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Specific Learning Trajectories of Spelling Regularities /

Trajetórias específicas de aprendizado de regularidades ortográficas

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ABSTRACT

This study analyzes four regular spelling patterns: (1a) final unstressed <e>; (1b) final unstressed <o>; (2a) final <r> in infinitive verbs; and (2b) final <r> in nouns. Patterns in (1) are similar in terms of stress context, as both involve unstressed vowels. Patterns in (2) involve the occurrence of the letter <r> at the end of words. Writing samples were collected from children and adolescents enrolled in the 1st, 3rd, 5th, 7th, and 9th grades of a public elementary school in Belo Horizonte, Brazil. The hypothesis tested was that spelling error rates would vary significantly depending on the type of spelling pattern. The data supported this hypothesis. In final unstressed contexts, learners made more spelling errors with the letter <e> than with <o>. Regarding the letter <r>, infinitive verbs were spelled with more errors than nouns. Drawing on the Integration of Multiple Patterns Theory (IMP) (Treiman & Kessler, 2014), we argue that seemingly similar spelling patterns may entail distinct learning trajectories. In other words, we assert that spelling acquisition occurs through multiple trajectories that can only be identified through contextualized analyses—ones that consider not only letter-sound correspondences but also phonetic variability and the morphological structures underlying each pattern. In summary, we propose that both the analysis and teaching of spelling should move beyond the traditional dichotomy of regularity versus irregularity.

KEYWORDS: Spelling regularities; Spelling erros; Final unstressed vowels; Final rhotics; Multiple patterns.

RESUMO

Este artigo analisou quatro padrões ortográficos regulares: (1a) <e> átono final; (1b) <o> átono final; (2a) <r> em final de infinitivos verbais; (2b) <r> em final de nomes. Os padrões em (1) se assemelham quanto ao contexto acentual: vogais átonas. Os padrões em (2) envolvem a escrita da letra <r> em final de palavras. Foram analisados dados de escrita, de crianças e adolescentes do 1°, 3°, 5° 7° e 9° anos do Ensino Fundamental, de uma escola pública de Belo Horizonte. A hipótese testada foi a seguinte: os índices de erros ortográficos diferem-se significativamente a depender

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do tipo de padrão ortográfico analisado. Os dados confirmaram a hipótese. Em contexto átono final, os aprendizes cometeram mais erros ortográficos relacionados à letra <e> do que à letra <o>. Em relação à letra <r>, os verbos de infinitivo foram grafados com mais erros ortográficos do que os nomes. Com o apoio da Teoria de Integração dos Múltiplos Padrões – a IMP (Treiman; Kessler, 2014), argumentamos que padrões ortográficos aparentemente semelhantes podem envolver trajetórias específicas de aprendizado. Defendemos que o aprendizado da ortografia se dá por múltiplas trajetórias, que só podem ser identificadas a partir de análises contextualizadas, que levam em conta não só as correspondências letra-som, mas também a variabilidade fonética e os aspectos morfológicos que operam por trás de cada padrão. Em suma, propomos que a análise – e o ensino – da ortografia deve ultrapassar a tradicional categorização entre regularidades e irregularidades.
PALAVRAS-CHAVE: Regularidades ortográficas; Erros ortográficos; Vogais átonas finais; Róticos finais; Múltiplos padrões.

1 Introdução

In Western societies, most writing systems follow an alphabetic model. An alphabet consists of a limited set of graphic symbols that represent the sounds of spoken language (Man, 2002; Veloso, 2005; Soares, 2018). Despite the diversity of alphabets – such as Greek, Latin, Semitic, Indian, Phoenician, among others – they all follow a common principle, known as the alphabetic principle. This principle states that each graphic symbol should represent at least one sound of speech.

Although all alphabets share this fundamental principle, there are conventions that regulate how they are used. These conventions, known as orthography, serve to systematize the written form of words, ensuring that they can be read by speakers of different varieties of the same language (Morais, 1998). If writing were based exclusively on individual speech patterns, a single word could have multiple spellings, since pronunciation varies from person to person. For example, the word *"plástico"* (plastic) might be spelled as <**plásticu*>, <**prástico*>, or <**pástico*>, as all reflect oral variants attested in Brazilian Portuguese (BP). However, without spelling rules, written language runs the risk of becoming unintelligible (Massini-Cagliari & Cagliari, 1999). Thus, spelling serves to ensure that writing remains stable and intelligible across speakers and over time.

The orthographic systems of natural languages are often described as opaque or transparent, depending on the types of relationships between letters and sounds. In opaque systems, these relationships are inconsistent – for example, when a single letter represents multiple sounds. In contrast, transparent systems exhibit a predictable correspondence between sounds and letters. When orthographic transparency is viewed as a continuum, one extreme includes

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highly transparent systems, such as Finnish and Turkish, while the other extreme consists of deeper systems, such as English (Caravolas, 2004).

The orthography of Brazilian Portuguese is considered relatively transparent, as there are direct correspondences between letters and sounds, although some irregularities do exist (Soares, 2018). Studies on Brazilian spelling generally classify these correspondences into four main categories: (1) direct regularities; (2) contextual regularities; (3) morphological-grammatical regularities and (4) irregularities (Lemle, 1987; Morais, 1998; Nóbrega, 2013; Faraco, 2015; Soares, 2018) (T.1).

Table 1: Letter-sound relationships in the spelling of Brazilian Portuguese

Category	Description	Sound/Context	e.g
Direct regularities	A single sound is represented by one letter.	[b]	**b**ola (ball)
Contextual regularities	Letter use is regulated by phonetic context	[h] in syllable-final position [ɪ] in final unstressed syllables	mar (sea) pente (comb)
morphological-grammatical regularities	Morphological-grammatical rules regulate the use of letters.	[eza] in nouns derived from adjectives.	bel**eza** (beauty) pobr**eza** (poverty)
Irregularities	A sound is represented by two or more letters.	Pre-tonic [i]	p**e**rigo (danger) **pi**rata (pirate)

Source: Adapted from Lemle (1987); Morais (1998); Soares (2018).

Direct regularities consist of a one-to-one correspondence between letters and sounds. For example, the letter <b> corresponds to the voiced bilabial plosive [b]. Contextual regularities, on the other hand, require the learners to understand the sounds, the letters, and the contexts in which those sounds occur. For instance, words that, in speech, end with the glottal fricative – ['mah] *(sea)* – must be written with the letter <r>, as in <mar>. Morphological-grammatical regularities are determined by the grammatical category of the word. For example, nouns derived from adjectives must be spelled with <eza>, as in <beleza> *(beauty)*, while adjectives indicating a person's place of origin are spelled with <esa>, as in <francesa> *(French, feminine).* Irregularities, in turn, depend on the individual memorization of each word's spelling, as there is no specific rule to predict the orthographic pattern. For example, the sound sequence [pi] can be spelled in two different ways: <pe> or <pi>, depending on the lexical item, as in <*perigo*> (danger*)* and <*pirata*> (pirate).

Traditionally, studies indicate that the few regularities in Brazilian Portuguese are learned easily by students (Soares, 2018). Regarding contextual and morphological-grammatical regularities, Morais (1998) suggests that learning becomes easier when schools support students in understanding the orthographic rules relevant to each case. Irregularities, on the other hand, are

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identified as the most challenging aspect of learning (Lemle, 1987). In summary, spelling manuals state that the level of difficulty in learning to spell varies depending on the category to which the word belongs.

Comparing the learning process of direct, contextual, morphological-grammatical regularities and irregularities allows us to identify patterns in spelling acquisition. However, the categorical analysis of orthographic patterns often implies that items within the same category share the same nature. *But are all contextual regularities necessarily more difficult to learn than direct ones? Are there specific challenges associated with learning patterns within the same category?* It is within this context that the present article seeks to advance the discussion. This paper proposes a comparative analysis of four regular spelling patterns: (1a) final unstressed <e>; (1b) final unstressed <o>; (2a) <r> at the end of infinitive verbs; (2b) <r> at the end of nouns. Patterns in (1) are similar in terms of stress context, while those in (2) involve the use of the letter <r> at the end of words. All four patterns are considered contextual regularities. Patterns in (1) involve a syllabic-stress context; those in (2), a syllabic-morphological context.

Drawing on the Integration of Multiple Patterns Theory (IMP) (Treiman; Kessler, 2014), we argue that seemingly similar spelling patterns may follow specific learning trajectories. In other words, we assert that spelling learning occurs through multiple processes, which can only be identified through contextualized analyses that consider not only letter-sound correspondences, but also phonetic, phonological, morphological and lexical factors underlying each pattern.

