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Co-occurrence of phonological traits in orthographic replacement of sonorant phonemes

Coocorrência de traços fonológicos em substituições ortográficas de fonemas soantes

ABSTRACT

Purpose: This short presentation aims to indicate phonological features inherent to the sonorant consonant class (nasals and liquids) that might be relatively problematic in the orthographic records of these phonemes. **Methods**: orthographic replacement in text compositions from children in the first grade of elementary school was analyzed. Data analysis was performed according to the *Padrão de Aquisição de Contrastes* (PAC). **Results**: Results reveal that replacement was distributed between the two classes, and within each subclass, relatively unstable phonological contrasts were detected in the orthographic records of these phonemes. **Conclusion**: This relative instability of contrasts pointed out phonological issues, as well as issues related to the orthographic complexity of each these segments, thus indicating a non-direct relation between speech and spelling.

RESUMO

Objetivo: Esta comunicação breve tem como proposta mostrar os traços fonológicos inerentes à classe das soantes – nasais e líquidas – que seriam mais ou menos problemáticos no registro ortográfico desses fonemas. **Método**: Foram analisadas substituições ortográficas de produções textuais realizadas por crianças da 1ª série do Ensino Fundamental. A análise dos dados foi realizada de acordo com o modelo *Padrão de Aquisição de Contrastes* (PAC). **Resultados**: Foi observado que as substituições foram distribuídas entre as duas classes de fonemas e, no interior de cada uma, foram detectados contrastes fonológicos mais e menos instáveis no registro ortográfico desses fonemas. **Conclusão**: Essa maior e menor instabilidade de contrastes apontou para questões fonológicas, bem como para questões relacionadas à complexidade ortográfica desses segmentos, indicando, portanto, uma relação não direta entre fala e ortografia.

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INTRODUCTION

In a syllabic attack position, the sounding consonants - a large phonological class that groups the subclasses of the nasal and liquid consonants - are gradually acquired by Portuguese-speaking children as their mother tongue. Nasals, along with plosives, are the first to be acquired, and the liquids are the last[1-7].

In addition to the gradual acquisition between these subclasses, there is also a gradual acquisition of the segments within each one of them. In nasal, phonemes /m/ and /n/ tend to be stabilized before phoneme /ɲ/. In liquids, laterals are acquired before non-lateral ones, and between the lateral ones, /l/ is acquired before /ʎ/, and between the non-lateral ones, /r̄/ before /ɾ/[1].

In this study, it is assumed that although phonological acquisition processes are distinct from the processes involved in orthographic acquisition/learning, there are undoubtedly connections between them[8-12]. Based on this principle and assuming the complexity in the functioning of this great class, the question is: to what extent would this complexity also be present in the acquisition of its spelling?

For the development of the research, the theoretical basis was the *Padrão de Aquisição de Contrastes* (PAC) model, built from phonological principles based on traits. The PAC formalizes the construction of a phonological language system through the emergence of contrasts, allowing "[...] to analyze a child's sound inventory during acquisition and to identify cases of PD (phonological disorder) [...]."[3]:115.

Although the model proposes to analyze the acquisition of speech phonemes, in this work, its scope was expanded, adapting it to the orthographic acquisition of sounding consonants.

Although aspects of the orthographic acquisition of sounding consonants have been described, such as (i) the relationship between these aspects and those of auditory-perceptual nature[9], or (ii) the relation between right/wrong and syllable accent in the orthographic register of these consonants[9, 10], there is no detailed characterization of the operation of the sounding class in this acquisition. Thus, the purpose of this brief paper is to analyze the graphic representations of the sounding consonants and to verify which phonological features inherent to the nasal and liquid classes would be more - or less - problematic in the orthographic register of these segments.

METHODS

The Research Ethics committee of IBILCE/Unesp approved the development of the research under number 0856/2013. The Free and Informed Consent Form (ICF) was waived because it was the analysis of productions from a database of the Research Group "Studies on language" (in Portuguese, GPEL/CNPq), whose constitution was approved by the Research Ethics committee of the FFC/UNESP under number 0132/2010.

The analyzed data were extracted from 801 textual productions resulting from the development of 14 different thematic proposals produced by children of the 1st grade of Elementary School of two public schools from São José do Rio Preto.

