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**Exploiter les connaissances des enfants sur les relations entre  
les mots afin d'améliorer l'orthographe au Québec francophone:  
Étude expérimentale et d'intervention**

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# Improving children's spelling ability with a morphology-based intervention

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## Abstract

Children who have difficulty with literacy development often experience pervasive and enduring trouble with spelling, even after receiving remedial instruction. Our study tests a new approach to improving the spelling of these children. We designed an instructional program emphasizing the morphological structure of words, and directly contrast its benefits to instruction that focuses on word meanings, avoiding any discussion of morphology. The intervention was conducted with French-speaking children in Grades 3 and 5 with varying literacy abilities. The results reveal that our intervention improved the spelling of all children in the study, but it was especially effective for children who displayed low spelling performance. Moreover, low-performing spellers who received the morphology instruction showed a greater improvement in their spelling of suffixes than children who participated in the vocabulary instruction. Our findings suggest that spelling instruction concentrated on morphological structure may be a powerful tool for improving children's spelling ability.

**Keywords:** morphology; spelling; literacy; vocabulary; intervention; French

## Introduction

Learning to spell is an essential component necessary for gaining a complete command of written language. While literacy research traditionally concentrates on reading development, recently, a shift in focus to the development of spelling skill has emerged (cf. Griva & Anastasiou, 2009). This shift in emphasis is particularly important for studies of poor reading and dyslexia, as spelling difficulties are closely entwined with reading impairment. For example, spelling difficulties observed in dyslexic children are often more profound than problems with reading (e.g., Bodor, 1973). Additionally, Egan and Taintier (2011) indicate that it is rare to find children who experience reading difficulty but have typical spelling ability, while it is much more common for children who have typical reading levels to have poor spelling ability. An increased understanding of the processes that underlie spelling development will have direct and substantial consequences for children experiencing reading difficulty.

Traditional interventions for reading impairment target children's phonological awareness skills, as phonological processing is an instrumental cognitive process for reading in an alphabetic language (for reviews, see Adams, 1990; Goswami & Bryant, 1990). However, certain languages, including French, are morpho-phonological. This means that in addition to phonology, morphological information is also

represented in the written form. As such, morphological processing (e.g., recognizing that the word *reheatable* is made up of three sub-parts, the prefix *re-*, the stem *heat*, and the suffix *-able*) is an important part of reading in these languages.

The importance of morphological processing to literacy skill is supported by studies reporting that increased morphological awareness is associated with better spelling performance in English and French (Deacon, Kirby, & Casselman-Bell, 2009; Sénéchal, 2000). Additionally, teaching typically developing children explicitly about the relationship between morphological structure and spelling has been shown to improve their reading and spelling skill (see Bowers, Kirby, & Deacon, 2010, for a review). Importantly, research indicates that morphological processing skills remain intact for dyslexic readers (Fowler & Liberman, 1995), so morphological awareness training may provide a powerful tool for children with dyslexia to overcome their phonological processing difficulties.

Despite this evidence, only a small number of studies have tested the use of morphological training to improve the literacy skills of poor readers. Elbro and Arnback (1996) conducted one of the first investigations of a morphology intervention for reading, examining the effects of an intervention targeting morphological skills for improving word decoding and text reading in dyslexic adolescents. While the differential benefits were modest, the authors report that the children who took part in the morphologically-focused intervention were significantly better able to spell compound words than the control group, suggesting that morphological processing may be used as a compensatory strategy for children with reading difficulties.

Elbro and Arnback's seminal study shifted the focus of remedial reading research, leading other researchers to examine the benefits of morphological training for children with literacy difficulties (see Goodwin and Ahn, 2010 for review). Although small in number, studies that have done so suggest that morphological processing can be used as a compensatory strategy for reading (Elbro & Arnback, 1996; Tssemli & Seymour 2009). However, the evidence remains limited and the benefit of a morphologically-focused intervention for dyslexia remains uncertain (Nagy, Carlisle, & Goodwin, 2013).

Studies investigating the use of morphological instruction to improve literacy have used a diverse range of teaching methods, making it difficult to disentangle which methods produce the most substantial gains, and for which literacy outcomes these gains occur. This problem is particularly

evident when considering the distinction between the effects of morphology and vocabulary instruction on literacy outcomes. Morphologically related words share similar form and meaning, so teaching morphological structure also involves discussion of word meaning. Due to this inherent association, literacy interventions incorporating the teaching of morphological knowledge tend to confound this instruction with teaching of vocabulary knowledge (e.g., St-Pierre & Dubé, 2012). As such, it is not clear whether the literacy gains reported in morphological intervention studies are a direct result of the training of morphological structure, the vocabulary knowledge that is taught concomitantly with morphological instruction, or some combination of these two.

The data examined in the present study are derived from a previous intervention where we disambiguated the potential benefit of morphological knowledge from the benefits of word meaning instruction. We isolated the teaching of morphological structure and compared its effects on spelling outcomes to that of vocabulary training for French-speaking children (Kolne, Hill, & Gonnerman, 2013). We found that morphological training provided a differential improvement over vocabulary training for spelling complex words. Specifically, our study showed that children who received instruction focused on morphological structure improved more on spelling than children whose instruction focused on word meaning. Our results suggest that a morphological instruction method improves children's spelling of complex words.

The morphologically-focused intervention may provide a compensatory tool for children who have difficulty with spelling, allowing them to overcome the reduced phonological processing abilities associated with reading and spelling difficulties. As such, the morphology intervention used in our previous study may be especially beneficial for children with lower spelling performance, as compared to those with typical spelling ability. However, our previous analysis did not differentiate the effects of the intervention based on children's literacy abilities, so the unique benefit of a morphological intervention has yet to be identified for children who struggle with spelling.

The present study revisits the data collected in our previous intervention study, this time dividing our sample into groups based on the children's spelling performance prior to starting of the intervention. In this way, we are able to assess the relative benefit of our intervention for children with higher and lower spelling performance. We will focus on the children's spelling of suffixes taught in the intervention, as this is where the differential benefit of the morphological intervention was strongest in our previous study. We hypothesize that our intervention will produce greater spelling gains for children who show difficulty with spelling, as compared to children with typical spelling performance, irrespective of instruction type. Additionally, we predict that both teaching methods are likely to benefit children with low spelling accuracy; but that the benefit of

instruction focused on morphological structure will be greater than instruction focused on word meaning.

## Methods

### Participants

Eighty-four French-speaking children from Montreal, aged 8-to10- years old took part in the study. 36 children from Grade 3 participated (23 girls and 13 boys), as well as 48 children from Grade 5 (27 girls and 21 boys).

Children's spelling ability was assessed using a modified version of the Test Ortho3 from the Batterie d'Évaluation du Langage Écrit et de ses troubles (BELEC) (Mousty, Leybaert, Alegria, Content, & Morais, 1994). Children's scores on this test were ranked, and those falling below the 50<sup>th</sup> percentile were considered poor spellers. This identification was used for data analysis only, and both high and low ability spellers were combined in the intervention groups. Children were assigned to one of two intervention groups, based on their general spelling performance, such that good and poor spellers were equally represented in both treatment groups. In addition, the children in the two intervention groups were matched on language background (monolingual Francophone, or multilingual), and gender, with approximately equal ratios of boys to girls in each intervention group.

