ADDING TRANSPARENCY TO MORPHOLOGICALLY OPAQUE WORDS THROUGH INSTRUCTION

By:

PETER N. BOWERS

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Abstract

This study investigated the effects of explicit morphological awareness (MA) instruction on the literacy skills of 82 Grade 4 and 5 students from two schools. MA is a linguistic awareness for how sub-lexical units (bases, prefixes, and suffixes) represent meaning. A few morphological intervention studies have been reported and show positive effects for spelling and reading measures. The depth of morphological content targeting morphological opacity and a problem-solving focus make this intervention unique.

One Grade 4 and one Grade 5 class from each school comprised the experimental group, and the other Grade 4 and 5 classes were the control. The experimental group received 20 lessons (50 min. each) 3-5 days a week for five weeks while the control group continued with regular literacy instruction. A battery of cognitive and literacy measures which addressed both instructional content and learning transfer was administered in the two weeks following the intervention.

Data were analyzed with aptitude-treatment interaction regression analysis. A significant interaction was found for only one measure, which indicated the instruction was more effective for stronger readers. The experimental group improved more than the control group in measures of written MA, spelling, and reading designed around the instruction, but not standardized measures of word reading and spelling. Significant effects on non-experimental measures of orthographic processing showed that the training effects transferred beyond the specific items/concepts instructed. Evidence of medium transfer, combined with the enthusiastic response from students and teachers suggest that this morphological instruction warrants further study.

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In memory of my dad, Kenneth S. Bowers, who had much to do with this interest of mine without knowing it. He would be shocked at his middle son's interest in spelling, but he would have really loved it. He loved playing with words almost as much as he liked playing the drums – especially if it involved his kids.

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Chapter 1: Introduction

Reading is commonly defined as the act of gaining meaning from print (Rayner, Foorman, Perfetti, Pesetsky, & Seidenberg, 2001). This premise suggests that it may be productive to look at how the English writing system is structured to represent meaning. If instruction could more accurately reveal the conventions by which meaning is represented in print, would measurable improvements to children's literacy result?

Adjusting reading instruction to focus more on features of how the writing system works is by no means a new idea. It was a central premise of the scientific community's emphasis on the importance of direct, systematic instruction of letter-sound (grapheme-phoneme) correspondences and its rejection of whole language (Adams, 1990; Rayner et al., 2001). Some proponents of whole language argued that learning to read and write was as natural as learning to speak; and thus formal, systematic and sub-lexical instruction was unnecessary, and even detrimental to a natural learning process (Goodman, 1986). Whole language proponents claimed that a supportive, print rich environment that encouraged a love of books with only *ad hoc* context-based instruction about sound-letter correspondences was the most effective form of reading instruction. However, researchers have since presented much evidence countering the hypothesis that the most effective reading instruction could avoid sub-lexical instruction linking letters or groups of letters with sounds they represent in spoken words (National Reading Panel, 2000).

A closer look at the learner on one hand, and the writing system on the other was fruitful. Research found that children's phonological awareness (PA) before formal reading instruction was a strong predictor of later reading success (Adams, 1990; Bradley & Bryant, 1983). PA refers to a child's ability to recognize and manipulate the sounds -- typically *phonemes* -- of words. A phoneme is the smallest unit of sound that can affect

the meaning of a word. A child who is able to identify that the last sound (phoneme) in *cat* is /t/, or say the word *bake* without the /b/ has more PA than a child who cannot. PA before formal instruction was found to be predictive of later reading ability, and teaching PA was found support reading and writing skills (Vellutino et al., 1996). It is probable that the oral skill of PA supports children in the process of learning to recognize common connections between phonemes and graphemes in words. (Graphemes are letters or combinations of two or three letters that represent a single phoneme.) Direct, systematic instruction about common grapheme-phoneme correspondences brought significant gains to children's literacy as compared to instruction that avoided or minimized this sub-lexical instruction, particularly for those identified with phonological deficits (Adams, 1990; National Reading Panel, 2000).

Having made an effective case for systematic instruction about grapheme-phoneme (letter-sound) correspondences, some researchers turned their attention to children's awareness of other linguistic features of the English writing system (e.g., Arnbak & Elbro, 1996, 2000; Carlisle, 1996, 2000, 2003; Nunes, Bryant & Bindman, 1997; Nunes Bryant & Olsson, 2003). If PA was an effective predictor of reading skill and informed improved instructional practice, perhaps morphological awareness (MA) would also be important. MA refers to a child's awareness of, and ability to manipulate, the smallest meaningful units of words called *morphemes* (prefixes, suffixes and bases) that provide clues to meaning and connections between words. To facilitate an understanding of these concepts and their relation to the development of literacy skills, a brief background on the structure of English orthography is offered.

Background on the Structure and Purpose of English Orthography

The prime function of any orthography is to represent the meaning of a language to those who already understand and speak it (Chomsky & Halle, 1968). English orthography uses three interrelated elements to represent meaning: *morphology*, *etymology,* and *phonology*. More simply, but less precisely, these elements can be thought of (in corresponding order) as the *meaning*, *historical,* and *sound* elements of an orthography. To study the role of MA and PA in relation to literacy learning and instruction in English, it is essential to consider the integrated role of the units of meaning (morphemes) and units of sound (phonemes) in the oral and written language. "The alteration of sounds in related words – for example, *food-feed*, *sane-sanity*, and *breath-breathe* – comprises a special area of phonology called *morphophonemics*. In preserving the visual identity of morphemes, English orthography has developed a large number of patterns that are important for letter-sound mappings" (Venezky, 1999, p. 71). The nature of the English language is such that for its orthography to represent morphemes consistently, phonemes must have an elastic representation. This relationship between the morphemes and phonemes has been labelled the morphophonemic principle. For example, the word ***sign*** is a word made with a single base morpheme pronounced /saɪn/. When the suffix *–al* is fixed to this base, the result is the morphologically complex derivation ***sign****al*, pronounced /sɪgnəl/. To maintain a consistent written representation of this base morpheme, and thus provide a visual marker to the core meaning of both words, English orthography *must* use an elastic representation of pronunciation in letters. Whatever one's opinion of how English orthography has coped with the morphophonemic principle, it is the spelling system we have and it brings ramifications for literacy learning and instruction that need to be considered carefully.

Relevance of Orthographic Structure for Research on Learning to Read

Researchers have found that MA is mediated partly through the degree of phonological shift that occurs between morphologically connected words. Derivations in which little or no sound shift occurs (e.g. ***mouth***/***mouth****ful*) are considered morphologically transparent in terms of phonology while derivations such as ***heal***/***heal****th* or ***do***/***do****es* are more morphologically opaque due to shifts in pronunciation. *Opaque* words are also referred to as *shift* words (Carlisle, 2003). It is worth noting that in linguistics, the terms *opaque* and *transparent* are absolute terms that do not denote gradations of clarity (Crystal, 1989). I use these terms as applied in the reading literature, in which morphological derivations can be considered more or less opaque, based on shifts of linguistic features between morphologically related forms.

A second source of morphological opacity is orthographic shifts between related words due to suffixing patterns. For example, noting the connection between ***carry*** and ***carri****age* may be hindered in part by the spelling shift resulting from the suffixing conventions for *y/i* changes. The *word sum* is a linguistic tool that shows the written morphological structure of words, and which effectively reveals the spelling shift between such derivations (e.g., ***carry/i***+*age*→ *carriage*). The third source of morphological opacity is semantic shifts, which refer to the clarity of meaning connections between related forms. For example, while transparent phonologically and orthographically, the semantic link between ***help*** and ***help****ful* seems more transparent than that between ***sign*** and *as****sign****ment*.

Not surprisingly, researchers have shown that more transparent morphological relationships (little or no phonological, orthographic, or semantic shift) facilitate awareness of morphological cues (Carlisle, 2003). Conversely, these shifts between

morphologically related words are common features of the English language that inhibit MA, and therefore limit the potential for children to make use of this linguistic awareness to support their reading and writing skills (Carlisle, 1988, 2003).

Is There Evidence of a Relationship Between MA and Reading?

It has long been recognized that young children show implicit, uninstructed awareness of morphemes. Berko (1958) showed that preschool children apply morphological rules to pseudowords, such as producing ***wugs*** as the plural of a ***wug***. Reading researchers ask whether this type of awareness contributes to the process of learning to read. Carlisle (2000, p. 170) argued, "Morphological awareness, as it contributes to reading, must have as its basis the ability to parse words and analyze constituent morphemes for the purpose of constructing meaning." If this view is correct, then those with stronger morphemic awareness should be stronger readers. Carlisle (2000) tested this hypothesis with 8- and 11-year old children by measuring their morphological awareness with three tests and then relating the results to reading comprehension scores. The three tasks included morphological decomposition and production tasks, morphological problem solving tasks based on Anglin (1993), and the reading of morphologically complex words. Carlisle found that performance on these tasks accounted for 43% of the variance in reading comprehension for third graders and 55% for fifth graders. While compelling, this study failed to control for variables such as PA, intelligence, or vocabulary.

Mahony, Singson and Mann (2000) investigated this relationship with 98 children in Grades 3-6. To measure MA they used a judgement task that asked children to distinguish morphologically related word pairs (*allow-allowance*) from foil pairs (*ill-illegal*). Controlling for vocabulary and phonological awareness, Mahony et al. found morphological awareness accounted for about 5% of the variance in reading ability, while phonological

awareness uniquely contributed 13%. The authors pointed out the similarity of their results to those of Shankweiler et al. (1995) despite the differences in their methods. While Mahony et al. looked at students in Grades 3-6 and controlled for vocabulary and phonology, Shankweiler et al. focused on Grade 3 and controlled for general intelligence. Their morphological tasks also differed. Shankweiler et al. used a production task while Mahony et al. used a judgement task. Despite these differences, both studies found morphological awareness contributing about 5% of the variance while phonological awareness remained in the 10% - 15% range.

