

# INVENTED SPELLING PROGRAMMES AND THE ACCESS TO THE ALPHABETIC PRINCIPLE IN KINDERGARTEN

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*Abstract.* This study aims to understand the effects of two invented spelling programmes in the development of children's invented spelling, namely to the phonetization of writing and to understand the correlations between phonological awareness and knowledge of letters and the phonetization procedures. Fifty-six five-year-old were divided into two experimental groups and one control group. In the pre and post-tests, children's spellings were assessed through pseudo-words that contained fricatives and stops worked during the programmes and other non worked phonemes, both in initial and in final position. In between, G1 worked the grapho-phonetic correspondences of fricatives and G2 of stop consonants. Results show that both experimental groups achieved greater progress in spelling than the control group with no statistically significant differences between the experimental groups. In these groups the participants were able to spell the worked and the non worked phonemes in initial and in final position correctly. In G1, statistically significant differences were found, with better results in the phonetization of the worked fricatives in initial position than in final position. The results also indicated that the number of letters known in the pre-test has a significant correlation with the number of phonetizations in the post-test, whereas phonological awareness does not.

*Key words:* Invented spelling programmes; preschool children; phonetization procedures; letter knowledge; phonological awareness.

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### Dutch

[Translation Tanja Janssen]

TITEL. Programma's voor verzonden spelling en toegang tot het alfabet in het kleuteronderwijs  
 SAMENVATTING. Doel van dit onderzoek is inzicht te krijgen in de effecten van twee programma's voor "invented spelling" (spellen naar eigen inzicht) in de ontwikkeling van de spelvaardigheid van kinderen, namelijk op fonetisch schrijven, en om inzicht te krijgen in de samenhang tussen fonologisch bewustzijn en kennis van letters en procedures voor fonetisch weergeven. 56 Vijfjarigen werden verdeeld over een experimentele en een controle groep. Bij de voor- en natoets werd het spellen van de kinderen gemeten door pseudowoorden die frikatieven en 'stops' bevatten, zowel in begin- als eindpositie. Tijdens de interventie werkte de experimentele groep (G1) met grafisch-fonetische overeenkomsten van frikatieven, en de controlegroep (G2) met eindconsonanten. Resultaten wijzen uit dat beide experimentele groepen meer vooruitgingen in spelling dan de controle groep, waarbij de experimentele groepen niet statistisch van elkaar verschilden. In deze groepen waren de kinderen in staat fonemen in begin- en eindpositie correct te spellen, zowel fonemen die behandeld waren tijdens het programma als niet-behandelde fonemen. In G1 werden statistisch significante verschillen gevonden, met betere resultaten voor het fonetisch weergeven van behandelde frikatieven in de begin- dan in de eindpositie. De resultaten wezen ook uit dat het aantal letters dat een kind kende bij de voortoets significant gecorreleerd was met het aantal fonetische weergaves in de natoets, terwijl dit niet correleerde met fonologisch bewustzijn. TREFWOORDEN: programma's voor verzonden spelling; kennis van letters, procedures voor fonetisch weergeven, fonologisch bewustzijn, kleuters

### Greek

[Translation by Panatoya Papoulia Tzelepi]

Τίτλος. Προγράμματα επινοημένης γραφής και η πρόσβαση στην αλφαβητική αρχή στο Νηπιαγωγείο.  
 Περίληψη. Η μελέτη αυτή στοχεύει στην κατανόηση των αποτελεσμάτων προγραμμάτων επινοημένης γραφής στην ανάπτυξη της επινοημένης γραφής και πιο συγκεκριμένα στη φωνητικοποίηση της γραφής καθώς και στην κατανόηση της σχέσης μεταξύ της φωνημικής επίγνωσης, της γνώσης των γραμμάτων και της διαδικασίας της φωνητικοποίησης. Πενήντα έξι πεντάχρονα παιδιά χωρίστηκαν σε δύο πειραματικές ομάδες και ομάδα ελέγχου. Στις δοκιμασίες πριν και μετά η επινοημένη γραφή των παιδιών προσεγγίστηκε μέσω ψευδολέξεων που περιείχαν συριστικά και κλειστά σύμφωνα που είχαν δουλευτεί κατά τη διάρκεια του προγράμματος και άλλα φωνήματα που δεν είχαν δουλευτεί, στην αρχική ή στην τελική θέση. Ανάμεσα στις δοκιμασίες, η Ομάδα 1 εργάστηκε στη γραφοφωνημική αντιστοιχία των συριστικών και η Ομάδα 2 των κλειστών συμφώνων. Τα αποτελέσματα δείχνουν ότι και οι δύο πειραματικές ομάδες επέτυχαν καλύτερες επιδόσεις από την ομάδα ελέγχου, χωρίς όμως στατιστικά σημαντικές διαφορές μεταξύ τους. Στις ομάδες αυτές τα παιδιά μπορούσαν να γράφουν σωστά τα φωνήματα με τα οποία δούλεψαν είτε στην αρχική είτε στην τελική θέση. Στην Ομάδα 1 βρέθηκαν στατιστικά σημαντικές διαφορές με καλύτερα αποτελέσματα στη φωνητικοποίηση των αρχικών συριστικών στην αρχική παρά στην τελική θέση. Τα αποτελέσματα επίσης έδειξαν ότι ο αριθμός των γνωστών γραμμάτων στη δοκιμασία πριν από την παρέμβαση έχει σημαντική σχέση με τον αριθμό των φωνητικοποιήσεων στη δοκιμασία μετά την παρέμβαση, ενώ η φωνημική επίγνωση δεν έχει.  
 Λέξεις κλειδιά: Προγράμματα επινοημένης γραφής, γνώση των γραμμάτων, διαδικασίες φωνητικοποίησης, φωνημική επίγνωση, παιδιά προσχολικής ηλικίας.

