The impact of invented spelling on early spelling and reading

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Various authors argue that invented spelling activities with preschool-age children help them to analyse the oral segments of words and to discover the relations between those segments and the corresponding letters. Several studies have shown the impact of invented spelling programmes on early spelling, but few experimental ones have looked at the impact of invented spelling on early reading. Our aim was to assess the impact of an invented spelling programme on children's early spelling and reading. We worked with 108 five-year-old Portuguese children who were not able to read or write. Their initial cognitive ability, knowledge of letters and phonological awareness were controlled. Children were randomly divided into an experimental and a control group. They were evaluated in a pre- and a post-test in which they were asked to write and read a set of words. The experimental group participated in a 5-week invented spelling programme. We expected the experimental group to have better post-test scores than the control group. Data analysis showed statistically significant differences between the two groups, with the experimental one having better results in spelling and reading than the control group, supporting the idea that the acquisition of spelling and reading may be mutually facilitative.

Keywords: Invented spelling; early reading; spelling programme; preschool children

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The understanding of the abstract rules that underlie the organisation of alphabetic systems is a process that begins early on, via the informal contacts that children make little-by-little with written language. In their efforts to understand the meanings of graphic marks and via interaction with others (both peers and adults), children gradually ask themselves questions about the correspondences between objects and writing, about the graphic features of writing, and about the relationships between the oral and the written forms of language. In this way they build up ideas about the properties of writing and what it represents (Tolchinsky, 2005).

Ferreiro and Teberosky (1979) and Ferreiro (1988) analysed the evolution of children's knowledge of written language from a constructivist point of view. In their view, children think about the nature of writing and build up conceptual hypotheses that reflect an active reconstruction of the logic of the units that are represented by written language. One of the main mechanisms for evolution are children's discoveries (and cognitive conflicts caused by those discoveries) during their attempts to write or analyse conventional written forms. They worked with Spanish-speaking children who had not yet received any formal teaching in reading and writing. The results of their research led to the conclusion that children's knowledge of written language evolves from an initial level, where linguistic segments are not taken into account, to a final level, where the alphabetic nature of the writing system is understood.

The first level can be characterised by the search for criteria that make it possible to differentiate between drawings and written language, and by the gradual perception that a sequence of letters constitutes an object that stands in for the real thing. In parallel, children also elaborate criteria that make a series of letters into something that can transmit a message. At this level, children consider that there must be a minimum number of letters to read and write a message and also that the letters must vary. The latter criterion leads children not to use the same sequence of letters to spell different words. For example, a child may spell *coche* (car) as NMP, *tren* (train) as PAOM and *avion* (airplane) as MAOM (Ferreiro, 1988). A second level involves a refining of the forms of qualitative and quantitative differentiation between chains of letters to ensure differences between the ways in which different words are represented. At these levels children have not yet established any relationship between oral and written language and, in certain cases, the way in which they spell some words takes account of the properties of the reference items – for example, a child may spell *gato* (cat) with four letters and *gatos* (cats) with 8 letters saying that *gatos* must have more letters because there are several cats (Ferreiro, 1988). Generically speaking, it is possible to call these first two levels pre-syllabic.

Subsequently, children begin to establish a relationship between the graphic and the phonological forms of words. They start by using syllables as the basis for co-ordinating both the phonological structure of words and the activity of writing itself (syllabic level). For example, a child may spell *cane* (dog) using two letters to note the two syllables and spell *cagnolino* (doggy) using four letters (Ferreiro, 1988). Then they begin to analyse oral language in a way that goes beyond the syllabic level and they

represent all the phonemes in some of the syllables of a word, while continuing to use single letters to denote other syllables in the same word (syllabic-alphabetic level). For example, a child may spell *caballo* (horse) as CVAIO using one letter to note the first syllable and noting alphabetically the last ones (Ferreiro, 1988). Children finally evolve to the point at which they understand the structure of alphabetic notation and they write appropriate letters to fully codify the phonetic structure of the word, even though not all the applicable orthographic conventions are respected (alphabetic level).

Subsequently, many other authors have studied this evolutionary path for a wide range of languages, including English (Sulzby, 1989), French (Besse, 1996), Greek (Tantaros, 2007), Hebrew (Tolchinsky & Teberosky, 1998), Italian (Pontecorvo & Orsolini, 1996) and Portuguese (Alves Martins, 1993). With a few differences derived from the particular characteristics of each language and with variations in the names by which the authors in question designate the various levels, a quite similar evolutionary path has been identified by these authors. However, the syllabic level seems to be more frequent in languages such as Italian, Spanish and Portuguese, perhaps because in these languages there are many polysyllabic words, and the syllabic structure which predominates is that of open syllables of the consonant/vowel type.

Chomsky (1970) and Read (1971) were the first authors to use the concept of invented spelling. Children's invented spellings offer a glimpse into the child's developing knowledge of how spoken language is represented in print. This conception of pre-conventional spelling has been associated with a phonological view of children´s spelling development. The phonological perspective describes the development of children's spelling skills in terms of their increasing ability to map sounds of words to phonetically appropriate letters. According to this perspective, written language is conceived as an instrument for translating the oral language and phonological awareness determines the precision of invented spelling. From the perspective of these authors (Ehri, 1991, 1997; Gentry, 1982) evolution in spelling reflects a progression from initial non alphabetic markings, through increased proficiency in capturing a word's phonology in print, up to the emergence of conventional word-specific forms.

Ehri (1991) identified four phases in the development of the spelling of the English-speaking children that she studied. During the first one (pre-alphabetic phase), children randomly combine letters and pseudo-letters without paying attention to correspondences between letters and sounds. For example, children may spell *quick* as HS (Ehri, 1991), the letters H and S having no relationship to the sounds in the word. There are some similarities between this phase and the first two levels defined by Ferreiro (1988) – pre-syllabic levels.

