

## The impact of a naturalistic intervention on preschool children's morphological awareness development

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**Abstract:** This study evaluated the effectiveness of a morphological awareness intervention delivered by preschool teachers in the naturalistic setting of their classrooms. The participants were 162 Portuguese children, attending kindergarten who were allocated as groups to experimental and control conditions. The former group was the object of six-weeks morphological awareness intervention anchored on explicit discussions about the morphological structure of words appearing in selected storybooks. The control group received normal curriculum activities. Results showed strong to high effect sizes on morphological awareness post-test abilities of children in the experimental group related to identifying words of the same “family”, interpreting the meaning of stems and affixes in morphologically structured pseudowords and finding the base word in derived or inflected stimuli, after controlling for age, cognitive ability, vocabulary, pre-test phonological and morphological results. The relevance of developing tools that help preschool children to consciously manipulate morphemes as meaningful building blocks of words, in partnership with preschool teachers, is proposed.

**Keywords:** Morphological awareness, Naturalistic intervention, Preschool children, Preschool teachers, Literacy.

### Introduction

Children develop their morphological knowledge, naturally, as long as they deal with language. Progress starts early in the preschool years (Berko, 1958; Read, 1986; Treiman & Cassar, 1996; Treiman et al., 1994). School-age students follow a specific developmental path (Nunes et al., 1997a; Nunes & Bryant, 2006) in the process of becoming literate. The level of complexity of the morphological transformations of each language (Carlisle, 1988) mediates how and when learners master those complexities in reading and spelling.

Although development may follow its expected course, intervention studies have shown that it may be important to provide school-age students with explicit tools for thinking about morphology (Nunes et al., 2003). Lesser attention has been given to whether progress in the understanding of morphological issues can be enhanced through explicit morphological interventions with preschool children. Thus, the aim of this study was to analyse whether an explicit morphological intervention, conducted in the naturalistic context of preschool classrooms by preschool teachers, is effective in ameliorating Portuguese children's morphological awareness.

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This introduction starts by summarizing what the literature has shown about the impact of morphological training on literacy, and then focus on intervention studies with preschool children.

Early morphological knowledge has an impact on reading as examined by Sanchez and colleagues (2012). Their aim was to evaluate the specific roles of early morphological knowledge on reading. The role of phonological knowledge was taken as already well established (Bradley & Bryant, 1983; Castles & Coltheart, 2004; Deacon, 2012). The study involved sixty-four French-speaking children who were assessed for non-verbal intelligence and vocabulary at time 1 (preschool), for phonological, morphological and orthographic knowledge at times 1 and 2 (grade 1) and for reading at times 2 and 3 (grade 2). A series of fixed order hierarchical regression analyses provided evidence that early morphological knowledge contributed with unique variance (5%) to 1<sup>st</sup> grade real word reading and to 2<sup>nd</sup> grade real word (0.5%) and pseudoword reading (11%) even after partialling out the effects explained by non-verbal intelligence, vocabulary and phonological knowledge. They concluded that preschool morphological knowledge has an independent contribution for later reading development.

A growing body of research has outlined that morphological knowledge can and should be potentiated through carefully designed interventions. One of the first researchers to point in that direction was Carlisle (1988) when she referred that due to the complexity of morphological transformations, some form of explicit training might be needed. Also Nunes et al. (2003) and Nunes and Bryant (2006) showed that school-age students could enhance their morphological awareness if enrolled in carefully designed training programmes related to the roles of morphemes in literacy. They also provided extensive evidence for the interrelation between morphological and phonological awareness and that interventions on these metalinguistic domains could be effective when implemented by the classroom teachers themselves.

Bowers and colleagues (2010) and Rueda-Sanchez and López-Bastida (2016) performed two meta-analyses of studies examining the effects of instruction about the morphological structure of words on literacy learning. The first one analysed twenty-two studies involving preschool to grade 8 students and the second one, twenty-five studies involving 5 to 15 year-old students. The results indicate that morphological awareness training has a significant impact on a diverse range of literacy outcomes, with very high to moderate effect sizes. Interventions appear to be especially effective in studies involving at-risk students, as already shown by Goodwin and Ahn (2010). They concluded that instruction on morphological awareness should be considered as a substantial tool for the development of literacy of school-age students and that these interventions should be delivered within the classroom general dynamics, in small groups of students, by previously trained teachers. The number of studies involving preschool children was very small.

Casalis and Colé (2009), Lyster (2002), Lyster and colleagues (2016), Ramirez and colleagues (2013) are some of the scarce and most representative studies analysing the impact of metalinguistic interventions with preschool children.

Casalis and Colé (2009) reported two studies examining the effect of a programme of training, provided to 144 French speaking six-year-old non-readers, on morphological and phonological awareness abilities and, later on, on first grade reading skills. Children were randomly allocated to three groups, morphological, phonological and control. Training lasted for 9 weeks (12 sessions) in small groups outside the classroom. Results showed that there was a reciprocal, although specific, influence of training on morphological and phonological awareness. Both types of training were effective at kindergarten, when compared to the control condition. At the end of grade 1, it was possible to test 78 of the original children on a spelling and a reading measure. Results showed that there were no differences across groups, to the exception of a significant relation between phonological awareness training and reading. However, the reading test did not contain morphologically complex words, which questions why no relation between training in morphological awareness and reading was found.

