

Morphological awareness training in reading and spelling of Portuguese

Treinamento de consciência morfológica em leitura e ortografia do português

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Summary

This study investigates the effects of instruction in morphology in both oral and written modality on morphological skills and both spelling and reading of a group of Portuguese speaking children in Grade 3. We conducted morphological training across 19 sessions with 17 students and compared its effects to a 'business as usual' control group of 16 students. The groups were matched based on performance on measures of verbal and non-verbal abilities as well as phonological awareness. Pre- and post-tests included morphological awareness, spelling of morphologically complex words and other word types, as well as word-level reading. Analyses revealed significant effects of the intervention on morphological awareness and spelling of morphologically complex words, but not on word-level reading or spelling. These findings point to relatively specific effects of morphological training, albeit ones that are likely to be quite helpful to children given the prevalence of morphologically complex words in written texts.

Keywords: Spelling. Morphological Awareness. Morphological Intervention. Reading.

Resumo

Este estudo investiga os efeitos do ensino de morfologia na modalidade oral e escrita nas habilidades morfológicas e na ortografia e leitura de um grupo de crianças falantes de português na 3ª série. Realizamos treinamento morfológico em 19 sessões com 17 alunos e comparamos seus efeitos a um grupo de controle de 16 alunos. Os grupos foram pareados com base no desempenho em medidas de habilidades verbais e não verbais, bem como, de consciência fonológica. Os pré e pós-testes incluíram consciência morfológica, ortografia de palavras morfológicamente complexas e outros tipos de palavras, bem como, leitura em nível de palavra. As análises revelaram efeitos significativos da intervenção na consciência morfológica e na ortografia de palavras morfológicamente complexas, mas não na leitura ou ortografia no nível da palavra. Estas descobertas apontam para efeitos relativamente específicos do treino morfológico, embora sejam provavelmente bastante úteis para as crianças, dada a prevalência de palavras morfológicamente complexas em textos escritos.

Unitermos: Ortografia. Consciência Morfológica. Intervenção Morfológica. Leitura.

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Introduction

Morphemes are the foundational units of meaning in language. Several studies now show that children's morphological awareness, or the ability to reflect on and manipulate morphemes in oral language (Carlisle, 2000), supports literacy development (e.g., Deacon & Kirby, 2004). Morphological awareness is an oral language skill that allows children to break individual complex words into component parts. In turn, through the application of morphological decoding, this is meant to support the spelling and reading of morphologically complex words (e.g., Levesque et al., 2017), contributing to reading and spelling of a broader set of words and comprehension of a whole text (Kirby et al., 2012). This argument has been made most prominently for English (Mann, 2000), which has many morphophonemic regularities (Venezky, 1967), with advocacy that effects of morphological instruction should not emerge in languages with fewer deviations from phonology in the spelling of words (Mann, 2000). And yet, many languages are not as transparent as originally conceptualised; in Portuguese, for instance, the word *desanimado* [discouraged] is spelled based on its morphological structure, with the spelling *s* in the suffix *des* retained despite a shift from /s/ to /z/ at the morphological boundary. As such, awareness of this morphological structure could support children's spelling of this complex word. Further, morphemes are foundational units of meaning in all languages and so the oral basis of these effects should be consistent across all languages. Clearly, testing effects of morphological instruction in more transparent languages is important for building theories that apply beyond English (Share, 2008). Towards this end, we test these effects of morphological training on Portuguese-speaking third grade student's literacy skills.

Portuguese is an interesting language in which to test the effects of morphological instruction because of its relatively transparent orthography and a simple syllabic structure (Seymour et al., 2003). A simple syllabic structure (with most syllables as CV) can give the impression of phonologically transparent representation that is easy to read. And

yet, there are many departures from one-to-one correspondences in Portuguese based on contextual and morphological regularities (Nóbrega, 2013; Morais, 2009). For instance, the inflectional morphemes *am* and *ão* sound the same (/aw/), with spellings marking different meanings (i.e., past tense for *am* and future tense for *ão*). Derivational morphemes also have consistent spellings. The word *beleza* [beautiful] ends with *-eza* because *-eza* is a morpheme that changes the adjective *bela* [beautiful] to an abstract noun, while in the monomorphemic word *mesa* [table], *-esa* is part of the morpheme. Also, referring to the morphemes can help children in understanding the words in both examples. Morphological structure then can offer a clue to the spelling and meaning of some words in Portuguese.