During the second one (partial alphabetic phase), children begin to phonetically represent some of the components in words by choosing letters from among those with which they are familiar. The letters that are employed in this way may represent both sounds and syllables in the word in question. This phase possesses similarities with Ferreiro's (1988) proposals in relation to the syllabic-alphabetic level. In this phase,

many of children's initial sound representations are based on a letter name strategy (e.g., *R* for *are*; U for *you;* TL for *tell),* the phonological characteristics of the syllables to be written mediating the way in which preschool children learn the relationships between speech and print.

The third phase (full alphabetic phase) is characterised by a systematic correspondence between letters and sounds, but without any respect for orthographic conventions. This phase is equivalent to the alphabetic level defined by Ferreiro (1988).

In the final phase (consolidated alphabetic phase) children begin to take account of the fact that the way in which they are supposed to write may be influenced by morphemic factors. At this point in development, children are competent readers and spellers. This last phase has no equivalent with Ferreiro's (1988).

Cardoso-Martins (2005) found evidence that children learning to read and spell in Portuguese follow a similar pattern of development to that proposed by Ehri (1991). On the other hand, Wimmer and Landerl (1997) have suggested that children learning to read and spell in German, which has a more regular writing system than English, skip the earliest phases and move straight into the full alphabetic phase.

The phonological perspective considers that the differences found between spelling development in English and other languages are due to differences between the regularity of grapheme-phoneme correspondences among those writing systems.

Both the authors who advocate a constructivist perspective, and those who advocate a phonological one, consider that preschool children's spelling activities play an important role in children's understanding of the alphabetic principle, inasmuch as they involve explicit reflection about the oral segments of words and the corresponding letters (Adams, 1998; Treiman, 1998). In fact, the exploratory nature of invented spelling allows children to analyze the correspondences between sounds and letters, and therefore it facilitates and strengthens the connections between graphic and phonological representations.

Several experimental studies with preschool children were developed by Alves Martins and Silva (2006) and Silva and Alves Martins (2002). These evaluated the effects of training programmes designed to promote the evolution of children's conceptual hypotheses about written language on both the quality of their invented spelling and their phonological skills. Children's conceptual levels were assessed in a pre-test and a post-test, using a grid based on Ferreiro's (1988) work. In these programmes, after spelling each word, children were confronted with spellings by a child at a level immediately above their own. Children were asked to analyse the word in the oral form, to think about the two spellings, to choose one, and to justify their choice. The main cognitive activities involved were: predicting the number and type of letters to be written, comparing the child's own spelling with spellings one level higher, evaluating which one was better, and justifying their choice. This was designed to create conditions for a cognitive conflict in which the situation itself led children to think about ways of spelling that were not very distant from their own ones. These programmes, which were based on a constructivist approach, proved their efficacy not

only in terms of the way in which children evolved in their spelling, but also in terms of their phonemic awareness.

While there is a consensus that invented spelling promotes the understanding of the alphabetic principle, there are several views concerning the relationship between invented spelling and reading. There are some correlational studies showing that there are strong links between invented spelling and early reading (Levin, Shatil-Carmon & Asif-Rave, 2006; Mann, 1993; McBride-Chang, 1998; Shatil, Share & Levin, 2000; Uhry, 1999). However, there have been relatively few experimental studies, and although early studies tended to support the claim that invented spelling promotes learning to read (Clarke, 1988; Ehri & Wilce, 1987; Richgels, 1995), these were open to alternative interpretations. More recently, there has been conflicting evidence about the potential benefits of invented spelling on reading acquisition.

Rieben, Ntamakiliro, Gonthier, and Fayol (2005) developed a carefully controlled multiple-group intervention study with five-year-old French-speaking children. They compared different word-spelling-practice conditions in kindergarten and assessed their effects on letter knowledge, phonological awareness, reading, and spelling. Three different experimental treatments were designed to mimic different teaching practices by having children practice invented spelling, copied spelling or invented spelling with feedback on correct spelling, whereas a fourth group, serving as a control group, only made drawings. The invented-spelling group with feedback scored significantly higher than the control group and all other experimental groups in reading practiced words. However, no between-group differences were evident for reading words not used in the training programme, and more surprisingly, no group differences were reported in measures of phonological awareness and invented spelling complexity. The fact that different spelling practices had no effect on the phonemic task led the authors to suggest that the segmenting processes involved in spelling would not transfer to the blending process necessary for reading. The authors conclude that children might not learn enough from invented spelling where reading is concerned. They also note that in their study inter-individual variability was very high for all the variables and for all the treatment groups. So, in general, the authors were quite skeptical about the impact of invented spelling on reading.

In spite of these authors' conclusions, the limited impact of invented spelling may be due to the fact that the 18 training sessions given to each group were spread out over six months – i.e. they may not have been intensive enough to promote learning. Participants' letter knowledge was also very limited, and this may have constrained learning across all conditions and precluded those in the invented-spelling groups from benefiting from the intervention, especially given the complexity of the reading-test stimuli used.

On the other hand, the relevance of invented spelling was confirmed by an intervention study by Ouellette and Sénéchal (2008), which tested whether invented spelling plays a causal role in learning to read. They evaluated the benefits of training kindergarten children to be better invented spellers through a pre-test, post-test,

comparison-group design. Three groups of kindergarten children participated in a 4-week intervention. Children in the invented-spelling group spelled words as best as they could and received developmentally appropriate feedback. Children in the two comparison groups were trained in phonological awareness or drew pictures. Although all groups learned letter-sound knowledge, the invented-spelling group demonstrated more advanced invented spellings than did the other groups, and both the invented-spelling group and the phonological-awareness group demonstrated superior phonological awareness. The invented-spelling group also had better results in terms of orthographic awareness and the reading of words used in the training protocol. Importantly, the invented-spelling group learned to read more words in a learn-to-read task than the other groups. The words used in the reading task were not the same as those practiced in the invented spelling group. These results offer direct training evidence that improvements in invented spelling can bring about an advantage in learning how to read in English. These findings are in accordance with the view that invented spelling coupled with feedback encourages an analytical approach and facilitates the integration of phonological and orthographic knowledge, hence facilitating the acquisition of reading.