Lyster (2002) aimed at investigating whether morphological training would show a higher metalinguistic effect when compared to phonological training and how those different types of intervention were related to reading. The participants were 273 preschool Norwegian children. They, and their preschool teachers, were randomly allocated as whole groups to the experimental conditions (morphology and phonology). The interventions lasted for 17 weeks (30 minutes/week). Children in the control group received no training. All children were first assessed 10 months before primary school entrance and just after the intervention on a range of measures of phonological and morphological awareness. Five months before school entrance, at school entrance and by the end of first grade they performed reading tests. Post-test results showed that both training groups significantly outperformed controls on phonological and morphological awareness measures. At school entry and at the end of first grade, the two experimental groups were better than controls on text reading but the morphological group was also significantly better than the phonological one on orthographic coding and word identification. The author concluded that both linguistic training programmes, delivered at preschool, were effective and showed long lasting effects, but that the effect of the morphological training clearly showed the strongest effect.

Lyster et al. (2016) reported a follow-up study examining long-term effects of morphological and phonological awareness training, delivered in preschool to 269 Norwegian children, on word reading and reading comprehension at the end of grades 1 and 6. Structural equation analyses showed that, at the end of grade 1, students from both the phonological and morphological training groups were significantly and similarly better than those in the control group on word reading and reading comprehension. When ending grade 6, the phonological group was not different from controls on word reading and reading comprehension but the morphological group was significantly better on reading comprehension. They concluded that both morphological and phonological interventions had an impact on reading at the shorter term but only morphological awareness intervention showed potential to provide long-term effects on reading comprehension.

Ramirez et al. (2013) examined whether a kindergarten, whole class, teacher-delivered morphological awareness programme, focusing on compound words, was feasible and whether there would be reciprocal influences between morphological awareness and vocabulary. The participants were 108 kindergartners, English speaking Canadian children, attending schools serving socioeconomically disadvantaged neighbourhoods. All children were tested at time 1, enrolled in a training programme for three months, and then retested on morphological awareness and expressive vocabulary. There was not a control condition. Strong gains in morphological awareness were found. Children in the first quartile on morphological awareness (time 1) showed the greatest improvement. Again, strong gains were also found on vocabulary and children in the first and second quartiles of vocabulary (time 1), also made the strongest gains. Finally, regression analyses showed that there was a reciprocal and independent contribution between morphological awareness and vocabulary. Although acknowledging that not having a control group is a significant limitation, Ramirez et al. (2013) point out for the feasibility of teacher-delivered morphological awareness interventions and suggest that instruction in morphological awareness and in vocabulary can be combined because they have a recursive impact on both abilities.

Seixas and Rosa (2009) performed an intervention study on the short-term effect of morphological training on the development of morphological knowledge by preschool Portuguese children. Forty-five children, from three different preschool classrooms were randomly allocated to three experimental conditions: a reading plus morphological intervention group, a reading plus drawing intervention group and a control group. Children in the reading conditions had 6 sessions, in small groups outside the classroom, and were read six storybooks. Each story was explored for text comprehension and children were also required to retell the story or to anticipate what was going to happen next. Then, in the reading plus morphological group a set of orally presented morphological awareness exercises, anchored on base, derived and inflected words printed on the

storybooks, were explicitly explored, whilst the second group drew about the features they found most relevant in the story. All children were tested for their vocabulary knowledge and pre- and post-tested with morphological awareness measures. The results showed that the morphological group significantly outperformed both the drawing and the control groups on Word Family and on Interpretation of Pseudowords. The latter groups did not differ on these measures. No differences were found for Word Analogy, a task that was found as extremely difficult by children. It was concluded that preschool children could take advantage of explicit morphological training because they had improved their abilities to find morphologically related words and perform morphological analysis that required parsing base morphemes and affixes followed by identification and blending of their meanings.

To summarize, the studies just reviewed confirm that: morphological awareness training interventions with preschool children are effective at the shorter-term; morphological and phonological training programmes are similarly effective at the end of preschool and grade 1 and have a reciprocal although specific influence on literacy measures; much longer-term effects (6<sup>th</sup> grade) appear more associated to morphological awareness training at preschool.

Previous evidence showed that more naturalistic interventions were effective with older students (Nunes & Bryant, 2006) and the studies just reviewed point to the effectiveness of morphological interventions with younger children. Nevertheless, few studies have examined whether interventions in morphology can be delivered in the naturalistic context of the preschool classroom, by the preschool teacher, himself or herself and how effective those are.

In this study it is hypothesized that there should be a positive impact of a morphological intervention on children's morphological awareness, as measured by tasks of Word Family, Word Analogy, Pseudoword Interpretation and Identification of Base Words, when compared to a control condition.