Results from longitudinal studies, and from studies using more stringent controls, provide even more compelling evidence that MA contributes unique variance to children's literacy development. Deacon and Kirby's (2004) 4-year longitudinal study (Grades 2-5) found that MA made a significant contribution to reading even 3 years after the measures were taken. Further, this relationship survived controlling for PA and verbal and non-verbal intelligence. Other longitudinal studies have also shown MA as a unique contributor to literacy skills (e.g., Carlisle, 1995; Carlisle & Flemming, 2003). A recently completed study with 182 grade 3 students (Roth, Lai, White & Kirby, 2006) found that MA provided unique variance to a variety of reading measures after controlling for verbal and nonverbal intelligence, PA, naming speed, and orthographic processing. After controlling for all of these variables, measures of reading speed, reading accuracy, and decoding were all uniquely predicted by MA. Passage comprehension showed the strongest result, having 8% of its variance accounted for by MA after controlling for all five variables described.

While these studies provide growing evidence that MA is an important linguistic knowledge that supports literacy, it is still possible that differences in reading skill associated with MA are in fact the results of other underlying factors such as phonological

skill. In a study of second to fourth grade readers using an oral morphological production task, Fowler and Liberman (1995) found that only the ability to solve phonologically complex items separated the stronger and weaker readers as measured on tests for word recognition and decoding of pseudowords. Using an oral task, Windsor (2000) also found that it was performance on derived words with phonological shifts that predicted reading achievement. These researchers concluded that differences measured in MA were in fact dependent on differences in PA. Carlisle (2003) argued that care needs to be taken before these results are used to conclude that phonology is a relevant variable but morphology is not. She pointed out that both of these studies used oral morphological tasks. It is not surprising that weaknesses in PA would affect performance on oral tasks, a result corroborated by other research (e.g., Roth, Lai, White & Kirby, 2006). Such tasks demand phonological processing to recognize morphological connections between words in which a phonological shift distorts the pronunciation of the base (e.g., ***real*** + ity → ***real***ity). In opaque words, it is the *written* domain – with consistent representation of the base – that offers the clearest morphological marker. On an oral morphological decomposition task with junior high students, Carlisle (1988) found that children had more difficulty with words that underwent both orthographic and phonological changes (e.g., ***decide, decis****ion*) than words that underwent only phonological changes (e.g. ***magic***, ***magic****ian*). She concluded that exposure to written words may support much of the learning of morphological relationships.

This summary of the literature suggests that one feature of MA that needs to be considered carefully is the distinction between oral and written measures of MA. Researchers often measure morphemic awareness through oral tasks (e.g. Elbro & Arnbak, 2000; Windsor, 2000) in order to avoid confounding morphological knowledge with variables such as orthographic knowledge and reading ability. However, as emphasized by

Carlisle (2003) and Elbro and Arnbak (2000), the consistent orthographic representation of morphemes may bring particular benefits for reading. If readers are to benefit from MA, particularly in morphologically opaque words, it is likely that they would gain from being able to recognize how written morphemes convey meanings and connections of meaning between words, regardless of shifts in pronunciation.

It is also noteworthy that the role of MA has been studied in a context where students receive more instruction (formal or informal) on letter-sound correspondences than on the morphological structure of words. Few teachers are equipped with knowledge to support morphological instruction (Carlisle 2003; Henry, 1993, 2003). Given that phonics receives more attention than morphological instruction in our morphophonemic language, findings regarding a link between MA and literacy skills may be conservative. Research should not just consider the effects of MA in the typical instructional context. We do not yet know the role of MA for literacy development (or even that of PA), when children learn how to read in an instructional context that emphasizes explicit, systematic instruction about the ordered way morphology and phonology are represented in our orthographic system.

The Structure of English Orthography and Instruction

Reading and spelling instruction focused on (but also limited to) common letter-sound correspondences proved superior to whole language instruction that avoided instruction of sub-lexical features of oral and written language. However, phonics by itself misrepresents fundamental aspects English orthography. “English orthography is not a failed phonetic transcription system, invented out of madness or perversity. Instead it is a more complex system that preserves bits of history (i.e., etymology), facilitates understanding, and also translates into sound” (p. 4, Venezky, 1999). Many words that follow predictable patterns of the orthography system can only be presented as irregular

spellings by strictly sound-based literacy instruction. Teaching words as if they are irregular offers no generative insight into underlying patterns that drive the workings of the writing system, or footholds for vocabulary development. For example, although the word *sign* is irregular in terms of common letter-sound correspondences, it is a particularly a useful hook for the teacher trying to engage students with an understanding of how the writing system works. He or she can use this word as an example of the building block nature of morphemes, and the relationship between written morphemes and pronunciation. Faced with the opaque word *sign,* with its seemingly arbitrary letter *g,* a teacher can ask his or her class to consider the word created by adding the *–al* suffix to this base. The word *signal* does pronounce the *g* grapheme and is clearly related in meaning and spelling structure to its base *sign*. Clarifying the ordered meaningful and structural reasons for the letter *g* in the word *sign* likely facilitates students' memory for how to read and spell this word more than simply telling students to keep practicing writing this irregular word until they remember it. Perhaps more importantly, studying the structural spelling/meaning connection of common derivations with phonological shifts (irregular words in phonics) helps children see the workings of English spelling as described by linguists such as Venezky, Chomsky and Pinker. The ***sign****/****sign****al* connection also provides the context for further orthographic and vocabulary instruction. A teacher can draw attention to common suffixes (sub-lexical units that inform countless words) in a lesson that has his or her class build a large family of words built on this base. Such a list of words could include ***sign****ature*, *de****sign***, *de****sign****ate*, *re****sign*** and *re****sign****ation.* The structure ***sign*** + *ate*/ + *ure* → ***sign****ature* can be used to spark interest in studying patterns for orthographic shifts, another source of morphological opacity. Why is the *e* of the *–ate* suffix replaced by the *–ure* suffix? This question can lead to investigations helping

students to understand that vowel suffixes (but not consonant suffixes) replace the final, single, silent *e* of stems to which they are added. Linking letter patterns of words to consistent structure and meaning may support a child's memory for reading and spelling. Instead of presenting words like *sign*, *does,* or *business* as irregular spelling that learners have to put up with, common opaque words like these provide productive entry points for making sense of the complex, but ordered English spelling system. As Venezky (1999) noted, "English orthography suffers abuse and scorn from those who see it for what it is not and probably was never intended to be" (p. 10).

In no way does the preceding diminish the key role of direct, explicit phonological instruction that shows children common grapheme-phoneme correspondences. This type of instruction brings important benefits to children's literacy, as evidenced by the success of phonics instruction over whole language (Adams, 1990). However, typical instruction that points to phonological patterns, but provides little emphasis on morphology leaves a gap between the structure of English orthography and instruction of the written word. This gap of linguistic knowledge in schools represents an important target for educational research. "Beginning with phonology, but moving on quickly to include syntax, semantics, and morphology as well, psychologists have established a now undoubted link between what children know about spoken language and their ability to read and write" (Bryant, 2002, p. 200).

This line of inquiry raises the important theoretical and practical issue of the potential for students with deficits in PA to use MA as a compensatory strategy for literacy development. However, the view that MA can act in such a way needs to account for the fact that students with reading difficulties are frequently found to have deficits in both phonological and morphological processing. For example, a number of studies (e.g.,

Carlisle, 1987; Deacon, Parrila & Kirby, 2006; Elbro, 1990; Leong, 1989) showed that dyslexics are poorer than normal controls at deriving and inflecting words in oral tasks. Carlisle, Stone, and Katz (2001) found that 10- to 15-year-old poor readers had particular difficulties making accurate morphological judgments in derivations with phonological shifts as compared to normal readers of the same age. As discussed earlier, some researchers (e.g., Fowler & Liberman, 1995; Windsor, 2000) have suggested that since many students with poor PA also show weaknesses in MA skills, any MA deficit is really attributable to problems in phonological processing. To provide a compensatory strategy, MA needs to be a linguistic resource that can act independently of PA, at least to some extent. The complex relationship of morphology and phonology complicates the problem of understanding whether, and to what extent MA and PA are distinct constructs. Recent factor analysis by Roth, Lai, White and Kirby (2006) provides evidence of MA as a unique construct, distinct from PA and other reading-related skills.

It is also important to keep in mind that phonological shifts in morphologically related words inhibit MA for both skilled and poor readers. Similarities and differences between normally developing and poor readers with respect to MA and PA make it difficult to unravel these linguistic awarenesses. Arnbak and Elbro (2000) provided one way of clarifying this picture when they suggested that the frequent co-occurrence of poor PA and MA might have a more indirect explanation. They argued that perhaps the reading difficulties resulting from PA deficits lead to less written language experience. As a result, dyslexics have less opportunity to become proficient at noting morphological cues in opaque words. Reading experience rather than PA may be the more direct source of their poor written MA. This view is consistent with the finding in their training study (2000) that there was no significant correlation between the severity of dyslexic students'

phonological deficits and their gain in morphological awareness.

Intervention studies are needed to find answers to questions at the heart of this research. Does MA account for unique variance in literacy development? Would explicit instruction about morphological structure and its relationship to phonology bring differing effects to strong and weak readers? So far, only a handful of intervention studies have addressed these questions (e.g., Arnbak & Elbro, 2000; Nunes, Bryant & Olsson, 2003, Nunes & Bryant, 2006). These studies provide modest, but promising findings with regards to word reading, comprehension, vocabulary and spelling.