However, the inconsistency between the results of the last two studies, and the small number of studies concerning the impact of invented spelling training programmes on reading, suggest that experimental evidence is still lacking, particularly in languages other than English or French. Unlike English, which is regarded as having a deep orthography containing many inconsistencies and complexities, and unlike French, which contains many morphological influences on spelling, the Portuguese spelling system is relatively shallow. According to Defior, Martos and Cary (2002) the Portuguese language has 9 oral vowels, 5 nasal vowels and only 5 corresponding letters (*a, e, i, o, u*); the *i* and *u* letter names correspond to the sounds they represent; The *a*, *e* and *o* can have different phonetic values. Where the consonants are concerned, the Portuguese language has 16 oral consonants and 3 nasal ones corresponding to 25 graphemes. The correspondences between them are usually regular or governed by contextual or positional rules; in some cases they are irregular, as with the phoneme [s], or [ʃ]. Despite some irregularities, Morais (1997) points out that the Portuguese language can be read using simple contextual or positional rules. These characteristics may facilitate the transfer from invented spelling to reading.

The present study therefore evaluated the benefits of training Portuguese kindergarten children to be better invented spellers through a pre-test, post-test, comparison-group design. We hypothesized that the training procedures implemented would prove effective; in that the experimental group would show improved spelling abilities compared to the control group. We also hypothesized that the experimental group would be able to transfer from invented spelling to reading, thereby demonstrating better reading abilities than the control group.

1. Method

1.1 Design

This was an experimental study in which children were given a pre-test and a post-test intended to evaluate their invented spelling and their reading. The tests used at the pre and the post-test moments were the same.

Children were randomly divided into an experimental group and a control group. Between the two tests the experimental group took part in an invented spelling programme and the control group a drawing programme.

The experimental and control-group programmes began one week after the pre-test and lasted for five weeks (2 individual sessions per week). The post-test was carried out one week after the programmes were concluded.

1.2 Selection of Participants

To select the participants we evaluated 180 five-year-old Portuguese children from 9 kindergartens in Lisbon. None of these kindergartens included regular classroom activities/instruction related to reading or writing. The only regular activities related to reading and writing were story reading and activities in which children had to write their own names (e.g. to identify their drawings). In Portugal the teaching of reading and writing usually begins in the first year of elementary school. All children spoke Portuguese as their primary language.

Children's knowledge of letter names and letter sounds was assessed. We only selected children who knew at least three vowel letters (A, I and O) and the consonants B, D, F, P, T and V, as the words used in the pre- and the post-test were only composed of those 9 letters. These consonants were chosen because they have regular correspondences with the phonemes they represent.

Children's reading and writing skills were also assessed. Children were asked to read a list of 6 high-frequency regular words, and then one week later to write the same list. Children who were able to write or read one or more words were not considered for the present study.

1.3 Participants

From the initial pool of 180 children 108 five- year-old Portuguese children (49 boys and 59 girls) were selected because they matched the above criteria. These were randomly divided into an experimental group and a control group with 54 participants each. The mean level of education of the parents completing the permission form was 14 years of formal schooling (college or undergraduate university), and parental education ranged from 9 years of formal schooling (compulsory education) to postgraduate studies. Only one father had just 4 years of schooling.

Children's cognitive and phonological awareness were assessed to control for the equivalence of the groups.

1.4 Measures

Letter knowledge

In order to determine how many and which letters the children were familiar with, they were given a set of cards containing both individual uppercase and lowercase letters of the alphabet, and they were asked the letter's name and to provide its sound (K, W and Y were excluded as they are very rare in Portuguese words). Letters were presented in a fixed random order. The range of possible points in this test was 0 to 23 for the names and for the sounds. Children who didn't know the 6 consonants and the 3 vowels that were going to be used in the pre and post-tests were not selected.

Cognitive ability

Children's cognitive ability was evaluated using the coloured version of Raven's Progressive Matrices test (Raven, Raven, & Court, 1998), because it is not very dependent on verbal aspects. One point was given for each correct answer, so the results could vary from 0 to 36 points.

Phonological awareness

In order to evaluate the children's phonological awareness, they were given an initial-syllable classification test and an initial-phoneme classification test, both taken from Silva's (2002) battery of phonological tests. Each test was composed of 14 items preceded by 2 examples. In each item the children were presented with four drawings, each representing an oral word (there were no written words); two of the words in each item began with the same syllable or the same phoneme, whereas the others started with different ones, and the children had to identify the words that began with the same syllable or phoneme. One point was given for each correct answer, so the results for each test could vary from 0 to 14 points.

Reading performance

In order to assess children's reading, we asked them to read 20 words (5 mono-syllabic and 15 dissyllabic) containing the consonants B, D, F, P, T and V and the vowels (A, I, or O)]. Seven were low-frequency words according to Bacelar do Nascimento *et al*. (2000). All words were between 2 and 4 letters in length and represented a variety of syllabic features, although most of the syllables had a CV structure. The stop consonants B, D, P and T were practiced during the invented spelling programme, while the fricatives F and V were not. Thirteen words only contained the letters practiced during the programme, while seven words also contained the non-practiced consonants, F and V. The words were presented one at a time on separate cards. They were presented in a fixed random order in two separate sessions, 10 per session. No feedback was given. None of these words were used during the programme. The list of words, as they were presented to the children, is presented in Appendix A.

