were not found in the second complex onset position.

In summary, the results shown here point to: (1) regarding accuracy, a greater number of conventional records than of unconventional records in the two syllabic positions analyzed;

(2) regarding the hits, greater number of conventional records in the second complex onset position when compared to the coda position; and (3) regarding the typology of errors, in a position of coda, more omissions than substitutions and transpositions, and, in the second position of complex onset, only omissions.

## DISCUSSION

The discussion of the trends detected in the results related to the first objective is discussed. Children of the 1st year orthographically registered the phonemes /l/ and /r/, mostly, in a conventional way in the two syllabic positions analyzed. This greater occurrence of conventional records shows that the children in the present study, even at the beginning of literacy, already have remarkable stability in the orthographic record of these phonemes. Such stability suggests the effectiveness of literacy practices in which these children were inserted in their literacy.

Attention is drawn to this result due to how the right/wrong relationship is highlighted in the literature. Two trends of analysis of this relationship are identified in the literature that investigates it.

In the first trend, spelling is not mentioned or, when mentioned, it is very little described<sup>(15,16)</sup>. In other words, this trend emphasizes errors as indicators of orthographic performance, without considering their percentage of occurrence regarding the total possibilities of the categories to which they refer. In addition to this restriction, errors are only typified, without mentioning any gradient between them.

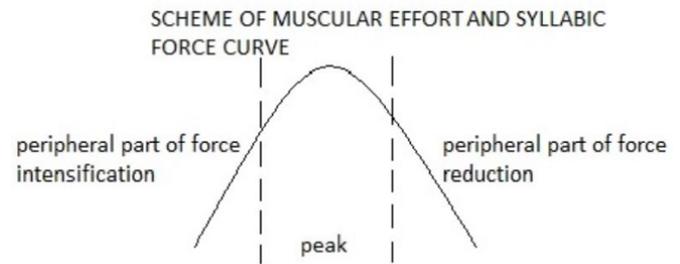
In the second trend, a tripartition is identified between studies that address the relationship between right and wrong: (i) without typifying the error<sup>(17)</sup>; (ii) typifying the error<sup>(18,19,20)</sup>; and (iii) pointing out the existing gradient in the typification, although without this gradient being analyzed<sup>(21,15, 22)</sup>.

Here, the difference in focus of the right/wrong relationship is highlighted because, in the characterization of children's orthographic performance, the emphasis has been placed on error. Even more: omissions, transpositions and substitutions are placed on the same and only plane - that of errors -, when, in fact, they should be situated on different planes, since these are qualitatively different errors, to be positioned in degrees hierarchical regarding the hit.

Moreover, in the first objective's results shows a greater number of hits was observed in the second complex onset position than in the coda position. This difference between syllabic positions can be justified by the phonetic and phonological characteristics of the syllable.

From a phonetic point of view, the syllable can be described from its physical characteristics of production, distribution of acoustic energy and auditory perception. Regarding the physical characteristics of production, the muscular effort that generates the syllable is intensified and reduced, and can be distributed in three moments: (1) intensification of strength; (2) maximum force limit reached; and (3) progressive reduction in strength<sup>(23)</sup>. Figure 3 shows a diagram with the distribution of muscle strength, as proposed by Cagliari:

**Figure 3.** Scheme of muscular effort and syllabic strength curve.



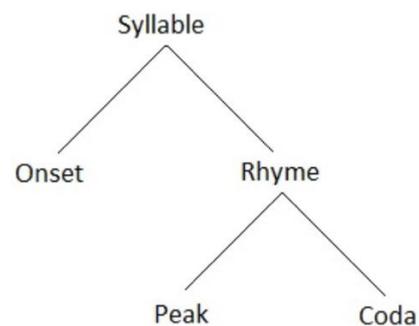
Source: Cagliari (2007).

As a result of this muscle movement, the distribution of acoustic energy is uneven within the syllable: the part with the greatest sonority is precisely where the greatest muscle strength occurs and the parts with the least sonority are those where intensification occurs - increasing energy - and reduction of this strength - decreasing energy<sup>(24,23)</sup>.

Finally, regarding auditory perception, the audibility of parts of the syllable is related to both acoustic and motor characteristics; therefore, it is directly related to the way "[...] the discharge, the culmination and the arrest of its motor impulse occur."<sup>(24)</sup>. Thus, the part that has the greatest sonority is the one with the best auditory perception regarding the intensification and reduction parts.

From the phonological point of view, the internal structure of the syllable is organized in a hierarchical way, as its components establish, among themselves, more or less necessary relations, according to their common characteristics. In this view, from the main node of the syllable, two fundamental constituents emerge: the onset and the rhyme. The onset, is the first position of the syllable, preferably filled by a consonant; the rhyme will house the rest of the elements. In general, the rhyme still branches into two positions: that of the nucleus or peak (which houses the element with the highest degree of sonority in the syllable); and that of the coda (final position, not necessarily present in the syllable)<sup>(25)</sup>. In Figure 4, the syllable internal organization model follows:

**Figure 4:** Hierarchical syllable organization model.

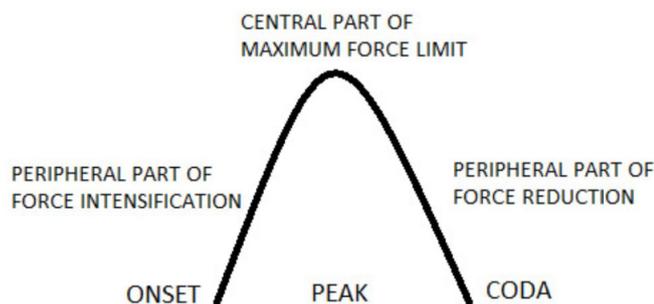


Source: Selkirk (1982)

From the phonetic and phonological characteristics exposed above, the coda position presents greater instability: from a phonetic point of view, while in the onset position there is an increase in muscle strength, an increase in acoustic energy and, consequently, greater auditory favoring, the position of coda

suffers decreased muscle strength, reduced acoustic energy and, thus, greater hearing impairment. From a phonological point of view, because the coda is in a branched position, it fills a weaker position phonologically, more distant from the main node. Below, Figure 5 shows the relationship between the phonetic and phonological aspects of the syllable:

**Figure 5. Phonetic/phonological aspects of the syllable.**



Source: Prepared by the authors.

The second objective results revealed a greater number of omissions in both positions. One factor of phonological nature that could possibly justify this trend would be the universal pattern of the consonant-vowel (CV) syllabic structure<sup>(26)</sup>. Since the issue seems to be ramifications (of the onset and the rhyme), the syllable structure resulting from these divisions causes, in the syllable organization, distances from what would be its preferential (and universal) pattern. Thus, the omission of elements that fill the branched positions could be interpreted as an adjustment that the child makes, in spelling, towards the preferential (and universal) pattern of the syllabic structure. One can deduce that the further the syllabic structure to be spelled is from the universal standard, the greater the chances of omissions occurring.<sup>(26)</sup>

Other factors that can favor omissions in the initial writing are pedagogical literacy practices typically developed in classrooms. In these practices, “[...] syllabic families are exhaustively presented to children in the form of CV, discarding, at least at the beginning of literacy, other patterns of syllabic structuring in writing.”<sup>(27)</sup>

The fact that omissions in a complex onset and in coda predominate over substitutions and transpositions seems to result from possible integration between phonetic-phonological characteristics of the syllable and pedagogical literacy practices, which, at least in the first year of elementary education, favor working with syllabic families with a CV structure. Consequently, and conversely, transpositions and substitutions, in these two syllable positions, indicate, in the initial writing of children, the emergence of more complex syllabic patterns in this writing - which shows that the errors in children’s spelling are qualitatively different since they indicate different ways the complexity of the syllable is shown in children’s writing.

The possible action (or conjunction) of these two factors - phonological characteristics of the syllable and traditional literacy practices - confirms results of studies on children’s writing<sup>(12-15)</sup> who have been calling attention to the fact that,

although evidently related, aspects of speech do not have direct relations with aspects of spelling. The present study shows that, although restricted to the orthographic record of only two of the phonemes of the BP, the child’s written product results from its insertion both in oral social practices (from which the child recovers aspects of speech) and in literacy social practices (from which it recovers aspects of how writing is shown or taught/learned). This contributes to the writing heterogeneity, which is shown as the fruit, as previously mentioned<sup>(14)</sup> - with double insertion of the child in social practices that involve the circulation of language.

A final issue to be highlighted in the results concerns the distribution of hits and errors, as well as the distribution of types of errors, when compared to the two different syllabic positions analyzed. As observed, not only this relationship, but also the types of errors depended on whether the analyzed phonemes occupy the second branching onset position or the coda position in the syllable structure. Unlike previous studies described<sup>(4-10)</sup>, the results of the present investigation suggest that the child’s perception of the relationships between phonemes and graphemes does not depend directly on these relationships. This is because correspondence can be affected both by other phonological aspects disregarded in these relations (such as, in the case of the results under discussion here, the syllabic positions), and by the action that pedagogical practices can have on such relations.

## CONCLUSION

Our results confirm the starting hypothesis: that the phonetic-phonological characteristics of the syllable exert influence in the way that children in the beginning of literacy register the phonemes in their spelling. In addition, we show that these children (i) are much more correct than they are wrong, and that (ii) errors are gradual, which means analyzing them in different hierarchical planes regarding the conventions that regulate the relations between phonemes and graphemes, given their different distances towards the hit.

We point to the importance of the professional’s attention (be it health or education) to two central aspects of the orthographic acquisition of phonemes that occupy complex positions (1) the relationship between successes and errors in the spelling of these phonemes, since successes largely predominate over errors, a fact that is often disregarded by the literature; and (2) the gradient of errors, since its qualitative difference concerns not directly the relationships between phonemes and graphemes, but, mainly, the structural characteristics of the syllable. The results also allow us to better understand the difficulties that children in the beginning of literacy can present, especially regarding the spelling of the phonemes /l/ and /r/ in complex positions - the target of this research -, contributing to more effective educational and clinical practices that reduce these difficulties. Finally, we provide subsidies for more accurate diagnoses, thus reducing the clinical demand, allowing speech therapy intervention only in cases of difficulties deviating from the expected for the development stage under consideration.

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## Authors' contributions

*MVA* main researcher, research elaboration, literature survey and data analysis, article writing, article submission and procedures; *SV* researcher, literature survey, data collection and analysis, writing and correction of the article; *Researcher CV*, literature survey, data collection and analysis, writing and correction of the article; *LC* supervisor, research coordination, data analysis, correction of article writing, approval of the final version.