Most studies to date of the effectiveness of morphological training have been conducted in English. For instance, systematic review on morphologically based interventions in alphabetic orthographies by Bowers et al. (2010), identified 22 studies, only four were on languages other than English (see also Goodwin & Ahn, 2013). Clearly, studies in English dominate the literature on the effects of morphological training on reading outcomes.

Another meta-analysis, this time of children with reading difficulties, suggested that effects of morphological instruction on reading might be smaller in languages with more transparent orthographies. Goodwin and Ahn (2010) found larger effects for studies conducted in the US—all of which were in English—than those outside the US—half of which were in more transparent languages. Below we review the few intervention studies on alphabetic languages other than English, including those conducted since those reviews. As we will see, it is not clear whether morphological training has a positive effect on literacy outcomes.

Two studies provide quite strong evidence of effects of morphological training on literacy outcomes for readers of more transparent languages. Both focused on training of morphological awareness—specifically in the oral modality. In a study of kindergarten Norwegian-speaking children, Lyster (2002) reported significant effects of training

of morphological awareness on word reading when compared to both untrained and phonological control groups. There were also effects on word reading and reading comprehension at Grade 1 and specifically on reading comprehension at Grade 6 (Lyster et al., 2016). Similarly, in a study of Danish-speaking dyslexic children in Grades 4 and 5, Arnbak and Elbro (2000) found that training in morphological awareness resulted in gains in both spelling and reading comprehension, although not in word reading, compared to teaching that did not focus on morphology.

Another few studies, all of languages with simple syllabic structures, provide little evidence of effects of morphological training on literacy skills for readers of relatively transparent orthographies. In two separate studies of Greek-speaking children in kindergarten, Manolitsis (2017) found effects of training in morphological awareness on morphological awareness itself, but not on word reading when compared to a 'business as usual' control group. In a study with Grade 4 Portuguese-speaking children, Barbosa et al. (2015) found that children receiving instruction in morphologically based spelling rules improved more than the control group in spelling the same words that were taught in the intervention. In the absence of transfer items, it is challenging to draw strong conclusions. Across these studies, mixed results could certainly be due to differences in quantity or modality of instruction, age of participants, and other methodological differences. In this context, additional tests of the effectiveness of morphological interventions for children learning to read in more transparent orthographies are needed.

We report here on a small-scale study of the effects of a morphological intervention with Portuguese-speaking children enrolled in Grade 3 in state schools. We included training in morphology in both the oral and written modalities, in keeping with most prior research (see e.g., Bowers et al., 2010) and to increase the likelihood of transfer to reading and spelling. In this preliminary work, we compared performance to 'business as usual' in the classroom; this approach follows a good deal of

other exploratory research (e.g., Manolitsis, 2017; for review see Bowers et al., 2010).

We test effects on morphological skills and lexical level reading and spelling outcomes. We expect effects on morphological measures, given prior evidence that morphological training has the strongest effects on morphological outcomes (e.g., Bowers et al., 2010; Goodwin & Ahn, 2010). We also test whether effects flow through to lexical level word reading and spelling. We did so by asking children to spell and read whole words—these included irregular words and words with contextual rules. Effects on lexical level reading are likely more difficult to detect (e.g., Bowers et al., 2010). We include measures of other metalinguistic and cognitive skills to ensure that groups are appropriately matched and that morphological effects do not flow through to non-target outcomes, such as phonological awareness and non-verbal intelligence. We group these latter skills together as general skills.