### The intervention

All of the children took part in one of two interventions. The same 30 words were taught in each intervention, differing only in the emphasis of instruction. The first intervention provided spelling instruction that explicitly discussed the morphological structure of words (Morphology group), while the other provided instruction that focused solely on the meanings of the words (Vocabulary group), intentionally avoiding any discussion of morphological structure. For example, the Morphology group was taught that there are two parts to the word *finlandais*, namely the stem *finland* and the suffix *-ais*, while the Vocabulary group was taught that the word *finlandais* describes 'something or someone that comes from the country, Finland.' For a complete list of the words taught in the intervention each week, see Table 1.

Table 1: Target words taught each week of the intervention in the Morphology and the Vocabulary intervention groups.

Week	Morphology Group	Vocabulary Group
1	finlandais, japonais, camerounais	ogresse, huileux, galanterie
2	ogresse, délicatesse, hardiesse	finlandais, luthier, délicatesse
3	laiteux, huileux, duveteux	porcherie, laiteux, gaufrier
4	porcherie, mutinerie, galanterie	camerounais, mutinerie, abricotier
5	abricotier, luthier, gaufrier	hardiesse, japonais, duveteux
6	profondeur, puanteur, propulseur	sportif, beuglement, profondeur
7	alpiniste, portraitiste, miniaturiste	propulseur, parrainage, alpiniste
8	sportif, tardif, craintif	sournoisement, vagabondage, tardif
9	pèlerinage, vagabondage, parrainage	portraitiste, puanteur, pèlerinage
10	prodigieusement, sournoisement, beuglement	craintif, miniaturiste, prodigieusement

The words taught in the intervention contained one of a set of 10 suffixes. These suffixes are relatively frequent and productive in Quebec French, such that they are preferentially used to form new words. For each of the 10 suffixes, three different stems were chosen, resulting in the 30 complex words to be taught. These words were relatively infrequent, so it would be unlikely that the children would already be familiar with their spellings or meanings.

The intervention was taught in 10 one-hour, weekly sessions, with 3 words taught in each session. Each week the Morphology group focused on the three words with the same suffix. However, for the Vocabulary group, words with the same suffix were never taught in the same session. For example, in one week the Morphology group worked with the words *finlandais*, *japonais*, and *camerounais*, whereas the Vocabulary group learned *ogresse*, *huileux*, and *galanterie*. In each session, the children played a ‘Game of the Week’ with the new target words for that week. While children in each group played similar games, these games were adjusted depending the focus of the intervention (See Figure 1 for a sample ‘Game of the Week’). Over the course of the ten weeks, each group ultimately learned the same set of 30 complex words.

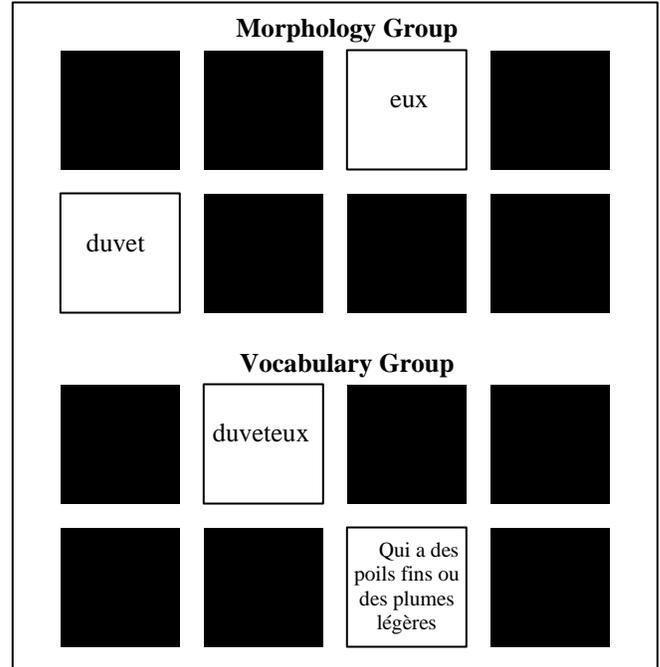


Figure 1: Sample ‘Game of the Week’: Concentration Game, shown for the Morphology and Vocabulary intervention groups

#### Materials for assessing intervention effectiveness

The effectiveness of the intervention for improving children’s spelling ability was assessed using a spelling test that we designed to target specific outcomes. The children took the test before starting the intervention (*pre-intervention*) as well as just after (*post-intervention*). The test required children to spell complex and simple words, and to generalize the spelling of stems and suffixes taught in the intervention to new words not taught in the intervention. The items on the test were either the exact complex word taught in the intervention (i.e., a taught stem and a suffix), a taught or an untaught stem without a suffix, or a combination of a taught/untaught stem and suffix in a complex word (i.e., a taught stem with a new suffix, or a new stem with a suffix, for examples, see Table 2).

Table 2: Sample items on the spelling test.

	Word taught in the intervention	Word on the spelling test
Exact word	profond-eur	profond-eur
Taught stem, no suffix	duvet-eux	duvet
Taught stem, untaught suffix	gaufri-ier	gaufri-ette
Untaught stem, taught suffix	propuls-eur	institut-eur

## Procedure

The spelling test was administered to all of the children simultaneously. The words were presented within a sentence read by a native speaker of Quebec French. Words were repeated as many times as needed for all students to fill in the blanks with the appropriate word.

## Results and Discussion

We predicted that the intervention, regardless of the focus of instruction, would lead to greater improvements in spelling for the lower ability spellers, than for the children with higher spelling ability, so we compared the overall change in spelling scores from pre- to post-intervention of high performing and low performing spellers. Moreover we predicted a differential benefit of morphological instruction for the spelling of suffixes when considering only children with spelling difficulty. Thus, we also analyzed the relative effects of the two instruction types for children who displayed lower spelling ability before the intervention began.

Three children were absent from either the pre- or post-intervention assessment, and these children were excluded from the following analyses.

The spelling test was scored based on whether the whole words were spelled correctly, as well as whether the stems and suffixes of complex words were spelled correctly. Thus, each complex word received three scores, one for the whole word, one for the stem, and one for the suffix. Mean percent correct scores on the whole words, stems, and suffixes were calculated for the following analyses.

### Effectiveness of the intervention for high and low performing spellers

To determine whether our intervention was differentially effective for high or low performing spellers, we compared the changes in overall spelling accuracy for all the words on our test. A two-way ANOVA was conducted with the factors Test Time (pre- and post-intervention) and Spelling Ability (high and low performing spellers). The results showed a main effect of Test Time (pre- and post-intervention), such that all children improved post-intervention  $F(1,64) = 26.24, p < .001$ . Moreover, the interaction of Test Time and Spelling Ability (high and low performing spellers) was significant, such that low performing spellers benefited more than high performing spellers  $F(1,64) = 10.83, p = .002$  (See Figure 2). These findings support our hypothesis, suggesting that the intervention, irrespective of instruction type, was successful for all children, and children with spelling difficulty were aided most by the intervention.