### Italian

[Translation Manuela Delfino, Francesco Caviglia]

TITOLO. Programmi di "ortografia intuitiva" e accesso al concetto di alfabeto nella scuola dell'infanzia  
 SINTESI. Questo studio si pone l'obiettivo di capire gli effetti di due programmi di istruzione sull'ortografia intuitiva nello sviluppo dell'ortografia intuitiva dei bambini, mirata alla fonetizzazione della scrittura e alla comprensione della correlazione tra la consapevolezza fonologica e la conoscenza delle lettere e delle procedure di fonetizzazione. Cinquantasei bambini di 5 anni sono stati divisi in due gruppi sperimentali e in un gruppo di controllo. Nei pre- e post-test, la produzione scritta dei bambini era verificata dalla trascrittura di pseudoparole contenenti fricative e occlusive esercitate nel corso dei due programmi d'istruzione, come pure di altri fonemi non esercitati, posizionati sia all'inizio, sia alla fine della parola. Dopo il pre-test, il Gruppo 1 si è esercitato sulle corrispondenze grafo-fonetiche delle fricati-

ve, mentre il Gruppo 2 si è esercitato sulle consonanti occlusive. I risultati mostrano come entrambi i gruppi sperimentali abbiano ottenuto nell'ortografia progressi maggiori rispetto al gruppo di controllo, senza differenze statisticamente significative tra i due gruppi sperimentali. Nei gruppi sperimentali, i partecipanti erano in grado di scrivere correttamente i fonemi esercitati e quelli non esercitati in posizione iniziale e finale. Nel Gruppo 1 sono state trovate differenze statisticamente significative, con risultati migliori nella fonetizzazione delle fricative occluse in posizione iniziale piuttosto che finale. I risultati indicano anche che il numero di lettere conosciuto, come misurato nel pre-test, ha una correlazione significativa con il numero di fonetizzazioni del post-test, mentre la competenza fonologica non è correlata.

**PAROLE CHIAVE:** programmi di ortografia intuitiva, conoscenza delle lettere, procedure di fonetizzazione, competenza fonologica, bambini in età prescolare

### **Polish**

[Translation Elżbieta Awramiuk]

**TITUŁ.** Programy rozwijania wczesnych umiejętności pisania a rozumienie istoty pisma alfabetycznego w przedszkolu

**STRESZCZENIE.** Celem niniejszego artykułu jest omówienie wpływu dwóch programów wprowadzających dzieci w istotę pisma alfabetycznego na rozwój wczesnych umiejętności pisania tych dzieci, a mianowicie na fonetyzację ich pisma, oraz zrozumienie korelacji między świadomością fonologiczną, wiedzą o literach a procedurami fonetyzacji. Pięćdziesięcioro sześciorgo dzieci w wieku pięciu lat podzielono na dwie grupy eksperymentalne i jedną kontrolną. W testach początkowych i końcowych pisownia dzieci była oceniana na podstawie pseudowyrazów zawierających w pozycji nagłosowej i wygłosowej spółgłoski szczelinowe i zwarte omawiane w trakcie realizacji programów oraz inne nieomawiane fonemy. Między testami grupa G1 omawiała grafo-fonetyczne zależności głosek szczelinowych, a grupa G2 – głosek zwartych. Wyniki dowodzą, że obydwie grupy eksperymentalne osiągnęły w pisowni wyraźnie większy postęp niż grupa kontrolna, jednak bez istotnej statystycznej różnicy między wynikami osiągniętymi przez grupy eksperymentalne. W obu grupach uczestnicy potrafili poprawnie zapisać w pozycji nagłosowej i wygłosowej omawiane i nieomawiane fonemy. Grupa G1 wykazała się istotnie lepszymi pod względem statystycznym rezultatami w fonetyzacji omawianych fonemów szczelinowych w pozycji nagłosowej niż wygłosowej. Wyniki badań dowiodły także, że liczba znanych liter w teście początkowym wykazuje istotną korelację z liczbą fonetyzacji w teście końcowym, podczas gdy świadomość fonologiczna nie wykazuje takiej zależności.

**SŁOWA-KLUCZE:** programy rozwijania wczesnych umiejętności pisania, wiedza o literach, procedury fonetyzacji, świadomość fonologiczna, dzieci w wieku przedszkolnym

### **Spanish**

[Translation Isabel Martinez-Alvarez]

**TÍTULO.** Programas de ortografía inventados y el acceso al principio alfabético en jardín de infancia.

**RESUMEN.** Este estudio se propone entender los efectos de dos programas de ortografía inventadas en el desarrollo de la ortografía inventada en niños, concretamente la fonetización de la escritura y entender las correlaciones entre la conciencia fonológica y el conocimiento de las letras y los procedimientos de fonetización. Cincuenta y seis niños de cinco años fueron divididos en dos grupos experimentales y uno control. En los pre y post-tests, accedimos a la ortografía de los niños a través de pseudo-palabras que contenían fricativos y oclusivas trabajadas durante los programas y otros fonemas no trabajados, ambos en las posiciones iniciales y finales. Entremedias, G1 trabajó las correspondencias grafo-fonéticas de fricativos y G2 las consonantes oclusivas. Los resultados muestran que ambos grupos experimentales alcanzaron un mayor progreso en ortografía que el grupo control sin diferencias significativas entre los grupos experimentales. En estos grupos los participantes fueron capaces de deletrear correctamente los fonemas trabajados y no trabajados en la posición inicial y final. En G1, se encontraron diferencias estadísticamente significativas, con mejores resultados en la fonetización de los fricativos trabajados en la posición inicial frente a la final. Los resultados también indicaron que el número de letras conocidas en el test pre tiene una correlación significativa con el número de fonetizaciones en el test post, mientras que la conciencia fonológica no.