The children's reading was recorded. We analysed whether they correctly read each word or part of it in the pre and the post-tests. Two reading scores were created: the number of words correctly read and the number of letters correctly decoded. So the

result concerning the word-reading score ranged from 0 to 20 points, while that corresponding to the correctly decoded letters ranged from 0 to 68 points.

Some examples of the scoring system that was used with regard to the number of letters that were correctly decoded are presented in Appendix B.

This scoring system takes into account the grapheme-phoneme correspondences that were correctly decoded by the participants, in the proper order, even if the output was not the word in question, but part of it, a pseudo-word that partially corresponds to the word in question or another word that shares one or more phonemes with the target-word.

The scoring system was used separately by two researchers. The inter-scorer agreement in word-by-word classification using the Kappa statistic was 0.98 in the pre-test and 0.96 in the post-test.

Invented spelling

In order to assess children's spelling, we asked them to spell the same 20 words that were used in the reading test. The words were presented in a fixed random order in two separate sessions, 10 per session. No feedback was given.

We analysed whether the children correctly represented the consonants and the vowels of the different words in the pre and the post-tests, and allocated 1 point for each correctly spelled phoneme. So the results could range from 0 to 68 points. Even though it is known (Clay, 2005) that beginner spellers often record the last letter they hear in a word first and then go back and write other letters, with the correct letters appearing out of sequence, we only awarded points if the letters appeared in the proper sequence. Some examples of the scoring system that was used are presented in Appendix B.

Two researchers used the scoring system separately. The inter-scorer agreement in word-by-word classification using the Kappa statistic was 0.96 in the pre-test and 0.94 in the post-test.

Training programme

The training programme was organised around situations that led the child to think about spelling from two points of view: his/hers and that of a hypothetical boy/girl from another school, with alphabetic spellings. This programme was based on those developed by Alves Martins and Silva (2006) and Silva and Alves Martins (2002), with the important difference that, in this programme, the confronting spellings were always alphabetic and children's attention was progressively drawn to all the letters that composed the words whereas, in the previous programmes, children were confronted with spellings by a child at a level immediately above their own.

The training programme lasted for 10 sessions of around 15 minutes each, and was designed to lead the children to use conventional letters to represent the different sounds in each word. The words used in the programme were always different from those in the pre- and post-tests. In each session the child was asked to spell a word as best they could, and was then shown the same word spelled by a child from another

school who had used correct letters to spell the word. They were asked to think about their spelling and that of the other child, and to try to think which one was better and why. Eight words were used in each of the four initial sessions, and six in the following ones. In each of the first four sessions we only asked the child to spell words beginning with the same letter (in the first session, P, in the second T, in the third B and in the fourth D); in these sessions the child's attention was drawn to the first letter in the word. Each of these sessions involved two words whose initial syllable matched the name of the letters P, T, B and D respectively, so as to facilitate the use of those letters. The initial letter in the other six words was followed by the vowel I and the open vowels A or O. For example, in the first session, children were asked to write the words "Peta" [petɑ] (Lie), in which the first syllable matches the name of the letter P [pe], and the words "Papa" [papɑ] (Porridge), "Pipa" [pipɑ] (Cask), "Poda" [pɔdɑ] (Pruning). In the fifth session children were asked to write 6 words beginning with the consonants that had been practiced previously. In the following 4 sessions children were asked to write 6 words beginning with 2 of the previous consonants; for example, 3 words beginning with P and 3 others with T, followed by the vowels A, I and O. Children's attention was drawn not only to the first and second letters, but also to the other letters composing the words. As in the fifth session, in the last one the words began with the consonants B, D, P or T.

Some examples of the interaction between the researcher and children during the spelling programme sessions are presented in Appendix C.

Children were always encouraged to think about their own spelling and about the alphabetic spelling made by the other child (children were not told that the alphabetic spelling was the correct one). They were asked to analyse both of the written words carefully, to say which of the two versions was better and to try to justify why they had spelled the word in their way and why the other child had spelled it differently. In addition, they were encouraged to analyse the sounds that composed the word and to think about the letters that may correspond to such sounds, using their knowledge about letters' names and sounds.

Control group programme

Children from the control group were asked to do some drawings. The control group programme was equivalent in time to the training one and was individualized.

1.5 Procedure

Children were withdrawn from class and assessed individually in a quiet room within their school. The invented spelling programme and the control group programme also took place in a quiet room within the school.

Participant's assessment was made in November and December by five educational psychologists, each of whom had completed a Master's Degree in Educational Psychology and had experience with conducting children's assessments.

The experimental and control-group programmes were conducted by two of the five educational psychologists who had received special training within our research team on how to carry out this sort of programme. The children were randomly divided between them. The psychologists who conducted the post-test didn't know from which group each child came.

2. Results

In order to compare the equivalence of the 2 groups prior to training, we performed t-tests using the group as the independent variable, and age (in January), letter names and letter sounds known, level of cognitive ability and results in two phonological awareness tests as dependent variables. Table 1 shows the means and standard deviations for the two groups' results for these variables.

Table 1. Means and standard deviations for the age (months), knowledge of letters, cognitive ability and phonological awareness of the two groups

	Age		L. Names		L. Sounds		C. Ability		I.S.C.		I. Ph.C.	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
E.G.	66.85	3.11	17.56	3.58	10.41	2.94	16.46	3.97	6.52	3.31	4.09	2.05
C.G.	66.67	3.70	16.94	4.01	10.57	3.54	17.20	4.10	5.80	3.09	3.61	1.77

Note. E. G. = Experimental Group; C. G. = Control Group; C. Ability= Cognitive Ability (max.= 36; L. Names= Letter Names (max.=23); L. Sounds= Letter Sounds (max.=23); I. S. C. = Initial Syllable Classification (max.=14); I. Ph. C. = Initial Phoneme Classification (max.=14)

There were no statistically significant differences between the two groups ($p > .19$ in all cases).