This paper is structured as follows: the next section presents a review of previous studies on how spelling patterns are learned in Brazilian Portuguese. Section 3 discusses in detail each of the spelling patterns analyzed in this study. Section 4 introduces the theoretical model that underpins our analysis. Section 5 describes the methods used for data collection. Section 6 presents and discusses the results. Finally, Section 7 offers some concluding remarks.

2 The learning of spelling patterns

The Brazilian Portuguese alphabet originates from the Latin alphabet, itself adapted from the Etruscan writing system (Fischer, 2009). In the 1st century BC, the Latin alphabet had a transparent correspondence between letters and sounds (Fischer, 2009, p. 132). Over the course of the evolution from Latin to Brazilian Portuguese, however, some letters came to represent more

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than one sound, and certain sounds began to be represented by different letters. For instance, the letter <s> can represent the sound [z] in '*casa' (house)* and the sound [s] in '*sapo' (frog).* Likewise, the sound [i] can be written with <e>, as in '*menino'* (*boy*), or with <i>, as in '*miséria'* (misery).

The relationships between letters and sounds are complex, as the written form does not always faithfully mirror the spoken form (Cagliari, 1989). Spoken language, being more variable and dynamic than written language, tends to generate inconsistencies between the two systems (Treiman & Kessler, 2014). These inconsistencies help explain many of the difficulties encountered in learning alphabetic-orthographic writing. In the early stages of literacy development, children often rely on their spoken language, which leads to spellings that reflect oral features. For example, it is common to find in beginner writers' work spellings such as <*penti> for 'pente' (comb), <*patu> for 'pato' (duck), <*cantá> for 'cantar' (to sing) e <*celulá> for 'celular' (cell phone). Such forms largely stem from a lack of knowledge of orthographic norms. Learners' understanding of the conventions that structure the alphabetic system can be supported when they are given opportunities to engage with these rules through explicit instruction and exposure to printed materials (Treiman & Kessler, 2014).

According to Morais (1998), the teaching and learning of spelling should be guided by a reflective analysis of the orthographic system. The Portuguese language teacher is primarily responsible for helping learners understand how the system operates. For this to happen, it is first necessary to understand how the orthography is organized (Morais, 1998). Therefore, Morais (1998) proposes a classification of Brazilian Portuguese orthography based on types of letter-sound correspondences. In the author's words:

> Our aim in this chapter is to examine how the orthographic norm of our language is organized: which letter-sound correspondences are regular and, therefore, can be understood and internalized, and which ones are irregular, requiring memorization by the learner. This distinction allows us to understand that spelling errors are not 'all the same,' as similar-looking errors — those involving the 'substitution of one letter for another' — may have different underlying natures. (Morais, 1998, p. 27, our translation).

The classification proposed by Morais (1998), along with contributions from other authors such as Lemle (2003), continues to serve as the foundation for much of the research on spelling in Brazil today. In academic research, Morais's categories are frequently referenced both in descriptions of the orthographic system (Soares, 2018) and in analyses of the spelling difficulties encountered by Brazilian students (Sartori, Mendes, & Costa, 2015). In the pedagogical sphere, Morais's framework supports many of the methodologies proposed for teaching orthography. For

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example, Brazil's National Common Curricular Base (BNCC) (Brasil, 2017) includes the following recommendations (T.2):

Table 2: Spelling in the BNCC

Grade	Practice	Skills
3rd	Linguistic/Semiotic Analysis	(EF03LP01) Read and write words with contextual regular grapheme-phoneme correspondences – c/qu; g/gu; r/rr; s/ss; o (rather than u) and e (rather than i) in unstressed syllables at the end pf words.
4rd		(EF04LP01) Spell words using **regular direct and contextual phoneme-grapheme correspondence rules.**
5rd		(EF05LP01) **Spell words using regular, contextual, and morphological phoneme-grapheme correspondence rules, as well as frequently used words with irregular correspondences.**

Source: BNCC (Brazil, 2017, emphasis added; translation ours)

As can be seen, the BNCC (Brazil, 2017) establishes a progression in the teaching of spelling from the 3rd to the 5th year of elementary school. In the 3rd year, students are expected to learn to read and write words with contextual orthographic regularities. In the 4th year, they should be able to spell words with direct and contextual regularities. By the 5th year, students are expected to master regular, contextual, and morphological orthographic correspondences, as well as frequently used irregular words. In this way, the teaching of orthographic relations is introduced in the 3rd year and deepened in the following years. The BNCC (Brazil, 2017) draws on Morais's categories when referring to spelling and establishes a learning sequence that begins with regularities and progresses toward irregularities. In other words, the BNCC (Brazil, 2017) is based on the premise—supported by the literature (Morais, 1998; Lemle, 2003; Soares, 2018)—that the teaching of spelling should begin with simpler patterns (regular) and move toward more complex ones, which require memorization (irregularities).

Notably, the expectations set by the BNCC (Brazil, 2017) are not fully met in actual classroom practice. There is evidence that Brazilian students, across various grade levels, face difficulties in spelling patterns associated with all types of letter-sound correspondences (Meireles & Correa, 2005; Kusner et al., 2006; Veçossi, 2010; Sartori, Mendes & Costa, 2015; Nobile &

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Barrera, 2016; Souza, Brandão & Melo, 2020). In other words, although students are expected to understand the organization of the orthographic system by the 5th grade of elementary school, their written texts show difficulties with all types of orthographic patterns—whether in direct, contextual, or morphological-grammatical regularities, or in irregularities.

Meireles and Correa (2005), for instance, examined the differences between contextual and morphosyntactic regularities in the orthographic representations produced by 2nd- and 4th-grade elementary school students. The authors hypothesized that morphological regular patterns would be more complex for students than contextual regular patterns. However, the data did not support this assumption. Participants exhibited difficulties in spelling the letter <r> following consonants—e.g., *desrespeito* (disrespect) and *genro* (son-in-law) — as well as the suffix <eza>. In general, the findings reported by Meireles and Correa (2005) do not allow for generalizations. The lack of empirical support for their initial hypothesis invites further reflection on the categorical analysis of orthographic patterns in Brazilian Portuguese. While linguistic theory tends to classify graphemes based on letter-sound correspondences, learners appear to develop specific strategies for approaching each pattern individually. Meireles and Correa's study emphasizes the importance of moving beyond fixed categories—such as regularities and irregularities—when analyzing orthographic knowledge. A deeper exploration of letter-sound correspondences is essential to fully understanding the diverse individual trajectories that contribute to the development of orthographic competence.

Still regarding Elementary School (Grades 1–5), Souza, Brandão, and Melo (2020) conducted a qualitative study with 5th-grade teachers from public schools in Brazil. The authors asked the teachers several questions about the spelling performance of their students. One question, in particular, is of interest to us: 'What are the students' greatest spelling difficulties?' (Souza; Brandão; Melo, 2020, p. 122, our translation). According to one of the teachers, the greatest spelling difficulties of 5th-grade students are 'letter swaps when there is the same sound, as well as difficulties with orthographic regularities and irregularities' (Souza; Brandão; Melo, 2020, p. 122). The teacher's response demonstrates his knowledge of the terminology used in orthographic manuals (Morais, 1998) and in the BNCC (Brazil, 2017). He understands that orthographic patterns are traditionally categorized according to the type of letter-sound correspondence. However, his answer is rather general. Do 5th-grade learners struggle with the spelling of all regular and irregular patterns? Or are some patterns more challenging than others?

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Regarding regularities, which patterns prove to be the most difficult? To answer these questions, it is necessary to expand the analysis of orthography, moving beyond traditional categorization.

Spelling difficulties are found not only in the texts of students in the early years of elementary school (Grades 1–5), but also in those of students in later years (Grades 6–9). Veçossi (2010) analyzed 35 texts written by 8th-grade students from a state public school in Santa Maria. He identified 28 errors caused by the possibility of multiple spellings. Of these, 57% could have been avoided if the students had mastered the contextual rules of Portuguese spelling. Additionally, 43% of the errors were related to irregular patterns. In short, most of the errors were linked to contextual and morphological challenges. According to the author, this highlights the importance of focusing on contextual rules in classroom practice. Veçossi's study contributes to the present work in two main ways: (1) by highlighting how often students make mistakes in regular contextual and morphological patterns; and (2) by showing that 8th-grade students — who are nearing the end of middle school — still make errors in both regular and irregular patterns. In other words, irregularities did not necessarily pose greater difficulty than regularities, contrary to what has been traditionally suggested by Lemle (2003) and Morais (1998). Veçossi's findings provide further evidence that rethinking traditional categories of spelling patterns is essential to better understand how students learn to spell.