**PALABRAS CLAVE:** programas de ortografía inventadas, conocimiento de la letra, procedimientos de fonetización, conciencia fonológica, niños de preescolar

### **Turkish**

[Translation Burak Sunguralp Tekin]

BAŞLIK. Anaokulunda yazım programları ve alfabetik ilkeye erişim

ÖZET. Bu çalışma çocukların yazım gelişimlerinde iki yazım programının etkilerini ve fonolojik farkındalık, harf bilgisi ve yazım yöntemleri arasındaki ilişkileri anlamayı amaçlamaktadır. Beş yaşındaki elli altı çocuk iki deney grubuna ve bir kontrol grubuna ayrıldılar. Ön ve son testlerde, programlarda hem ilk hem de son konumlarda olmak üzere çalışılan sürtünmeli ve patlamalı sesbirimlerini ve diğer çalışılmamış sesbirimlerini de içeren uydurma kelimeler aracılığıyla çocukların yazımları elde edilmiştir. G1 sürtünmeli sessizlerin grafo-fonetik eşlerini çalışırken, G2 de patlamalı sessizlerinkini çalıştı. Sonuçlar göstermektedir ki her iki deney grubu da kendi aralarında istatistiki olarak anlamlı bir fark olmaksızın kontrol grubundan daha fazla ilerleme göstermiştir. Bu gruplarda, katılımcılar ilk ve son konumlardaki çalışılmış ve çalışılmamış sesbirimlerini doğru bir şekilde yazabildiler. G1’de çalışılmış sürtünmelilerin yazımında ilk konumdakilere göre istatistiki açıdan anlamlı farklılıklar ortaya çıkmıştır. Sonuçlar yine göstermektedir ki ön testte bilinen harf sayısının son testte yazılanların sayısıyla önemli bir ilişki varken, fonolojik farkındalık bu konuda önem arz etmemektedir. ANAHTAR KELİMELEER: Yazım programları, harf bilgisi, yazım prosedürleri, fonolojik farkındalık, anaokulu çocukları

## 1. INTRODUCTION

Invented spelling activities in kindergarten play an important role regarding the understanding of the alphabetic principle.

Byrne and Fielding-Barnsley (1989) define the alphabetic principle as “useable knowledge of the fact that phonemes can be represented by letters, such that whenever a particular phoneme occurs in a word, and in whatever position, it can be represented by the same letter” (p.313), implying that functional understanding of the alphabetic principle depends integrally on the association between explicit awareness of phonemes and knowledge of letters (Adams, 1990).

The importance of children’s experiences with writing and its benefits to the development of phonemic awareness was demonstrated by several authors (Hohn & Ehri, 1983; Kamii & Manning, 2002; Stahl & Murray, 1998; Treiman, 1998; Vernon & Ferreiro, 1999).

The studies conducted by Alves Martins and Silva (2001, 2006a, 2006b) and by Silva and Alves Martins (2002, 2003) in the European Portuguese language, also prove that spelling activities improve phonological skills. The authors undertook intervention programmes designed to lead the quality of preschool children’s invented spellings to evolve. These invented spelling programmes were designed as follows: after writing a few words the children were shown spellings of those words written by more evolved children – confrontation spellings. They were asked to analyse the word orally and to think about the letters that were used in both spellings. The children were then asked to choose the best spelling and to justify their choice – that is, the children were induced to think about speech, about letters and about the relationships between them.

This procedure led to a clear progress in the quality of the children’s spellings, but also to an improvement in children’s phonemic awareness. In fact, spelling activities led children to achieve significant improvements in their results in the phonemic tasks and to represent the same sound with the same letter in different words (Silva & Alves Martins, 2003).

With the same procedure as described, and to better understand the impact of invented spelling on phonemic awareness, Alves Martins and Silva (2006b) estab-

lished three experimental groups and three control groups according to the nature of the invented spelling in the pre-test. The experimental groups undertook a training programme designed to induce a restructuring in children's invented spellings, while the control groups were involved in categorization exercises with geometric figures. In each session, children were invited to spell words that began with the same vowel or with the same consonant and where the first syllable of the first word coincided with the letter's name (e.g. a'gua (water) coincides with the name of the letter A, or pera (pear), that coincides with the name of the letter P).

The results of the post-test indicated that, despite the nature of the invented spellings, the training programme led to an improvement in children's performances in the phonemic awareness tasks. The results support the idea that "involvement in writing situations prior to formal education is a factor in the development of phonemic awareness" (Alves Martins & Silva, 2006b, p. 52).

The complex interaction between the process involved in becoming aware of sound units and the understanding of how the written code works, is thus achieved through children's invented spelling activities (Alves Martins & Silva, 2006b).

Moreover, Ouellette and Sénéchal (2008) consider that invented spelling coupled with feedback will encourage an analytical approach and will facilitate the integration of phonological and orthographic knowledge, which will facilitate the acquisition of early literacy skills. Their study with kindergarten children included one invented spelling training group and two control groups, one of which received training in phonological awareness. The other control group was asked to draw picture for the target words used with the invented spelling training group. The authors aimed to increase the sophistication of children's naturally-occurring invented spellings by asking them to write the target words after they had been dictated four times. After spelling each word, the instructor would give individual tailored feedback in which each invented spelling was contrasted with an instructor-generated invented spelling that was representative of minimal increases in sophistication (Ouellette and Sénéchal, 2008). The results of this study highlight the importance of invented spelling with developmentally appropriate feedback in the acquisition of early literacy skills, providing valuable insight and practice with the alphabetic code (Ouellette and Sénéchal, 2008).

The functional understanding of the alphabetic principle also depends on letter knowledge (Adams, 1990), that includes knowledge of letter names and of letter sounds, and the ability to retrieve this information quickly and with no effort (Treiman, 2000). As Adams, Treiman and Pressley (1998) refer children use their knowledge of letter names as a guide to sound-spelling correspondences. That is, when they are familiar with the names of the letters, children use this knowledge in their spellings (Alves Martins & Silva, 2001; Byrne & Fielding-Barnsley, 1989; Ehri, 1997; Mann, 1993; Quintero, 1994; Read, 1971; Treiman, 1993, 1994, 1998, 2006).

As Tolchinsky (2004) states "it is in this transition to the alphabetic principle that the specific characteristics of the phonological and morphological structures of a language, and the way in which these characteristic are reflected in the script, play a crucial and distinctive role." (p. 26).

Martins, Silva and Pereira (2010) analysed the effect that the articulatory properties of the initial phoneme in a word have on the evolution of the processes involved in the phonetization of writing, that is, using the letters that correspond to the sounds of the word.

In their study, thirty-nine five-year-old children were divided into two experimental groups that undertook two invented spelling programmes - one with stops (P, B) and the other with fricatives (F, V) as initial phonemes. The authors compared the children's phonetizations in the post-test and the children's ability to generalise the phonetization procedures to grapho-phonetic correspondences that were not worked during the programmes between both groups (Z and D). The results showed that participants of both experimental groups were able to phonetize virtually 100% of the fricative phonemes whereas participants that worked fricatives were not able to phonetize some of the stop phonemes, which seems to indicate that it is easier to acquire the phonetization of the fricatives than of stops (Martins, Silva & Pereira, 2010).