Nunes, Bryant and Olsson (2003) used an experimental group (n = 218) and a control group (n = 237) to look at the effect of morphological and phonological training with 7- and 8-year-old children. The control group continued with typical literacy instruction. The experimental group was divided into four roughly equal groups of about 55 students. Each group received distinct types of instruction conducted in small groups of 5 to 8 children. Participants received either: morphological training alone, morphological training with writing, phonological training alone, or phonological training with writing. The only distinction in content and activities designated by the labels *with writing* or *alone* was whether or not the rules taught were instantiated with writing. The intervention taught about word stems and grammatical categories in relation to inflectional and derivational affixes and emphasized the effect of affixes on word meanings. For example, they taught how an agentive suffix such as *–ian* indicates that a ***music****ian* is a person who plays ***music***. This is an example of instruction helping children note morphological connections between phonologically opaque words.

All four experimental groups performed better on the Schonell Word Reading Test (Schonell & Goodacre, 1971) than the control group. This test assesses children on

increasingly long and unfamiliar words out of context. Differences did not reach significance on the Schonell Spelling Test (Schonell & Goodacre, 1971). On experimental tests of spelling derivational suffixes and stems in pseudowords, *only* the morphology with writing group out performed the control group. These positive results support the view expressed by a number of researchers (e.g. Carlisle, 2003; Henry, 1988; 1997), that morphological instruction is important particularly for success with learning to read and spell the longer, more morphologically complex words that children encounter more and more as they move through elementary school. Also, this intervention showed that with only 12 sessions it is possible to use oral or written morphological training to improve word reading skills and knowledge of morphologically based spelling rules.

Arnbak and Elbro's (2000) intervention with Danish dyslexic students in grades 4-5 looked at the effect of morphological instruction on a treatment group (n = 33) compared to a similar group of untrained students (n = 27). The experimental group received 36 lessons, each about 15 minutes long from their regular remedial teacher during the time when they would otherwise receive typical remediation classes. The control group received non-morphological training in similar small group settings. The morphological training focused on semantic aspects of morphologically transparent words and was conducted orally. This means that the control groups actually experienced more written language instruction in their typical remediation instruction.

Arnbak and Elbro used a large battery of 17 tests in order to have a variety of outcome measures for MA, reading, PA, spelling and control measures of verbal short-term memory and non-verbal intelligence. There was a modest effect of training, with two of the four MA measures showing significant differences in favour of the experimental group. There was a stronger effect on spelling. All spelling measures, including those for

compounds and derived words, were significantly affected by the training. This finding is particularly striking considering the morphological instruction was oral and the control group continued with typical remedial instruction that included written practice. It is also interesting in light of the fact that in Nunes, Bryant and Olsson's (2003) study, only the instruction that included written instruction had a significant affect on spelling compared to controls. These studies need to be compared cautiously. Arnbak and Elbro taught transparent words while Nunes, Bryant and Olsson taught with opaque words. Also, grammar and morphology play a similar role in English and Danish, but English orthography is still considered to be deeper (Juul & Elbro, 2004).

Arnbak and Elbro found that their experimental group showed a larger gain in reading comprehension than controls. This finding supports the call for the introduction of more explicit morphological instruction in elementary schools as a way to boost reading comprehension (e.g., Carlisle, 2003; Henry, 1988; 2003). "Without recognizing the value of syllabic and morphological patterns...the student is constrained from using clues available to identify long, unfamiliar words" (Henry, 1993, p. 105-106).

Arnbak and Elbro's results also highlighted distinctions between MA and PA. Their instruction brought modest gains in MA, but similar gains for PA were not found. Also, they found no significant correlations between the severity of dyslexics' phonological deficits and their gains in MA. They concluded that awareness of morphemes can be trained independently of other linguistic awarenesses such as PA.

A recent study with (Nunes & Bryant, 2006) provides further evidence that morphological instruction brings benefits to the literacy of children, and shows that teachers can be trained to implement such a program effectively in a short amount of time. For their study, 17 teachers volunteered for a 10-session literacy course supporting

morphological instruction in their classrooms (grades 3 to 6). The 318 students of the teachers who took this course made significant gains in spelling compared to 346 students from similar classrooms that received standard instruction. Before the intervention, the groups were compared on an experimental spelling test. Only in Grade 3 was there a difference, in favour of the control group. The effect size of the instruction was .50, which the authors note was impressive for a whole-class intervention conducted by teachers learning a new technique. Although teachers who volunteer for such a project should not be regarded as a representative, these results do show that at least some teachers can be trained in morphological instruction in a relatively short time, with the result of improved literacy skills for students.

The evidence from this research suggests that MA is a linguistic awareness of significant educational importance. Correlational and longitudinal studies show that MA makes a modest but significant unique contribution to reading and writing skills after controlling for a variety of variables associated with literacy development (e.g., Carlisle, 2000; Carlisle & Nomanbhoy, 1993; Deacon & Kirby, 2004; Fowler & Liberman, 1995, Roth, Lai, White & Kirby, 2006; Singson, Mahony, & Mann, 2000). Further, each of the intervention studies I have been able to identify brought benefits to children's literacy. Intervention studies investigate not only whether instructed MA offers benefits for literacy, but also may address whether some children benefit more than others. Finally, evidence from studies that also provide an effective model of morphological instruction in the typical classroom setting is of particular interest to educators. With these points in mind, the current intervention study addressed the following research questions.

Research Questions

1) Does instruction about written morphological structure and its relation to the representation of phonology in English orthography affect literacy skills, and how far does any effect extend?
2) Is the effect of this instruction moderated by initial reading ability?

Study Overview

Morphological knowledge developed through explicit, systematic classroom instruction may bring benefits unavailable through typical instruction. Grade 4 and 5 classes were recruited to help test this possibility. The experimental group received instruction designed to target morphological opacity resulting from phonological, orthographic and/or semantic shifts that inhibit uninstructed MA (Carlisle, 2003). The control group continued with regular literacy instruction.

The current study differs from those of Arnbak and Elbro (2000) and Nunes, Bryant and Olsson (2003) by conducting instruction in the regular classroom instead of in small groups. The Arnbak and Elbro study was in Danish and used oral morphological instruction of words selected for phonological transparency. In contrast, the current intervention taught how English employs consistent written morphological representations despite phonological shifts. Previous interventions focused on studying specific features of oral and/or written morphology. For example, Nunes, Bryant and Olsson emphasized specific suffixes such as *–ian* and their semantic and phonological effect when used on a base like *magic.* In contrast, the current intervention targeted full morphological analysis, rather than the teaching of specific affixes. The current study taught the conventions for the three suffixing patterns, the role of *bound bases* such as

rupt for ‘break’, and *twin bases* such as *struct/stroy* for ‘build’. To my knowledge, the depth of morphological instruction in the current intervention is unique.

Another important distinction between the current and previous interventions is the emphasis on a problem solving approach. Instead of treating specific words, prefixes, suffixes, and bases as the main content of the instruction, morphologically complex words and morphemic units provided the context needed to focus students’ attention on the morphological conventions of the English orthography. The typical classroom setting was used in order to evaluate whether this level of morphological instruction could be effectively presented in a realistic school setting. In essence, the current study investigates the question: *Can morphological transparency be added to morphologically opaque words through classroom instruction and, as a result, support children’s literacy development*?

Chapter 2: Method

Participants

This study was conducted with two Grade 4 classes and two Grade 5 classes from two public Catholic schools in and around the area of Kingston, Ontario. One school was in a suburban neighbourhood and the second was in a nearby small town. The sample (N = 84) included a treatment group (n = 38) and control group (n = 46) assigned by coin toss with the constraints that each included one Grade 4 and one Grade 5 class, and that both groups had a class from each school. Pretest reading and reading-related measures showed no significant differences between groups prior to instruction (see Table 2 in the Results chapter). All the parents from the four classes received letters of information (Appendix A 1). Students who returned signed consent forms (Appendix A 2) participated in the testing. Data from students designated by the school with a learning disability, language impairment, or autism were excluded from the analysis.

Of the 110 students in the 4 classes, 94 handed in signed permission forms (85%). Of those with signed forms, one student moved before post-test, and nine were dropped from the analysis due to the learning difficulties described above, leaving the final sample size of 84 from 100 students who met inclusion criteria. While only students with signed permission forms participated in the testing, all students in the treatment classes participated in the intervention lessons, which were treated as a part of the core literacy curriculum by the school. This arrangement helped the intervention reflect the realities of a typical classroom. Teachers expected all students, with or without signed forms, to participate in the lessons, assignments, and quizzes that made up the intervention. The only distinction between students who did and did not have signed forms was participation in the pre- and post-tests.

The description of testing procedures and details of the measures used for the intervention are presented in chronological order. First the testing procedures used at pre-test are described, followed by a detailed account of the pre-test measures. Finally, the procedures and measures used at post-test are described.

Procedure for Testing at Pre-Test

In the three weeks prior to instruction for the treatment group, participants were assessed on a battery of general mental ability, MA, and other reading-related measures. The three trained testers (including the author) assessed participants from the four classes during the same time period to avoid order effects. The assignment of classes to control and experimental conditions occurred at the end of testing so that testers did not know which students would be in the treatment group. Pre-tests were divided into those that were to be administered individually or in whole class conditions. Pre-tests for individuals were administered during the regular class time in a quiet room at the participant's school. Group tests were conducted during class time in the participants' classroom. Completing the individual measures took approximately 50 – 60 minutes, and was usually conducted over two sessions. The group tests were finished in one session of approximately 30 minutes. For group tests, students were arranged in rows and instructed by the examiner and classroom teacher to treat these tests with the same seriousness as the standardized tests they had taken in the province-wide Grade 3 testing. A trained examiner led the group tests, with the classroom teacher and at least one other teacher's aid or additional examiner in the room to minimize distractions.

Pre-Test Measures

This study employed 18 control and outcome measures over the pre- and post-test periods: one verbal intelligence, two PA, two naming speed, four reading, two spelling,

two orthographic processing, two oral MA, two written MA, and one arithmetic measure. All pre-test measures were used to compare the treatment and control groups prior to instruction and/or as part of the aptitude-treatment regression analyses. Four pre-test measures were also included in the post-test battery as outcome measures. All tests used in the study are listed in Table 1. This table indicates when each test was used, its length, status as a control or outcome measure and other details. In the next section, a brief description of all pre-test measures is offered; the final section contains a description of the post-test procedures and measures.