Regarding high school, Sartori, Mendes, and Costa (2015) analyzed spelling errors in 70 texts written by first-year students from a public school in Belo Horizonte (MG). They found numerous irregular spelling errors, but there were also cases in which students misspelled regular patterns. In other words, Sartori, Mendes, and Costa's study shows that students struggle with spelling patterns across all traditional categories: regularities (direct, contextual, and morphosyntactic) and irregularities. In addition, the authors also proposed some teaching activities that could be used in the classroom to support students in developing spelling knowledge. These activities were carefully designed to address the most frequent problems found in students' writing. For instance, Sartori, Mendes, and Costa (2015) did not include a single activity aimed at all contextual regular patterns, since each pattern within this category demands specific types of knowledge from the learner. In other words, the authors, aware of the complexity of letter-sound relationships, proposed activities that target specific spelling patterns in Portuguese. This is where our study seeks to contribute. Traditional orthographic categories (Lemle, 2003; Morais, 1998) are useful for organizing the spelling system. However, when it comes to developing pedagogical

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materials aimed at building spelling skills, it is necessary to consider ways of addressing the particularities of each type of spelling error — moving beyond traditional categories.

Texts from higher education students also highlight the need to reflect on the different learning paths related to spelling patterns. Kusner et al. (2006) analyzed the spelling performance of 88 university students and found that 75% (N=66) made a variety of errors. The authors aimed to confirm the poor spelling performance of university students, which has been highlighted in both national and international assessments, as well as in students' own complaints when seeking psychopedagogical support. Regarding orthographic patterns, the findings contradicted the authors' hypothesis. Initially, they expected more errors related to irregular patterns than to others, based on trends documented in the literature (Morais, 1998). However, statistical analysis revealed no significant difference between the number of errors related to irregularities and those related to contextual regularities. The authors argue that errors involving direct regularities are more common at the beginning of literacy, as indicated by the low number of errors in this category. The most common errors in contextual regularities involved substitutions such as i/e, r/rr, and u/l. In terms of irregularities, more errors occurred in pairs like x/ch, x/ks, c/ss, and s/z. Therefore, some spelling errors were more prominent in the students' writing. What caused these errors to stand out? Kusner et al. (2006) did not explore this question in depth. However, closely examining each type of error could provide valuable insights into orthographic learning.

In general, the studies reviewed in this section indicate that students from elementary school, high school, and even university still face difficulties across all categories of spelling, whether regularities (direct, contextual, and morphosyntactic) or irregularities. Given this, it is necessary to think about new theoretical and methodological approaches that consider each spelling difficulty of our students, so that we can effectively contribute to the development of spelling knowledge.

This text argues, in short, that the analysis – and teaching – of spelling should consider the specificities of each type of spelling pattern, going beyond the simple categorization into regularities and irregularities. The discussion developed here will be grounded in the analysis of four regular patterns – final unstressed <e>; final unstressed <o>; <r> at the end of verbs; <r> at the end of nouns – described in detail in the following section.

3 Regular Spelling Patterns: Unstressed Vowels and Final Rhotic Sounds

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The four patterns analyzed in this article are described below (T.3).

Table 3 – Analyzed Contextual Regular Patterns

	Context	Examples
Unstressed Vowels	(1a) <e> is used at the end of words ending with unstressed [ɪ].	pent**e** *(comb);* dent**e** *(tooth);* mol**e***(soft)*
	(1b) <o> is used at the end of words ending with unstressed [ʊ].	pat**o** *(duck);* gat**o** *(cat),* mat**o** *(bush)*
Rhotics	(2a) <r> is used at the end of infinitive verb forms.	cantar (*to sing);* correr *(to run);* sorri**r** *(to smile)*
	(2b) <r> is used at the end of words ending with rhotic sounds.	amo**r** *(love);* cellula**r** *(cellphone);* mulhe**r** *(woman)*

Source: created by the author

The patterns described in (1a) and (1b) refer to final unstressed vowels in Brazilian Portuguese. In spoken language, final unstressed vowels are systematically pronounced as [ɪ, ə, ʊ] in most varieties of Brazilian Portuguese (Câmara Junior, 1970; Bisol, 2003). For example: [ˈmɔlɪ] (soft); ['balə] (candy), [ˈpatʊ] (duck). The pronunciation of final unstressed vowels, particularly [ɪ] and [ʊ], can lead to spelling errors in writing; speakers pronounce [ˈmɔlɪ] and [ˈpatʊ], and as a result, they are often written as <*moli> and <*patu>. Several studies have documented that spelling errors in final unstressed vowels occur mainly at the beginning of schooling, when learners are still forming a direct relationship between spoken and written forms (Cagliari, 1989; Lemos, 2001; Miranda, 2010). To address these spelling errors, learners must pay attention to the phonetic, stress, and spelling contexts of the Portuguese language. The final unstressed vowels, pronounced as [ɪ] and [ʊ], should be written, in the majority of Portuguese words, with the letters <e> and <o>. Therefore, understanding the letter-sound correspondence, the position of the letter (at the end of words), and the stress context of Portuguese (unstressed context) allows for the prediction of the standard spelling pattern to be used.

The patterns explained in (2a) and (2b) refer to final rhotic sounds in Brazilian Portuguese. The term "rhotic" is used to refer to the R sounds (Ladefoged; Maddieson, 1996). In writing, rhotic sounds are represented by the letter <r>, while in speech, these sounds can be omitted when they occur at the end of verbs and nouns in Brazilian Portuguese. For example: [vaˈɦe] (to sweep), [seluˈla] (cell phone) (Oliveira, 1997; Huback, 2003). The omission of the final-R in speech tends to lead to the omission of the letter <r> in writing. For example: <varrê> and <celulá> (Costa, 2009; Torres; Oliveira, 2015; Freire; Hora, 2019). To address this type of spelling error, learners can also

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rely on phonetic and syllabic context. Some syllables (called closed syllables) end in rhotics in speech (CVr). In writing, these syllables should end with the letter <r>.

It is important to note that identifying which contexts require the <CVr> pattern is not always easy, given that the omission of final-R in speech results in the letter <r> to losing its phonetic counterpart. In verbal forms, for instance, final-R is consistently omitted in the speech of people from various regions of Brazil (Callou; Moraes; Leite, 1996). When the final-R is omitted in speech, the oral and written systems become asymmetric; that is, there are more letters in writing than there are sounds in speech. This creates a situation where there are no clear phonetic cues to guide the learner in recalling the correct written form. In such cases, knowledge of morphology can support the learner. For example, with verbal forms, there is a morphological-grammatical regularity related to verb tense that standardizes the use of the final letter <r>: infinitive verbs forms must end with <r>, even though the rhotic sound is not pronounced in many regions of Brazil. Therefore, in order accurately spell the letter <r> in verbs, learners must first understand the concept of the infinitive form.

In summary, understanding contextual regularities requires attention to multiple linguistic patterns. Writing learners should be encouraged to reflect on the phonetic, syllabic, and morphological structures of the language to better understand the system's functioning and, as a result, grasp the rules that govern spelling. Morais (1998, p.32) emphasizes that

> although all the letter-sound relationships discussed in this section are determined by context, understanding these different rules requires the learner to pay attention to various aspects of words. For example, in some cases, the learner will need to observe the letters that come before or after [...]. In other cases, attention must be given to stress [...]. Therefore, it becomes clear that learning these contextual rules requires the learner to adopt different ways of thinking about words. This needs to be considered when designing teaching strategies aimed at helping students internalize the rules of our spelling system (Morais, 1998, p. 32, our translation).

Teaching strategies for spelling rules need to be regularly reviewed and updated**,** as changes in the phonological system can affect how letters and sounds relate. Current linguistic theory shows that spoken language is naturally variable and constantly changing (Weinreich, Labov, & Herzog, 2006; Labov, 2008). Writing, however, is more stable and only changes through official regulation. This contrast can create mismatches between speech and writing. A sound change, for example, can affect letter-sound correspondences. As a result, learners might start reasoning differently about spelling, which makes it necessary to rethink and adapt teaching strategies for the orthographic system.