These results are consistent with Byrne and Fielding-Barnsley (1990), who verified that teaching phoneme identity was easier for fricative consonants than for stops. Fricatives were also more easily identified in nonsense words than stops (McBride-Chang, 1995). In fact, several authors consider that fricatives are easier to pronounce in isolation – with less interference of the vocalic sound – and that their acoustic representations can be more constant (Lieberman, Cooper, Shankweiler & Studdert-Kennedy, 1967), which facilitates their identification compared to stop consonants.

However, the results of Treiman, Broderick, Tincoff and Rodriguez's study (1998) of the linguistic factors that influence children's performance on phonemic awareness tasks showed that, in a phoneme recognition task, children performed better with stops than with fricatives.

In fact, Treiman, Broderick, Tincoff, Mouzaki and Francis (1998) refer that the properties of the phoneme itself do not appear to have a consistent influence on children's ability to relate the phoneme to its spelling. What seems important is whether the phoneme occurs in the name of the letter and its position in the letter name (Treiman, 2006).

Despite phoneme characteristics, Byrne (1998) stresses the robustness of the alphabetic principle regarding to new letters, that is, once the concept of phoneme identity is consolidated, children will be able to transfer their knowledge of the relations between spelling and sounds beyond those that had been taught explicitly (Adams, 1990; Byrne & Fielding-Barnsley, 1991). In fact, Martins, Silva and Pereira (2010) and Silva, Almeida and Alves Martins (2010) verified, for the Portuguese language, that the phonetization procedures extended to other phonemes that were not object of intervention.

The studies presented highlight the importance of invented spelling activities, and more specifically, of interventions programmes, to the understanding of the alphabetic principle. These programmes lead to an increase in children's phonemic awareness and to a better quality in children's spellings, namely towards phonetization.

However, the variables involved in this progress were not analysed. Albeit the participant's age, intelligence, phonological awareness and knowledge of letters had been assessed at the beginning of the programmes, their relation with the results in the post-test were not considered. It would also be of interest to extend the transfer ability to a larger number of consonant letters and to phonemes in final position.

In this sense, this study aims to understand the effects of two invented spelling programmes in the development of children's invented spelling, namely to the phonetization of writing. More specifically, this study aims to: a) compare the number of phonetizations between children who undertook an invented spelling programme that worked fricatives and children who undertook an invented spelling programme that worked stop consonants; b) verify if the children of each group are able to transfer the phonetization procedures to non worked grapho-phonetic correspondences; c) compare if they are equally able to apply the phonetization procedures to initial and to final consonants.

This study also aims to understand the correlations between phonological awareness and knowledge of letters and the phonetization procedures.

## 2. METHODS

### 2.1 *The experimental design*

This was an experimental study in which children's invented spellings were assessed on a pre- and on a post-test. We established two experimental groups and a control group. In between the pre- and the post-test, experimental group 1 undertook an invented spelling programme that worked fricatives, experimental group 2 undertook an invented spelling programme that worked stops and the control group took part in exercises involving the categorisation of geometric figures according to their shape, size and colour.

The experimental and control group programmes started a week after the pre-test and lasted four weeks. The post-test was carried out one week after the programmes were concluded.

The tests used at the pre- and the post-test were the same.

### 2.2 *Participants*

The participants in the study were 56 middle-class Portuguese pre-syllabic (Ferreiro, 1988) children - 31 girls and 25 boys, with an average age of 65.59 months and a standard-deviation of 4.03 months, a minimum age of 59 months and a maximum age of 75 months. These children were selected from a total of 118 attending six kindergarten classrooms in three private schools in Lisbon and had not received any formal training in reading and writing. The only regular activities related to reading and writing were story reading, teaching letter names, activities in which children had to write their own names (eg. to identify their drawings, paintings, ...). None of the children knew how to read – they were presented with a list of dissyllabic words.

Only pre-syllabic children were selected.

The participants were assigned to each group: experimental group 1 (N = 19); experimental group 2 (N = 19); control group (N = 18). The three groups were equivalent in terms of age, intelligence, phonological awareness and knowledge of letters.

Table 1 presents the means and standard deviations for these variables.

*Table 1. Means and standard deviations scores of age, intelligence, phonological awareness and knowledge of letters in the pre-test for each group. G0 – Control group; G1 – Experimental group 1 (unvoiced fricatives); G2 – Experimental group 2 (unvoiced stops). isc – initial syllable classification test; ipc – initial phoneme classification test*

	Control Group N=18		Experimental Group 1 N=19		Experimental Group 2 N=19	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Age	64.74	4.54	65.89	8.76	66.16	3.80
Intelligence	17.84	4.02	17.11	3.51	17.66	5.38
Phonological Awareness isc	3.11	2.60	4.67	3.55	3.00	2.73
Phonological Awareness ipc	2.16	2.75	2.89	2.11	2.95	3.60
Letters	6.47	6.27	9.00	5.75	8.16	6.34

We carried out ANOVAs to compare these variables. The results were:  $F(2,55) = 0,66$ ,  $p = 0.523$  for the age;  $F(2,55) = 0,21$ ,  $p = 0.808$  for the intelligence;  $F(2,55) = 1,80$ ,  $p = 0.18$  for the initial syllable classification test;  $F(2,55) = 0,44$ ,  $p = 0.65$  for the initial phoneme classification test;  $F(2,55) = 0,82$ ,  $p = 0.446$  for the letter knowledge.

### 2.3 Instruments and Procedures

#### 2.3.1 Assessment of the children's invented spelling to select the participants

To select the pre-syllabic children, all of the 118 children attending the three kindergartens were asked by a collaborator to spell as they knew their own name and six words. After spelling each word they were asked to read it. They were also asked why they had used certain letters and not others and why they had used fewer or more letters in some words than in others.

Children's responses were categorised according to Ferreiro (1988) and Alves Martins' (1993) description of children's early conceptualizations about written language, with the following categories: pre-syllabic; syllabic without phonetization; syllabic with phonetization; syllabic-alphabetic / alphabetic.