2.1 Invented spelling

We will begin by giving an account of the children's invented spelling in the pre-test and the post-test. Table 2 shows the descriptive statistics for the number of letters correctly written by experimental and control group members at the pre- and post-test moments of the invented spelling test.

Table 2. Means and standard deviations for the number of letters correctly written by experimental and control groups at the pre- and post-test

	Pre-test		Post-test	
	M	*SD*	*M*	*SD*
E.G.	12.89	9.87	44.87	12.56
C.G.	12.60	10.01	11.28	11.32

Note. E.G. = Experimental Group; C.G. = Control Group

In order to analyse the differences between the two groups as regards the number of letters correctly written in the post-test, we conducted a one-way analysis of covariance (ANCOVA) using the group (experimental or control) as independent variable, the results in the pre-test (number of letters correctly spelled) as covariate and the number of letters correctly spelled in the post-test as the dependant variable. The two groups differed significantly with regard to the results obtained in the post-test ($F(1, 104) = 150.74$, $p < .001$, $\eta_p^2 = .59$), the experimental group obtaining better results. The covariate significantly contributed to the post-test results ($F(1, 104) = 44.02$, $p < .001$, $\eta_p^2 = .30$) and did not interact with the independent variable ($F(1, 104) = 1.84$, $p = .179$, $\eta_p^2 = .02$). Figure 1 shows the spellings of six words by Afonso, a child from the control group in the pre- and the post-tests.

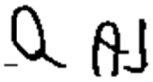
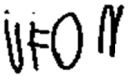
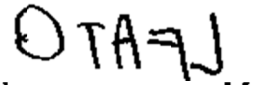
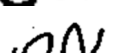
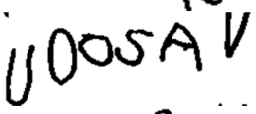
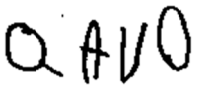
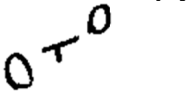
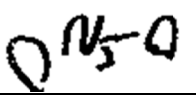
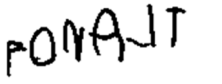
Words	Pre-test	Post-test
Bota		
Tio		
Dita		
Fada		
Fio		
Vi		

Figure 1. Example of writing in the pre- and post-tests by Afonso – Control Group.

As we can see, Afonso used strings of letters that have no relation to the word we asked him to spell in the pre-test and in the post-test.

Figure 2 shows the spellings of the same six words by Mafalda, a child from the experimental group.

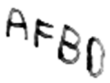
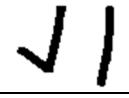
Words	Pre-test	Post-test
Bota		
Tio		
Dita		
Fada		
Fio		
Vi		

Figure 2. Example of writing in the pre- and post-tests by Mafalda – Experimental Group.

As can be seen in Figure 2, in the pre-test Mafalda used, like Afonso, strings of letters with no relation to the word we asked her to spell. In the post-test, Mafalda was able to write all the letters of the words in question, albeit using the letter U instead of O at the end of two words.

In order to see if children from the experimental group could generalize the procedures learnt during the programme to grapheme-phoneme correspondences that had never been practiced, we carried out a paired sample t-test to compare the differences between the spelling of practiced and non-practiced consonants by the members of the experimental group. We only used the consonants at the beginning of the words (there are 3 words that begin with each of the 6 consonants) and not the consonants that appear in other positions within the words, as it is known that the position of the letter within the word has effects on its spelling.

The means and standard deviations for the number of words in which the children in the experimental group used a correct letter to represent the practiced consonants were $M = 0.63$, $SD = 0.33$, while for the non-practiced consonants $M = 0.65$, $SD = 0.35$. The results of the t-test show that there were no statistically significant differences between the consonants that were practiced during the programme (B, D, P, T) and those that were not practiced (F,V): $t(52) = -0.82$, $p = .416$. We can thus say that there was a generalisation effect.

2.2 Reading

Our second hypothesis stated that the experimental group would be able to transfer from invented spelling to reading, thereby demonstrating better reading abilities than the control group. Table 3 shows the descriptive statistics for the number of letters correctly decoded by experimental and control group members at the pre- and post-test moments of the reading test.

Table 3. Means and standard deviations for the number of letters correctly decoded by experimental and control group at the pre- and post-test

	Pre-test		Post-test	
	M	SD	M	SD
E.G.	9.32	6.87	32.87	15.65
C.G.	7.57	5.78	6.63	6.71

Note. E.G. = Experimental group; C.G. = Control group

In order to analyse whether there were any differences between the two groups with regard to the number of correctly decoded letters we performed an ANCOVA using the group (experimental or control) as independent variable, the number of letters correctly decoded in the pre-test as covariate and the number of letters correctly decoded in the post-test as the dependant variable. The two groups differed significantly with regard to the results obtained in the post-test ($F(1, 104) = 98.11$, $p < .001$, $\eta_p^2 = .49$), the experimental group obtaining better results. The results of the covariate significantly contributed to the post-test results ($F(1, 104) = 6.86$, $p = .010$, $\eta_p^2 = .06$) and did not interact with the independent variable ($F(1, 104) = .01$, $p = .922$, $\eta_p^2 < .001$).

As we established when we selected participants, none of the members of the experimental or the control groups were able to correctly read any word in the pre-test. In order to analyse whether there were any differences between the two groups with regard to the number of words correctly read in the post-test, and as there was no homogeneity of variance between the two groups, we performed a Mann-Witney test using the group as the independent variable and the number of words correctly read as the dependant one. This showed a highly significant difference between the groups ($U = 421.5$, $p < .001$, $r = .69$), with the experimental group (*Mdn* = 3, *Range* = 15) being able to read a higher number of words correctly after training than the control group (*Mdn* = 0, *Range* = 4).