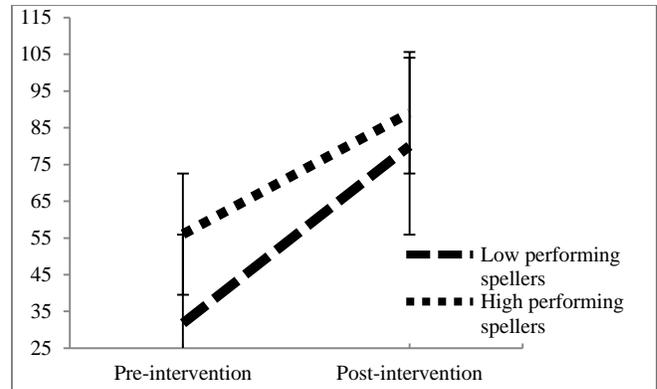


Figure 2: Overall mean percent correct on the spelling test items for high and low performing spellers at pre- and post intervention

### Differential effects of instruction type for low performing spellers

The primary purpose of this investigation was to differentiate the effects of a morphology intervention from vocabulary instruction for children with low spelling ability. Thus, we contrasted the effects of our two instruction types on children's spelling ability. We specifically focused on the performance on suffixes taught in the intervention, as this is where the differential benefit was found when considering all children together.

The differential benefit of the instruction type for low performing spellers on suffixes was assessed with a two-way ANOVA, with the factors Test Time (pre- and post-intervention) and Instruction Type (morphology or vocabulary). The results of this analysis show that all children improved from pre- to post-intervention,  $F(1,31) = 36.06, p < .001$ . The interaction of Test Time and Instruction type was also significant, indicating that children in the morphology group showed a greater improvement on the spelling of suffixes from pre- to post-intervention than children in the vocabulary group,  $F(1,31) = 4.77, p = .04$  (see Figure 3). This finding suggests that a morphologically focused intervention is beneficial for children experiencing difficulty with spelling.

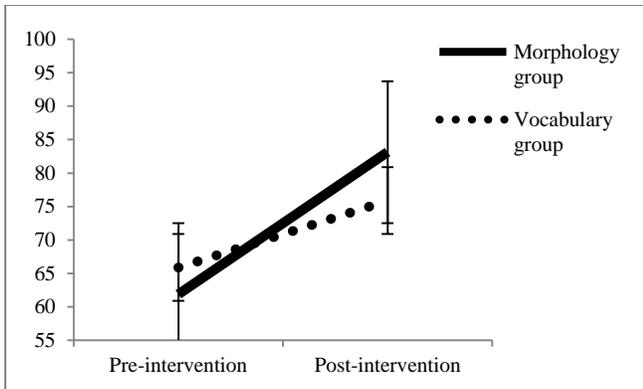


Figure 3: Mean percent correct on the suffixes for low performing spellers in the Morphology and Vocabulary groups at pre- and post intervention.

### General Discussion

We have provided support for a beneficial role of morphological instruction for improving the spelling ability of children who are experiencing literacy difficulties. Our intervention taught children using complex words composed of stems and suffixes. Regardless of the method of instruction, children gained exposure to these words orally, and in print, and they gained practice writing them. The present findings suggest that this experience working with complex words leads to spelling improvement for children of all spelling abilities. Moreover, our intervention was especially helpful for children who scored low on a general spelling measure, as compared to children who scored higher. If morphological processing skills remain intact for struggling readers, as evidence suggests (Fowler & Liberman, 1995), then instruction that exposes children to morphologically complex words seems to allow these children to take advantage of this strength and overcome their difficulty.

Importantly, this study provides novel evidence for the unique benefit of morphologically-focused instruction for children with spelling difficulty, independent from any concomitant vocabulary gains. Previously we reported that children of undifferentiated spelling ability show a greater improvement on their spelling of suffixes when they participate in an intervention using a morphology-based instruction method as opposed to a vocabulary-based method. The present findings indicate that morphology instruction is also differentially beneficial for improving spelling for low performing spellers. Not only does learning these suffixes help children spell the words taught in the intervention, it also assists them with spelling these suffixes in any context. Given that 60-80% of new words that school-aged children must acquire are morphologically complex (thus they contain suffixes) (Nagy and Anderson (1984), an intervention that improves spelling of morphemes is valuable for children struggling with spelling.

### Conclusion

Problems with spelling are pervasive for children who face literacy difficulties. Our study demonstrates that an intervention exposing children who struggle with spelling to morphologically complex words improves the spelling performance of these children. A teaching method focused exclusively on morphological structure is especially beneficial for low performing spellers. Such an intervention provides struggling spellers with a tool that makes use of their strengths and that is not limited to the context of the intervention.

The goal of this study was to isolate the benefit of morphological instruction from vocabulary instruction for low performing spellers. However combining the teaching of morphological structure and word meaning may provide the greatest improvements, and will be investigated in future studies. Additionally, we have chosen to focus only on the effects of our intervention for spelling outcomes, but a morphologically-based intervention may influence many other literacy outcomes, including word decoding, reading fluency, and reading comprehension, all of which require further exploration. Thus, this study constitutes an important initial step in the on-going pursuit to help children who struggle with literacy.

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# The role of morphology in spelling: Long-term effects of training

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## Abstract

We compared the effectiveness of two spelling interventions: one focused on morphological structure and one emphasizing word meanings, on spelling acquisition in French speaking children in 3<sup>rd</sup> and 5<sup>th</sup> grades. The morphology intervention led to significantly greater improvement in spelling than the vocabulary intervention, especially for children in grade 5. To compare the long-term effects of the two interventions, we tested the children's spelling ability six-months after the conclusion of the intervention program. Results show that both grades maintain an increase in spelling accuracy compared to their pre-intervention performance. Additionally, the children in grade 5 who received morphological instruction retained more spelling knowledge than those who received the vocabulary instruction. These results suggest that teaching children about the structure of complex words supports their spelling ability in the long-term, providing evidence for the importance of morphological knowledge in literacy development.

**Keywords:** morphology; spelling; literacy development; vocabulary; intervention; French

## Introduction

Learning to spell is a critical aspect of literacy development, yet research has typically focused on the development of reading skills. Understanding the process of learning to spell has become particularly important in Quebec, where a widespread decline in children's spelling ability has become apparent (Jalbert, 2007). Contributing to this decline is the difficult nature of French spelling. French has a one-to-many mapping of sounds-to-orthography, so the same sound may be written in a number of different ways. Additionally, silent letters are common in written French, so children must learn to spell parts of words for which there is no overt pronunciation to guide them. These features of written French make learning to spell in this language a complex task.

Recent evidence suggests that literacy instruction focused on morphological knowledge, or on the ability to recognize and process sub-lexical units in language (e.g., recognizing that the word *reheatable* is made up of three sub-parts, the prefix *re-*, the stem *heat*, and the suffix *-able*) may assist children's spelling development. In fact, children who have greater metalinguistic awareness of morphological structure are better able to spell words correctly (e.g., Deacon, Kirby, & Casselman-Bell, 2009; Sénéchal, 2000) and teaching children explicitly about the morphological relationships

between words improves their reading and writing skills (see Bowers, Kirby, & Deacon, 2010, for a review).