To make this clearer, let us once again consider the variable pronunciation of final rhotics

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in Brazilian Portuguese. Callou, Morais, and Leite (1996) conducted a detailed study in five Brazilian cities: Porto Alegre, São Paulo, Rio de Janeiro, Recife, and Salvador. Among their findings, the following are particularly relevant: (1) the final >r; was dropped in 37% of all cases; (2) in verbs, the final <r> was deleted in 65% of cases, while in nouns, this occurred in only 17% of cases. These results show that the omission of final /r/ occurs variably across different parts of Brazil and is more frequent in verbs than in nouns. This variability in speech can affect writing. Since verbs are more likely to lose the /r/ sound in spoken language, they also tend to show more <r> omission in writing. Therefore, it is important to develop distinct strategies for teaching the spelling of final <r> in verbs and nouns.

The spelling of words like 'cantar' *(to sing)* and amor *(love)* may appear similar, since both end with the letter <r>. This apparent similarity between verbs and nouns ending in <r> might suggest they follow the same contextual rule. However, despite their similar spelling, there are important differences in how the final <r> relates to the sound system. Based on the findings of Callou, Morais, and Leite (1996), we can infer that the final <r> in nouns tends to have a consistent phonetic realization in speech. In contrast, the final <r> in verbs is associated with a much more variable sound category and is frequently subject to rhotic deletion.

It is also important to point out that each of the cities analyzed by Callou, Morais, and Leite (1996) showed different rates of final-R deletion. The highest rate was found in Salvador (61%) and the lowest in Porto Alegre (37%). In São Paulo and Recife, final-R was deleted in 49% of the cases, and in Rio de Janeiro, in 47%. This variation in the pronunciation of final rhotics should influence how spelling is taught. For example, a teacher in Salvador should consider the high frequency of final-R deletion when planning spelling lessons. In this context, students from Salvador may benefit more from learning morphological and grammatical patterns than from relying on sound-letter correspondences. After all, if the teacher focuses only on the sound of the <r>, they may end up linking it to a pronunciation that is rarely heard in the students' everyday speech.

In Belo Horizonte, for example, Oliveira (1997) found that final rhotic deletion occurs in almost 100% of the analyzed verbs. Therefore, people from Belo Horizonte are likely accustomed to pronouncing and hearing variants such as [kã'ta] (to sing), [ko'he] (to run), [pah'ʧi] (to leave). If a Portuguese teacher is unaware of the high rates of deletion in speech, it could hinder the students' learning of spelling. For instance, associating the final <r> in verbs with the glottal fricative could be challenging for students from Belo Horizonte, considering the rare use of this variant in their everyday speech.

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The same reflection applies to final unstressed vowels. Vieira (1994) demonstrated there is still variation between high and mid-unstressed vowels in final position in Rio Grande do Sul. For example: ['pẽʧɪ] ~ ['pẽʧe] (comb). The vowels [e] and [o] thus appear in the spoken language of some varieties from the southern part of the country. Children from this region, accustomed to producing and perceiving mid unstressed final vowels, can benefit from this knowledge to develop orthographic skills. One may say ['pẽʧe] and write <pente>. In other regions of Brazil, however, there is evidence that final unstressed vowels are categorically realized as high vowels. Example: ['pẽʧɪ] (comb) and ['patʊ] (duck) (Câmara Junior, 1970). This explains, as mentioned earlier, the difficulties related to orthography.

There is also an emerging phenomenon occurring in unstressed contexts: vowel reduction. Oliveira (2011), Dias and Seara (2013), Assis (2017), Lima Junior and Araújo (2022), and Gomes (2023) observed that final unstressed vowels are undergoing reduction in Brazilian Portuguese, with the possibility of being completely dropped in oral speech. The implementation of the vowel reduction phenomenon seems to be favored by the preceding high vowel. That is, the studies show that the vowel [ɪ] reduces more frequently than the vowel [ʊ] (Lima Junior and Araújo, 2022). Example: ['pẽʧ] (comb); ['ʃɛk] (bank check). In other words, even though they are seemingly similar, final unstressed high vowels appear to be involved in different sound variation phenomena. This fact may influence letter-sound correspondences. The final letter <o> in Belo Horizonte, for instance, is mostly associated with the sound category [ʊ]. The letter <e>, on the other hand, may come to be associated with the absence of a sound, which could lead to new challenges for learners of writing. For example, learners may end up spelling words like ‘pente’ and ‘cheque’ without the final vowel: <*pent> and <*chek>.

In general, the reflection raised in this section is that orthographic patterns may relate to different linguistic information, which, consequently, can affect the learning of Brazilian Portuguese spelling. The text aims to argue that it is necessary to consider phonetic, morphological, and contextual aspects when teaching spelling, as well as adapt teaching strategies according to the variability found in speech, so that students can understand the rules that govern writing.

4 Integration of Multiple Patterns Theory

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The discussion presented in this paper is based on the Integration of Multiple Patterns (IMP) theory (Treiman & Kessler, 2014). This theory proposes that spelling acquisition involves learning the multiple patterns that occur in the words of a language. For example, the word *pato* ('duck') contains phonotactic patterns (CV.CV), phonological patterns ([ˈpatʊ]), morphological patterns (*pat-o*), and spelling patterns (p-a-t-o). According to IMP, learning these different patterns makes orthography knowledge motivated rather than arbitrary (Treiman & Kessler, 2014). Understanding that the letter <p> represents the sound [p] in Brazilian Portuguese, for instance, means that the student has learned a pattern, and this understanding will support the acquisition of new spelling forms.

According to Treiman and Kessler (2014), the patterns learned during literacy acquisition can be grouped into two general categories. The first category includes external spelling patterns, that is, those related to the visual appearance of the writing. The shape of letters and the organization of graphic symbols into sequences are examples of external spelling patterns. The second category involves patterns that arise from the connection between the writing form and its linguistic function. For example, by understanding that the letter <f> represents the phoneme [f], the child learns an internal spelling pattern.

Concerning external patterns, there is evidence that children are able to perceive visual characteristics of writing from an early age. Treiman and Zhang (2020) argued that three-year-old children already seem to recognize the graphic symbols of their culture. American children more easily judged the letters of the Latin alphabet compared to symbols from other cultures, such as Chinese (Treiman & Zhang, 2020). Moreover, children appear to be sensitive to the frequency with which letter sequences appear in texts they are exposed to. Pollo, Kessler, and Treiman (2005) found that Brazilian prephonological children use more vowels in their writing than children from the U.S. According to the authors, these results are explained by the quantitative difference in the number of vowels in written Portuguese compared to English. Since vowels are more common in Portuguese than in English, Brazilian children choose to write vowels more frequently than American children (Pollo, Kessler, Treiman, 2005, p.178). According to Treiman and Kessler (2014), learning external spelling patterns helps limit the set of possibilities that the child must consider when thinking about the orthographic form of words. For example, if the child knows that the consonant + vowel sequence is frequent in Brazilian Portuguese, they may use this knowledge to think about the spelling of words.

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In terms of internal spelling patterns, IMP argues that writing patterns are associated with various linguistic knowledge. The association between the letter <c> and the sound [k], for example, involves phonological knowledge. Other patterns involve knowledge of morphology, such as the relationship between the letter <r> and the verbal infinitive morpheme in Brazilian Portuguese. According to Treiman and Kessler (2014), knowledge of linguistic patterns helps children remember letters. If the child knows that the letter <r> represents the verbal infinitive, they may remember to write it at the end of infinitive verb.

According to the IMP, children rely on general learning abilities to learn a language's orthography. Among these abilities is statistical learning, defined as the capacity to learn about the frequency with which events and combinations of events occur in the world (Treiman & Kessler, 2014). Treiman and Kessler (2014) argue that children use statistical learning not only to detect categorical patterns but also probabilistic ones — those that do not fully conform to a rule. For example, a Portuguese-speaking child may judge that the name “Paveno” refers to a male person, even without knowing anyone by that name. This judgment arises because, in Brazilian Portuguese, many words ending in <o> refer to males. Given that the child already knows the association between the letter <o> and masculine gender, they may infer that the new word fits a highly probable pattern in the language.

Statistical learning helps humans understand probable events (Treiman & Kessler, 2014). As children are exposed to multiple instances of written words, they develop an extensive network of associations between written forms and begin to understand generalizations (Treiman & Kessler, 2014). For example, a child who is exposed to writing from an early age may notice that many words are spelled with the letters <e> and <o>, while few are spelled with <i> and <u> in unstressed final position in Brazilian Portuguese. This observation helps the child understand which spelling patterns are more and less probable in Brazilian Portuguese.

In summary, the IMP holds that there are multiple pathways for learning an orthographic pattern. This is because the learning process involves identifying different types of patterns—such as phonological, morphological, and graphic—allowing children to understand orthography through various approaches and associations. Each orthographic pattern can be learned in different ways, depending on the interactions between visual perception, linguistic knowledge, and the observation of frequent patterns in the language.