## Methods

### *Participants*

One hundred and sixty-two children, with a mean age of 71.13 months (5.9 years), seventy-nine boys (48.8%) and eighty-three girls (51.2%), from two different schools (state ran and private) and eighteen different preschool classrooms, were allocated as groups to Experimental (10 classrooms,  $N=90$ ) and Control (8 classrooms,  $N=72$ ) conditions.

The state ran school was attended by a very heterogeneous population and is especially funded by education authorities for serving a disadvantaged area. Parents pay no fee. The private school also gets state funding because children from the whole socio-economic spectrum are enrolled and fee payment is dependent on parents' income. Both schools are situated in the greater Lisbon area, in Portugal. Mean class size is 25 children, 20 if a child with special needs is included.

All preschool teachers were experienced and appropriately trained according to Portuguese education law, either with an honour's degree (academic training completed before 2010) or a master's degree (thereafter). Preschool teachers followed national curriculum guidelines although curriculum implementation encompassed a wide range of pedagogical practices. Although print is present in daily classroom activities (e.g., storybook reading, children's names, area labels, activity maps), formal reading and writing instruction is neither mandatory nor encouraged explicitly. In both schools, preschool teachers developed some activities within a phonological rationale (e.g., exploring rhymes, parsing words in syllables, identifying first letter of children's

names). No regular activities with an explicit morphologic rationale were observed by the researcher.

All preschool classrooms were heterogeneous in age level, i.e., were attended by 3- to 6-year-old children. Although the intervention was delivered by each preschool teacher in the naturalistic classroom context, involving sometimes the whole group or smaller groups of children, data was only gathered from 5- and 6-year-olds, those who qualified for entering compulsory education in the following school year. Children with a special needs statement were not included. Two children for whom it was impossible to collect a complete set of data were also excluded.

### *Design*

This was a quasi-experimental intervention study with pre-test assessment, six-weeks explicit morphological awareness intervention delivered to children in the experimental group, followed by post-test assessment. The intervention followed a naturalistic rationale, because was intended to anchor on activities normally used in the classroom (storybook reading) and was conducted by the preschool teacher.

Method of allocation differed slightly across schools. Because all preschool teachers and their head teachers were genuinely pressing for inclusion in the study, in the state ran school, data from the control group was gathered in the previous school-year and the experimental group data was collected in the following year, within the same time range. Thus, children in both conditions shared the same socio-economic and cultural characteristics, the same school and were attended by the same preschool teachers. In the private school, the whole study was conducted in just one school-year. Here, five teachers entered the experimental group and two other, joined the control group. Pre-test, intervention and post-test activities took place during the third trimester, after Easter holidays. The intervention started immediately after pre-test data collection and post-test data were collected one week after intervention end.

### *Measures*

Each child was individually pre-tested with standardized measures of Cognitive Ability [Series A, Ab and B developed by Raven et al. (1998) normalized by Simões (1994) for the Portuguese population], Vocabulary WISC – III subtest (WISC scale validated for the Portuguese population by Simões et al., 2003), and Phonological Awareness (Initial Syllable Classification and Initial Phoneme Classification developed and validated for the Portuguese population by Silva, 2002). Each subtest of this last measure is composed of fourteen items. In each item children are presented with four pictures of known objects, orally named by the experimenter, and the child was required to identify two of those objects that start with the same syllable or with the same phoneme, respectively. Each correct answer is scored with one point. The results could range from 0 to 14 points.

They were also pre- and post-tested with non-standardized Morphological Awareness measures. The latter measures were specifically designed for the study because there were no standardized measures in the Portuguese language. These follow a rationale developed in previous research with English (Nunes et al., 1997a) and Portuguese (Rosa & Nunes, 2008; Seixas & Rosa, 2009) students. All pre- and post-test assessments took place in a separate room (two sessions of 30 minutes, approximately). All assessments were only oral. To prevent constraints related to short-term memory load and assure that children understood what was being asked, three practice trials with feedback were provided to children before presentation of experimental items. No feedback was given thereafter.



*Word Family.* The Word Family task, composed by ten experimental items, assessed children's knowledge of derivational and inflectional processes. The child is requested to provide "as many words as he or she can remember related to, or 'family of' ...", a given base word. For example, for the item "gato" (cat) the child could provide answers such as 'gataria' (a lot of cats), 'gatinho' (kitten), 'gatos' (cats). Each correct derived or inflected word is given one point. Thus, there is not a fixed maximum possible score since it is the sum of all correct answers.

*Word Analogy.* The aim of the Word Analogy task was to measure how aware the children were of the analogies between words of the same grammatical categories (Nunes et al., 1997b). This task was constructed according to an analogy paradigm, a:b::c:d, used in cognitive psychology research (Piaget et al., 1977; Sternberg, 1977). There were twelve experimental items.