In pre-syllabic writing, children make no attempt to establish letter-sound correspondences and are influenced by the referent's characteristics. They write several letters and then read the written string globally.



In syllabic writing without phonetization, children begin to establish a relationship between oral and written language based on syllabic units, making a strict one-to-one correspondence between the oral syllables and the letters they wrote. Each syllable is represented by a random letter. They read the words syllabically.

In syllabic writing with phonetization, children's writing is still based on syllabic units. However, they use a conventional letter to represent the sound of each syllable.

In syllabic-alphabetic / alphabetic writing, children use conventional letters to represent sounds. In syllabic-alphabetic writing, they represent all the phonemes in some of the syllables of a word and continue to use a single letter in the other syllables of the same word. In alphabetic writing, children represent all the phonemes in all the syllables of the word, even though not all the applicable orthographic conventions are respected.

The chosen words to assess children's spellings were linguistically different as to their size (mono, di, tri and poli-syllabic words) and some of them referred to items of different sizes (eg. Boi [boy] (ox); Formiga [furmigã] (ant)). These words enable us to understand whether the reasoning that underlined the children's spelling was based on the linguistic characteristics of the words, or on the referent's characteristics. Pre-syllabic children are expected to use non-linguistic criteria in their spellings such as a fixed number of random letters and different combination of letters to distinguish different words. They are also expected to justify their spellings making no reference to the relations between the oral and the written language.

On the other hand, non pre-syllabic children use linguistic criteria in their spellings – the number of syllables or the use of pertinent letters – and justify their spellings considering the correspondences between the oral and the written language.

Fifty six children were pre-syllabic.

### 2.3.2 *Assessment of the children's intelligence*

Children's level of intelligence was by assessed using the coloured version of Raven's Progressive Matrices test (Raven, Raven & Court, 1998) because it is not a verbal dependent test.

### 2.3.3 *Assessment of the children's phonological awareness*

To evaluate children's phonological awareness we submitted them to two subtests based on Silva's battery of phonological tests (2002): an initial syllable classification test and an initial phoneme classification test. Each of the tests was composed of 16 items preceded by 2 examples. In each item the children were presented with four drawings representing four oral words (there were no written words); in the initial-syllable classification test two of the words in each item began with the same syllable, while the other two started with different ones (e.g., sofá (sofa)/ fada (fairy)/ vaca (cow)/ fato (suit)) and the children had to identify the words that began with the same syllable; in the initial-phoneme classification test two of the words in each item began with the same phoneme, whereas the others started with different

ones and the children again had to identify the words that began with the same phoneme (e.g., *peessoa* (person)/ *pinheiro* (pine tree)/ *boneca* (doll)/ *tapete* (carpet)).

#### 2.3.4 *Assessment of the children's knowledge of letters*

Children were shown a set of cards with the 23 letters of the Portuguese Alphabet in capitals and were asked to name them. The score on this test ranged from 0 to 23.

#### 2.3.5 *Assessment of the children's invented spelling in the pre- and post-test*

Each child was asked to write fifty pseudo-words with a CVCV structure. According to Vigário, Martins and Frota (2006), CV, V and CVC structure syllables are the most frequent in the spontaneous talk of adults in European Portuguese, respectively 46%, 16% and 11%.

We wanted to compare the phonetization of fricatives and of stops, so the pseudo-words contained the unvoiced fricatives [f] and [s] and the unvoiced stops [p] and [t] that were worked during the programmes. We also wanted to verify the children's ability to transfer the phonetization procedures to non worked grapho-phonetic correspondences. The chosen phonemes were the correspondent, in manner of articulation, voiced fricatives [v] and [z] and voiced stops [b] and [d], and another unvoiced fricative [ʃ] and unvoiced stop [k].

Since we also wanted to analyse the children's phonetizations of the initial and of the final consonants, pseudo-words were used as there are no Portuguese words that satisfy these conditions.

They were also used so that the stress should be on the consonants and on their position in the word and not on the vowels. In fact, Portuguese children use more vowels than consonants in their spellings (De Abreu & Cardoso-Martins, 1998; Pollo, Kessler & Treiman, 2005), and often the syllable coincides with the vowel's name. Alves Martins and Silva (2009) state that the facilitating effect of letter names seems to be more accentuated for vowels than for consonants in Portuguese, specifically, open vowels. In this sense, except for the vowels *i* and *u*, the first vowel of each pseudo-word was closed – [a], [e], [ə], [o] – (Cunha & Cintra, 2000) and the final vowel was always [ə]. For example, *fasse* [ˈfasə], *sefe* [ˈsefə], *pite* [ˈpitə], *tope* [ˈtopə], *bude* [ˈbudə], *caxe* [ˈkaxə], *dabe* [ˈdabə], *veze* [ˈvezə], *xique* [ˈʃikə], *zive* [ˈzivə].

Each pseudo-word was dictated to the child by the experimenter.

There were no phonetizations in the pre-test.

In the post-test, children's spellings were assessed using the same pseudo-words and the same procedure.

All of the suitable grapho-phonetic correspondences of the initial and of the final consonants were considered as phonetizations and accounted for. Since Portuguese is not a transparent writing system, the phonemes [k], [s], [ʃ] and [z] can be represented by more than one grapheme, i.e., we considered the graphemes *c* and *q* for [k], the graphemes *c* and *s* for [s], the digraph *ch* and the grapheme *x* for [ʃ] and the graphemes *s* and *z* for [z] suitable.

#### 2.4 Invented spelling programmes

The invented spelling programmes were organised in four individual sessions, once a week, and were designed to lead the children to use conventional letters to represent the initial consonant in each word. Each session lasted approximately fifteen minutes.

Experimental group 1 (G1) worked the grapho-phonetic correspondences of the unvoiced fricatives ([f] and [s]) and experimental group 2 (G2) worked the grapho-phonetic correspondences of the unvoiced stops ([p] and [t]).

In each session, the child was invited to write twelve different words beginning with the targeted phoneme.

In session 1 the target phoneme was [f] (G1) and [p] (G2) and in session 2 the target phoneme was [s] (G1) and [t] (G2). The words in sessions 3 and 4 started with both phonemes – [f] and [s] (G1); [p] and [t] (G2) (see Appendix 1).