While morphological awareness training may be a beneficial teaching method for fostering literacy development, there are a number of important issues to be resolved to ensure that children receive the most effective instruction. Firstly, most of this evidence is derived from studies of English-speaking children, and little is known about the contribution of morphological skills to writing ability in French (cf. Sénéchal, 2000; Sénéchal, Basque, & Leclaire, 2006; Pacton & Deacon, 2008). French has a richer morphological system than English, so it is likely that morphology may have an even more influential role in learning to spell in French. Intervention studies with French-speaking children are needed to test this hypothesis.

Additionally, children as young as two to three years demonstrate knowledge of morphology (Berko, 1958; Clark, 1993, Gonnerman, 2007), but it is not clear when this knowledge begins to influence spelling ability. Some researchers have argued that morphological knowledge has an early influence as children begin to develop literacy skills (e.g., Deacon & Kirby, 2004), while others report that the influence of morphological knowledge on spelling ability does not have a large impact until later in development (e.g., Carlisle, 1995; Kirby et al., 2012; Singson, Mahony, & Mann, 2000). To provide the most effective instruction to children, it is crucial to understand the most appropriate stage of development to introduce morphological training.

Typically, instruction of morphological structure also involves discussion of word meaning, because morphologically related words share similar form and meaning. Previous studies have yet to investigate the distinction between morphological and vocabulary instruction (e.g., St-Pierre & Dubé, 2012), thus the relative contribution of morphology versus semantics to improving spelling ability is unknown. To disambiguate the potential benefit of morphological knowledge from the benefits of word meaning instruction, it is necessary to isolate the teaching of morphological structure and compare its effects on spelling outcomes to that of vocabulary training.

Finally, it is important to find out whether the benefits of a morphological intervention program can be maintained across time, and whether the knowledge will transfer to new words not taught in the intervention. Carlisle (2010) conducted a review of instructional programs using morphological awareness training to improve literacy outcomes, and reported that the majority of these studies fail

to report the long-term maintenance of the effects, or the transfer of learning to new words. It is critical to evaluate both the maintenance and transfer of learning to ensure that a morphological intervention provides children with long-lasting abilities beyond the context of the intervention.

We have conducted an intervention study to investigate the role of morphological training for improving spelling in Quebec French. In a previous study, we analyzed and reported the results immediately after the conclusion of the intervention. The focus of the present study is to examine the long-term effects of the intervention, as measured at a follow-up session six months after the conclusion of the intervention. We compared the long-term effects of morphological instruction for 3<sup>rd</sup> graders and 5<sup>th</sup> graders, explicitly contrasting its relative contribution to spelling ability with that of vocabulary instruction. Thus, our research question is two-fold:

1. Is there a difference in relative long-term intervention effectiveness by grade? That is, will a morphology intervention improve long-term spelling performance of children in grade 3 versus 5?
2. Is there a difference in long-term intervention effectiveness by instruction method? That is, will a morphology intervention lead to great long-term spelling improvement than a vocabulary intervention?

In the sections that follow, we describe the intervention that was conducted, as well as the spelling outcomes following the intervention for children in grades 3 and 5. To address our research questions, we present data from a six-month follow-up test evaluating the long-term effectiveness of the morphology and vocabulary training for improving spelling performance.

Overall, we expect that the children will experience some degree of forgetting, such that their spelling accuracy at the six-month follow-up will be lower than at post-intervention; however we expect that the children will retain some of the spelling knowledge from the intervention, so their spelling scores at the six-month follow-up will be higher than at the pre-intervention. Moreover, we predict that the greater benefit observed for the morphology intervention will be maintained in the long-term.

### The Present Study

We developed an intervention to target the spelling of a set of morphologically complex words, with emphasis on either morphology or vocabulary instruction. The present study aims to assess the long-term outcomes of our spelling intervention. Six months after the intervention ended, we went back to the school and administered the same spelling test to the children who had participated in the intervention. The children's performance on this test at the six-month follow-up will be compared to their performance on the test

as measured before the intervention as well as immediately after the intervention.

## Methods

### Participants

Eighty-four children were recruited from one elementary school in the greater Montreal area and took part in the intervention. Children from two Grade 3 and two Grade 5 classes within the school participated. The primary language of instruction in this school is French. 36 children from Grade 3 participated (23 girls and 13 boys), as well as 48 children from Grade 5 (27 girls and 21 boys).

Children were randomly assigned to one of the two treatment groups, based on their general spelling abilities prior to their participation in the intervention study. General spelling ability was assessed using a modified version of the Test Ortho3 from the Batterie d'Évaluation du Langage Écrit et de ses troubles (BELEC) (Mousty, Leybaert, Alegria, Content, & Morais, 1994). Children in each intervention group were also matched on language background (monolingual Francophone, or multilingual), and gender, with approximately equal ratios of boys to girls in each treatment group.

### The intervention

Children in grade 3 and grade 5 took part in the intervention. The children were divided into two groups, one which received instruction explicitly focused on the morphological structure of the words to be learned (Morphology group), the other receiving instruction focused on the meanings of the words (Vocabulary group). For example, the Morphology group was taught that there are two parts to the word *finlandais*, namely the stem *finland* and the suffix *-ais*, while the Vocabulary group was taught that the word *finlandais* describes something or someone that comes from the country, Finland. The children were taught to spell an identical set of 30 words, with only the emphasis of instruction differing across intervention groups. The intervention was given during 10 weekly sessions, each lasting one hour.

Ten suffixes were taught in the intervention. The suffixes were relatively frequent and productive in Quebec French, such that they are preferentially used to form new words. Three words were chosen containing each of the 10 suffixes, creating the list of 30 words that were taught in the intervention. These words were relatively infrequent, so it would be unlikely that the children in grade 3 or 5 would already know these words.

The 30 words were distributed across the 10 intervention sessions, with three words taught per session. In each session, the children in the Morphology group were taught the three words with the same suffix. For the Vocabulary group, words with the same suffix were distributed across the 10 sessions, such that the words with the same suffix were never taught in the same session. For example, in the first session, the Morphology group was taught *finlandais*,

*japonais*, and *camerounais*, whereas the Vocabulary group was taught *ogresse*, *huileux*, and *galanterie*. Thus, each group was taught the same words, just in different sessions.

### Materials for assessing intervention effectiveness

We developed a test to determine the effectiveness of the intervention on children's spelling ability. This test was administered before (*pre-intervention*), immediately after (*post-intervention*), and six months after the intervention concluded (*six-month follow-up*). We designed this spelling test to measure specific outcomes from our intervention. The test assessed the spelling of complex and simple words, and required children to generalize stems and suffixes taught in the intervention to new words not taught in the intervention. The items on the test were either the exact complex word taught in the intervention (i.e., a taught stem and a taught suffix), a taught or an untaught stem without a suffix, or a combination of a taught/untaught stem and suffix in a complex word (i.e., a taught stem with a new suffix, or a new stem with a taught suffix).