Verbal Intelligence

The Peabody Picture Vocabulary Test III (Dunn & Dunn, 1981). This test is used as a measure of both receptive vocabulary and verbal intelligence. For this study it is referred to as a test of verbal intelligence. In this task, a vocabulary word is presented orally to the child who is asked to point to one of four pictures that best represents the meaning of the word. Two practice pages were used to make sure children understood the task. Following instructions from the manual, examiners started Grade 4 students on item 73 and Grade 5 students at item 85. The basal rule of no errors in a set of 12 items was used, and the examination was ended when a participant made eight or more errors in a set. Examiners noted responses on a record sheet while the subject pointed to their choices in the booklet. The maximum number of items on the test is 204, but the highest item a participant reached was 192. The score was the total number of correct responses, plus credit for the items before the first error free set. The alternative forms reliability coefficient is .91 for 10-year-olds on this task.

Table 1

Table of Measures: Testing Time and Type

Measure	pre-test	post-test	Time (min.)	setting	Test Type	Analysis
Phonological Awareness (CTOPP)						
Blending and Elision	X		10	I	NE	C
Naming Speed (CTOPP)						
Digits and Letters	X		2	I	NE	C
Receptive Vocabulary (PPVT-3)	X		10	I	NE	C
Word Reading Accuracy (WID)	X	X	10	I	NE	C/O
Word Reading Speed (TOWRE)		X	2	I	NE	O
Reading Comprehension						
Subtest of Gates--MacGinitie	X		20	G	NE	C
Spelling (WRAT)	X	X	5	G	NE	C/O
Arithmetic (WRAT)	X	X	5	G	NE	C/O
Orthographic Processing						
Orthographic Choice		X	1	G	NE	O
Word Chains		X	1	G	NE	O
Oral Morphological Awareness						
Morphological Analogy		X	5	I	NE	O
Morphological Production		X	5	I	NE	O
Written Morphological Awareness						
Morphological Choice	X	X	5	I	E	C/O
Base Identification		X	7	I	E	O
Spelling Choice		X	5	SG	E	O
Reading MA		X	7	I	E	O

Note. I = individual tests; G = group tests; SG = small group tests; E = experimental test; NE = non-experimental test; C = control measure; O = outcome measure

Phonological Awareness

Word Blending – Comprehensive Test of Phonological Processing (CTOPP), (Wagner, Torgesen & Rashotte 1999). In this task, discrete sounds (e.g., /c/a/t/) are presented to a child who is asked to say the word they form. Although this task is usually conducted with an audio recording, the examiner pronounced the individual sounds orally. Feedback was provided for the practice items, and the first three test items only. The test was discontinued if three consecutive errors were made. If the participant requested, the examiner was allowed to repeat the word segments once. The score was the number of correctly answered test items. For 10-year-olds the reported alpha reliability coefficient for this task is .87.

Elision – Auditory Analysis Test (AAT), Adapted from Rosner & Simon (1971): shortened version (Newby-Clark & Bowers, 1998). For this task, a child is presented with a word and asked to say it after dropping a given sound (e.g., say *belt* without the /t/). In each case, removing the identified unit of sound led to the pronunciation of a real word. The task used 27 items in order of increasing difficulty. The score on the test was the total number of correct responses. A stop rule after 10 errors was applied. The Cronbach alpha reliability coefficient on this task was .82.

Naming Speed

The Rapid Digit and Rapid Letter Naming Speed Subtests of the CTOPP (Wagner, Torgesen & Rashotte, 1999). This task was administered first with letters, then after an unrelated reading task, the digit form of the test was given. The examiner presented the participant with 4 lines of 9 letters (or digits) on a printed page. Children were asked to name the letters (or digits) as fast as possible without error. Feedback was only provided for the practice items, which consisted of one line of digits or letters before beginning the

test. There was no stop rule and the score was the number of seconds the participant took to name all the letters or numbers. If a participant skipped, or named the digit or number incorrectly, the item was marked incorrect; however, no accuracy score was used. Nine participants made one error. One participant made two digit errors, and one reversed the order of two letters. One participant made two digit and two letter errors. The alternate-form reliability coefficient for 10 year-olds is .90 for Rapid Digit Naming and .86 for Rapid Letter Naming.

Reading Measures

Word Identification Subtest of the Woodcock Reading Mastery Tests – Revised, Woodcock [Form G] (Woodcock, 1998). This is a non-timed test using 106 words presented in sets of up to nine words on a page in order of increasing difficulty. Following instructions from the manual, Grade 4 students began on the 47th item, and Grade 5 students on the 56th. The participant was asked to read the words on each page in the booklet out loud. If the participant did not get six words in a row correct on the first set of items, the examiner went to the previous page until six words in a row were read without error. The test was discontinued after six consecutive errors. The score was the number of correct responses plus credit for earlier items not administered. This task has a split-half reliability coefficient of .97 for 10-year-olds. This measure was also used as an outcome measure at post-test.

Reading Comprehension Subtest of the Gates—MacGinitie (MacGinitie & MacGinitie, 1989). In a group setting, subjects were presented with a booklet containing a series of passages, each followed by multiple-choice questions. Subjects recorded answers about the content of the text by filling in the letter, which was paired with the correct answer on a separate answer page. The process of marking multiple-choice

answers was modeled using the practice passage and multiple-choice questions provided with the test booklet. Subjects had 20 minutes to silently read and answer as many questions as they could. As this task was only used to compare the two groups at pre-test the normal test time for this measure was reduced from 30 minutes to 20 minutes as a way to reduce the overall time taken by the pre-test. The KR-20 reliability coefficient for Grade 5 and 6 students is .91.

Spelling Subtest of the Wide Range Achievement Test (WRAT) (Wilkinson, 1993). This test was used both as a control and outcome measure. In this spelling dictation test, a list of progressively more difficult words was read aloud to children who wrote their spellings on a page formatted for the test. This test is normally administered individually and uses a stop rule after six consecutive errors. To minimize the overall testing time for students, this task was administered in the group setting, and students asked to do their best on all of the words, even the most difficult spellings. Students were scored on the correct spellings of words up to the point where they made six consecutive errors. The Cronbach alpha reliability coefficient for this test is .88.

Morphological Awareness

Morphological Choice. This was an experimental measure of written MA designed specifically around the instruction, and is the one measure of MA used at both pre-test and post-test. In the individual testing setting, participants were presented with a cue word followed by a row of six words that were either from the same morphological family (built on the same base), or foil words using a similar spelling pattern but without a morphological link. Testers explained the task with this scripted introduction:

> This activity is called "Find the **Real** Connection". You may have noticed how some words are connected to other words of the same meaning. For example

> (pointing to examples), the words **helpful** and **helps** are connected through the more basic word 'help'**.** These words all have a "real" connection to each other because their **meanings** are connected. For this activity, the word **playful** couldn't have a "real" connection to the others because it doesn't connect to the meaning 'help'.

The instructions were scripted to avoid using the terms *prefix*, *suffix,* or *base*, but to make it clear that connections of affixes were not enough to indicate a morphological, or what the testers called "a *real* connection" for this task.

Participants who were better able to identify real morphological connections, and to avoid being fooled by foil derivations, were judged to have more developed written MA. Thus, circling a word morphologically related to the cue word earned one point, as did avoiding circling morphological foils. For example, one of the 13 items used the cue word *real* followed by the words: *cereal, ideally, reality, unreal, nearly,* and *realization*. The student who circled the morphologically connected words *reality, unreal,* and *realization* but not the foils, scored a perfect score of 6 out of 6 for this item. The task included 13 cue words, each with six words to choose from, leaving the subject with 78 choices to make. From 2 to 5 of the 6 words that followed the cue words were targets, for a total of 39 target words and 39 foils. A copy of the task and further description of how it was administered are in Appendix B 1. The Cronbach alpha reliability calculated for this measure was only .4. A discussion of this low measure of reliability is provided in the Results chapter.

Arithmetic

Arithmetic Subtest of the Wide Range Achievement Test (WRAT) (Wilkinson, 1993). This test was used both as a control measure at pre-test, and as a post-test outcome

measure to establish whether any gains that might result from the intervention were confined to the area of literacy. This group test starts with very simple arithmetic questions such as 1 + 1, but becomes progressively more difficult quickly. Students had 15 minutes to solve as many questions as they could. A student's score was the number of correct answers until they made five errors in a row. The Cronbach reliability coefficient for this test is .85.

Procedure for testing at post-test

There is an important distinction regarding the administration of pre- and post-test measures that needs to be highlighted. Since the author was also the instructor of the intervention, and had developed a relationship with the students in the treatment group, he did not administer any of the post-test measures. Another graduate student was hired as an additional examiner to help conduct the post-tests along with the two other pre-test examiners. The only interaction between the post-test examiners and subjects was during testing. Various strategies were used to keep the examiners blind to students' status as control or treatment participants. For example, the examiners tested children in small rooms away from the classrooms. Classroom teachers alternated randomly between sending training and control students to be tested. In other respects the procedures at post-test mirrored those of pre-test as much as possible. One small distinction was that one experimental measure, Spelling Choice, was administered as a small group test to groups of 3 to 8 students at a time in a quiet room in the school.

Post-test measures

Tests administered as post-tests are shown in Table 1. Tests that doubled as pre- and post-test measures were administered as similarly as possible at both times and thus will not be described again in this section.

The outcome measures were planned in an effort to obtain a clear picture of the boundaries of any effect of instruction on the treatment group. With this purpose in mind, post-test measures included experimental and non-experimental measures. The experimental measures were designed specifically around the words taught in the intervention. In this way, measures could assess the effect of instruction along a continuum of transfer from near (words explicitly taught in the intervention) to far (words not taught in the intervention). Non-experimental outcome measures were tasks taken from the existing literature that were not adapted to the specific instruction of the intervention, and thus served to assess any evidence of more distant transfer.