In order to verify the existence of more or less problematic features for the graphic recording of nasal and liquid consonants, the orthographic substitutions that altered the phonological value of the word and occurred between graphemes that referred to the large class of sounders - such as the record of <pala> to <palha> - were analyzed according to the co-occurrences of phonological features involved in the substitution. For the analysis of these co-occurrences, we used the *Padrão de Aquisição de Contrastes* (PAC) model[3]. The substitutions were analyzed obeying the hierarchy proposed in the model for speech acquisition, according to the following directions:

1. from nasal (N) to liquid (L), for example from "nuvem" to "luvem";

2. from liquids (L) to nasal (N), for example from "lata" to "mata";

3. inside the nasal:

   3.1. from coronal nasal (Cn) to labial nasal (Ln), for example from "punho" to "pumo";

   3.2. from labial nasal (Ln) to coronal nasal (Cn), for example, "cama" to "cana";

4. inside liquids:

   4.1. from lateral liquid (Ll) to non-lateral liquid (Nll), for example from "velha" to "vera";

   4.2. from non-lateral liquid (Nll) to lateral liquid (Ll), for example from "barata" to "balata";

5. inside the coronal nasal:

   5.1. from anterior coronal nasal (Acn) to non-anterior coronal nasal (Nacn), for example from "gana" to "ganha";

   5.2. from non-anterior coronal nasal (Nacn) to anterior coronal nasal (Acn), for example from "vinho" to "vino";

6. inside non-lateral liquids:

   6.1. from liquid non-lateral coronal (Lnlc) to dorsal non-lateral liquid (Dnll), for example from "careta" to "carreta";

   6.2. from dorsal non-lateral coronal (Dnlc) to coronal non-lateral liquid (Cnll), for example from "carro" to "caro";

7. inside the lateral liquids:

   7.1. from anterior lateral liquid (All) to non-anterior lateral liquid (Nall), for example from "bola" to "bolha";

   7.2. from non-anterior lateral liquid (Nall) to anterior lateral liquid (All), for example from "telha" to "tela".

Finally, the statistical treatment of the data was performed using Statistica software (version 7.0). For the descriptive analysis of the data, we used a measure of central tendency

(mean), and a measure of dispersion (standard deviation). For the inferential analysis, we used the nonparametric tests: (i) Sign test for dependent variables in the analysis of substitutions within the nasal and liquid subclasses; and (ii) Friedman ANOVA and Kendall Coeff. Concordance, in the analysis of the substitutions found for the nasal and liquid subclasses.

For each analysis, the significance level adopted was (α) ≤ 0.05. Values with statistically significant differences are marked in the tables with an asterisk (*).

RESULTS

We found 487 unconventional records that altered the phonological value of the word - with the substitution of one sounding consonant for another of the same large class, as anticipated. Of these 487, 210 (36.61%) involved graphemes that referred to nasal subclass phonemes, with an average of 15 and a standard deviation of 11.05. The other 277 (63.39%) unconventional records involved graphemes that refer to subclass phonemes of liquids, with an average of 19.78 and a standard deviation of 15.8.

Although there was a higher number of substitutions involving the liquid subclass (63.39%), the values showed no statistically significant difference (Z = 0.80; p = 0.42).

For better visualization of the substitutions of graphemes that refer to the phonemes of each subclass, the first substitutions related to the nasal subclass will be exposed in Table 1:

The most frequent substitution of graphemes involved, in the phonemes mobilized by it, the coronal nasal ➜ nasal direction – as in the register of "nercado" to "mercado" (Figure 1) – whereas the less frequent one involved the anterior coronal nasal direction ➜ non-anterior coronal nasal direction – for example, in the registration of "bigornha" to "bigorna" (Figure 2). Thus, in the nasal subclass, the co-occurrence of the traits [+nasal, labial] presented the greatest difficulty in the orthographic registration of children. Also, the statistical test showed a significant difference, indicating that the distribution of substitutions did not occur at random.

Finally, the results found for substitutions involving the subclass of liquids are presented in Table 2.