### Procedure

All students took the spelling test in the classroom at the same time. The instructor read each sentence once, repeating the missing words as many times as necessary for all students to fill in the missing word. The instructor was a female native speaker of Quebec French.

## Results and Discussion

We assessed the effects of our intervention immediately following the conclusion of the intervention program, analyzing the changes in spelling performance from pre- to post-intervention. Before we report the results of the six-month follow up, the pre- to post- test analyses will be summarized. As the focus of the present study is the long-term spelling outcomes, only statistics including the six-month follow-up scores will be reported in this paper.

There were 15 children who participated in the original intervention who were absent from the six-month follow-up session. These children were excluded from the following analyses. Additionally, 3 children were absent from either the pre- or post-intervention assessment, and these children were also excluded from the following analyses.

The children's performance on the spelling test was scored based on whether the whole words were spelled correctly, and also whether the stems and suffixes of complex words were spelled correctly. Accordingly, each complex word received three scores, one for the whole word, one for the stem, and one for the suffix. Mean percent correct scores on the whole words, stems, and suffixes were calculated for the following analyses.

### Question #1: Is there a difference in relative long-term intervention effectiveness by grade?

**Pre- to post- intervention summary** We compared the changes in spelling accuracy over all the items on the

spelling test, from pre- to post-intervention, for grade 3 and 5 students. The results of this analysis revealed that children in both grades improved their spelling from pre- to post-intervention, with children in grade 5 scoring higher overall than those in grade 3. However, the children in grade 3 showed a greater differential between pre- and post-intervention than those in grade 5, indicating that the children in grade 3 were aided more by the intervention, irrespective of the type of instruction.

To test whether these differences remained six months after the intervention, we calculated mean percent correct at each test time. These mean scores for grades 3 and 5 are displayed in Figure 1. We entered the whole word accuracy scores on all of the spelling test items into a 2x3 ANOVA with the factors Grade (grade 3 or grade 5) and Test Time (pre-intervention, post-intervention, or six month post) to assess the long-term effects of the intervention for each grade. The main effect of Grade was significant,  $F(1, 64) = 16.98$ ,  $p < .001$ , indicating that the children in grade 5 scored significantly higher than the children in grade 3. The main effect of Test Time was also significant,  $F(2,128) = 174.92$ ,  $p < .001$ , as was the interaction of Grade and Test Time,  $F(2,128) = 6.73$ ,  $p = .002$ , indicating significant differences between the spelling performance of grade 3 and 5 children across the three testing sessions.

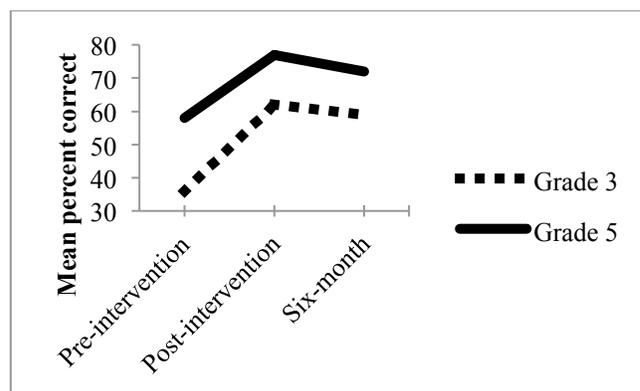


Figure 1: Overall mean percent correct on the spelling test, for grade 3 and grade 5 at pre-intervention, post-intervention and the six-month follow-up.

**Post-intervention to six-month follow-up** To specifically examine the potential differences in the long-term effects of the intervention for grade 3 and 5 children, a planned comparison of the whole word accuracy scores for all items, with the factors Grade (grade 3 or grade 5) and Test Time (post-intervention or six month post) was conducted. The results show that the grade 5 children had significantly higher spelling scores than the grade 3 students from post- to six month post-intervention,  $F(1,64) = 11.55$ ,  $p < .001$ . Collapsing across both grades, scores were significantly higher at post-intervention than at the six month follow-up,  $F(1,64) = 12.01$ ,  $p < .001$ , indicating that the children had forgotten some of the spelling knowledge they gained from the intervention six months later. Interestingly, the

interaction of Grade and Test Time was not significant,  $F(1, 64) = .35, p = .55$ , indicating no difference between grade 3 and grade 5 in the amount of spelling knowledge that was forgotten. In fact, there was only a small, albeit significant, decrease in spelling ability six months after the intervention, approximately 5% in each grade.

**Pre-intervention to six-month follow up** To ensure that six months later the children retained much of the spelling knowledge they originally gained from the intervention, we conducted a planned comparison of the whole word spelling accuracy scores of all items, with the factors Grade (grade 3 or grade 5) and Test Time (pre-intervention or six month post-intervention). Once again there was a significant main effect of Grade,  $F(1,64) = 17.57, p < .001$ , such that the children in Grade 5 scored higher than those in Grade 3. The main effect of Test Time was significant,  $F(1,64) = 193.01$ , as was the interaction between Grade and Test Time,  $F(1,64) = 10.85, p = .002$ . These results indicate that children in both grades maintained their spelling improvement, scoring higher at the six-month follow-up than at pre-intervention. Moreover, the children in grade 3 improved more from pre-intervention to the six-month follow-up than the children in grade 5. Thus, the children display long-term learning, having retained a large amount of the spelling knowledge that they gained from the intervention six months later.

**Question #2: Is there a difference in long-term intervention effectiveness by instruction method?**

**Pre- to post- intervention summary** Given the differences between grades in intervention effectiveness, we analyzed pre- to post- intervention differences between the Morphology and Vocabulary group for each grade

separately. In general, children in both instructional groups increased from pre- to post- intervention, indicating that both types of instruction effectively improved children’s spelling ability for both 3<sup>rd</sup> and 5<sup>th</sup> graders. Looking more closely at the accuracy for stems and suffixes of the test items, differential effects according to intervention group emerged, with the Morphology group showing a larger increase in spelling accuracy than the Vocabulary group.

The results immediately following the intervention suggest that the instruction focusing on the morphological structure of words provides an advantage to children over an intervention that focuses on word meanings. Specifically, children who have had morphological-based training were able to generalize the knowledge they gained in the intervention to be able to correctly spell morphologically related words that had not been taught directly. While the Morphology group showed differential improvements over the Vocabulary group in both grades, the morphological intervention provided the strongest benefit for children in grade 5.

To determine whether the advantage of a morphological intervention over a vocabulary intervention for learning to spell was maintained after a period of no instruction, we compared the changes in spelling accuracy of the two intervention groups from immediately after the intervention to the six-month follow-up assessment. Additionally, we compared the long-term effects of the morphology and vocabulary instruction for 3<sup>rd</sup> and 5<sup>th</sup> grade separately, to determine the developmental stage for which the spelling intervention is most effective. Each grade was thus examined separately in the following analyses.. The mean percent correct on the complex words, stems and suffixes for both intervention groups are displayed in Table 1 for Grade 5, and in Table 2 for Grade 3.