Methods

Participants

Participants were 33 native speakers of Portuguese enrolled in a state school in Brazil. Children were in Grade 2 at the time of pre-testing. The intervention was carried out in the first months of Grade 3 and the post-test was administered in the beginning of the second semester of Grade 3 (roughly 29 weeks after the pre-test). The intervention group consisted of 17 children (10 boys, 7 girls), all in the same class and with an average age of 7 years and 9 months ($SD=5.9$ months). The control group consisted of 16 children (10 boys, 6 girls), with an average age of 7 years and 10 months ($SD=2.9$ months). There was no age difference between the groups ($1,31 = 1.10$ $p=0.30$). Children in the control group were also all in the same class, a different one from the intervention group. Allocation to the groups was based on school requests. Like all children in Brazil, the children participating in this study followed a minimum National Curriculum. All children participated with parental consent and child assent and completed the study through to the post-test.

Children in the two groups were of similar age and performed similarly on verbal and nonverbal abilities and phonological awareness (Table 1) and confirmed with ANOVA, $F_s(1, 31) \leq 1.50$, $ps \geq .23$. The two groups also did not differ in any pre-test metrics for the intervention study (i.e., word reading, morphological awareness, and spelling measures, $F_s(1, 31) \leq 1.10$, $ps \geq .30$).

Measures

General Skills

Verbal and nonverbal intelligence were measured with the vocabulary and block design subsets of the Brazilian version of Wechsler Intelligence Scale for Children – third edition (WISC III; Wechsler, 2002). Internal consistency from the manual is .79 and .82, respectively.

Phonological awareness was measured with a Spoonerism task developed by Cardoso-Martins et al. (1998). The participant is asked to switch the first sound of one word for the first sound of another word. One point was given for correct responses. Cronbach's alpha was .85 for this sample.

Morphological Abilities

Morphological awareness was measured with an word analogy task administered in the oral modality (e.g., *artist:art::painter::*; Nunes et al., 1997). There were 17 inflectional and 17 derivational items. Reliability (Cronbach's) ranged from .72 to .82 for this sample.

Morphological spelling was measured with items from an experimental spelling task from Justi (2009) and Barbosa et al. (2015). There were 12 words following morphological spelling rules. For instance, in Portuguese the sound /iw/ can be represented by the sequence of letters *il* at the end of nouns (e.g., *mil* [thousand]) and *iu* at the end of verbs (e.g., *caiu* [fell]). One point was given to each correct response.

Lexical Level Reading and Spelling

Word reading accuracy was measured with the reading subtest of the *Teste de Desempenho Escolar* (Stein, 1994). This test included 70 words of increasing difficulty. Two words in the text used the same morphemes used in the training. About 50% of these

Table 1

Descriptive statistics

Variable (Maximum score)	Pre-test				Post-test	
	Treatment N=17	Control N=16	F(1,31) ^b	p ^b	Treatment N=17	Control N=16
	M (SD)	M (SD)			M (SD)	M (SD)
Nonverbal intelligence ^a	8.2 (3.5)	8.2 (2.7)	.00	.96	12.4 (2.8)	11.2 (2.7)
Verbal intelligence ^a	11.3 (3.3)	9.8 (3.6)	1.36	.25	11.3 (3.3)	10.8 (3.0)
Phonological awareness (30)	13.2 (9.7)	9.3 (8.0)	1.50	.23	18.6 (8.0)	18.6 (6.0)
Morphological awareness						
Derivational (17)	6.4 (4.7)	6.4 (2.6)	.01	.98	10 (3.5)	7.6 (3.5)
Inflectional (17)	7.0 (4.0)	7.0 (3.4)	.02	.96	9.3 (4.0)	8.7 (3.2)
Spelling						
Morphologically complex words (12)	6.4 (2.1)	6.1 (1.4)	.13	.72	9.3 (2.0)	6.8 (2.0)
Words with contextual rules (16)	12.0 (3.0)	12.5 (3.0)	.08	.77	15.0 (2.8)	14.3 (2.0)
Irregular words (20)	12.7 (2.5)	12.0 (2.4)	1.07	.30	14.6 (1.7)	13.3 (2.3)
Word reading accuracy (70)	57.8 (9.8)	58.3 (8.0)	.02	.88	63.0 (6.3)	62.4 (4.0)

^a Standard scores.