The words that were more often correctly read by the members of the experimental group were the monosyllabic ones, particularly Ti ($n = 36$), Vi ($n = 32$) and Pai ($n = 24$), and the dissyllabic words Dado ($n = 14$) and Fio ($n = 11$). The words that were more difficult were Vota and Dita ($n = 5$), Babo and Tapa ($n = 4$).

It often happened that children from the experimental group who could correctly decode the first letters of CVV or CVCV words were not able to correctly decode the last one and produced a pseudo-word; this was due to the fact that grapheme/phoneme

correspondences of the vowels A and O at the end of the words are respectively read [ɑ] and not [a] and [u] and not [ɔ]. For example, the word Pia [piɑ] was read Piá [pia] by 5 children and the word Vota [votɑ] was read Votá [vɔta] by 4 children; the word Fio [fiu] was read Fió [fiɔ] by 6 children and the word Tio [tiu] was read Tió [tiɔ] by 7 children.

Another particularity occurred with the reading of CVV words. These were often transformed into CVCV words, which correspond to the most frequent syllabic pattern in Portuguese words. This was the case for the word Pia [piɑ], which was read as Pita [pitɑ] by 3 children, and the word Tio [tiu], which was read as Tito [titu] by 5 children.

We analysed the relationship between the number of letters that were correctly written and decoded by the members of the experimental group at post-test, using a Pearson correlation. This showed that there was a statistically significant positive correlation between reading and spelling performance ($r = .76$, $p < .001$).

3. Discussion

We confirmed our first hypothesis, as the experimental group displayed improved spelling relative to the control group, and were able to spell more letters correctly in the post-test than the control group.

In line with other research (Alves Martins & Silva, 2006; Ouellette & Sénéchal, 2008; Silva & Alves Martins, 2002), these results confirm that conducting intervention programmes that work on pre-school children's invented spelling has an impact on children's thinking about the characteristics of the written code. We found that children in the experimental group, whose spelling had no relation to the oral word we asked them to spell during the pre-test, began to use appropriate letters to represent all or part of the phonemes of the words during the post-test. They understood the nature of the relationships between phonemes and graphemes, inasmuch as the words used in the pre and the post-test were different from those used in the intervention programme. It would thus seem that the tasks that were put to them – to think about their spelling and compare it with the alphabetic spelling of an hypothetical schoolmate – made it possible to initiate metalinguistic thinking processes at the level of segments of speech and print, and about the relationships between them, which in turn developed children's understanding that the code is a system for writing down sounds. As children from the experimental group were encouraged to segment and spell words in order to choose the most correct spelling, they were able to generalize the procedures learnt during the programme to grapheme-phoneme correspondences that were never practiced. This effect of the intervention programme sustains the idea that this kind of intervention leads to a gradual understanding of the alphabetic logic of the written code.

Most importantly, the present study provides direct evidence of the role that invented spelling programmes seem to have in the process of learning to read, as stated

in our second hypothesis. The experimental group displayed improved decoding abilities compared to the control group.

These results are consistent with the studies that confirm the impact of invented spelling programmes on reading (Ouellette & Sénéchal, 2008; Richgels, 1995). However, our results are not in the line with those obtained by Rieben *et al*. (2005); this may, at least in part, be explained by the characteristics of the words we used to evaluate reading, inasmuch as our words were less complex than those used by those authors.

Nevertheless, as we might expect, the effect of the intervention programme was greater in the decoding of small words rather than longer words, as is the case in the normal process of learning to read in the first year of elementary school. A more consistent effect on readers would probably be obtained with an intervention programme with a longer duration.

From a theoretical point of view, the reading results obtained by the children in the experimental group confirm the hypotheses of Treiman (1998) and Ouellette and Sénéchal, (2008). Treiman (1998) noted that the act of spelling words encourages preschool children to practice phonemic segmentation skills, which clarifies the relationship of graphemes to phonemes when reading words. The impact of invented spelling in phonemic skills has been confirmed by Ouellette and Sénéchal (2008) and Alves Martins and Silva (2006). However, invented spelling involves more than phonological awareness – namely it provides a valuable insight into, and practice with, the alphabetic code which seems to have a direct impact on reading.

Our results are in line with the perspective adopted by Ouellette and Sénéchal (2008) when they assume that: "The exploratory nature of invented spelling encourages children to use an analytical approach that also promotes the integration of phonological and alphabetic information into initial lexical representations that connect phonological and orthographic information; as these lexical representations become refined, they may facilitate the acquisition of reading." (p. 909).

Regarding the impact of the invented spelling programme on early reading - specifically, the correlation that was obtained between writing and reading - our results support the theoretical assumptions that learning how to spell and learning how to read words are interdependent, as stated by several authors (Ehri, 1997; Rieben, Saada-Robert, & Moro, 1997) and that their acquisition may be mutually facilitative.

From an educational point of view, the results we obtained point to the importance of promoting early invented spelling practices, which implies that children should be confronted with activities that encourage spelling much earlier than is usually the case. The present research provides empirical support for the proposal that invented spelling should be incorporated into early literacy instruction. In particular, this intervention model that combines children´s thinking about their way of spelling and that of another child, and leads children to think which was the better way to write the word and why, could be used by kindergarten teachers to promote growth in children's ability to capture spoken language in writing and to read words. The present study thus presents

an instructional strategy – comparison of differently spelled words – that seems to improve both early spelling and reading.