According to the instructions in Nunes et al. (1997a), the experimenter used two finger puppets to present the tasks. In the Word Analogy task, the first puppet 'said' a word (e.g., 'pato', 'duck') and the second 'repeated' the word with a change in its derivational or inflectional components (e.g., 'pata', 'female duck'). Then the first puppet 'said' a third word (e.g., 'galo', 'cock') and the child was required to take the place of the second puppet and produce the fourth word ('galinha', 'hen'). Children were instructed to ask for a repetition, if they needed to, in order to assure that wrong answers were not just caused by the difficulty to keep in memory the first three items in each trial. The experimenter also repeated the items if the child did not provide any answer. Children performed the analogy task orally and the experimenter wrote down their answers. Each item was scored as correct (1) when the child made the correct morphological transformation by analogy. A score of (0) was given otherwise. The results could range from 0 to 12 points.

*Pseudo-word Interpretation.* The Pseudo-word Interpretation task was designed according to a similar measure developed by Nunes et al. (1997a) used in studies with English children and, later on, with Portuguese children (Rosa, 2003; Seixas & Rosa, 2009). This measure examines whether children can parse the constituent morphemes, base forms and affixes, in a pseudo-word stimulus, access their independent meanings, and consider those together in order to interpret the 'novel' word. Thus, it measures children's ability to access, recognise, and interpret morphemes.

Each stimulus is formed by morphemes that exist in the language, a base form and an affix, in a combination that does not form a word. This configuration controls for direct lexical access to the meaning of the stimulus. For example, in the pseudo-word 'regritar', formed by a prefix 're-' plus the verb infinitive form 'gritar' (re- + scream), the child had to perform:

- 1) a correct parsing of the morphemes 're-' + 'scream';
- 2) access the meanings for the prefix (=repetition) and the verb form (=to scream) and then,
- 3) consider them together to produce a global meaning – 'voltar a gritar' (to scream again).

Children were told: "I am going to tell you a word that I invented: 'regritar' (re- + scream). If this word were to exist, what would it mean? What would 'regritar' mean?"

There were eight experimental items. Each correct answer, showing evidence for the three cognitive steps above, was awarded one point. Frequent answers where only the meaning of the base form was provided were scored with zero. The results could range from 0 to 8 points.

*Identification of Base Words.* The Identification of Base Words task assesses children's ability to identify the base form when a derived word is provided. This kind of task has been used extensively in research on morphological awareness and was based on a rationale developed by Carlisle (1988). Twelve experimental items were orally presented to the child asking 'which word was hidden inside' a given item. For example, in the item 'dentada' (bite) one expected that the child would extract the base form 'dente' (tooth). One point was awarded for each correct answer. The results could range from 0 to 12 points.

## Procedure

Formal authorizations were obtained from educational authorities and school management. Parents were explained about the study's aims and procedures and gave written consent.

All preschool teachers volunteered to participate. Those whose children entered the experimental group participated in a 60 minutes training session. Studies highlighting the contribution of metalinguistic awareness and specifically of morphological awareness for literacy development were summarized and teachers' literacy practices were shared and discussed. A special emphasis was given to the presentation and discussion of a previous non-naturalistic intervention study developed by our research team where morphological intervention had been attempted with Portuguese preschool children.

Teachers agreed to explore one book per week. They were told to anchor their activities on what they already used to do with storybook reading, keeping all the good practices such as reading aloud, anticipating what would come next, retelling, making content discussion and comprehension and all other relevant practices such as using marionettes or other plastic forms of animation. Intervention stimuli should occur, as naturally as possible, within normal conversations and play activities around the story and should be pleasurable. Teachers in each school were then invited to reach an agreement about six storybooks they considered especially stimulating for reading to their children. Then, they were instructed on how to prepare explicit morphological interventions based on selected word stimuli from those books. One week later, on another 60 minutes training session, summary tables for each book were prepared and analysed. Each table listed six exercises close to the rationale of each morphological awareness measure and served as a guide that teachers would use throughout the intervention.

Exercises on Word Family provided training on derivation and inflexion processes. For example, the preschool teacher would notice to the children: *The story tells us that Little Red Riding Hood was going to visit her grandmother and met the wolf ('lobo') in the forest. If one wants to say that the wolf was very small in size, how would one say that? 'Lobinho'. That's right, 'lobinho' means a very small-sized wolf. And now, how would one say that it was a very big wolf? 'Lobão'. Right. 'Lobão', is a really big wolf. What if Little Red Riding Hood met not only one wolf but two of them? She would meet two \_\_\_\_? 'Lobos'. Right. What now if she met just one female wolf? 'Loba'. That's right, 'loba' is a female wolf. And if she met two of them? Right! 'Lobas' means two female wolves.*

Exercises on Word Analogy required capturing the morpho-syntactic relation within one pair of words. Then, the child was required to perform the same relation on a second pair (Nunes et al., 1997a) after being provided the first item of the second pair. For example, the preschool teacher would notice: *The story tells us that the wolf hid ('escondeu-se') behind a tree. Let's imagine that these two finger-puppets are talking to each other about that. The blue one says: 'o lobo vai-se esconder' (the wolf is going to hide) and the yellow one replied: 'o lobo já se escondeu' (the wolf already hid). Right! Listen well! 'Esconder – Escondeu' (to hide – hid). Now, the blue puppet says: Little Red Riding Hood 'vai fugir' (Little Red Riding Hood is going to run away); what should the yellow one reply? 'Ele já \_\_\_\_\_'? 'Ele já Fugiu' (he ran away, already). Right! Let us recall now the whole thing together: 'Esconder – Escondeu' / 'Fugir – \_\_\_\_\_? Fugiu' (to hide – hid; to run away – ran away).*