**Table 1.** Grade 5 mean percent correct on complex words, stems and suffixes at post-intervention and six-month follow-up.

	Morphology Group				Mean Difference	Vocabulary Group				
	Post-intervention		Six-month follow-up			Post-intervention		Six-month follow-up		
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>		<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	
Complex Words	83.33	17.25	74.31	17.40	-9.02	86.84	15.29	68.42	21.40	-18.42
Stems	86.96	9.66	78.99	13.52	-7.97	80.78	15.76	75.06	16.00	-5.72
Suffixes	91.67	7.11	88.19	8.27	-3.48	93.42	6.41	83.55	13.54	-9.87

**Table 2.** Grade 3 mean percent correct on complex words, stems and suffixes at post-intervention and six-month follow-up.

	Morphology Group				Mean Difference	Vocabulary Group				
	Post-intervention		Six-month follow-up			Post-intervention		Six-month follow-up		
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>		<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	
Complex Words	81.25	16.08	63.39	21.63	-17.86	78.33	21.89	65.00	16.50	-13.33
Stems	72.98	15.27	67.70	13.82	-5.28	73.91	18.00	68.12	19.28	-5.79
Suffixes	88.39	7.70	81.70	13.97	-6.69	79.58	19.11	76.67	16.61	-2.91

**Performance on complex words** We first looked at the long-term changes in whole word spelling accuracy of the complex words that were taught in the intervention. The whole word scores for the complex taught words were entered into a separate ANOVA for each grade, with the factors Intervention Group (morphology or vocabulary) and Test Time (post-intervention or six-month post-intervention). Looking first at the results for grade 5, the main effect of Test Time was significant, with children scoring higher at the post-test session, than the pretest session,  $F(1,35) = 21.98, p < .001$ . The main effect of Group was not significant,  $F(1,35) = .05, p = .81$ , nor was the interaction of Test Time and Group,  $F(1,35) = 2.52, p = .12$ . Thus, both groups display some forgetting of how to spell the complex words that were taught in the intervention, but this change is not differential based on the intervention group.

For the 3<sup>rd</sup> graders, the main effect of Test Time was once again significant,  $F(1,27) = 20.68, p < .001$ , while the main effect of Group was not significant  $F(1,27) = , p = .92$ . Unlike the pattern observed in the 5<sup>th</sup> grade, the interaction of Group and Test Time was not significant,  $F(1,27) = .44, p = .51$ . For children in grade 3, after six months both groups showed a similar decrease in spelling accuracy for the complex words taught in the intervention.

**Performance on stems** To assess the long-term effects of instruction on the spelling of taught stems, mean percent correct scores for taught stems were entered into an ANOVA with the factors Test Time (post-intervention or six-month-post intervention) and Group (morphology or vocabulary), for each grade separately. The results for the 5<sup>th</sup> grade children showed a significant main effect of Test Time,  $F(1,35) = 12.70, p = .001$ , but not a significant main effect of Group,  $F(1,35) = 1.44, p = .24$ , nor an interaction between Test Time and Group  $F(1,35) = .35, p = .56$ .

Similarly, in the 3<sup>rd</sup> grade, the main effect of Test Time was significant,  $F(1,27) = 9.68, p = .004$ , while the main effect of Group and the interaction of Test Time and Group were not,  $F(1,27) = .01, p = .91, F(1,27) = .02, p = .89$ , respectively. For both Grade 3 and Grade 5, performance on the taught stems decreased somewhat for both the morphology and vocabulary groups, but this small decrease was the same across both groups. Thus, the initial learning based on the intervention resulted in approximately 21-31 percent increases in spelling of the stems, and after 6 months, both groups still showed significant improvements in spelling, only dropping 1 to 6 percent in their scores.

**Performance on suffixes** We compared the long-term effects of the two intervention types on the spelling of suffixes taught in the intervention. For each grade, the mean percent correct scores for taught suffixes were entered into separate ANOVAs, with the factors Test Time (post-intervention or six-month post-intervention) and Group (morphology or vocabulary). For grade 5, the main effect of Test Time was significant,  $F(1,35) = 18.22, p < .001$ , while

the main effect of Group was not,  $F(1,35) = .30, p = .56$ . Interestingly, the interaction of Group and Test Time was significant  $F(1,35) = 4.08, p = .05$ , revealing that six months after the intervention, the morphology group showed greater retention for the spelling of taught suffixes. This finding suggests that for children in grade 5, instruction focused on morphological structure is more beneficial in the long-term for learning to spell morphologically complex words than instruction focused on word meaning.

The analysis for grade 3 children showed that the main effect of Test Time was marginally significant,  $F(1,27) = 4.00, p = .06$ , and that the main effect of Group was not,  $F(1,27) = 1.86, p = .18$ . In contrast to Grade 5, the interaction of Test Time and Grade was not significant for Grade 3,  $F(1,27) = .64, p = .43$ . There is a slight decrease in the spelling of taught stems at the six-month follow-up for both intervention groups, and this decrease is not different by intervention received. Given the differing pattern of results for performance in the spelling of taught suffixes, with the 5<sup>th</sup> graders in the morphology group showing greater retention, the morphology-based instruction seems to provide an advantage over a vocabulary-based instruction for learning to spell at later stages of literacy development.

## General Discussion

The present study evaluated the long-term effectiveness of a morphology-based intervention for elementary school-aged French-speaking children. The intervention contrasted the effects of a training program focused on the morphological structure of words, with one that concentrated only on word meaning. While other intervention studies have confounded morphology and vocabulary instruction (see Bowers, Kirby, & Deacon, 2010, for a review), our study design allowed us to disambiguate the relative benefits of morphology and vocabulary instruction for spelling outcomes. Additionally, by conducting the intervention with children in 3<sup>rd</sup> and 5<sup>th</sup> grade, we could assess the effects of morphological instruction at different stages of literacy development.

While both interventions led to significant spelling improvements from pre- to post-intervention, the Morphology group displayed significantly greater improvement in their ability to generalize their spelling knowledge beyond the words that were taught in the intervention. The differential benefit in favour of the morphology group was particularly pronounced for the children in grade 5. Overall, the results suggest that teaching children about morphological structure successfully improves spelling accuracy more than instruction based on word meaning does.

In addition, in the results reported here, we demonstrate the long term learning effects of the morphology intervention by re-examining the children after a six-month delay. We found that for both the morphology and vocabulary groups, the improvement in spelling accuracy remains six months later, as the children spell significantly better at the six-month follow-up than at pre-test. These effects hold for children in both grades 3 and 5. The

children do display some forgetting at the six-month mark, with scores significantly decreasing from post-intervention to six-month follow-up, however, the decreases were very small (approximately one to six percent) and there were no differences in the amount of forgetting between grades. This finding suggests that, regardless of instruction type, children benefit from our spelling intervention.

Importantly, when examining the differential effects of instruction type, we found a significant, long-term advantage for grade 5 children in the Morphology group over children in the Vocabulary group. At the six-month follow-up, those who received morphology instruction showed greater retention of spelling knowledge than those who received the vocabulary instruction. Our intervention study and the subsequent follow-up suggest that morphological training provides sustained improvement to children's spelling accuracy in French, greater than instruction on word meaning, particularly for older elementary school-aged children.