The first four words of sessions 1 and 2 started with the sound (fricatives) or with the name (stops) of the letter corresponding to the targeted phoneme (e.g. feno [‘fenu] [hay]; pena [‘penα] [feather]; seda [‘sedα] [silk]; tema [‘temα] [theme]). In the other words the vowel was different (e.g. fama [‘famα] [fame]; sino [‘sinu] [bell]; poço [‘posu] [well]; tubo [‘tubu] [tube]) to avoid a repetition effect.

After writing a word, the experimenter asked the child to point and read it aloud. Then the experimenter showed to the child the same word written by another child with the same age in a more advanced way. In sessions 1 and 2 the confronting spelling was syllabic with phonetization and in sessions 3 and 4 the confronting spelling was alphabetic. We did not present alphabetic writing in the first two sessions because we considered it to be conceptually too distant from the children’s initial spellings.

The child was then asked to analyse and to compare both spellings, to evaluate which one was better and to justify his/her choice.

The following example of the interaction between the researcher (R) and a child named Rita (C) during the invented spelling programme sessions illustrates the child’s progresses.

*Example 1x. Script 1<sup>st</sup> session (partial) -*

---

R	Write as you know the word PENA [‘penα]
C	writes “RPTIA”
R	Show me where it’s written with your finger and try reading it.
C	Pena (points “RPTIA”)
R	What letters did you use?
C	reads the letter names R-P-T-I-A
R	I was with a child named Maria from another school and she wrote PENA in a different way. Do you want to see it?
C	Yes.
R	shows ‘PN’.
C	She only put 2.
R	Yes, she used 2 letters to write PENA. Why do you think she did it?
C	I don’t know...

---

---

R	Read it and show me with your finger.
C	reads PENA pointing “PN”
R	What letters did Maria use?
C	P-N
R	Read it again.
C	PE-NA (pointing P and N)
R	PE-NA! Why do you think she used P to write PENA?
C	I don’t know
Cont.	(...)

---

*Example 2. Script 3<sup>rd</sup> session (partial).*

---

R	Rita, now write PELO [‘pelu]
C	Pe-pe... (writes P), a T... Pelo-lo (writes U) – PTU
R	Do you want to see how Maria wrote PELO?
C	nods and R shows PELU.
R	Which one do you think is better?
C	Mine!
R	Why?
C	Because...
Cont.	(...)

---

### 2.5 Control group programme

A set of exercises was organized with the control group using the logical blocks. The children were asked to classify geometric shapes according to their identical shape, size, or colour. These activities did not involve any linguistic activities that may interfere with the spelling programmes.

The programme involved four sessions that lasted approximately fifteen minutes each and were individually conducted by us with the children once a week.

## 3. RESULTS

As referred previously, there were no phonetizations in the pre-test. Children used conventional letters and in some cases pseudoletters to represent the pseudo-words. Mostly, children used strings of random letters or letters from their own names combined differently from pseudo-word to pseudo-word. *Figure 1* shows an example of António’s pre-syllabic spelling in the pre-test.

PDBR	Fasse
ABNRP	Fesse
RBMT EFR	Fisse
DRPAE	Fosse
ODMD	Fusse

*Figure 1 – Example of António's pre-syllabic spelling in the pre-test..*

As we can see, António used several random letters to represent each of the pseudo-words we asked him to write. He didn't use any conventional letter to represent both consonants of the pseudo-words: fasse ['fasə]; fesse ['fesə]; fisse ['fisə]; fosse ['fosə]; fusse ['fusə].

In the post-test the 25 children who have phonetized their spellings used conventional letters to represent the consonants (12 from experimental group 1, 12 from experimental group 2 and 1 from the control group). *Figure 2* shows an example of the same child's writing in the post-test.

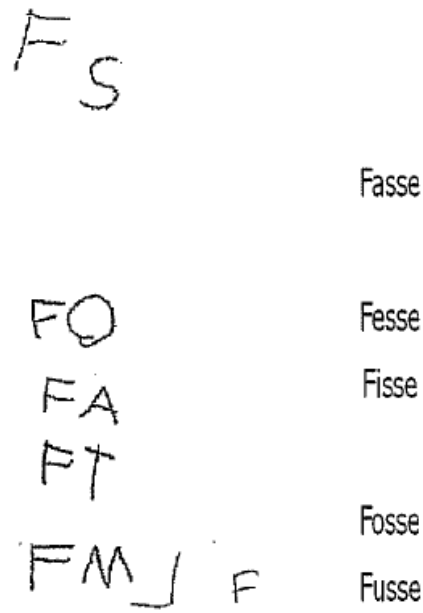


Figure 2 – Example of António's syllabic with phonetization spelling in the post-test..

As illustrated in Figure 2, António was able to use the correct consonant to represent the initial phoneme *f* of the pseudo-words and, in *fasse* [ˈfasə] he was also able to phonetize the final consonant *s*. Table 2 presents the means and standard deviations of the phonetizations in the post-test of the three groups.

Table 2. Means and standard deviation scores of the phonetizations in the post-test of the three groups. G0 – Control group; G1 – Experimental group 1 (unvoiced fricatives); G2 – Experimental group 2 (unvoiced stops)

	<i>N</i>	<i>M</i>	<i>SD</i>
G0	18	0.5	1.47
G1	19	17.58	26.13
G2	19	16.53	20.49

To compare the number of phonetizations in the post-test between the groups, non-parametric tests were used as there was no homogeneity of variance between the groups.

We performed a Kruskal-Wallis test using the groups as the independent variable and the phonetizations of the consonants as the dependent one. The results indicate that there are significant differences between the three groups  $H = 12.84$ ,  $p < 0.01$ .

The pairwise comparisons indicate that there are significant differences between experimental group 1 and the control group,  $p < 0.01$  and between experimental group 2 and the control group,  $p < 0.001$ . These results indicate that the children of both intervention programmes were able to phonetize their spellings after the invented spelling programmes. When comparing experimental group 1, who worked fricatives, and experimental group 2, who worked stops, the results indicate that there are no significant differences between them,  $p = 0.702$ .

Thus, both invented spelling programmes with fricatives and with stops proved to be equally effective on children's spelling development.