Training on Pseudoword Interpretation required identifying the base form and the affixes, interpreting each morpheme's meaning and provide a global interpretation. The pseudowords were formed with real morphemes in non-existing combinations in the Portuguese language. For each story, six base words were selected and printed in yellow cards. Most frequent prefixes (*i-*; *in-*; *re-*; *des-*) and suffixes (*-eiro*; *-or*; *-ada*; *-aria*; *-ão*, *-arra*; *-inho*; *-ito*) were similarly printed in

red and blue cards, respectively, and children were taught which cards went before or after the base forms. For example, the preschool teacher would notice to the children: *The story says that the giant ordered that a very big castle ('castelo') be built for him. Here is the yellow card with the word 'castelo'. Now, what blue card do you think one could add?* Children chose the suffix – *eiro* (-er; as in baker). *Right. If one say 'castelo' + -eiro', what word will one get?* Time was provided for children's discussion. *'Casteleiro'. What will 'casteleiro' mean?* Children were encouraged to discuss among them the diverse interpretations proposed and reach some agreement, mediated by the preschool teacher. *Very good! 'Casteleiro' is a person who works at the castle.*

*What now if one takes the blue card away and chose a red card? Which one should one select?* Children select the prefix *des-* (dis-, as in disconnect). *Right! If one says 'des- + castelo', what word would one have now? 'Descastelo' (dis+castle). What would 'descastelo' mean?* Children discuss whatever meanings they propose and reach some agreement. *Right! A 'descastelo' would mean a castle that does not exist anymore. Very good!*

*And now, let's try out something even more interesting. If one puts the three cards 'des- + castelo + -eiro' together, one would come about with the word 'descasteleiro'. Look! 'Des- + castelo + -eiro'. What would this bigger word mean now?* Children take their time to propose interpretations, with a closer mediation by the preschool teacher, due to the complexity of the task. *All right! 'Descasteleiro' would mean someone working at a non-existing castle. Excellent!*

Training in Identification of Base Words requires parsing the base form within a derived or inflected word. For example, the teacher would tell the children: *The story says that when the castle was finished it looked colossal and gigantic ('gigantesco'). This word, 'gigantesco', has a word hidden inside, the word where 'gigantesco' comes from. Which word will it be?* Children discuss it and reach some agreement. *'Gigante'. Wonderful! 'Gigantesco' (gigantic) comes from gigante (giant). Brilliant!*

No words used to assess children's morphological awareness appeared in the intervention activities.

The intervention lasted for six weeks. The researcher visited each classroom once a week. This allowed for sorting out any doubts or suggestions and for encouraging quality and coherence in the delivery of interventions across teachers. Coherence was also assured through a systematic, rich and relevant cooperative work among preschool teachers in each school. Information about how each book had been explored for morphology and feedback on children's discussions and findings were regularly exchanged contributing for the development of a sense of ownership of this programme of intervention.

After post-test data collection, a meeting took place in the two schools with the preschool teachers, school heads and parents (the latter only in the private school) where results were presented and discussed.

Children in the control group performed normal curriculum tasks including storybook reading and associated activities but no explicit morphologic awareness intervention.

## Results

### *Reliability of non-standardized measures*

In order to examine the reliability of non-standardized measures of morphological awareness, Cronbach alphas ( $\alpha$ ) were computed. Results are displayed on Table 1.



Table 1

*Reliability of morphological awareness measures (Cronbach's alpha), by time of testing*

	Pre-test	Post-test
	$\alpha$	$\alpha$
Word Family	.87	.92
Word Analogy	.56	.76
Pseudoword Interpretation	.75	.84
Identification of Base Words	.60	.68
All items	.83	.93

The results suggest that pre-test scores of Word Analogy and Identification of Base Words showed less satisfactory internal consistency. This may be due to floor effects, children finding very hard to perform analogy and extraction of base words. Lack of consistency greatly disappeared in the post-test. When all items in the four measures were entered for analysis together, because they are likely to be inter-correlated and therefore represent a unique construct, the consistency of the whole scale is very good.

At pre-test, all measures were inter-correlated (correlations ranging from  $r=.23$  to  $r=.31$ , all  $p<.001$ ) to the exception of a non-significant correlation between Word Family and Interpretation of Pseudo-words ( $r=.02$ ,  $p>.05$ ). At the post test, all measures were significantly inter-correlated (correlations ranging from  $r=.47$  to  $r=.67$ , all  $p<.001$ ).

Table 2 displays the means and standard deviations for the control measures by group.