^b Results from comparisons of groups at pre-test.

words were morphologically complex, although the morphological complexity did not necessarily guide the pronunciation of these words. All words were presented individually to the children. We used the raw scores of the number of words read correctly. Reliability (Cronbach's α) is .99.

We also assessed lexical level spelling with two sets of items from an experimental spelling task developed from Justi (2009) and Barbosa et al. (2015). There were 16 words with spellings that followed contextual rules. For instance, in Portuguese, the nasal sound is spelled with *m* before the letters *p* and *b* (e.g., *samba*), but with an *n* in all other words (e.g., *santo* [saint]). There were also 20 irregular words that have ambiguous spellings that do not follow orthographic rules (e.g., the /f/ sound in *bruxa* [witch] that can be spelled with a *ch* in some words and *x* in others). One point was given to each correct response.

'Business as Usual' in the classroom

All children in the study participated in the standard municipal teaching plan, none of included the topic of spelling or less morphological awareness. As such, the content of the morphological awareness training was new for both children and teachers. In the early years of elementary school, the Portuguese language curriculum is based on the explicit teaching of phonological awareness, with little on orthography or grammar.

Morphological Intervention

The morphological intervention involved teaching children to identify and reflect upon morphemes both orally and in spelling. The intervention was conducted by one of authors during a period in which the children were taken out of the classroom. As such, the time spent in education was comparable for the two groups. The intervention was carried out in 19 sessions of 50 minutes each in the classroom twice a week. The sessions were organized based on the type of morphemes being taught. Children were explicitly taught about stems and grammatical categories of words and how those

relate to inflectional and derivational morphemes. The activities were first presented orally and then in written form. Children were asked to build morphologically complex words and to break them down into morphemes. Non-words were used to make the connections between stems and affixes more explicit. For example, children were given a real word in Portuguese such as *pizz-aria*. They were asked to reflect upon the fact that this word was made up of two units *pizza* and *aria*. Other examples were given. Then a non word based on a real word was introduced. For instance, *solaria* was made up of two parts: *sol* [sun] and *aria* (suffix). This nonword was defined as a place that sell suns. Children were encouraged to produce non-words. The non-words and real words were spelled by the instructor and the children.

The inflectional morpheme training targeted suffixes with different spellings for the same sounds (i.e., *-am/-ão* and *-iu/-il*). For instance, the past tense verb *abriu* [opened] has the same ending sound as the adjective *gentil* [gentle], despite differences in the spelling of the ending sounds. The target derivational morphemes were the sets of morphemes of *-aria* / *-eiro*, *-esa* / *-eza*, and *in-/im/des-*. All activities had the items presented in phrases and short texts to serve as context for learning. The final sessions reviewed all studied morphemes, and each child constructed a book on morphemes. This book described the morphological spelling rules taught to consolidate knowledge. None of the words trained were included in the pre- and post-test tasks. Four morphemes were the same in the training and pre- and post-test tasks (occurring in 7 items).

Results

Means and standard deviations on pre- and post-test measures are in Table 1. These show good ranges of scores, with little evidence of floor or ceiling effects. We chose MANOVA for several reasons (Kraska, 2010). MANOVA is recommended to analyse data when there is a good theoretical basis to combine variables into groups (Field, 2009). To review in brief, we expected no significant treatment effects on the variables placed together

as ‘general skills’ because there is no theoretical basis to expect effects of a treatment specific to morphology to transfer to any of these variables. We expected treatment effects on the morphological tasks, based on both theory (e.g., Levesque et al., 2021) and prior evidence. The lexical abilities grouping focuses on the word level, which is also conceptually related and theoretically grouped in that it has the lowest likelihood of transfer. There is quite a bit of literature to suggest that MANOVAs are recommended when variables are positively and moderately related (Maxwell, 2001; Zaiontz, 2023; Tabachnick & Fidell, 2007), as long as this does not reach the point of multicollinearity. Our data fit this description, with correlations in the moderate level, with the highest correlations within each grouping at .7. This is well within this range, far below concerns for multicollinearity and on the threshold of moderate correlation. For these conceptual and statistical reasons, we think that MANOVA is appropriate for our data.