We will now analyse if the children of each group were able to transfer the phonetization procedures to non worked grapho-phonetic correspondences. For experimental group 1 we compared the differences between the phonetizations of the worked fricatives ([f] and [s]) and of the non worked fricatives ([v], [x], [z]) and between the phonetizations of the worked fricatives and of the non worked stops ([b], [d], [k], [p], [t]) using two t-tests for paired samples.

Table 3 shows the means and standard deviations of the children's phonetizations of the fricatives worked in the invented spelling programme and of the non worked phonemes by G1.

*Table 3. Means and standard deviation scores of the phonetizations of the fricative consonants worked in the invented spelling programme and of the non-worked phonemes (G1) (n=19).*

*wfric – fricatives worked in the invented spelling programme (f and s);  
nwfric – fricatives non worked in the invented spelling programme (v, x, z);  
nwstops G1 – non worked stops by G1 (b, d, k, p, t)*

	<i>M</i>	<i>SD</i>
Pair wfric	2.05	2.89
nwfric	1.88	2.82
Pair wfric	2.05	2.89
nwstopsG1	1.64	2.57

The results of the paired sample t-tests show no significant differences between the fricatives that were worked during the programme and the ones that were not,  $t(19) = 0.67$ ,  $p = 0.510$ , which means that the children in G1 transferred the phonetization procedures to other fricatives. Furthermore, they were also able to transfer the phonetization procedures to stops,  $t(19) = 1.23$ ,  $p = 0.234$ .

As for experimental group 2, we carried out two t-tests for paired samples in order to analyse the differences between the phonetizations of the worked stops ([p],

[t]) and of the non-worked stops ([b], [d], [k]) and between the phonetizations of the worked stops and of the non-worked fricatives ([f], [s], [v], [x], [z]).

Table 4 presents the means and standard deviations of children's phonetizations of the stops worked in the invented spelling programme and of the non worked phonemes by G2.

*Table 4. Means and standard deviation scores of the phonetizations of the stop consonants worked in the invented spelling programme and of the non worked phonemes (G2) (n=19).  
wstops – worked stops in the invented spelling programme (p, t);  
nwstops – non worked stops in the invented spelling programme (b, d, k);  
nwfricG2 – non worked fricatives by G2 (f, s, v, x, z)*

	<i>M</i>	<i>SD</i>
Pair wstops	2.00	2.42
nwstops	1.44	1.98
Pair wstops	2.00	2.42
nwfricG2	1.60	2.08

The results of the paired sample t-tests indicate that there were no significant differences between the phonetizations of the worked stops and of the non worked stops,  $t(19) = 1.70$ ,  $p = 0.106$ . There were also no significant differences between the phonetizations of the worked stops and the phonetizations of fricatives,  $t(19) = 1.16$ ,  $p = 0.260$ . Hence, children who worked stops were able to transfer the phonetization procedures to other stops and to fricatives.

The study also aims to compare the children's ability to equally apply the phonetization procedures to the initial and to the final consonants. Therefore, two t-tests for paired samples were used. Table 5 presents the means and standard deviations of the phonetizations of the initial and of the final worked phonemes in the post-test for experimental group 1 and for experimental group 2.

The results of the paired sample t-tests indicate that there are significant differences between the phonetizations of the initial and of the final worked unvoiced fricatives – [f] and [s] - in the post-test for experimental group 1,  $t(19) = 3.24$ ,  $p < 0.01$ . This means that although the children's ability to phonetize the final consonantal phoneme of the pseudo-words, this ability is significantly better for the initial position regarding fricatives.

As for experimental group 2, the results show no significant differences between the phonetization of the initial and of the final worked unvoiced stops – [p] and [t],  $t(19) = 1.96$ ,  $p = 0,065$ . Children in experimental group 2 were equally able to phonetize the stop phonemes [p] and [t] both in initial and in final positions.



Table 5. Means and standard deviation scores of the phonetization of the worked consonants in initial and in final position in the pseudo-word for G1 (n=19) and G2 (n=19).

G1 – Experimental group 1 (unvoiced fricatives);

G2 – Experimental group 2 (unvoiced stops);

wfrici - phonetizations of the worked unvoiced fricatives (f and s) in initial position;

wfricf - phonetizations of the worked unvoiced fricatives (f and s) in final position;

wstopsi - phonetizations of the worked unvoiced stops (p and t) in initial position;

wstopsf - phonetizations of the worked unvoiced stops (p and t) in final position

	<i>M</i>	<i>SD</i>
G1		
wfrici	1.63	2.01
wfricf	0.42	1.20
G2		
wstopsi	1.45	1.80
wstopsf	0.63	1.26

Finally, the study aims to understand the correlations between phonological awareness and knowledge of letters and the phonetization procedures. In this sense, and considering that there was no normal distribution within these variables, we used the Spearman's correlation test. The values of the means and of the standard deviations of children's phonological awareness and knowledge of letters and of the total of phonetizations in the post-test can be observed in Table 1. Table 6 shows Spearman's correlation and p-values between the total of phonetizations in the post-test and phonological awareness and letter knowledge.

Table 6. Spearman's correlation and p-values between the total of phonetizations in the post-test and phonological awareness and letter knowledge.

isc – initial syllable classification test;

ipc - initial phoneme classification test

		Phonological. Awareness		Letters
		Isc	ilpc	
Total Phonetizations (N=83)	r	.107	.248	.616
	P	.523	.134	.000

The results indicated that phonological awareness does not have a significant correlation with the number of phonetizations. The results also indicate that the number

of letters known in the pre-test has a significant correlation with the number of phonetizations in the post-test,  $\rho = 0.616$ ,  $p = 0.000$ .

#### 4. DISCUSSION

Our first aim was to understand the effects of two invented spelling programmes in the development of children's invented spelling. This study confirms that children from both experimental groups evolved in their spellings from a pre-syllabic level in which they made no attempt to connect print with speech towards the phonetization of writing.

This progress depends on the complex interaction between becoming aware of the oral units of speech at the phoneme level – phonemic awareness – and the understanding of how the written code works, which children can achieve through invented spelling activities (Alves Martins & Silva, 2006b). In fact, writing experiences provided through individual instruction and group activities – guided invented spelling (Treiman, 1998) – help children master the alphabetic principle.