In the spelling substitutions that mobilized phonemes of the subclass of liquids, the most frequent involved the dorsal
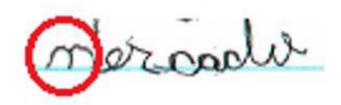

Figure 1. Example of substitution involving nasal to the coronal nasal direction
Source: Research Data

Figure 2. Example of substitution involving anterior coronal nasal direction to non-anterior coronal nasal
Source: Research Data

Table 1. Phonological spelling substitutions within the nasal subclass

Substitutions	Occurrence Number	Average	Median	Standard deviation	Sum of Rank	Friedman ANOVA and Kendall Coeff. of Concordance
Nasal – liquid (N-L)	38	2.71	1	5.24	41	χ^2= 29.74
Coronal nasal - Labial nasal (Cn-Ln)	60	4.29	4	3.24	54	df= 4
Labial nasal – Coronal nasal (Ln-Cn)	88	6.29	3	7.28	58.5	p= 0.00*
Anterior coronal nasal - Non-anterior coronal nasal (Acn – Nacn)	1	0.07	0	0.27	19	
Non-anterior coronal nasal - anterior coronal nasal (Nacn – Acn)	23	1.64	1	2.56	37.5	

Source: Research Data. Friedman ANOVA and Kendall Coeff. of Concordance (α≤0.05). **Caption:** The asterisk (*) indicates that there was a statistically significant difference

Table 2. Phonological spelling substitutions within a subclass of liquids

Substitutions	Occurrence Number	Average	Median	Standard deviation	Sum of Rank	Friedman ANOVA and Kendall Coeff. of Concordance
Liquid – nasal (L - N)	18	1.28	1.00	1.44	53	χ^2= 23.98
Lateral liquid - non-lateral liquid (Ll -Nll)	6	0.43	0	0.51	45.5	df= 6
Non-lateral liquid - lateral liquid (Nll – Ll)	28	2.00	1.00	3.14	57.5	p= 0.00*
Anterior lateral liquid - non-anterior lateral liquid (All - Nall)	22	1.57	0.5	3.27	53	
Non-anterior lateral liquid - Anterior lateral liquid (Nall – All)	49	3.5	2.5	3.32	70	
Coronal non-lateral liquid - Dorsal non-lateral liquid (Cnll - Dnll)	2	0.14	0	0.36	34.5	
Dorsal non-lateral liquid - Coronal non-lateral liquid (Dnll – Cnll)	152	10.86	5.00	14.25	78.5	

Source: Research Data. *Friedman ANOVA and Kendall Coeff. of Concordance* (α≤0.05). **Caption:** The asterisk (*) indicates that there was a statistically significant difference

Figure 3. Example of substitution involving dorsal non-lateral to coronal non-lateral liquid direction
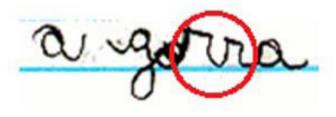**Source:** Research Data

Figure 4. Example of substitution involving coronal non-lateral to dorsal non-lateral liquid direction
Source: Research Data

non-lateral liquid ➔ coronal non-lateral liquid direction – for example, in the record of "morer" to "morrer" (Figure 3) –, while the less frequent one involved the reverse direction, i.e., coronal non-lateral liquid ➔ dorsal non-lateral liquid – as in the "agorra" to "agora" record (Figure 4). Therefore, in the subclass of liquids, the co-occurrence of the [-nasal, -lateral, dorsal] features presented the greatest difficulty in the children's spelling record. The statistical test as well as for the nasal subclass showed a significant difference, indicating that the distribution of substitutions did not occur randomly.

DISCUSSION

The lack of predominance of substitutions involving nasal or liquid subclasses indicated that graphemes that refer to phonemes of these subclasses seem to be acquired in near moments. This result is justified by the fact that subclasses grouped into a phonological class undergo common phonological processes and, therefore, function similarly within the phonological system[9], which, in the case of sounding consonants, was found in writing data analyzed - although not verified in speech acquisition.

Although there are no statistically significant differences, liquid consonants seem to present more difficulties for spelling, since the distribution of the number of spelling errors that involved them presented a higher standard deviation than in errors involving nasal consonants, indicating lower data consistency (cf. Table 1). This small difference corroborates trends found for the speech acquisition of children[1,3,13,14]. According to the Robustness Scale[3], the co-occurrence of the traces [+sounding; -continuous] - which characterizes nasal consonants - appears in speech before co-occurrence [+sounding; +continuous] - which characterizes the liquid consonants. Thus, nasal consonants are acquired in the first stage of phonological acquisition, whereas liquid consonants begin to be acquired in a third stage. Therefore,

at least to this aspect of orthographic acquisition, a similar phenomenon that observed in phonological acquisition of speech.