Our first analysis was a two-way repeated measures MANOVA with the data for the general skills: nonverbal intelligence, verbal intelligence and phonological awareness. We had time (pre-versus post-test) as the within-subjects factor and treatment group (treatment versus control) as the between-subjects factor. There was a significant main effect for time, likely reflecting general maturation and educational effects for both groups, $\Lambda=.31$, $F(3, 29)=21.63$, $p<.001$, $\eta^2p=.70$. There were no significant effects for group $\Lambda=.97$, $F(3, 29)=0.31$, *n.s.*, nor was there an interaction between time and group $\Lambda=.85$, $F(3, 29)=1.65$, *n.s.*, pointing to no significant effects of the intervention on general skills.

We then evaluated the effects of the intervention on morphological abilities with a MANOVA set up in the same way. Here we analysed effects on derivational morphological awareness, inflectional morphological awareness and spelling of morphologically complex words. We found a significant main effect for time $\Lambda=.34$, $F(3, 29)=18.8$, $p<.01$, $\eta^2p=.66$ and a trend towards a significant effect for group $\Lambda=.77$, $F(3, 29)=2.80$, $p=.053$, $\eta^2p=0.23$.

Critically, there was significant interaction between time and group, $\Lambda=.68$, $F(3, 29)=4.5$, $p=.01$, $\eta^2p=.32$. We conducted independent samples *t*-tests. The experimental and control groups performed similarly on all pre-test measures $ts(31)\leq 0.36$, $ps\geq .70$. On post-test measures, the experimental group outperformed the control group on spelling of morphologically complex words, $t(31)=3.45$, $p<.001$, with a similar trend for the derivational awareness task, $t(31)=1.90$, $p=.06$. There were no differences on inflectional awareness, $t(31)=0.40$, $p=.69$. The same pattern emerged in follow-up analyses with MANCOVA in which we controlled for numerical (though non-significant) differences in levels of phonological awareness and vocabulary at pre-test between the two groups.

Finally, we evaluated the potential effects of the intervention on lexical abilities, with a MANOVA that included word-level reading and spelling of irregular words and with contextual rules. There was a significant main effect of time, $\Lambda=.52$, $F(3, 29)=8.97$, $p<.001$, $\eta^2p=.50$, with no significant effect of group $\Lambda=.87$, $F(3, 29)=1.37$, $p=.27$, $\eta^2p=1.25$, or interaction between time and group $\Lambda=.97$, $F(3, 29)=.22$, $p=.89$, $\eta^2p=.002$, indicating no differential improvement between the groups.

Discussion

Here we report on a small-scale study exploring possible effects of morphological training administered in Grade 3 to Portuguese-speaking children. Conducting this study in a language with a simple syllable structure and a relatively transparent orthography adds to the limited studies to date for children learning to read in more transparent orthographies. In building up this evidence, we tested the effects of morphological instruction across multiple outcomes, spanning from morphological awareness itself to word-level reading and spelling outcomes. Morphological training improved children’s spelling of morphologically complex words with a trend towards improving derivational morphological awareness tasks, but not their broader word reading and spelling skills.