Non-Experimental Measures

Sight Word Efficiency: Test of "Word Reading Efficiency (TOWRE – Form A), Torgesen, Wagner, and Rashotte (1999). The subject was shown a list of 104 words, listed in order of increasing difficulty (e.g., from *is* to *transient*), and asked to read aloud as many words as possible in 45 seconds. The score was the number of correct responses read in the given time frame. A practice page with eight words preceded the test. The alternate-form reliability coefficient for the TOWRE is .95 for 10-year-olds.

Orthographic Choice, Kirby, Deacon, Parrila, and Wade-Woolley (2004-2007). Thirty pairs of irregular words and their pseudohomophones (e.g., answer – anser) were presented on a printed page. The subject was asked to indicate the correctly spelled words in the pairs by circling them as quickly and accurately as possible in one minute. This task was administered to class-sized groups. The score was the number of correct responses minus the number of incorrect responses, to correct for guessing. Items for this task, selected from the word pairs in the Orthographic Coding Task used by Olson, Forsberg, Wise and Rack (1994) are shown in Appendix B 2.

Wordchains, Kirby, Parrila, Curry, Sidhu, & Wade-Woolley (August, 2003). Eleven lines of print were presented to participants on a sheet of paper in the group setting. Each line consisted of unrelated words with no spaces between them. Fifty-one words in total were presented. The participant was given one minute to put slashes showing the location of missing spaces (e.g., *toydogcar* → *toy/dog/car*). The score was the number of correct lines drawn minus the number of incorrect lines and omissions up to the point where the participant stopped. The split-half coefficient with Spearman Brown correction was .888. The instructions and task are shown in Appendix B 3.

Word Analogy, Kirby et al. (2004-2007). This oral task was administered individually. Subjects were asked to provide a missing word based upon a morphological pattern from another set of words. For example, the examiner introduced the activity with a practice item saying, "I say *push* and then I say *pushed*; then I say *jump*, so then I should say _____? (*jumped*). First, six practice items were presented with the examiner giving feedback to ensure the subject understood the activity. After the practice, the 20 test items were administered without any feedback from the examiner. Both the practice and test items included inflections, derivations and also phonologically transparent and opaque forms. The test began with the ten inflection items, and followed with ten derivation items. There was no stop rule. The Cronbach reliability coefficient for this task was .714. The items are shown in Appendix B 4.

Morphological Production. This task, based on Carlisle (2000), was designed to assess subjects' awareness of connections between bases and derived forms. The task was divided into derivation and decomposition tasks. In the derivation task, a base word was presented orally to the subject, followed by a sentence with a missing word. The subject was asked to alter the word so that it matched the sentence. The correct answer was a

derivation of the base that was given. For example, one derivation task was, "**perform**. Tonight is the last _____."(*performance*). The process was the same for the decomposition task. The subject was asked to alter a word so that it fit a sentence that was presented orally. This time, however, the correct answer was to change the derivation into its base form. For example, "**dangerous**. Are the children in any ____?" (*danger*). Both opaque and transparent forms were in both the derivation and decomposition tasks. The score was the number of correct responses. There was no stop rule. All the items are presented in Appendix B 5. The Cronbach reliabilities for these tasks were quite low. The coefficients for the derivation and decomposition tasks were .435 and .386 respectively. Non-standardized measures that had to have their reliabilities measured at post-test have the problem that half of the sample has been taught morphological knowledge. The reliability of the Word Analogy task was calculated under the same circumstances, but was not similarly low. The Word Analogy task, however, is less similar to the instruction than Morphological Production, and it relies on analogical reasoning to some degree. It may be that the effect of half the sample being taught morphological analysis had a greater impact on the reliability of the Morphological Production tasks than it did on Word Analogy. Conclusions from the two Morphological Production Tasks need to be drawn with some care.

Experimental Measures

Reliabilities for all experimental measures were calculated and are provided in Table 9 in Appendix E. Four experimental measures were used at post-test. As indicated above, the experimental measures were designed around the words taught in the intervention. All experimental measures used an equal ratio of three categories of word. Each word type addressed a different level of instructional transfer: *Word Taught* (near

transfer), *Base Only Taught* (medium transfer), *Affixes Only Taught* (far transfer). Appendix B 9 lists all of the words used for each measure sorted by word type.

The unique status of Morphological Choice as an experimental measure at both pre- and post-test requires clarification regarding the use of these word types. At pre-test, neither the control nor the experimental group had received explicit instruction in any of the words used in Morphological Choice. The words for that task, however, were chosen with the planned lessons in mind. At post-test the 39 target words already described were made up of 13 words of each type. The definitions of these word types that were used for each experimental measure are explained in detail below.

1) *Word Taught*: This first category of word looked for evidence of the nearest transfer. Words of this word type were explicitly taught during the intervention. Inclusion criteria for this category were that the exact word had been included on one of the written assignments children worked on and/or that the instructor had addressed it explicitly in the course of a lesson. During the intervention, if a word appeared on a page handed out to the child, if it was on an overhead, or posted in the classroom, it was considered to be of the *Word Taught* category for the testing. This includes words that were not presented in full form, but could be created by the student from a word matrix presented by the teacher. See Figure 1 for examples of word sums and word matrices.

2) *Base Only Taught*: This category describes words with bases that were taught explicitly during lessons, but never in the specific derivational form used on the experimental test. The bases and affixes used in *Base Only Taught* words received direct instruction, but never in the specific combination needed to form the word in question. For example, the word *condensed* uses the base *dense*, the prefix *con-* and the suffix *–ed* (*con+dense/+ed* → *condensed*). As a *Base Only Taught* word, each of these morphemes

was taught in relation to a variety of words, but these two affixes were never combined simultaneously with the base *dense* during instruction. This category represented a level of transfer beyond *Word Taught* words. To demonstrate a gain from instruction on these words, students would have to apply knowledge of bases, affixes, and perhaps suffixing patterns, gained with instructional support, to a word that was not explicitly taught.

Word matrix for the base *sign*

a

	re as	**sign**	al ing ed ment ify	
re	de		ate	ure

Word sums from *sign* matrix

b

sign + al ⑧ signal
sign + ify ⑧ signify
as + sign ⑧ assign
as + sign + ment ⑧ assignment
de + sign ⑧ design ⑧ design
de + sign +ate ⑧ designate
sign + ate/ +ure ⑧ signature

Word web on the base *sign*

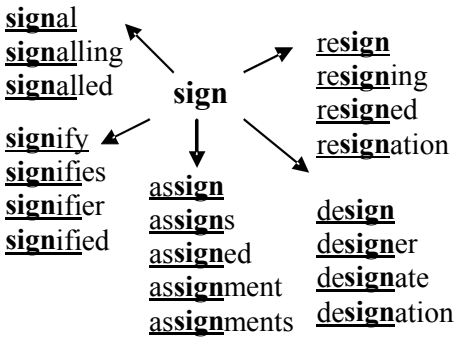

Figure 1 a, b, and c. Instructional tools for morphological structure: a) Word matrix (Ramsden, 2001); b) the word sum; c) the word web (Ramsden, 2001). In the word web, the base is shown in bold and the stem for each branch of the web is underlined.

3) *Affixes Only Taught*: Words of this category include affixes (prefixes and/or suffixes) that received explicit classroom instruction, but only as attached to bases that were never taught. Since the base is the morpheme that caries the core meaning of a word,

this category of word represents the farthest level of transfer of the three word types. Improving students' success with Affixes Only Taught words would imply that knowledge of morphological structure in general had transferred beyond the derivations of taught bases into morphological families of words that were never taught.

It was important to have strategies for maintaining the integrity of the word types over the course the intervention lessons. The instructor always had quick access to a list of all the bases and derivations that needed to be avoided during class discussions. On rare occasions a student independently presented a word that was designated as *Base Only Taught,* or *Affixes Only Taught* in the course of a lesson. In these cases, the instructor simply acknowledged the students' comment, but moved on to other derivations without bringing attention to the word to the individual or the class. It is also worth noting that, except for the Morphological Choice task, the experimental measures were finalized at the end of instruction. As a result, it was possible to systematically review the lessons to make sure that the word types were properly represented in the tasks for three of the four experimental measures.

Reading MA. In the individual testing setting, students were presented with 30 words to read out loud to the examiner one at a time. These words were chosen around the instruction (10 from each word type) and all were multi-morphemic. The words were presented to students in a booklet that used from six to nine words on a page. The task included numerous challenging words and a variety of more familiar words. The first and last pages of the booklet used six words, while the middle two pages used nine words. See Appendix B 6 for a full list of the words used. The examiner gave feedback on the five practice words that were used to begin the test. No feedback was given on the test items. A score of 0 or 1 was recorded on a separate sheet to indicate whether or not the subject

pronounced the word accurately. If a participant changed how they read a word, the examiner altered the score appropriately. There was no stop rule, so the subjects' total score was the total number of correct words out of 30. Sub-sets were scored out of ten.

Base Identification. This task used the same list of words as the Reading MA task, and was administered immediately following that test. For Base Identification, words were presented in a booklet using larger print than in the Reading MA booklet, and the words were arranged in a single column down the center of each page. The purpose of this task was to test subjects' ability to identify the base in a variety of multi-morphemic words presented in written form. The test was introduced to subjects as an activity called "Circle the Main Part of the Word". Examiners were specifically instructed not to use morphological terms such as *prefix, suffix,* or *base*, which only the treatment group would have had emphasized in recent instruction. The examiners avoided bringing attention to any occasion when students used specific orthographic terminology themselves. The scoring of this task was on a 3-point scale using the following criteria:

2 points: Circling the base or smallest stem of a word that can stand on its own as a word. (A *stem* is a base with at least one affix.)