Within the nasal subclass, the spelling errors that involved the most difficult contrast were between the [labial] and [coronal] strokes. According to the PAC model, the contrasts between the [labial] and [coronal] features are acquired already in the first stage of phonological acquisition; thus, the cooccurrences of [+sounding, -approximating, labial] and [+sounding, -approximating, coronal] traits are already present in the phonological inventory of children in the initial moments of acquisition, which would not, therefore, justify a greater difficulty between labial and coronal nasal. Thus, the difficulty presented seems to be more related to orthographic aspects than to phonetic-phonological aspects of the tongue, reinforced by the fact that the replacement of the coronal nasal by the labial nasal is the second most frequent substitution. Graphemes that refer to the labial nasal /m/ and coronal /n/ have similar graphic forms, and both can be used in syllable coda position to represent an unspecified nasal phoneme (i.e. an archiphoneme in another interpretation mode); These two reasons would justify the difficulty identified in the spelling of the two graphemes.

Regarding orthographic substitutions that involved subclass phonemes of liquids, the most difficult contrast was between dorsal non-lateral liquid and coronal non-lateral liquid, that is, the contrast between [coronal] and [dorsal] features. Regarding this result, once again, there is no agreement with what occurs in speech acquisition[1,3,15]. According to the PAC, the [dorsal] trait is acquired in the fourth stage of acquisition, as is the [coronal] trait, which would not justify the difficulty of children in contrasts that mobilize this trait.

Consequently, this result may be based on orthographic questions. In fact, of the seven sounding consonants, six - /m/, /n/, /ɲ/, /l/, /ʎ/ and /ɾ/ - have spelling transparency in the language. The only consonant of this large class that has spelling opacity is precisely the phoneme /ʀ̄/, which can be represented orthographically with <r> at the beginning of the word and after a consonant, or by the digit <rr> in an intervocalic context. When the child records only <r> in an intervocalic context, it causes phoneme substitution (/ʀ̄/ by /ɾ/). However, this substitution - which should be considered as phonological due to the effect it causes on reading - may be motivated by the fact that children have not yet acquired the context in which, by writing a <r>, they will mobilize the phoneme /ʀ̄/ or the phoneme /ɾ/. Thus, by registering <garafas> for <garrafas> the child may be making a phonological error due to non-stabilization of spelling patterns - if one takes into account the child's written product and not the reading product of a literate adult. Thus, children's orthographic records suggest their support not only in phonetic-phonological aspects of the language but also in aspects that refer to the conventions that regulate the relations between phonemes and graphemes, thus indicating a non-direct relationship between speech and spelling.

With the development of this work, it is expected to contribute to the field of speech-language therapy as well as to the area of education, concerning the identification of difficulties inherent in the orthographic development of the sounding class. Once aware of these difficulties, the therapist and/or teacher may adopt facilitating strategies for children to realize that spelling

substitutions may be due to misconceptions and/or difficulties that result from the very phonological complexity of this class, as well as relationships between this complexity and the conventions governing the use of spelling. Finally, it is also expected to fill gaps in studies on the development of writing in students in the field of linguistics, especially regarding the research that this field makes of the relationship between speech and writing.

CONCLUSIONS

The children investigated showed no preference for one subclass or another of the large class of sounding phonemes since they had the errors distributed between the subclasses of nasal consonants and liquid consonants. Within each subclass, some contrasts were less stable than others. These are those between the [labial] and [coronal] features in the nasal, and between the [dorsal] and [coronal] features in the liquids, which were the most problematic for orthographic recording. The greater instability in some contrasts suggests a gradual acquisition of graphemes that refer to sounders. This grading stems not only from phonological questions but also from questions concerning orthographic complexity, thus indicating a non-direct relationship between speech and spelling.

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Author contributions

SV main researcher, research elaboration, schedule elaboration, literature survey, data collection and analysis, article writing, article submission and procedures; LC advisor, research coordination, data analysis, article writing correction, final version approval.