In conclusion, we would like to point out some limitations of our study and a few directions for future research. One of the limitations of this study concerns the fact that children's oral ability was not controlled. Another limitation concerns the fact that the intervention programme was conducted outside the classroom context and was individual. Future research should analyze the efficacy of developing this sort of programme in small groups or large groups and in classroom contexts. Another limitation concerns the fact that the programme was conducted in a spelling system that is relatively shallow, so the results can't be generalized to languages in which letter-sound correspondences are less consistent. A further limitation concerns the choice of the drawing programme applied to the control group. In future research it would be more interesting to choose activities such as another sort of spelling programme or a phonological training programme that could serve as a more powerful comparison with the experimental group. Finally, in future research it would be interesting to work with children who know a broader range of letters; this would make it possible to use words containing more consonants and vowels so as to minimize the phonetic and orthographic similarity between the words used in the training and in the evaluation.

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References

Adams, M. (1998). *Beginning to read: Thinking and learning about print*. Cambridge, MA: MIT press.

Alves Martins, M. (1993). Évolution des conceptualisations d'un groupe d'enfants d'âge pré-scolaire sur l'écriture du portugais [The evolution of the conceptualisations of a group of preschool-age-children about writing in Portuguese]. *Études de Linguistique Appliquée, 91*, 60-69.

Alves Martins, M., & Silva, C. (2006). The impact of invented spelling on phonemic awareness. *Learning and Instruction, 16*, 41-56. doi: 10.1016/j.learninstruc.2005.12.005

Bacelar do Nascimento, M. F., Casteleiro, J., Marques, M. L., Barreto, F., Amaro, R., & Veloso, R. (2000). *CLUL - Léxico Multifuncional Computorizado do Português Contemporâneo* [Multifunctional Computational Lexicon of Contemporary Portuguese]. Centro de Linguística da Universidade de Lisboa.

Besse, J.-M. (1996). An approach to writing in kindergarten. In C. Pontecorvo, M. Orsolini, B. Burge, & L. Resnick (Eds.), *Children's early textconstruction* (pp. 127 -144). New Jersey: Lawrence Erlbaum.

Cardoso-Martins, C. (2005). Beginning reading acquisition in Brazilian Portuguese. In R. M. Joshi & P. G. Aaron (Eds.), *Handbook of orthography and literacy* (pp. 171–188). Mahwah, NJ: Erlbaum.

Chomsky, C. (1970). Reading, writing and phonology. *Harvard Educational Review, 40*, 287-309.

Clarke, L. K. (1988). Invented versus traditional spelling in first grader's writings: Effects on learning to spell and read. *Research in the Teaching of English, 22*, 281-309.

Clay, M. (2005). Literacy lessons designed for individuals part one : Why ? When? And How?. Portsmouth, NH: Heinemann.

Defior, S., Martos, F., & Cary, L. (2002). Differences in reading acquisition development in two shallow orthographies: Portuguese and Spanish. *Applied Psycholinguistics, 23*(1), 136-148. doi : 10.1017.S0142716402000073

Ehri, L. C. (1991). The development of reading and spelling in children: An overview. In M. Snowling & M. Thomson (Eds.), *Dyslexia: Integrating theory and practice* (pp. 63–94). London: British Dyslexia Association.

Ehri, L. (1997). Learning to read and learning to spell are one and the same, almost. In, C. Perfetti, L. Rieben & M. Fayol (Eds.), *Learning to spell – research, theory and practice across languages* (pp. 237-269). New Jersey: LEA.

Ehri, L. C., & Wilce, L. S. (1987). Does learning to spell help beginners learn to read words? *Reading Research Quarterly*, *20*, 47-65.

Ferreiro, E. (1988). L´écriture avant la lettre [Writing before the letter]. In H. Sinclair (Ed.), *La production des notations chez le jeune enfant [The production of notations in young children]* (pp.18-69). Paris: Presses Universitaires de France.

Ferreiro, E., & Teberosky, A. (1979). *Los sistemas de escritura en el desarrollo del niño*. México: Siglo XXI. [Trans. 1982. *Literacy before schooling*. Exeter, NH: Heinemann Educational Books].

Gentry, J. R. (1982). An analysis of developmental spelling in *GNYS AT WRK*. *The Reading Teacher, 36*, 192–200.

Levin, I., Shatil-Carmon, S., & Asif-Rave, O. (2006). Learning of letter names and sounds and their contribution to word recognition. *Journal of Child Psychology, 93*, 139-165. doi: 10.1016/j.jecp.2005.08.002

Mann, V. A. (1993). Phoneme awareness and future reading ability. *Journal of Learning Disabilities, 26*, 259-269. doi: 10.1177/002221949302600406

McBride-Chang, C. (1998). The development of invented spelling. *Early Education and Development, 9*, 147-160. doi: 10.1207/s15566935eed0902_3

Morais, J. (1997). *A arte de ler [The art of reading]*. Lisboa: Cosmos.

Ouellette, G., & Sénéchal, M. (2008). Pathways to literacy: A study of invented spelling and its role in learning to read. *Child Development, 79*(4), 899-913. doi: 10.1111/j.1467-8624.2008.01164.x

Pontecorvo, C., & Orsolini, M. (1996). Writing and written language in children´s development. In C. Pontecorvo, M. Orsolini, B. Burge, & L. Resnick (Eds.), *Children´s early text construction* (pp. 3-23). Hillsdale, N.J.: Lawrence Erlbaum.

Raven, J., Raven, J. C., & Court, J. H. (1998). Manual for Raven's progressive matrices and vocabulary scale. Section I. General overview. Oxford: Oxford Psychologists Press.

Read, C. (1971). Pre-school children's knowledge of English phonology. *Harvard Educational Review, 41*, 1-34.

Rieben, L., Saada-Robert, M, & Moro, C. (1997). Word search strategies and stages of word recognition. *Learning and Instruction, 7*(2), 137-159. doi: 10.1016/s0959-4752(96)00014-X

Rieben, L., Ntamakiliro, L., Gonthier, B., & Fayol, M. (2005). Effects of various early writing practices on reading and spelling. *Scientific Studies of Reading, 9*, 145-166. doi: 10.1207/s1532799xssr0902_3

Richgels, D. (1995). Invented spelling ability and printed word learning in kindergarten. *Reading Research Quarterly, 30*(1), 96-109.