Table 2

*Means and standard-deviations for both groups (experimental/control) regarding age, cognitive ability, vocabulary, initial syllable classification and initial phoneme classification*

	Exp. G.		Control G.	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Age	71.03	4.20	71.34	4.07
Cognitive Ability	18.01	4.39	17.79	4.84
Vocabulary	10.02	4.40	9.61	3.91
Initial Syllable	5.13	3.26	7.18	4.30
Initial Phoneme	2.83	3.04	5.03	3.68

Results from *t*-tests showed that the two groups were equivalent on Age ( $t_{(160)}=-.313$ ,  $p=.754$ ), Cognitive Ability ( $t_{(160)}=.302$ ,  $p=.763$ ) and Vocabulary ( $t_{(160)}=.620$ ,  $p=.536$ ). As for the two measures of phonological awareness, the control group was significantly better than the experimental group on Initial Syllable Classification ( $t_{(160)}=-3.45$ ,  $p=.001$ ) and on Initial Phoneme Classification ( $t_{(160)}=-4.15$ ,  $p<.001$ ). The measures of phonological awareness were controlled for in subsequent analyses.

Table 3 displays the means and standard deviations for the morphological awareness measures by time of testing and group.

Table 3

*Means and standard-deviations for both groups (experimental/control) regarding morphological awareness measures by time of testing*

		Pre-test		Post-test	
		<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Word Family	<b>EG</b>	5.69	4.08	22.54	6.11
	<b>CG</b>	9.29	4.71	11.34	4.79
Word Analogy	<b>EG</b>	2.57	1.74	7.05	2.32
	<b>CG</b>	3.07	1.89	3.75	2.18
Pseudoword Interpretation	<b>EG</b>	2.80	1.96	5.47	1.72
	<b>CG</b>	1.33	1.87	2.08	2.44
Identification Base Words	<b>EG</b>	4.83	1.91	7.08	2.05
	<b>CG</b>	4.78	1.85	5.12	1.88

Independent samples *t*-tests on pre-test scores showed that both groups were equivalent on Word Analogy ( $t_{(160)}=-1.72, p=.09$ ) and Identification of Base Words ( $t_{(160)}=.14, p=.89$ ). The control group significantly outperformed the experimental group on Word Family ( $t_{(160)}=-5.21, p<.001$ ) and the experimental group significantly outperformed the control group on Pseudoword Interpretation ( $t_{(160)}=4.83, p<.001$ ). These pre-test results were also controlled for in subsequent analyses.

In order to analyse the significance of post-test differences, analyses of covariance (ANCOVA) were performed. Each post-test morphological awareness measure was entered as the dependent variable and group was the independent variable. The two phonological awareness measures and the morphological awareness pre-test measures were entered as covariates. Confidence intervals were adjusted with a Bonferroni correction procedure. Effect sizes (partial eta squared –  $\eta^2_p$ ) and statistical power ( $\pi$ ) were also computed.

A significant group effect was found. Children who performed the morphological awareness intervention got significant higher means than those who did not, in each and all measures of morphological awareness: Word Family  $F_{(1,157)}=275.90, p<.001, \eta^2_p=.62, \pi=1$ ; Word Analogy  $F_{(1,157)}=192.22, p<.001, \eta^2_p=.55, \pi=1$ ; Pseudoword Interpretation  $F_{(1,157)}=65.36, p<.001, \eta^2_p=.29, \pi=1$ ; Identification of Base Words  $F_{(1,157)}=53.42, p<.001, \eta^2_p=.25, \pi=1$ .

Progress was especially impressive on Word Family, i.e., the ability to produce derivations and inflections when a base word is provided, where the experimental group showed an approximate fourfold significant mean increase. Progress on Word Analogy was also considerable (almost a threefold mean increase) and this suggests that intervention provided children with tools for thinking about morpho-syntactic relations. Effect sizes are very high ( $>0.5$ ) on Word Family and Word Analogy, and high ([0.25; 0.50]) on Pseudoword Interpretation and Identification of Base Words. This interpretation follows a criterion proposed by Marôco (2014), adapted from Cohen's (1988) seminal proposal. Additionally, observed powers (all  $\pi=1.00$ ) are very adequate (Marôco, 2014) suggesting that tests were sensitive to detect statistically significant effects.

## Conclusions and discussion

This study provided evidence for the feasibility of a naturalistic morphological intervention conducted by preschool teachers on children's morphological awareness and for a significant

short-term impact on their morphological awareness. Such impact was independent of age, cognitive ability, vocabulary, phonological awareness and morphological awareness pre-test differences. Thus, our hypothesis was confirmed. When comparing pre-test with post-test mean scores, it is clear that children in the experimental condition appeared to have learned diverse tools for thinking about morphology.