The multiple patterns will be considered in the analysis of the four regularities tested in this study. What we aim to argue, supported by the IMP, is that the analysis – and the teaching of

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spelling – should go beyond the traditional approach that relies solely on letter-sound correspondences. Unstressed final vowels, for example, are traditionally described as regular contextual patterns governed by a single rule: unstressed high vowels are spelled with the letters <e, o> in BP. Although this rule may assist the learner, there are other linguistic factors that can influence the acquisition of orthography for each vowel pattern. For example, the morphological inflection of grammatical gender may provide clues about the spelling of the unstressed vowel <o>.

The same reflection applies to rhotics. There are nouns and verbs ending in the letter <r> in Brazilian Portuguese. The letter <r>, although symbolically the same unit in all contexts where it occurs, is associated with multiple and distinct patterns, related to grammatical category, phonetic variability, syllable, word etc. Thinking about the acquisition of orthography through the association of multiple patterns (Treiman & Kessler, 2014) allows us to develop reflections that consider specific learning trajectories of orthographic patterns. This type of insight can improve pedagogical practices designed to help learners develop specific strategies for mastering each orthographic pattern.

5 Methods

This study comparatively analyzes four spelling patterns in Brazilian Portuguese – final unstressed <e>, final unstressed <o>, final <r> in infinitive verbs, and final <r> in nouns – using writing data collected through an experimental method in Belo Horizonte, MG. The subjects' profile, the corpus structure and organization, and the statistical procedures guiding the data analysis are described, respectively, below.

5.1 Subjects

The subjects of the study were children and adolescents from Belo Horizonte, enrolled in the 1st, 3rd, 5th, 7th, and 9th grades of a municipal school in Venda Nova, a district in the metropolitan region of Belo Horizonte, MG. The classes for each grade level were randomly selected by the school administration. From each class, 10 students were randomly chosen, resulting in a total of 50 participants in the study.

5.2 Corpus

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The corpus analyzed in this study consists of standard written words, collected through a carefully designed experiment involving a picture-naming task. In this task, the subjects were asked to write the names of selected images. Each image was accompanied by a guiding question to help the participants recall the corresponding word. The aim of the experiment was to encourage the subjects to write the same set of words (T.4)

Table 4: Set of Analyzed Words

Criteria for word selection	Words
Concrete nouns, stressed on the second-to-last syllable", ending in final unstressed <e>	*chav**e**, alfac**e**, sorvet**e**, lustre, cabid**e**, peix**e** garf**o**, lac**o**, caval**o**, cadern**o**, gat**o**, suc**o**[1]*
Verbs and nouns, stressed on the last syllable, ending in <r>	*lavar, jogar, cortar, pescar, varrer, comer, beber, morder, abrir, dirigir, imprimir, corrigir; celular, mar, jantar, bar, calcanhar, colar, professor, elevador, cantor, tambor, flor, pintor*[2]

Source: created by the author

To prevent subjects from producing spellings of non-target words, a preliminary training phase was conducted. In this phase, subjects were instructed to memorize the names of selected pictures. This step served to familiarize them with experimental words. The writing task began only after all picture names had been presented.

Each subject wrote 36 words, totaling 1,800 spelling data points. After excluding illegible responses and off-target words, 1,744 data points remained. Table 5 summarizes the total number of spelling data points by orthographic pattern and school grade.

Table 5: Total Number of Spelling Data Points

↓pattern | grade→	1st	3rd	5th	7th	9th	**Total by pattern**
Final unstressed <e>	58	57	59	59	60	*293*
Final unstressed <o>	60	60	59	60	59	*298*

[1] key, lettuce, ice cream, chandelier, hanger, fish, fork, bow, horse, notebook, cat, juice.
[2] to wash, to play, to cut, to fish, to sweep, to eat, to drink, to bite, to open, to drive, to print, to correct; cell phone, sea, dinner, bar, heel, glue, teacher, elevator, singer, drum, flower, painter.

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Final R in verbs	113	114	111	117	119	*574*
Final R in nouns	115	115	114	116	119	*579*
Total by grade	*346*	*346*	*343*	*352*	*357*	1774

Source: created by the author

The spelling data were categorized based on errors and correct spellings related to final unstressed vowels and rhotics. Spelling erros outside the scope of the study were not quantified[3]. This categorization allowed for the measurement of error rates by school grade and orthographic pattern type.

5.3 Statistical Procedures

Data analysis was performed using descriptive and inferential statistical methods. Descriptive statistics helped explore and visualize the data. Since the research variables are categorical, the descriptions involved counts and percentages. Given that the research variables are categorical, the analysis focused on counts and percentages. The error and correct spelling percentages were calculated and are displayed in tables and columns charts.

In addition to descriptive statistics, hypothesis tests were conducted to explore the data distribution and the relationship between variables. Specifically, the Pearson Chi-square test was used to measure the association or independence between the dependent variable (non-standard pattern rate) and the independent variables (school grade, spelling pattern) (Franke, Ho, Christe, 2012). The p-value was used to interpret the relationships between the variables, with a threshold typically set at 0.05 in social sciences. If the samples do not show significant differences, the p-value is greater than 0.05; if there are statistical differences, the p-value is less than 0.05.

The data analysis was performed using R Software (R Core, 2024). R is an environment built around a computational language that assists researchers in statistical analysis and graph plotting.

[3] Several types of errors, which fall outside the scope of the study, were found in the data. For example: <*abi> (abrir); <*aufasi> (alface); <*bb> (beber); <*cabite> (cabide); <*cadeno> (caderno); <*cacona>; <*caukanha> (calcanhar); <*cato> (cantor); *<xavi> (chave); <coriji> (corrigir), etc.*

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The data analysis was designed to test the following hypothesis: *spelling errors involving seemingly similar regularities differ significantly depending on the type of orthographic pattern being analyzed.* In other words, it is expected that the learning of seemingly similar orthographic patterns occurs through specific trajectories.

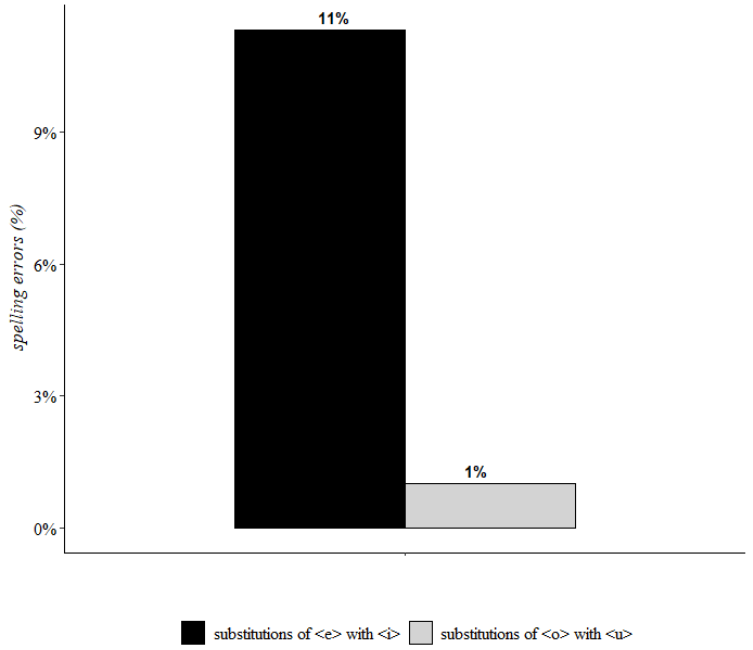
6 Analysis and Discussion of the Findings

This section is divided into two parts. Part I discusses the results related to final unstressed vowels. Part II presents the data related to final rhotics.

6.1 Part I: Final Unstressed Vowels

This section analyzes the spelling errors involving the substitution of the letter <e> with <i> and the letter <o> with <u> in final unstressed contexts. First, we present the total percentage indices of spelling errors in final unstressed contexts (Fig. 1).

Fig 1: Total Spelling Error Rate in Final Unstressed Contexts



Source: created by the author

The black column in Fig. 1 represents the percentage of instances where students substituted <e> with <i> in final unstressed contexts, while the gray column shows substitutions of <o> with <u> in the same context. As shown, elementary school students in Belo Horizonte made

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more errors with the final unstressed vowel <e> (11%, N = 30) than with the vowel <o> (1%, N = 3). Statistical analysis confirmed significant differences between the two sets of writing data (χ^2 = 25.348, df = 1, p-value = 4.787e-07). These results suggest that vowel type affects the rate of spelling errors made by the learners.