Shatil, E., Share, D. L., & Levin, I. (2000). On the contribution of kindergarten writing to grade 1 literacy: A longitudinal study in Hebrew. *Applied Psycholinguistics, 21*, 1-21.

Silva, C. (2002). Bateria de provas fonológicas [Battery of phonological tests]. Lisboa: ISPA.

Silva, C., & Alves Martins, M. (2002). Phonological skills and writing of pre-syllabic children. *Reading Research Quarterly, 37*, 466-483. doi: 10.1598/RRQ.37.4.6

Sulzby, E. (1989). Assessment of emergent writing and children´s language while writing. In L. Morrow & J. Smith (Eds.), *Writing in real time: Modelling production processes* (pp. 83-109). New York: Longman.

Tantaros, S. (2007). Invented spelling in the Greek context. *L1 – Educational Studies in Language and Literature, 7(3),* 31-62.

Tolchinsky, L. (2005). The emergence of writing. In C. MacArthur, S., Graham & J. Fitzgerald (Eds.), *Handbook of writing research* (pp. 83-96). New York: Guilford.

Tolchinsky, L., & Teberosky, A. (1998). The development of word segmentation and writing in two scripts. *Cognitive Development, 13,* 1–24.

Treiman, R. (1998). Why spelling? The benefits of incorporating spelling into beginning reading instruction. In J. L. Metsala & L.C. Ehri (Eds.), *Word recognition in beginning literacy* (pp. 289-313). Mahwah, NJ: Erlbaum.

Uhry, J. (1999). Invented spelling in kindergarten: The relationship with finger-point reading. *Reading and Writing: An Interdisciplinary Journal, 11*, 441-464. doi: 10.1023/A :1008032502132

Wimmer, H., & Landerl, K. (1997). How learning to spell German differs from learning to spell English. In C. Perfetti, L. Rieben, & M. Fayol (Eds.), *Learning to spell: Research, theory, and practice across languages* (pp. 81–96) Mahwah, NJ: Erlbaum.

Appendix A:

Words used to evaluate the children's invented spelling and reading

Pai (father)
Fio (string)
Dado (die)
Fita (ribbon)
Babo (drool) - low frequency
Tio (uncle)
Ova (roe) - low frequency
Vota (votes) - low frequency
Tapa (covers) - low frequency
Ti (you)
Bota (boot)
Dai (give) - low frequency
Dita (said)
Ato (tie) - low frequency
Bata (gown)
Vai (goes)
Vi (saw)
Pia (sink) - low frequency
Pato (duck)
Fada (fairy)

Appendix B:

Examples of scoring for reading performance and invented spelling

Reading of the word "Dita" [ditɑ]

If a child read "Nuno" [Nunu] or "Tapo" [tapu] a score of 0 was given, as there are no grapheme-phoneme correspondences between the written word and the one that was read; a score of 1 was given if a child read " Dedo" [dedu] or "Dado" [dadu], as the initial letter was correctly decoded; if a child read "Di" [di] or "Disse" [disə] a score of 2 was given, as two letters were correctly decoded in the proper sequence; a score of 3 was given if a child read "Dito" [ditu] or "Ditá"[dita]. A score of 4 points was only given if a child read the word correctly.

Writing of the word "Dita" [ditɑ].

A score of 0 was given for a random string of letters such as "OA" or "MB"; a score of 1 was given for the correct initial grapheme as "DO", where the first consonant is correct, or for the correct vowel in the first syllable, as in "IO"; a score of 2 was given if a child wrote 2 conventional letters in the proper sequence, such as "IT" or "DI"; a score of 3 was given if a child wrote 3 conventional letters in the proper sequence, such as "ITA" or "DITE"; a score of 4 points was given for proper conventional spelling.

Appendix C:

Examples of the interaction between the researcher and two children during the spelling programme sessions

First session with Tiago, where the researcher intends to make him aware of the first letter of a facilitating word "Peta" (Lie) (the first oral syllable corresponds to the letter name):

R..: Tiago, try to write the word "Peta" [petɑ].
Tiago writes "ATAGO".
R.: What was the first letter you wrote?
Tiago: A.
R.: Why have you written an A?
Tiago: I don't know.
R.: Yesterday, I asked a child from another school named Nuno to write the word "Peta". Shall I show you?
Tiago: Yes.
R. shows "PETA": What is the first letter that Nuno wrote?
Tiago: P.
R.: Is it different or the same as yours?
Tiago: It's different.
R.: What do you think about the way he wrote; do you think it begins with P?
Tiago: I don't know.
R.: Try to say the word slowly.
Tiago: Pe – ta.
R.: How does the word begin?
Tiago: P, with P.

Fifth session with Margarida, who writes the vowels I and A in the word "Bia" (a girl's name), but doesn't write the first consonant B. Margarida doesn't change her spelling, even after being confronted with the other child's alphabetic spelling.

R.: Margarida, can you write the word "Bia"?
Margarida: Bia? (Writes "IA").
R.: Let us see how Joana, a little girl like you from another school, wrote Bia?
Margarida: Yes.
R. shows "BIA": What letters has she written?
Margarida: B, I, A.
R.: And what about you, what were the letters you wrote?
Margarida: I and A.
R.: Is it different or the same as Joana's?
Margarida: It is different.
R.: You began with what letter?

Margarida: I.
R.: And Joana?
Margarida: She wrote B. But it is I.
R.: What was the word I asked you to write?
Margarida: Bi-a (Stresses the vowel I). You see, it is with I.
R.: Why?
Margarida: Because I hear the sound I, I.