### *Word Family*

Their learning about the use of affixes to make derivations and inflections (Word Family) was far from our most favorable prediction ( $\eta^2_p = .62$ ). When looking closer at children's post-test responses it is apparent the use of a distinctive strategy when approaching the experimental items of this task. As an example, many children learned that they could use a somewhat cognitive sequence to encounter morphologically related words. For example, one child replied when the item 'livro' (book) was proposed to him: 'livraria, livros, livra, livrinho, livrão' (bookstore, books, getting rid of, small book, big book). The cognitive sequence used consists of making a derivation, then, in turn, adding a plural marker, a gender marker, a diminutive and an augmentative marker, respectively. He goes on using the same strategy for 'sapato' (shoe): 'sapateado, sapata, sapatinho, sapão' (tap-dancing, slipper, small shoe, big toad), again using a similar sequence starting with a derivation, followed by gender, diminutive and augmentative markers, respectively. What is most striking and suggestive of a productive strategy, is that this child uses a cognitive sequence that he learned throughout the intervention as a tool for finding morphologically related acceptable words even though he goes on also producing unrelated non-words or just phonologically related words ('livra; sapão'). The word 'sapão' also calls for the use of phonological processes, since the child used the beginning of 'sapato' to provide a word initiating by the very same letters. Then, adds the augmentative suffix (-ão) showing learning transfer. Thus, despite the significant quantitative results, and very high effect size an analysis of qualitative cognitive strategies learned is also highly relevant and will be the object of an alternative research.

### *Word Analogy*

Children's relevant progress in Word Analogy ( $\eta^2_p = .55$ ) was to a certain extent a surprise since no such effect had been found on a previous study in Portugal (Seixas & Rosa, 2009). Then, it was claimed that this task was extremely difficult because its items were heavily loaded on verb morphology, the richest in the Portuguese language yet the hardest for the learner, especially if a preschooler. In the present study the task included mostly morphology relating to nouns (9 items) and only 3 items relating to verbs. One of the most interesting feature of this task is that children cannot reply using some form of phonological analogy. An example of that in English would be 'work – worker; bake / \_\_\_\_\_ (baker)' where one could infer *baker* from *worker*. The correct answer requires specific grammatical and vocabulary knowledge because the last word of the second pair sits on frequently opaque and irregular morphological transformations (e.g., 'sapato – sapatos / pão – \_\_\_\_\_ (pães)' (shoe – shoes / loaf – \_\_\_\_\_). In the Portuguese example, a regular plural marker (-s) is used in the first pair and an irregular one on the second pair (-ães). As expected, many children replied 'pãos' over-regularizing with the most common plural marker –s. The task also includes transformations requiring words ending in irregular gender markers, in different diminutive or augmentative markers and in verb tense transformations. Because of all this, performing word analogies successfully may be associated to a more extensive vocabulary and to a progressive grasping of irregular or less transparent morpho-syntactic changes.

### *Interpretation of Pseudowords*

This ability requires a set of sequential cognitive operations-parsing morphemes, identifying their specific meanings and then blending it all together – that are by no means simple. Progress done was significant and relevant ( $\eta^2_p = .29$ ). This measure is especially interesting because it provides some control for previous lexical knowledge obliging the child to dig on previous understanding of the meaning of affixes and to make them meaningfully associated to the meaning of base words. It also requires that parsing is done appropriately, which is also a difficult endeavour. Previous research with Portuguese students (Rosa, 2003) suggested that the use of pseudowords with a morphological structure rendered their morphemes more salient than when children parse morphemes in real derived words. As an example, children will probably find easier to parse morphemes in the pseudoword ‘*desfeliz*’ composed of ‘*des-* + *feliz*’ (*dis-* + *happy*) than to do it in a real word ‘*infeliz*’, similarly composed by ‘*in-* + *feliz*’ (*un-* + *happy*). In fact, they frequently take a real base word (*feliz*) and its derived (*infeliz*) as independent and unrelated lexical units.

### *Identification of Base Words*

Children also made a less impressive ( $\eta^2_p = .25$ ), although significant, progress on their ability to make a somewhat inverse operation of that done on Word Family, identifying the base form when an inflected or derived word is provided. Carlisle (1988) showed that this morphological operation is harder than its inverse, even for students in the fourth to the eighth grades and, certainly, dependent on the level of transparency of the transformations.

In order to contributing to the discussion of why these training activities were effective five arguments are proposed now.

First of all, they were contextualized as normal, pleasant, playful storybook reading activities, from especially suggestive books according to the criterion of professionals. Thus, they are activities well anchored on teachers’ and children’s usual practices.

Secondly, preschool teachers experienced ownership of the programme. We acknowledge research efforts to control for homogeneity of treatment conditions. In a non-naturalistic intervention study Casalis and Colé (2009) report having used “exhaustively detailed” (p. 122) instructions in a booklet given to the teachers and claimed that “the experimenters were instructed to follow the programme rigidly” (p. 122). One knows that there are no easy feasible means to ascertain whether everything is being conducted as instructed in real school contexts, that requiring sophisticated observation tools and data analysis. On the other hand, as educational psychologists, one must also acknowledge that, generally speaking, one lacks professional knowledge to conduct regular activities involving natural groups. Therefore, research evidence has to be optimized by teachers experience and professional knowledge if one wishes to contribute for the development of a strong research-based practice in schools (Nunes & Bryant, 2006).