### Conclusion

Findings from our follow-up study provide support for an advantageous role of morphology instruction for spelling outcomes in Quebec French. Explicitly teaching children about the components of complex words helps them to spell stems and suffixes better, and to generalize their knowledge beyond the words taught in the intervention. For older children, these effects are maintained well after instruction is finished, indicating that morphology instruction would be a useful tool for dealing with the spelling difficulties observed in Quebec. While we did not see the same differential long-term benefit of morphology training in the younger children, our findings indicate that both types of intervention were very beneficial in the long-term. As such, an intervention combining instruction of morphological structure and vocabulary knowledge may be especially helpful for these children.

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# Improving children's spelling ability with a morphology-based intervention: The role of language experience



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## Introduction

Morphological knowledge refers to the ability to recognize and process sub-lexical units in language.

Teaching children explicitly about the morphological relationships between words improves their reading and writing skills (e.g., Bowers, Kirby, & Deacon, 2010; Goodwin and Ahn, 2010, 2013).

French has a rich morphological system, and morphology may have an especially influential role in learning to spell in this language.

Morphologically related words share similar form and meaning, and vocabulary size is highly correlated with children's morphological awareness (Fowler & Liberman, 1995; Ku & Anderson, 2003). Previous intervention studies have confounded discussion of morphological structure with word meaning, so the benefit teaching of morphological structure, independent from vocabulary training remains unknown.

The effectiveness of a morphological intervention may vary based on language experience. Previously, we reported that the differential benefit of morphological instruction over vocabulary instruction for improving spelling was more robust for older (Grade 5) than younger (Grade 3) French-speaking children (Kolne & Gonnerman, 2014). This finding suggests that morphological instruction is more effective for children with more language experience.

## Present Study

- Examines the influence of language experience on the effectiveness of teaching morphology to improve spelling ability.
- If the differential benefit of morphological instruction increases with increasing language experience, then we predict that the benefit of morphological instruction over vocabulary instruction will be greater for monolingual French-speaking children than for bilingual children.

## Methods

### Participants

- Eighty 8-10 year old children in Grade 3 (23 girls, 13 boy), 48 children in Grade 5 (27 girls, 21 boys); recruited from a school where French is the primary language of instruction.
- Of this children, 44 monolingual French-speaking (**Francophone children**), and 36 bilingual children (all spoke French and another language, which varied across children) (**Allophone children**).

### Materials

- Ten relatively frequent and productive suffixes were taught.
- Three target words chosen containing each of the 10 suffixes, creating the list of 30 morphologically complex words that were taught in the intervention (See Table 1 for the complete list of words).
- The words were relatively infrequent, so unlikely that the children in grade 3 or 5 would already know them.

Table 1  
Target words taught each week of the intervention in the Morphology and the Vocabulary intervention groups.

Week	Morphology Group	Vocabulary Group
1	finlandais, japonais, camerounais	ogresse, huileux, galanterie
2	ogresse, délicatesse, hardiesse	finlandais, luthier, délicatesse
3	laiteux, huileux, duveteux	porcherie, laiteux, gaufrier
4	porcherie, mutinerie, galanterie	camerounais, mutinerie, abricotier
5	abricotier, luthier, gaufrier	hardiesse, japonais, duveteux
6	profondeur, puanteur, propulseur	sportif, beuglement, profondeur
7	alpiniste, portraitiste, miniaturiste	propulseur, parrainage, alpiniste
8	sportif, tardif, craintif	sournoisement, vagabondage, tardif
9	pèlerinage, vagabondage, parrainage	portraitiste, puanteur, pèlerinage
10	prodigieusement, sournoisement, beuglement	craintif, miniaturiste, prodigieusement

## The Intervention

- 10 one-hour weekly sessions; with 30 words distributed across the sessions - three words taught per session.
- The words contained one of a set of 10 suffixes.
- Children divided into two groups; the same words were taught to each group, the differed only in the emphasis of instruction:
  - Morphology Group** - Instruction explicitly focused on morphological structure deliberately avoiding discussion of word meaning. The children in this group were taught the three target words with the same suffix.
  - Vocabulary group** - Instruction focused on word meanings with no mention of morphological structure. For this group, words with the same suffix were distributed across the 10 sessions, such that the target words with the same suffix were never taught in the same session.
- In each session, the children played a 'Game of the Week' with the new target words for that week.
- While children in each group played similar games, these games were adjusted depending the focus of the intervention (See Figure 1 for a sample 'Game of the Week').

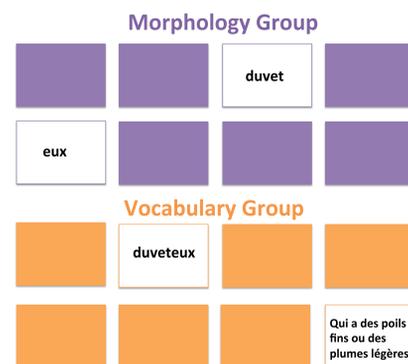


Figure 1. Sample 'Game of the Week': Concentration Game, shown for the Morphology and Vocabulary intervention groups.

## Spelling Test

- We created a test that assessed the spelling of complex and simple words, and required children to generalize stems and suffixes taught in the intervention to new words not taught in the intervention.
- The test was administered prior to training (*pre-intervention*), immediately after (*post-intervention*).
- The items on the test were either
  - The exact complex word taught in the intervention (i.e., a taught stem and a taught suffix);
  - A taught or an untaught stem without a suffix;
  - Or a combination of a taught/untaught stem and suffix in a complex word (i.e., a taught stem with a new suffix, or a new stem with a taught suffix) (See Table 2 for examples).

Table 2  
Example items from the spelling test, and corresponding target words taught in the intervention.

	Word taught in the intervention	Word on the spelling test
Exact word	profond-eur	profond-eur
Taught stem, no suffix	duvet-eux	duvet
Taught stem, untaught suffix	gaufri-er	gaufri-ette
Untaught stem, taught suffix	propuls-eur	institut-eur

## Results

- We assessed the effects of our intervention by analyzing the changes in spelling performance from the pre- to post-intervention.
- The children's performance on the spelling test was scored based on whether the whole words were spelled correctly, and also whether the stems and suffixes of complex words were spelled correctly.
- Each complex word received three scores: one for the whole word, one for the stem, and one for the suffix. Mean percent correct scores on the whole words, stems, and suffixes were calculated for the following analyses.
- To determine differential benefits of the Morphology and Vocabulary intervention based on language experience, we analyzed the Francophone and Allophone children separately.
- Analysis focused on where differences between the morphology and vocabulary groups were found when all children were considered together (viz., Kolne, Gonnerman, & Hill, 2013), namely:
  - Taught stems with no suffix
  - Taught suffixes with a new stem
- Mean percent correct for Francophone and Allophone children, by intervention type are presented in Table 2.