1 point: Circling any part of a word that removes at least one affix, but fails to reduce the target word to the smallest stem that can stand on its own as a word.

0 points: Circling part of a word in such a way that no base or a stem of the target word is accurately identified.

The scoring system was designed to avoid awarding points for knowledge of linguistic features that only students with explicit instruction could be reasonably expected to have. For example, for the word *victoriously,* circling the stem *victor* (*vict+or*) or circling the bound base *vict* for 'conquer' each earned 2 points. Only the training group had been

taught that a base does not have to be a word on its own. Circling *victori* (representing victory), or *victorious* both scored 1 point as these are stems of *victoriously* that form real words used, and further details of the scoring are presented in Appendix B 7.

Morphological Spelling Choice. This task was administered in large and small group settings and was designed to have children choose the correct spelling of a morphologically complex word out of a list of five phonologically plausible spellings. The 45 words chosen for this test stressed features of the English orthography system that were the focus of the instruction.

Subjects received a booklet that contained sentences with a blank representing a missing word. The correct spelling of that missing word was among a list of five phonologically possible spellings that were found below each sentence. For example, the first item used the sentence: *The bunny was _____ down the trail.* The five spellings presented to choose from were: *hawping, hopping, hauping, hoping, and haupping.* The examiner asked the students to read along silently as she read out loud, *"The bunny was hopping down the trail. hopping."* After hearing the sentence read out loud, subjects were instructed to circle the correct spelling of the missing word. The process was repeated until all 45 words were completed. There was no stop rule. Appendix B 8 shows a copy of instructions for the tester and the task used.

Instruction: content and approach

Morphological structure was the core content of this instruction. However, understanding how morphology works in a morphophonological system also requires phonological instruction. One cannot teach the morphological connection between ***sign*** and ***sign****al* without bringing out the fact that the English spelling represents morphemes consistently, but has an elastic relationship between letters and how we pronounce words

(phonology). Addressing the interrelation of morphology and phonology was central to the morphological instruction of this intervention that aimed to reduce the effect of morphological opacity due to phonological shifts. A detailed outline of the orthographic content is provided below.

The problem-solving guided discovery instructional approach was an additional key feature of the instruction that framed how that content was presented to the training group. An outline of this mode of instruction is offered, followed by a description of the specific orthographic content that was taught through this approach.

Approach: Process of orthographic problem-solving.

Each orthographic concept was introduced through a spelling problem that students were asked to solve by acting as *spelling detectives*. Students investigated each orthographic problem through studying words chosen specifically to reveal the targeted spelling pattern. Over the course of 20 lessons, a consistent process of instruction was employed to help students develop and test hypotheses about increasingly complex orthographic patterns. The basic structure of the instructional model was as follows:

1. An interesting spelling problem is presented that highlights a core orthographic concept.

   Examples:

   A – Core concept: Written morphological consistency despite pronunciation shifts.

   Interesting Question: Why is there a *g* in *sign*? See Appendix C1 for a copy of the introductory lesson that dealt with this question.

   B – Core concept: Pattern for doubling final, single consonants during suffixing.

Interesting question: Which word, *hopping* or *hoping*, describes what bunnies do, and how do you know?

2. Present students with sets of words selected to reveal a pattern that is the focus of the lesson. Encourage the development of hypotheses for the class to test.

   Example: See Activity 2 in Appendix C 2 that uses a matrix to build words on the base *move*. This set of words was used to help students develop the hypothesis that only suffixes beginning with a vowel letter drop the silent *e* of words to which they are added.

3. Test hypotheses in order to confirm and describe exact orthographic pattern.

   Example: Part 2 of Activity 2 (Appendix C 2) presented a number of word matrices to refine the original hypothesis for dropping of the silent *e* to include the following details: Vowel suffixes drop the final, single, silent *e* of the base or stem to which they are added. The matrices for *agree* and *be* clarified that bases ending in the letter *e* are not dropped if they are not both single and silent.

4. Practice newly learned patterns through a systematic application to a set of words chosen to illustrate a given pattern.

   Example: After discovering the pattern for dropping the single, silent *e*, students used a flow chart (see Figure 2, Ramsden, 2001) to internalize this convention by working through a set of words chosen to reveal this pattern (see example activity sheet in Appendix C 3).

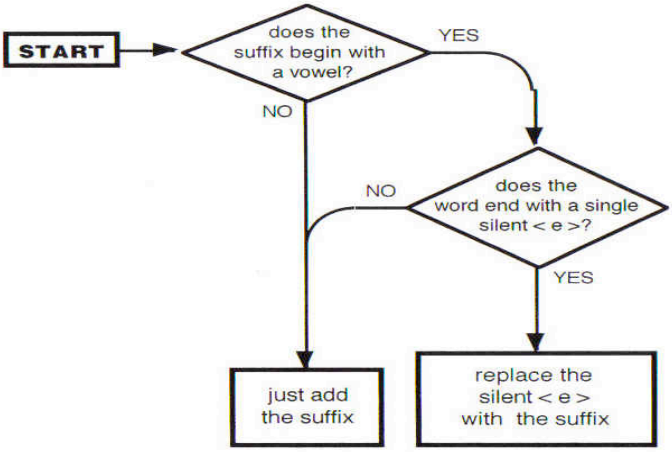

Figure 2. Flow chart of pattern for suffixing pattern for dropping the single, silent *e* (Ramsden, 2001, p17) *Reprinted with permission of author.*

5. During investigation of one concept, identify spelling problems in preparation for the next investigation that links to students' growing base of knowledge.

   Example: Understanding the convention for dropping the single, silent *e* provided students a way to work out which of the words, *hoping* or *hopping* was built from the base *hope*. The structure *hop(p)+ing* → *hopping*, had not been taught, and thus provided motivation to investigate the conventions for doubling final consonants during suffixing.

Instructional activities were of three types: exploratory problem-solving (hypothesis development), focused problem-solving (hypothesis testing/confirmation), and structured practice of newly learned content. Instructional time was divided roughly equally between activities that emphasized problem-solving, and those which emphasized practicing newly learned concepts. Often both types of activities occurred during the

same activity. For example, a lesson taking up answers to an activity sheet might begin with a focus on practicing application of the previous lesson. A shift to problem-solving emphasis might occur when a more complicated application of a pattern was discovered. For example, students were challenged to problem solve why the final *e* in the bases *agree,* and *be*, were not dropped when a vowel suffix was added to them. It is the judgment of the author/instructor that shifting regularly between practice and problem solving helped to maintain the interest of students, and supported learning of the content of the intervention.

The orthographic knowledge that grew through this process was intended to encourage independent hypothesizing, and investigations about orthographic patterns, and the knowledge of how to use resources to test those hypotheses. Examples of instructional tools that were used in the intervention included the *word matrix* (Ramsden, 2001), the *word sum,* and the *word web* (Ramsden, 2001) shown in Figure 1 and *flow charts* (Ramsden, 2001) such as the one shown in Figure 2. These tools were used to show children how morphemes (bases, prefixes and suffixes) can be arranged and rearranged like puzzle pieces into large numbers of words related in meaning despite changes in pronunciation. These tools were also intended to motivate active participation in word structure activities by offering an entertaining way to work with the orthographic content of the intervention.

Content: Orthographic Concepts of the Intervention.

If MA supports reading, it is likely by helping children parse words into meaningful units (morphemes) that can be analysed to construct meaning (Carlisle, 2000). The orthographic content of this intervention was designed with the view that instruction

about the workings of written morphology has the potential to develop children's literacy by providing linguistic knowledge as leverage for gaining meaning from print.

It has been shown that the application of MA, and thus any benefit for literacy development it might have, can be hindered by morphological opacity. Explicit instruction about all the major features of morphological structure in English orthography was targeted to reduce the effect of morphological opacity, thus heightening students' awareness of meaning cues within the morphological structure of words. The integrated nature of morphology and phonology in English orthography meant that instruction had to include phonological aspects of orthography in order to make sense of morphological structure. A summary of the key terms and concepts taught follows:

1. English spelling is a consistent system with few true exceptions, and its primary purpose is to represent the meaning of words.
2. Morphemes (bases, prefixes and suffixes) are the smallest units in a word that carry meaning. Morphemes can be combined and recombined to form many words like Lego pieces are rearranged into countless structures.
3. Except for changes due to suffixing patterns, bases, prefixes, and suffixes maintain consistent spellings in words regardless of shifts in pronunciation.
4. There are three consistent suffixing patterns: dropping the single silent *e* of a base or stem (see Figure 2), doubling of single, final consonants, and the *y/i* shift. (See Figures 7 and 8 in Appendix C 4).
5. The base carries the core meaning of a word, which is then modified by the affixes attached to it. A base that can stand on its own as a word is called a free base (e.g., *run*). There are many bases that never stand on their own as a word, which are called bound bases (e.g., *rupt* for 'break').

6. Twin bases are two forms of the same base that carry the same core meaning into the morphological family of words they build. Understanding twin and bound bases provides access to larger families of words based on a single base. For example, the twin bound base *duce/duct* for 'lead, bring' builds all the derivations built on both *product (pro+duct)* and *produce (pro+duce)* or others such as *educate (e+duce/+ate)*.

Chapter 3: Results

This chapter begins by providing an account of the characteristics of the sample prior to instruction. First, the whole sample is compared to standardized norms on a variety of reading and reading-related measures. Next, results of *t*-tests are used to compare the training and control groups on all pre-test measures to determine whether or not the groups differed significantly prior to the intervention training. An account of the classroom instruction follows the description of pre-test results. Reporting of post-test results begins with a presentation of means and standard deviations on outcome measures for the control and experimental groups. These results are presented first for non-experimental measures, then for experimental measures. Finally, aptitude-treatment interaction regression analyses are conducted to determine (a) whether, and for which outcome variables instruction explains a significant amount of variance after controlling the selected set of literacy measures, and (b) whether or not any gains from instruction are dependent upon initial word reading ability.