Traditionally, spelling errors in final unstressed contexts are explained as reflections of spoken language. As students pronounce final unstressed high vowels in speech, they tend to spell these vowels with <i> and <u>. For example: <*penti> (pente, comb) e <*patu> (pato, duck). Furthermore, orthography manuals classify final unstressed <e> and <o> as regular contextual patterns, since they can be learned through the accentual context of the Portuguese language. That is, if students understand the difference between stressed and unstressed vowels, they can apply the same rule to understand the pattern: *final unstressed high vowels are consistently written as <e> and <o>.* Although there are similarities, evidence from Fig. 1 shows that students in Belo Horizonte have more difficulty spelling the letter <e> than <o>. What explains this difference? Three possible answers to this question are presented below.

(1) Phonetic-phonological phenomena manifest differently depending on the type of final unstressed vowel. As discussed in Section 3 of this paper, there is evidence that anterior vowels are more susceptible to raising and vowel reduction than posterior vowels in various regions of Brazil (Oliveira, 2011; Dias & Seara, 2013; Assis, 2017; Lima Junior & Araújo, 2022). Given this, it is understandable that students make more spelling errors with the letter <e> than with <o>. See Fig. 2.

Fig.2: E Examples of spelling errors with final unstressed vowel omissionl

Source: created by the author

On the left side of Fig. 2, a 1st-grade student omitted the final <e> in *cabide* (hanger) (<*cabid*>). On the right, a 3rd-grade student wrote 'táxi' (taxi) without the final vowel *(<taquix>).* Interestingly, only final unstressed <e> and <i> were omitted; <o> was never omitted. These examples suggest that vowel reduction, favored by anterior vowels in the Belo Horizonte variety (Gomes, 2023), may influence children's spelling. Thus, <e> may become associated with the

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absence of sound in final unstressed position creating new and bigger challenges for young learners.

(2) There are more words in Portuguese that end with final unstressed <i> than with <u>. A search on the Portal da Língua Portuguesa identified 15 words ending in unstressed <i>, such as álibi, beribéri, cáqui, dândi, dóri, júri, Trípoli, táxi, somali, pêni, maori, macúti, papi, mami, and biquíni[4]. No words ending in unstressed <u> were found—only loanwords such as *shih-tzu* and *jiu-jitsu*. Based on the assumption, supported by the MPT framework, that learners acquire probabilistic patterns by observing and associating multiple instances of written words (Treiman & Kessler, 2014), we may infer that children are more likely to access the <i> pattern than the <u> pattern, since unstressed <i> occurs more frequently in Portuguese words.

(3) The interaction between orthography and morphology may account for the different treatment of final unstressed <e> and <o>. As argued by Miranda (2008), final <o> often functions as a marker of grammatical gender (masculine), whereas final <e> has no clear morphological status. Research suggests that morphological awareness can support orthographic learning. Treiman, Cassar, and Zukowski (1994) found that children aged 5 to 9 performed better in spelling when the letters belonged to morphological roots, as opposed to non-morphemic segments. Deacon and Bryant (2005) showed that, in the early school years, English children find it easier to correctly spell morphological inflections than derivations. Casalis and Louis Alexandre (2000) noted that children begin to acquire aspects of inflectional morphology before starting literacy, while derivational morphology continues to develop throughout elementary school. The results presented in this study are consistent with those of Treiman, Cassar, and Zukowski (1994), Deacon and Bryant (2005), and Casalis and Louis Alexandre (2000). The participants in this study were more accurate in spelling final unstressed vowels with morphological information. The results suggest that, for final unstressed vowels, morphological and grammatical regularity appears to facilitate orthographic learning.

In addition to the difference in the overall rates of orthographic errors in word-final unstressed contexts, there are also differences regarding the persistence of these errors throughout schooling (Fig. 3).

Fig. 3: Rate of spelling errors in word-final unstressed context by grade level

[4] alibi, beriberi, khaki, dandy, dory, jury, Tripoli, taxi, Somali, penny, Maori, macúti, papi, mami, bikini

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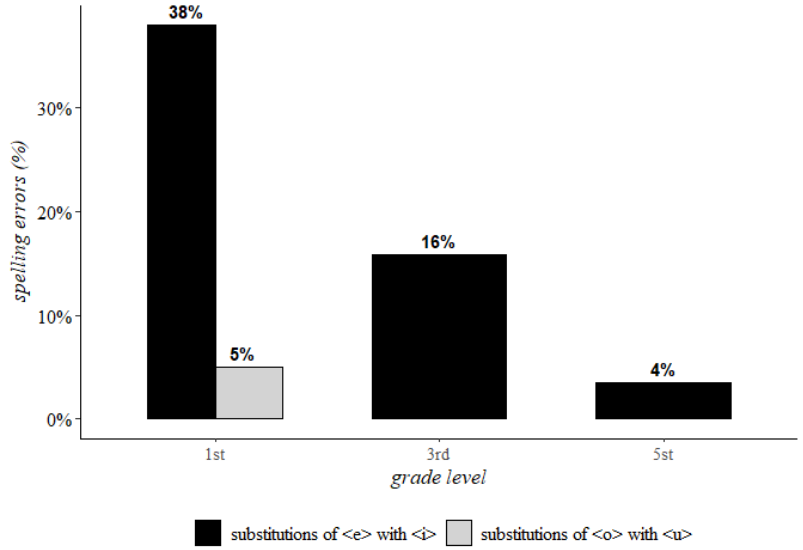

Source: created by the author

The black columns in Fig. 3 represent the percentage rates of substitutions of final unstressed <e> with <i>. The gray columns indicate substitutions of <o> with <u>. As shown, only 1st-grade elementary school students misspelled the letter <o> (5%, N = 3). From 3rd grade onward, no spelling errors involving the back vowel were observed. In other words, spelling errors resulting from the substitution of <o> with <u> are less persistent throughout schooling than those involving the substitution of <e> with <i>. These findings challenge the assumption that final unstressed <e> and <o> are governed by the same rule. If that were the case, both patterns would be expected to be acquired at the same stage of schooling, with no reason for one type of error to persist longer than the other.

Building on the idea that writing learners rely on multiple patterns to acquire spelling (Treiman & Kessler, 2014), it can be argued that throughout the spelling acquisition process, students draw on different types of generalizations to spell words in Brazilian Portuguese. For front vowels, learners need to rely on orthographic regularities and letter-sound correspondences (<e> - [ɪ]/[ø]). For back vowels, learners may also rely on morphological knowledge, in addition to phonetic-phonological patterns. Even when they do not know the correct spelling of words, they are more likely to spell them correctly based on morphology. Since most masculine nouns follow the orthographic pattern <o>, learners tend to predict that this letter is the most appropriate choice for the final sound of masculine words. This may help explain the lower rates of orthographic errors related to unstressed final <o>.

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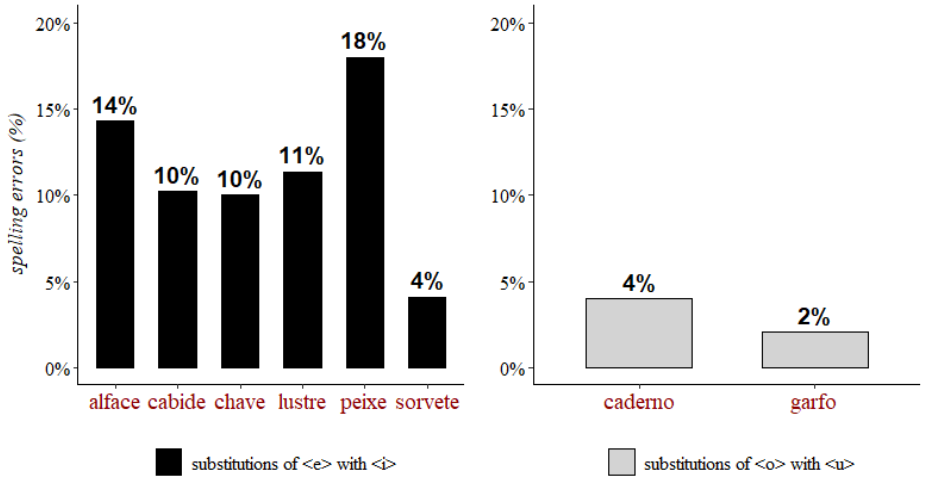
There is also another internal pattern, still little investigated in the field of spelling, that appears to influence the rates of spelling errors: the lexical item (Fig. 4).