### Taught stem, no suffix

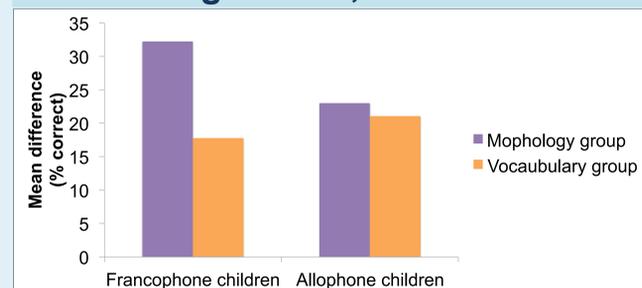


Figure 2. Mean difference from pre- to post-intervention for taught stems, for Francophone and Allophone children.

- Francophone and Allophone children improved from pre- to post-intervention.
- For Allophone children, the Morphology and Vocabulary groups did not improve differentially,  $F(1, 33) = .16, p = .69$ .
- Francophone children in the Morphology group improved significantly more than the Vocabulary group,  $F(1, 38) = .963, p = .004$ .

### Taught suffixes, new stem

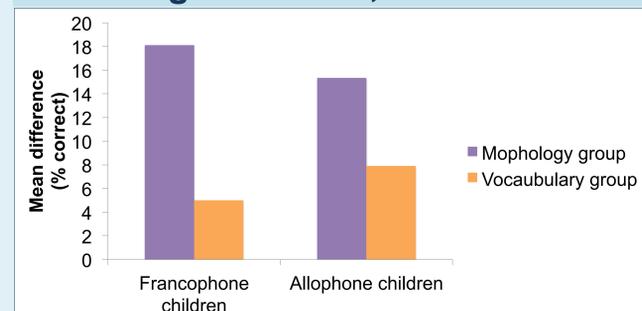


Figure 3. Mean difference from pre- to post-intervention for taught suffixes, for Francophone and Allophone children.

- Francophone and Allophone children improved from pre- to post-intervention.
- For Allophone children, the Morphology and Vocabulary groups did not improve differentially,  $F(1, 33) = .16, p = .69$ .
- Francophone children in the Morphology group improved significantly more than the Vocabulary group,  $F(1, 38) = .963, p = .004$ .

Table 2  
Mean percent correct on Taught stems with no suffix, and Taught suffixes with no stem, by intervention type for Francophone and Allophone children.

	Francophone		Allophone	
	Post-intervention	Six-month follow-up	Post-intervention	Six-month follow-up
Taught stem, no suffix	46.69	78.93	54.55	71.72
Taught suffix, new stem	67.73	85.91	74.44	79.44
Taught stem, no suffix	57.95	80.97	52.63	73.68
Taught suffix, new stem	69.38	84.37	76.84	84.74

## Conclusions

Our study shows that both morphological and vocabulary instruction benefit children learning to spell in French; moreover these interventions are beneficial for Francophone and Allophone children.

Training focused solely on morphological structure leads to greater spelling improvement than vocabulary training, specifically for Francophone children.

This finding corroborates with our previous finding that morphological instruction is most beneficial for older children, suggesting that morphologically focused instruction is beneficial for children who have more language experience.

## Future Directions

- Is there a minimum amount of language experience necessary for a morphologically-focused intervention to be optimally beneficial? Does this correspond to a specific age?
- Would there be an additional benefit to combining the discussion of morphological structure and word meaning?
- Would this intervention lead to improvements in other domains beyond spelling (e.g., reading fluency? reading comprehension?)
- Would the findings be replicated if a similar intervention were conducted in English?

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## Teaching spelling to poor readers: A morphological intervention study in French

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### Research question

A critical aspect of gaining command of the written language is the ability to spell words correctly. Studies of spelling ability have shown that children who recognize the morphological relationships between words, such as *candidat* and *candidature*, are better able to spell them correctly (Sénéchal, 2000). Additionally, morphological instruction can improve reading and writing skills (Bowers, Kirby, & Deacon, 2010). A remaining question is whether an intervention focused solely on morphology could improve the literacy skills of poor readers. The current project investigates this question by comparing spelling outcomes from two intervention techniques, one emphasizing only morphological structure, the other word meaning. The intervention targeted both good and poor readers learning to spell in French.

### Method

Eighty-four 8-10-year-old French-speaking children (50 girls, 34 boys) from Montreal participated in an intervention given over 10 one-hour weekly sessions. The children were divided into two groups, one receiving instruction explicitly focused on morphological structure (Morphology group), the other receiving instruction focused on word meanings (Vocabulary group).

### Results

To evaluate the intervention, children were given a 40-word spelling test before and after the training. The test included words taught in the intervention, and morphologically complex words not taught, to determine children's ability to generalize after training. Overall, results showed that while all children improved post-intervention, poor readers benefited more than good readers (Table 1),  $F(1,64)=10.83, p=.002$ .

Crucially, morphological training improved spelling significantly more than vocabulary training did, for both good and poor readers. This benefit was particularly pronounced for the untaught words, where children were asked to generalize spelling to new words (Figure 1), poor readers,  $F(1,31)=4.77, p=.037$ , good readers,  $F(1,31)=4.97, p=.03$ .

### Conclusion

Results suggest that explicitly teaching children about the morphological structure of words is more effective in improving spelling than teaching about word meaning, especially for poor readers.

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Table 1. Percent correct scores on the spelling test for good and poor readers, pre and post intervention. Scores are shown for words taught in the intervention.

	Pre-test	Post-test
Poor readers	32	80
Good readers	56	89

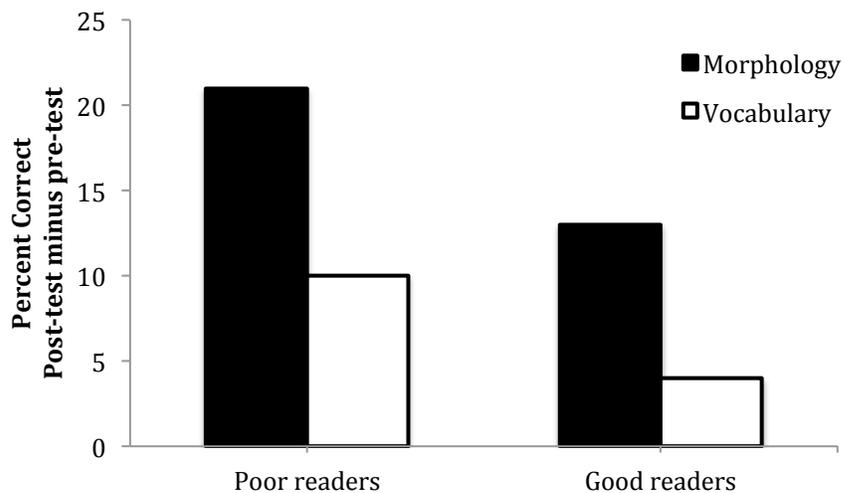


Figure 1. Improvement from pre- to post-test for good and poor readers in the Morphology and Vocabulary intervention groups. Improvement is measured as the percent change in scores on the spelling test. Scores are shown for words not taught in the intervention, where children generalized spelling to new morphologically complex items.