Participant Characteristics at Pre-Test

Raw scores were compared to published grade equivalent norms for the standardized pre-test measures. Scores on Word Identification, Reading Comprehension (from the Gates–MacGinitie Reading Test), and speed of word reading as measured by the TOWRE, all showed that the sample achieved scores at the grade equivalent of the fourth month of Grade 4. As the sample was a mix of Grade 4 and 5 tested midway through the school year, these results suggests the participants were somewhat below the expected level of achievement on these reading measures. The measure of verbal intelligence from the PPVT-3 showed students to perform at the level expected for students of 10.5 years, and therefore in the normal range of ability. The Word Blending

PA sub-test score showed the sample to be at the grade 5 level at pre-test. Participants' scores on the Auditory Analysis Test were similar to normative data on this shortened version for Grades 4 and 5 (Newby-Clark & Bowers, 1998). Naming speed was measured with the Rapid Digit, and Rapid Letter Naming subtests of the CTOPP. Only Form A of the digit and letter task was administered. The norms in the manual are based on the sum of Form A and Form B for these tasks. The proper raw score was estimated by doubling the raw scores of the single administration of each task, putting the sample at the Grade 5 level for Rapid Digit Naming and the sixth month of Grade 5 for Rapid Letter Naming. Overall, the sample appeared to be at, or slightly below, norms on standardized reading and reading-related measures at pre-test. Correlations between these measures for the sample are presented in Table 7 in Appendix D.

Experimental and Control Group Characteristics at Pre-Test

Means and standard deviations for all pre-test measures for experimental and control groups are presented as raw scores in Table 2. Groups did not differ significantly on any measure. Morphological Choice was the only experimental measure used at pre-test. A Cronbach alpha coefficient was calculated as a measure of the internal consistency reliability for this task. The resulting alpha coefficient of .4 is low. The nature of this task made it difficult to devise an appropriate reliability measure. The task has 13 cue words, each with six choices for a total of 78 judgements. As 78 items approaches the sample size, the reliability was calculated by treating the 13 cue words as items, each having a score from 0-6. An attempt was made to create a penalty score for incorrectly circling foils or not circling morphologically related words, but none was discovered that changed the over-all ranking of scores. The reliability of this test is discussed further when post-test results are addressed.

Table 2

Descriptive Statistics for Experimental and Control Groups at Pre-test

Measure	Experimental Group (n = 38)		Control Group (n = 46)	
	Mean	SD	Mean	SD
Phonological Awareness				
Word Blending[a]	14.22	3.02	14.26	3.76
Elision	20.74	6.05	20.70	4.69
Naming Speed				
Digit Naming	17.05	3.89	17.04	3.74
Letter Naming	18.13	3.90	17.50	3.24
Verbal intelligence (PPTV- 3)	130.50	15.75	135.17	14.57
Word Identification	67.18	7.96	67.70	8.86
Reading Comprehension	21.26	7.50	20.83	7.21
WRAT spelling	14.97	3.71	15.37	3.77
WRAT arithmetic[a]	13.03	2.74	12.24	3.00
Morphological Choice	56.71	3.49	57.85	4.23

Note. [a]n = 37 because one participant missed this test. No mean differences are significant at the $p < .05$ level.

Student Engagement in Instruction

Reports of the classroom instruction are by the author who was also the instructor. It appeared that instruction captured the interest and encouraged the participation of most

students over the course of the intervention lessons. There are a variety of sources of evidence supporting this observation. Understanding of key concepts was demonstrated on two quizzes, and during the regular intervention activities and class discussions. There was evidence that thinking sparked during the intervention lessons spread to the regular class time. Forms called *Spelling Questions for Mr. B* were posted in the class and were used as an invitation for students to describe spelling questions and hypotheses that they developed on their own. Although no grade or reward was associated with the task, many students of varied abilities took the time to write questions during regular classes and intervention lessons. Students indicated a clear interest for responses to their ideas. On a number of occasions questions raised by a student during regular class time generated a class-wide anticipation for a response to a particular question. For example, after teaching the patterns for changing the letter *y* to *i*, a note from the Grade 4 class addressed to the intervention teacher was written on the board that asked if *marry/i + age→ marriage* was an accurate word sum. A student observation had sparked this hypothesis, and the class decided to leave this message on the board. Presumably, this note was both a celebration of their thinking, and a way to confirm whether or not their theory was correct. With the class's attention focused on their word sum hypothesis, the parallel structure *carry/i+age→ carriage* was presented as evidence that their *spelling detective* work was correct.

The majority of students participated actively in lessons, particularly when they were able to act as *spelling detectives* trying to solve a spelling mystery. A review activity called *Spelling Jeopardy,* following the model of the TV game show, appeared to be particularly popular. For this activity, students spent a full class period "competing" in teams to answer detailed orthographic questions with a confidence that impressed the

classroom teachers. The teachers, principals, and teacher assistants who observed lessons in both classes over the course of the intervention said that they were impressed at how engaged students were with the lessons. It was noted with surprise that it was not uncommon for students to seek out dictionaries and other references independently to test the spelling theories they had developed. The feedback that was communicated from parents of students of both classes was only positive.

This assessment of the classroom atmosphere does not mean that all students were always focused and involved in the lessons. Typical examples of distracted and disruptive student behaviour were not absent from the intervention lessons. It is important to note that a difference in attention and behaviour was observed between the two classes. The Grade 4 experimental class included more students who exhibited disruptive behaviour in the regular class and during the intervention. While the majority of this class participated appropriately during most lessons, there was a group of three or four students (including two identified for behaviour disabilities) who were distracted on a somewhat regular basis. These disruptions likely affected the ability for some students to attend fully to lessons.

However, the overall response of the classes was such that teachers and teacher aids from both classes made it clear they were impressed with the instruction and their students' response to it. Both teachers noted that much of the content of the intervention was unlike any they had previously observed. They told the author that they were impressed at the level of thinking in which the students engaged, and the enthusiasm shown for discovering new ideas about the spelling of words. Furthermore, both commented on their surprise regarding the achievement and interest of weaker students who often struggled in writing tasks. The original assumption was that the intellectual

demands of the instruction might be too demanding for those students. Perhaps the clearest evidence of the positive response to the instruction by teachers and administrators is that both schools have purchased the Real Spelling materials (Ramsden, 2001) upon which the lessons were based.

Descriptive Statistics for Outcome Measures at Post-Test

Means and *SD*s for all non-experimental outcome measures are presented as raw scores in Table 3. Correlations for outcome measures are in Table 8 in Appendix D. The two non-experimental tasks that are not standardized measures do not have published reliability estimates. The split-half reliability coefficients, with Spearman Brown correction, were calculated for both of these measures. The reliability coefficients were .888 and .951 for Wordchains and Orthographic Choice respectively.

Descriptive Statistics for Experimental Post-Test Measures.

Cronbach alpha reliability coefficients of internal consistency were calculated for all post-test experimental measures. See Table 9 in Appendix E. All alphas were above .8, except for Morphological Choice with an alpha coefficient of .6. While not high, it was somewhat surprising that the alpha coefficient for this task rose to .6 from .4 after the experimental group, but not the control group received instruction in concepts related to this task. The complications in attempting to devise an appropriate reliability measure at pre-test have already been addressed. It is important to note that at *pre*-test, Morphological Choice showed no significant difference between groups (in line with the standardized literacy measures), but that as will be seen in the current analysis, a significant difference was found on this measure at *post*-test. Given that it is difficult to find significant differences with unreliable tests (Pedhazur & Schmelkin, 1991), it is possible that this alpha level is an underestimate of the test's reliability. Recall

that the reliability of this test was measured as if it were a 13 item test even though students made six judgements for each of the 13 cue words. Reliability could not be calculated as a 78 item test for two reasons. Firstly, this number approaches the number of participants. Secondly, the correct choices for each item relate to the cue, so these items are not entirely independent. Means and standard deviations for all experimental post-test measures are reported in Table 4.

Table 3

Descriptive Statistics For Experimental and Control Groups at Post-test for Non-Experimental Measures

Measure	Experimental Group			Control Group		
	n	Mean	SD	*n*	Mean	SD
WRAT spelling	38	16.53	4.01	46	16.41	4.27
Word Identification	38	69.45	8.10	44	71.93	8.06
Speed of word reading (TOWRE)	38	66.66	10.10	44	67.91	9.49
Oral Morphological Awareness						
Derivation	38	6.74	1.18	44	6.89	1.10
Decomposition	38	8.76	1.17	44	8.84	.99
Word Analogy	38	14.89	3.39	44	15.45	2.63
Orthographic Processing						
Orthographic Choice	38	30.45	5.87	46	28.37	6.15
Wordchains	38	39.03	6.86	45	31.93	8.86
WRAT arithmetic	38	14.66	3.74	46	13.93	3.09

Note. The variation in *n*s for control group are due to student absence and tester error.

Table 4

Descriptive Statistics for Experimental and Control Groups on Experimental Outcome Measures at Post-Test

Measure	Experimental group (n=38)		Control group (n=44)	
	Mean	*SD*	Mean	*SD*
Morphological Choice Total	62.63	4.32	59.34	3.81
MC Word Taught	8.79	1.92	6.77	1.84
MC Base Only Taught	8.00	1.82	6.93	1.80
MC Affixes Only Taught	9.08	1.34	8.75	1.43
Base Identification Total[a]	42.68	10.21	32.33	5.45
BI Word Taught[a]	13.79	4.20	9.47	2.07
BI Base Only Taught[a]	16.76	3.89	12.91	2.68
BI Affixes Only Taught[a]	12.13	3.29	9.95	2.53
Spelling Choice Total	30.79	6.58	27.05	7.27
SC Word Taught	10.66	2.66	9.61	2.97
SC Base Only Taught	9.50	2.77	7.45	2.87
SC Affixes Only Taught	10.63	2.20	9.98	.37
Reading MA Total	17.76	6.70	16.95	6.53
RMA Word Taught	5.79	2.11	5.36	2.33
RMA Base Only Taught	6.55	2.69	6.05	2.53
RMA Affixes Only Taught	5.42	2.83	5.55	2.35

Note. [a]n = 43 because one participant missed this test

Aptitude-Treatment Interaction Regression Analyses

These analyses were conducted to investigate the two research questions: (a) Does instruction about written morphological structure and its relation to the representation of phonology in English orthography affect literacy skills, and how far does the effect extend? and, (b) Is any effect of this instruction moderated by initial reading ability?