Fig.4: Rate of spelling errors in word-final unstressed context by word



Source: created by the author

The black columns represent the percentage of spelling errors made in lexical items ending in final unstressed <e>, while the gray columns indicate the error rates in words ending in final unstressed <o>. The first notable result is the following: all six words selected for the analysis of the letter <e> were spelled with some degree of spelling error. In other words, learners face challenges when spelling the final unstressed <e> in different words of the BP language. Additionally, the data reveal that the rates of spelling errors vary across words. The most common spelling error in the sample was <*peixi> (18%, N=9). The form <*alfaci> appeared in 12% of the data (N=6); <*cabidi, *chavi> appeared in 10% (N=5); <*lustri> occurred in 8% of the sample (N=3); and <*sorveti> in 4% (N=2). These findings suggest that the word itself may act as an internal pattern within the language, influencing the process of spelling acquisition either by facilitating or hindering it.

Another interesting result concerns the words *caderno (notebook)* and *garfo (fork)*. These two words, out of the six analyzed, were the only ones spelled with errors in final unstressed contexts. Traditional analyses might explain the errors <*cadernu> (4%, N=2) and <*garfu> (2%, N=1) as a consequence of oral language influence. However, this explanation does not account for why learners encountered difficulties only with these two words ending in <o>. Assuming that spelling knowledge is shaped by the learning of multiple patterns (Treiman & Kessler, 2014), we can hypothesize that in spelling a single word in Portuguese, learners make multiple linguistic

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associations.

The words 'caderno' *(notebook)* and 'garfo' *(fork)* share a common pattern: in both, the final unstressed syllable is preceded by a closed syllable, in which the coda is filled by a rhotic. Perhaps the preceding syllable is a factor that influences the spelling error in the final unstressed context. Research on the acquisition of oral and written language has documented that children face more challenges when speaking and writing CVC syllables than CV syllables (Miranda & Matzenauer, 2010). The spelling errors <*cadernu> and <*garfu> were made by 1st-grade elementary school students. It is possible that these students, still not fully mastering the graphic structure of CVC patterns, find the spelling of words like 'caderno' *(notebook)* and 'garfo' *(fork)* more difficult than words formed by CV syllables. The difficulty in spelling CVC syllables may extend to adjacent syllables, making the spelling of the entire word more challenging. Future studies could test the hypothesis that syllabic structure influences the overall writing difficulty of a word.

Overall, the results presented in this section highlight that final unstressed vowels are involved in specific trajectories of spelling acquisition. The letter <e> appears to be more difficult to spell than the letter <o>, even though both occur regularly in the same accentual context. We will see next that learners also face particular challenges when spelling the letter <r> in different contexts.

6.2 Part II: Final Rhotics

As mentioned in Section 4 of this paper, the IMP theory posits that spelling acquisition involves learning both external and internal patterns. External patterns refer to those related to the visual forms of writing. Considering the shape of the letter <r> and its position in words like <cantar> *(to sing)* and <amor> *(love)*, it is possible to argue that the infinitive verb forms and certain nouns in Brazilian Portuguese share common orthographic patterns. This reasoning is often applied in pedagogical activities aimed at teaching learners to write the letter <r> at the end of words. An example of such an activity is taken from the activity book developed by Nascimento (2019) for an intervention project in the PROFLETRAS program at the Federal University of Bahia (Fig. 5).

Fig 5: Intervention activity for learning the final <r> letter.

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2- Procure no quadro abaixo as palavras para completar os espaços das frases.

V	M	M	P	I	R	U	L	I	T	O	S	O	N	H	A	R
C	E	A	I	W	A	M	C	D	S	F	T	I	S	F	B	G
B	N	R	A	X	P	O	V	O	O	C	E	Ç	H	O	A	O
E	T	Q	S	O	R	R	I	R	R	O	V	G	R	R	J	S
F	I	G	V	Y	E	J	P	I	V	N	I	A	Q	M	U	T
M	R	L	Y	B	N	D	W	A	E	H	A	S	F	A	R	A
N	K	N	C	X	D	X	Q	U	T	E	J	B	L	R	U	R
Z	C	O	V	N	E	R	K	S	E	C	A	V	O	A	R	U
E	O	S	Z	O	R	P	E	I	X	E	R	N	R	A	U	A
U	A	P	A	G	A	D	O	R	I	R	Z	E	B	R	A	H

a) Quando me fazem cócegas não paro de _____.
b) A lâmpada do _____ está queimada.
c) Para usar o quadro da sala a professora precisa de pincel e _____.
d) Ainda preciso _____ muita coisa sobre a Língua Portuguesa.
e) Às vezes queria poder _____ como os pássaros.
f) _____ é melhor do que ter pesadelos.
g) O sonho de minha amiga é _____Anitta.
h) Meus pais me ensinaram a não _____, por isso sempre tento dizer a verdade.
i) Meu primo acordou com _____ de dente.

Source: Nascimento (2019)

The activity (Fig. 5) asks students to search for the necessary items in the word search to fill in the blanks of sentences (a) through (i). All the lexical items involved in the activity end with the letter <r>. Considering that children form linguistic generalizations by connecting similar elements (Treiman & Kessler, 2014), it is important to propose exercises that encourage them to notice similar orthographic patterns. However, it is also necessary to develop strategies to address the specific difficulties of words that are visually similar but may be internally distinct.

The words to be completed in the activity have differences: those highlighted in yellow (Fig. 5) – 'mentir', 'aprender', 'rir', 'conhecer', 'sonhar', and 'voar' – are verbal items. Those highlighted in blue (Fig. 5) – 'apagador', 'abajur', and 'dor' – are nouns. Although all end with the same letter <r>, there are differences in terms of the internal pattern accessed during the writing task. The final rhotic in verbs is linked to the infinitive morpheme and is systematically dropped in speech. The final <r> in nouns occurs variably and does not carry morphological information. The letter <r> is symbolically the same in both verbs and nouns; however, its representation differs depending on the grammatical category. These internal differences in the letter <r> appear to be important for the writing acquisition process, as learners seem to face distinct challenges in spelling the same <r> in verbs and nouns. See Fig. 6.

Fig.6: Total rate of spelling errors in final rhotics.

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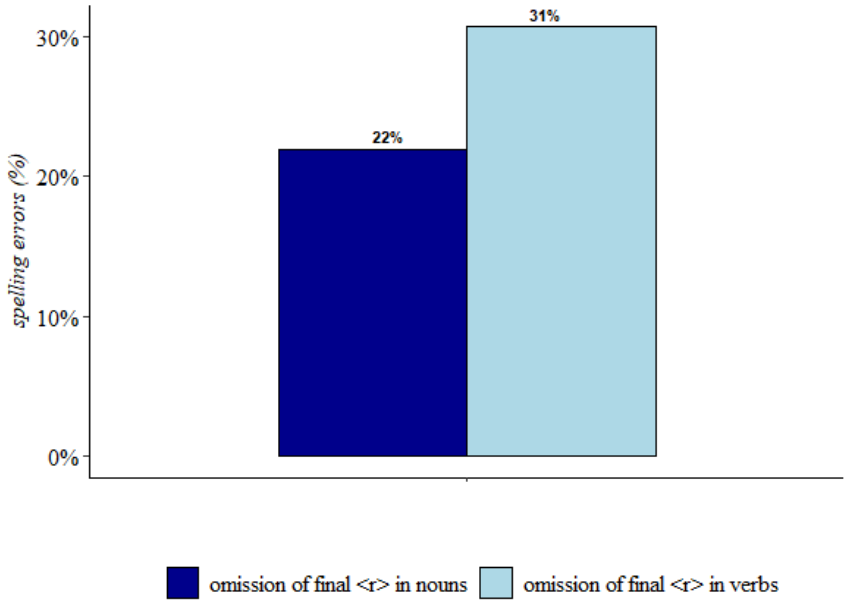

Source: created by the author

The dark blue column in Fig. 6 shows the percentage of times students omitted the letter <r> at the end of nouns. The light blue column represents the omission rates of final <r> in verbs. Elementary school students made more errors with verbs (31%, N=176) than with nouns (22%, N=127). The exploratory statistical analysis confirmed significant differences between the verb and noun data samples (χ^2 = 10.887, df = 1, p-value = 0.0009683). Thus, the data suggest that grammatical class affects the spelling of <r>.