A third reason is related to the effect of preschool teachers’ cooperative work. Preschool teachers were introduced to previous research evidence and methodology and then worked together as groups in each school to identify which books and word stimuli to select. In these preparatory meetings innumerable morphological discussions were raised. As an example, it is recalled here a discussion around the word ‘*casulo*’ (*cocoon*) appearing in a well-known Eric Carle children’s book, *The very Hungry Caterpillar* (1969). Was ‘*casulo*’ a derivation of the base form ‘*casa*’ (*house*) or not? What was its etymology? Online dictionaries were immediately searched for. Would it come from ‘*casa* + *-ulo*’ meaning a *small house*? Would there be other Portuguese words ending in the suffix *-ulo*? Yes, there were: ‘*tremulo*’ (*tremulous*) and ‘*habitáculo*’ (*cabin*) were examples of that. Would it come from the latin word *casula* (meaning a priest’s vest that “covers

all the body”) or from the latin *capsula* (meaning a small capsule)? Even though different directions appeared, a consensus was reached that this word could raise as very interesting discussions with children as it had raise amongst professionals. Knowledge about ‘*casulo*’ was highly relevant for understanding about the process of metamorphosis, as presented in Eric Carle’s book. This was also contextualized knowledge for the children once they were used to follow silkworms’ transformations as a normal springtime activity, where the sequence *caterpillar – encapsulation – butterfly* is regularly observed, registered, researched and discussed. Another indication of cooperative work was sharing information on how children approached the story and the training, their most interesting discoveries about words and resources produced while exploring the book, when one book was passed on to the next classroom and teacher.

A fourth reason related to this one, is that working with morphology may have an impact on motivation to learn more (Bowers et al., 2010). Especially on children’s discussions around the interpretation of pseudowords, one could observe how children and teachers found it enjoyably fun. Playing with words is fun (Kirby & Bowers, 2017) and self-rewarding. One agrees with Bowers et al. (2010) for the need to assess the influence of such programmes on children’s motivation to learn. The extent to which these programmes also impact on preschool teachers own professional motivation may also deserve research. Preschool teachers realise that working with morphology opens up a powerful and productive window into children’s language development, their word recognition strategies (Lyster, 2002; Lyster et al., 2016) and vocabulary knowledge (Ramirez et al., 2013).

Finally, the format of the intervention is fluid enough to be differentiated from formal schooling instruction activities. National curriculum guidelines do not prescribe it and it would be inadequate to force children into some form of cognitive acceleration.

There are of course some limitations. The study only provides evidence for immediate short-term benefits of a morphological intervention. There is also the need to standardize morphological awareness measures for the Portuguese population. Another issue is time of metalinguistic training provided to preschool teachers and for how long should interventions last. In this study, training of teachers was short and a six-week intervention with children was successful. It may be that shorter and intensive interventions are more effective than longer ones but evidence on naturalistic interventions is so scarce that this issue has to be left on hold.

In accordance with Lyster et al. (2016), when they stress that “we know enough to include morphological awareness training as a valuable component of preschool language programmes and early reading programmes” (p. 1285), this research also showed that naturalistic interventions conducted by especially trained preschool teachers, anchored on normal storybook-reading activities, are feasible and have significant short-term impacts on children’s morphological awareness. They go on saying, following Carlisle and Goodwin (2013) and Nunes and Bryant’s (2006) views that “we cannot assume that students learn the complex morphological system by themselves” (p. 1285).

It is therefore our responsibility as researchers and in partnership with practitioners, to develop tools that help preschool children to consciously manipulate morphemes as meaningful building blocks of words.

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## Author contributions

Conceptualization: JR, MAM; Methodology: JR, MAM; Formal analysis: JR, MAM; Investigation: JR; Writing – Original draft preparation: JR; Writing – Review and editing: MAM. All authors read and approved the final manuscript.

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### **Impacto de uma intervenção naturalística no desenvolvimento da consciência morfológica de crianças de jardim-de-infância**

**Resumo:** Este estudo avaliou a eficácia de uma intervenção sobre consciência morfológica desenvolvida por educadores de infância no contexto natural das suas salas. Participaram 162 crianças portuguesas que frequentavam jardins-de-infância, alocadas ao grupo experimental e ao grupo de controlo consoante as turmas que frequentavam. O grupo experimental foi objeto de uma intervenção de 6 semanas sobre consciência morfológica, em que foi explicitamente discutida a estrutura morfológica de palavras de livros de histórias selecionados. O grupo de controlo participou nas

atividades curriculares usuais. Os resultados do pós-teste mostraram que as crianças do grupo experimental tiveram melhores desempenhos na identificação de palavras da mesma “família”, na interpretação do significado de prefixos e afixos em pseudopalavras estruturadas morfológicamente e na identificação da palavra-base em palavras derivadas ou flexionadas, após controlo da idade, da competência cognitiva, do vocabulário e dos resultados do pré-teste relativos à consciência fonológica e morfológica. Este estudo mostra a relevância de desenvolver, em parceria com educadores de infância, instrumentos que ajudem as crianças em idade pré-escolar a manipular conscientemente morfemas enquanto constituintes das palavras.

**Palavras-chave:** Consciência morfológica, Intervenção naturalística, Crianças de jardim-de-infância, Educadores de infância, Literacia.

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