Effects on the spelling of morphologically complex words make sense given prior arguments about the utility of morphological awareness in supporting word reading and spelling, specifically by enhancing children's ability to analyse words into their component parts (Carlisle, 2000) and the value of this to morphological decoding (e.g., Levesque et al., 2017). The large size of these effects is in line with prior evidence that effects of morphological awareness training are strongest on morphology-specific outcomes (e.g., Bowers et al., 2010). Effects on the spelling of morphologically complex words is also in line with previous data showing that Portuguese-speaking children consider morphology when spelling at an early age (e.g., Mota & Silva, 2007). In our view, positive evidence of morphological instruction is particularly novel in terms of studies with simple syllabic structures, with null effects reported in prior studies of similar languages (e.g., Manolitsis, 2017).

In terms of awareness, we saw a trend, albeit non-significant, towards effects of morphological training for awareness of derivational, but not of inflectional morphology. Power analyses suggest that a sample size of 70 would be required for these to achieve significance (with alpha at .05 and power of .80), as such these might emerge in a more adequately powered study. The clear absence of effects of training on inflectional awareness is in keeping with the clearer rules for the relatively closed system of inflectional formation (Casalis & Louis-Alexandre, 2000). In our view, there is quite simply far more to learn about derivational forms, leaving more room for improvement in these skills.

The effects of the morphological intervention were not accounted for by an improvement in general skills, such as non-verbal intelligence and phonological awareness, nor did they transfer to lexical level reading and spelling measures. Together, these effects suggest that the effects of our intervention were relatively specific to the skills taught, given that the instruction focused on the spelling of morphologically complex words. Emergence of effects on the spelling of morphologically complex words is in keeping with evidence of effects of morphological awareness on spelling of morphologically complex

words, but not other words (see also Casalis et al., 2011). We might have observed a similar pattern for word reading had we included comparable metrics of morphological decoding, or use of morphemes in reading (e.g., Levesque et al., 2017). Power analyses suggest that effects might have emerged on spelling of irregular words, if the study had had a larger sample size. It is also possible that clearer effects of morphological training emerge on spelling than on reading (see also Arnbak & Elbro, 2000).

In terms of educational implications, our results support the potential utility of including morphological instruction in classroom teaching, even for children learning to read in languages with relatively transparent orthographies. This might be particularly valuable in the context in which we worked. PISA (2015) showed that Brazilian children scored below average in the three areas assessed (i.e., mathematics, reading and science). Considering this, literacy acquisition has been a source of concern for researchers and teachers in Brazil. Our intervention was designed to be presented in children's classrooms as part of their everyday instruction; we did so in the hopes that it could be more readily included in teachers' practice.

This approach also introduced some limitations. Due to the pilot nature of the research and our relationship with the school, it was not possible to do random assignment by child, blinding to condition, nor were we able to administer the pre-test immediately before the intervention. These decisions introduce potential confounds and open questions to other influences on detected effects. Further, we had a small sample size, which reduced our ability to detect smaller effects. For instance, effects on derivational morphological awareness might have reached statistical significance with a larger sample. We also leave open the possibility that, with different and/or more intensive training, effects of morphological awareness instruction might flow through to more distal outcomes, albeit with likely smaller effects (e.g., Goodwin & Ahn, 2013). Our results suggest that the intervention itself is promising, paving the way for implementing more rigorous controls in more ambitious and well-resourced studies.

Our findings are specific to Portuguese speaking children receiving our specific intervention in Grade 3. In this context, we found that morphological training had positive effects on spelling of morphologically complex words, with little evidence of transfer to lexical level reading and spelling. Going forward, we think that it would be important to systematically contrast effects of morphological training for children learning languages that vary in both syllable structure and writing system; the paucity of research to date on more transparent languages leaves the effects of these variables unclear. We also think that it is worth exploring effects at other developmental points. Reviews of studies primarily in English suggest comparable effects with younger readers, but this remains to be tested empirically. Another important focus would be on corpus and database development. We have data on the role of morphemes in the structure of the oral and written language for English (Sánchez-Gutiérrez et al., 2018; Nagy & Anderson, 1984), but little comparable corpora in other languages. Such data are essential if we are to move beyond considering writing systems as varying in phonological opacity, turning instead to the basis of these deviations, whether they are morphological or otherwise.

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