These results support the premise that spelling acquisition is motivated by access to multiple patterns. If the external pattern were the only factor in learning letters forms, learners would acquire the letter <r> in different contexts equivalently. However, the data indicate that the final <r> in verbs is more difficult to spell than the final <r> in nouns. This difficulty may be related to the internal patterns of writing; that is, learners may access different linguistic knowledge to spell the same letter in different contexts.

The difference between verbs and nouns is not only in the total number of spelling errors but also in the persistence of these errors over the school years. See Fig.7.

Fig.7: Spelling error rate in final rhotics by school year.

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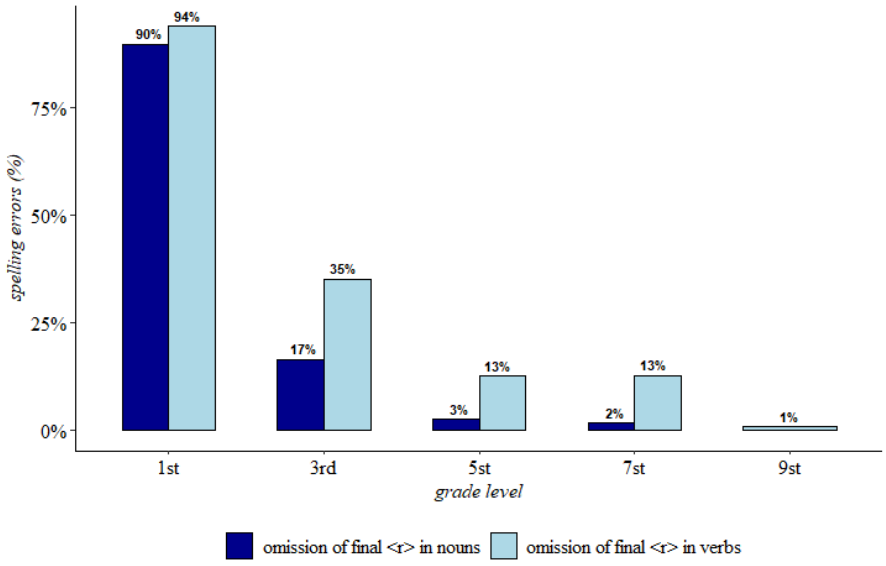

Source: created by the author

The light blue columns indicate the omission rates of the letter <r> at the end of verbs. The dark blue columns indicate the omission rates of the <r> at the end of nouns. Spelling errors related to the letter <r> were primarily concentrated in the 1st year. In the following school years, the error rates progressively decreased. However, two results should be highlighted: (i) the error rates in verbs are higher than in nouns across all school years; (ii) students continued to make errors with verbs until the 9th year; for nouns, however, spelling errors ceased in the 7th year.

The results clearly show that spelling errors in verbs are more frequent and persistent than spelling errors in nouns. We are left to consider the factors that motivate the different learning paths for the letter <r>.

The first reason that can explain the different rates of spelling errors in verbs and nouns relates to the specific phonological variation of each grammatical class. As discussed in Section 3 of this paper, the phonological phenomenon of final R deletion is more frequent in verbal forms than in nominal forms (Huback, 2003). Considering that, throughout the process of writing acquisition, students associate letters with phonetic variability, it is understandable that they spell verbs differently from nouns. Furthermore, it is justifiable that verbs have higher omission rates of the letter <r> in writing, given that deleted forms are prototypical in the verbal category.

Secondly, the persistence of spelling errors in verbs may be related to the semantics and the inflectional morphology of Brazilian Portuguese. Infinitive forms like 'sorrir' *(to smile)* and 'ler' *(to read)* are phonetically and semantically related to their inflected forms 'sorri' *(I smiled)* and 'lê *(he reads).* The phonetic relationship arises from the fact that sentences like 'eu sorri' – 'eu vou

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sorrir' (*I smiled – I will smile)* can be pronounced similarly, for example, as [eu̯ soˈhi], [eu̯ vosoˈhi]. The semantic relationship stems from the fact that both infinitive and inflected forms refer to the same action.

There is no consensus on when students begin to benefit from morphological knowledge. Some studies indicate the early development of morphological skills (Treiman, Cassar, & Zukowski, 1994), but there is also evidence that children become aware of a language's morphology at later stages (Paula, 2007). Paula (2007) mostrou que alunos mais avançados (5° e 7° ano) possuem mais sucesso em tarefas explícitas de consciência morfológica do que alunos dos anos iniciais do EF. Paula (2007) found that 5th- and 7th-grade students performed better on morphological tasks than younger students, suggesting that these skills improve in later years. This may explain why spelling errors in verbs persist longer in learners' writing than errors in nouns.

Conclusions

This paper conducted a comparative analysis of four regular orthographic patterns: (1a) final unstressed <e>; (1b) final unstressed <o>; (2a) final <r> in verb infinitives; (2b) final <r> in nouns. The study analyzed writing data from children and adolescents in the 1st, 3rd, 5th, 7th, and 9th grades of a public school in Belo Horizonte. The analysis was based on the theoretical framework of the Integration of Multiple Patterns (IMP) model (Treiman & Kessler, 2014). In brief, this theory proposes that spelling acquisition occurs through the assimilation of different patterns found in words, including phonotactic, phonological, morphological, and orthographic patterns. According to Treiman and Kessler (2014), these patterns can be classified as external—related to the visual appearance of written forms—and internal—related to the connection between orthographic form and linguistic function.

Based on the IMP framework, we formulated the following research hypothesis: spelling errors involving seemingly similar regularities differ significantly depending on the type of orthographic pattern being analyzed. The data confirmed this hypothesis. In final unstressed contexts, students made more spelling errors with the letter <e> than with <o>. Regarding final rhotics, omission of the letter <r> was more frequent in verbs than in nouns.

Based on these findings, this paper argued that spelling patterns that appear similar may, in fact, involve distinct learning processes, as they rely on access to different types of linguistic

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patterns. This suggests that spelling acquisition follows multiple pathways, which can only be fully understood through contextualized analyses. Such analyses must take into account not only letter forms and letter–sound correspondences, but also the phonetic, phonological, and morphological factors that influence each pattern.

Phonetic variability observed in speech is a factor that may influence spelling acquisition. Final unstressed vowels are involved in a phonological phenomenon known as vowel reduction (Oliveira, 2011; Dias & Seara, 2013; Assis, 2017; Lima Junior & Araújo, 2022). This phenomenon has been shown to occur more frequently with front vowels than with back vowels. In other words, vowel reduction seems to follow different evolutionary paths in Portuguese, depending on the vowel type—front or back. Final rhotics, in turn, may be omitted in speech due to a phonological process known as final-R deletion (Oliveira, 1997; Huback, 2003). This phenomenon occurs more frequently in verbs than in nouns. That is, final-R deletion in Brazilian Portuguese unfolds gradually, depending on the grammatical category. The different trajectories of implementation of phonetic and phonological phenomena in speech may be reflected in writing, resulting in distinct rates of spelling errors. Therefore, understanding these gradual paths of variation and sound change is essential for a more accurate analysis of spelling challenges and for developing pedagogical strategies that take the specific nature of each phenomenon into account.

Morphology also appears to influence the learning of spelling patterns. Morais (1998) points out that certain spelling regularities are related to grammatical categories. In such cases, spelling can be learned through the understanding of morphological rules. The author groups morphology-related patterns into a category called “morphological-grammatical regularities.” Creating orthographic categories helps organize the system and, consequently, facilitates analysis. However, it is important to note that categorical analyses may overlook relevant aspects tied to the specific features of each element within the category. For example, grammatical gender morphology may have supported students in correctly spelling final unstressed <o>, which could explain the low error rates in this context. Nevertheless, one cannot assume that morphological regularity always facilitates spelling acquisition. In the case of verbs, morphological regularity did not prove to be a facilitating factor for learning the letter <r>. On the contrary, elementary students had more difficulty spelling the final <r> in verbs than in nouns. Therefore, it is not possible to generalize about the acquisition of morphological-grammatical regularities. It is essential to examine the learning process of each spelling pattern individually.

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In general, the findings of this study suggest that spelling acquisition is a complex process, influenced by phonetic, phonological, morphological, and even lexical aspects. The analysis of spelling errors revealed that seemingly similar patterns may follow distinct acquisition trajectories, highlighting the importance of contextualized approaches in writing instruction. In light of this, we hope this paper contributes to reflections on the multiple patterns involved in spelling acquisition, emphasizing the need to move beyond the rigid boundaries of categorical analyses. By considering orthographic particularities, it may be possible to enhance pedagogical strategies that help students overcome spelling challenges, progressively reducing spelling error rates, and ultimately enabling them to become proficient users of the language's writing.

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