Our aim was also to compare the number of phonetizations between children who undertook an invented spelling programme that worked fricatives and children who undertook an invented spelling programme that worked stops.

The results showed no differences between the phonetizations of children who undertook the invented spelling programme with fricatives and of those who undertook the invented spelling programme with stops.

Despite the controversy of the previously mentioned studies that consider fricatives or stops easier, our results are consistent with Treiman, Tincoff, Rodriguez, Mouzaki and Francis's statement that "the properties of the phoneme itself (...) do not appear to have a consistent influence on children's ability to relate the phoneme to its spelling (1998, p. 1532).

This idea also supports our results regarding the participants' ability to transfer the phonetization procedures to non-worked grapho-phonetic correspondences. In fact, our results showed that participants, those who worked fricatives and those who worked stops, were able to transfer the phonetization procedures to non-worked grapho-phonetic correspondences, whether they were fricatives or stops.

Byrne and Fielding-Barnsley (1991) consider that "once the principle of phoneme identity is acquired for some phonemes, it will spread unaided to other sounds" (p. 453).

The results of this study confirm that children are able to spread the phonetization procedures to phonemes that had not been worked.

Another aim was to compare children's ability to equally apply the phonetization procedures to the initial and to the final phonemes. The results with the experimental group that worked the unvoiced fricatives indicate that, despite children's ability to identify and use pertinent letters to represent these fricatives in final position, it is significantly easier to do so when they appear in initial position.

These findings are consistent with the initial-letter hypothesis that underlines the occurrence of systematic grapho-phonological correspondences first for initial letters

(Bowman & Treiman, 2002) and with Byrne and Fielding-Barnsley studies (1991, 1993).

However, when it comes to the analysis of the findings regarding the experimental group that worked the unvoiced stops, results show that there were no significant differences between the ability to apply the phonetization procedures to the initial and to the final phonemes.

This may be related to differences in the letter names. Whereas fricatives have a VC structure in their names, stops have a CV structure, which facilitates the correspondence between the sound and the letter (Bowman & Treiman, 2002, McBride-Chang, 1999, Treiman, Tincoff, Rodriguez, Mouzaki & Francis, 1998). The fact that the sound made by the stops is the first phoneme on the letter's name, and the fact that we used [ə] as the final vowel, may explain why participants had a better performance in phonetizing the final stop phonemes than in phonetizing the final fricative phonemes.

All our participants knew the fricatives by their name, i.e., *f* as ['ɛfə] and *s* as ['ɛsə], for example. But in some schools, children learn the letters' sounds, i.e., *f* as ['fe] and *s* as ['se]. It would be relevant, in future research, to compare the phonetizations between fricatives and stops in final position according to children's knowledge of the letters' names and of the letters' sounds.

Finally this study aimed to analyse the correlations between phonological awareness and the phonetization procedures and between letter knowledge and the phonetization procedures.

As the understanding of the alphabetic principle depends on phonological awareness and of letter knowledge we would expect them to have a significant correlation with the phonetization procedures. In fact, Pollo, Treiman and Kessler (2008) state that "phonemes and phoneme sequences that are the names of letters can be heard in the pronunciations of certain words and, when children spell these words, they may symbolize that phoneme or phoneme sequence with the corresponding letter" (p. 2).

However, our results indicated that knowledge of letters had a significant correlation with the phonetization procedures whereas phonological awareness did not.

In our assessment of phonological awareness, children were asked to classify words according to the initial sound – syllable or phoneme. In this sense, our results highlight that, despite the fact that children may be able to identify the phonemes in a word, unless they know the names of the letters, they won't be able to symbolize that phoneme with its corresponding letter, that is, they won't be able to produce a phonetized spelling.

## 5. CONCLUSION

The presented study aims to understand the effects of invented spelling programmes in the development of children's invented spelling, namely to the phonetization of writing. It also aims to understand the correlations between phonological awareness and knowledge of letters and the phonetization procedures.

The results indicate that invented spelling programmes promote the understanding of the alphabetic principle. However, to better understand the developmental procedures, it would also be relevant to consider in future research the analysis of the interactions between the children and the experimenter during the sessions that lead to spelling development and analyse how does this development occurs.

A future replication of this study with more sessions would also be of interest. If the participants had more time for to reflect on their spellings, better results could be expected with the phonetization procedures.

The pseudo-words used in this study were due to the linguistic variables in analysis and, according Byrne and Fielding-Barnsley (1993), only those who understand the alphabetic principle can decode pseudo-words. Considering that the participants were able to phonetize their writing and were able to transfer their knowledge to other phonemes, these results indicate that invented spelling programmes in kindergarten contribute greatly to the understanding of the alphabetic principle regardless of the articulatory properties of the phonemes. The results also indicate that the knowledge of letters is a determinant factor to phonetized spellings.

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## APPENDIX 1

Words used in the invented spelling programmes

Grapho-phonetic correspondences of the unvoiced fricatives: [f] and [s]

Experimental group 1

First Session	Feno	Fêmea	Febra	Fez
	Fila	Fogo	Fofa	Fuga
	Fica	Fama	Fumo	Ferido
Second Session	Seda	Sena	Selo	Ser
	Soco	Sino	Sumo	Sopa
	Secura	Sapato	Sacola	Semana
Third Session	Fita	Foro	Furo	Fadiga
	Felino	Futuro	Siso	Soro
	Seguro	Salada	Subida	Selado
Fourth Session	Sina	Sono	Sujo	Sedoso
	Saliva	Sufoco	Fina	Fuso
	Folha	Fugido	Figura	Facada

Grapho-phonetic correspondences of the unvoiced stops: [p] and [t]

Experimental group 2

First Session	Pena	Pêra	Pelo	Peso
	Pipa	Pino	Pano	Puto
	Popa	Povo	Pulo	Pedido
Second Session	Tema	Telha	Teta	Ter
	Tina	Tiro	Toda	Tudo
	Tubo	Tolo	Tecido	Tabela
Third Session	Pula	Puma	Poço	Pinha
	Parado	Pesado	Tipo	Tuna
	Tona	Tijolo	Tetina	Tapado
Fourth Session	Tira	Tímido	Touro	Tigela
	Tabela	Temido	Pica	Ponha
	Pijama	Palito	Pedaço	Puxado