Aptitude-treatment interaction regression analyses were conducted using Word Identification in the interaction term with treatment group. Word Identification, PPVT-3, PA, and naming speed were entered together in the regression equation as control measures. Following the advice of Pedhazur and Schmelkin (1991), non-significant interactions were dropped from the models, which were then re-analyzed to test treatment group effects while controlling for Word Identification, verbal intelligence (PPVT-3), PA, and naming speed. In these analyses, the Group factor was coded -1 for the Control group, +1 for the Experimental group; thus positive Group effects indicate advantages for the Experimental Group.

Word Identification was chosen as the aptitude measure for the interaction term because it is a well-accepted measure of general reading ability, whereas the other aptitude measures are seen as correlates of reading ability (e.g., Rayner et al., 2001). When word reading and these correlates of reading are controlled, any effect of instruction is teased apart from several plausible reading related individual differences.

Reporting of the aptitude-treatment interaction regression analyses begins with the experimental measures (see Table 5). This table presents results taken from two different steps of analyses. Step one includes the interaction term along with the control variables, Word Identification, verbal intelligence (PPVT-3), PA (combined Word Blending and Elision), naming speed (combined letter and digit naming speed), and the independent

variable, Group. As indicated in the table, whenever the interaction term was not significant, the second step of the regression was re-run with the interaction term removed. For the cases in which the interaction term was significant (3 of the 4 regressions for the Base Identification test), the betas for the variables involved in the interaction (Word Identification and Group) should not be interpreted. Instead, graphs of these interactions are provided to interpret the instructional effect (see Figures 3, 4, and 5). A graph of the non-significant interaction of Word Identification by Group on the Base Taught category of Base Identification is also provided (see Figure 6).

Summary of Experimental Outcomes (for Analyses with Significant Interactions)

Description of group effects for the experimental outcome measures begins with interpretation of the graphs of significant interactions. Treatment interacted with Word Identification on the Base Identification Total Score, and two of the three subset scores. Inspection of the graphs of significant interactions for Base Identification Total Score (Figure 2), the Base Identification sub-sets Word Taught (Figure 3), and Affixes Only Taught (Figure 4), all show that there was little or no difference between control and experimental groups for those with the lowest Word Identification scores. As Word Identification pre-test scores increased, the difference between the control and experimental groups on the Base Identification measures increased in favour of the experimental group.

Table 5

Aptitude-Treatment Regression Analyses, Analyzing Group Post-Test Effects on Experimental Measures Controlling for PPVT-3, WID, PA, and NS

		Beta Coefficients					
Measure	Model	Group x WID[a]	WID	PPVT 3	PA	NS	Group
Morph. Choice Total	1	.073	.043	.187	.137	-.043	.342
	2	-	.040	.188	.139	-.043	.414***
MC Word Taught	1	.403	.066	.221†	-.096	.010	.113
	2	-	.048	.229†	-.087	.012	.513***
MC Base Only Taught	1	-.358	.033	.125	.095	.110	.675
	2	-	.049	.118	.086	.108	.320**
MC Affixes Only Taught	1	.308	.018	.132	.150	-.042	-.173
	2	-	.094	.137	.157	-.040	.144
Base Identification Total	1	1.957**	.490***	-.036	-.051	.016	-1.366*
BI Word Taught	1	2.152**	.336*	.027	-.135	.113	2.152**
BI Base Only Taught	1	1.010	.456**	-.064	.012	-.017	-.487
	2	--	.411**	-.044	.038	-.012	.517***
BI Affixes Only Taught	1	2.043*	.508***	-.063	-.003	-.070	2.043*

Table 5 Continued…

Measure	Model	Beta Coefficients					
		Group x WID[a]	WID	PPVT3	PA	NS	Group
Spelling Choice Total	1	-.150	.609***	-.074	-.007	.012	.430
	2	-	.616***	-.077	-.011	.011	.281**
SC Word Taught	1	-.086	.563***	-.048	-.059	-.262	.288
	2	-	.567***	-.050	-.061	-.028	.202*
SC Base Only Taught	1	.244	.536***	-.080	.020	.138	.122
	2	-	.524***	-.074	.027	.139	.364***
SC Affixes Only Taught	1	-.662	.488**	-.065	.025	-.107	.807
	2	-	.522***	-.081	.007	-.110	.149
Reading MA (RMA) Total	1	.488	.652***	.077	.206*	.063	-.364
	2	-	.630***	.086	.218**	.065	.120[†]
RMA Word Taught	1	.083	.452***	.132	.313**	-.061	.062
	2	-	.448***	.134	.315**	-.060	.145[†]
RMA Base Only Taught	1	.472	.677***	.001	.172*	.083	-.321
	2	-	.656***	.010	.183*	.085	.148*
RMA Affixes Only Taught	1	.702	.595***	.082	.083	.131	-.664
	2	-	.564***	.095	.100	.134	.033

Note. Model 1 includes interaction term of Word Identification x Group. Model 2 was only run when the interaction was not significant. Betas for *Group* and *Word Identification* should not be interpreted in models with significant interaction terms. Instead, Group effect for these measures can be observed in the interaction graphs presented in Figures 3, 5, and 5.
[a]Group by Word Identification interaction term.
[†]$p < .1$, *$p < .05$, **$p < .01$, ***$p \leq .001$

Figure 3. *Interaction of Group and Word Identification on Base Identification Total Score*

Figure 4. *Interaction of Group and Word Identification on Base Identification Word Taught*

Figure 5. *Interaction of Group and Word Identification on Base Identification Affixes Only Taught*

Figure 6. *Interaction of Group and Word Identification on Base Identification Base Only Taught*

The graph of the non-significant interaction of treatment by Word Identification on the Base Identification subset, Base Only Taught, is provided in Figure 5. It may be that the lack of a significant interaction on this measure was the result of an apparent ceiling effect for the experimental group. Although not a statistically significant interaction, the shape of the graph shows a similar pattern to the other graphs.

Word Identification was used in the interaction term because this study examined whether initial word reading ability moderated any gains realized by instruction. However, the same aptitude-treatment interaction regression analyses were repeated looking for interactions of Group by PA, naming speed, and verbal intelligence (PPVT-3) also. Only PPVT-3 had any significant interactions. With PPVT-3 by Group as the interaction term, 4 out of 24 analyses were significant. Those interactions were spread over all measures and did not present a consistent interaction shape.

Summary of Experimental Outcomes (for Analyses with Non-Significant Interactions)

After accounting for verbal intelligence (PPVT - 3), Word Identification, PA, and naming speed, Group accounted for significant variance in total scores for Morphological Choice and Spelling Choice, but not for Reading MA which only showed a trend for significance ($p < .1$). Each total score was made up of the three subsets based on how directly the words were taught during instruction. Word Taught represented near transfer. Base Only Taught represented medium transfer, and Affixes Only Taught represented the farthest transfer for the experimental measures. Group contributed significant variance to Morphological Choice and Spelling Choice for the near and medium transfer subsets, but not the far transfer subset. Investigating the subsets for the final experimental measure, Reading MA, shows that Group contributed significant variance only for the medium

transfer measure (Base Only Taught). There was a trend ($p < .1$) for Group to contribute variance to the near transfer subset of Reading MA, Word Taught.

Summary of Non-Experimental Outcomes

Aptitude-treatment interaction regression analyses for non-experimental measures are presented in Table 6. Four results are clear. First, no significant Word Identification by Group interactions for non-experimental measures was found. Second, Group did not account for significant variance in any of the standardized reading measures. Third, there was no effect of Group on the measures of oral MA. Fourth, both measures of orthographic processing, Orthographic Choice and Wordchains, did have a significant amount of their variance accounted for by the positive effect of Group

Table 6

Aptitude-Treatment Regression Analyses: Group Effects on Non-Experimental Measures at Post-Test Controlling for Verbal Intelligence (PPVT-3), Word Identification (WID), PA, and Naming Speed (NS)

Measure	Model	Beta Coefficients[a]					
		GxWID[a]	WID	PPVT-3	PA	NS	Group
Word Identification	1	.300	.754***	.000	.142†	.049	-.400
	2		.741***	.005	.149*	.050	-.101
TOWRE	1	-.079	.435***	-.083	-.092	.566***	.058
	2		.439***	-.084	-.094	.565***	-.021
WRAT Spelling	1	-.034	.744***	-.124	.157†	.030	.052
	2		.745***	-.125	.156†	.030	-.018
WRAT Arithmetic	1	.278	.350*	.134	-.042	.111	-.109
	2		.335*	.141	-.035	.113	.168

Table 6 Continued…

		Beta Coefficients					
Measure	Model	GxWID[a]	WID	PPVT-3	PA	NS	Group
Oral MA							
Derivation	1	1.032	.264†	.132	.251*	.073	-1.048
	2		.218	.151	.276*	.077	-.023
Decomposition	1	.915	.181	.181	.043	.197†	-.896
	2		.141	.198	.065	.201†	.013
Word Analogy	1	.894	.199	.043***	.205†	.011	-.907
	2		.159	.420***	.226*	.015	-.019
Orthographic Processing							
Orthographic Choice	1	.608	.454**	.040	-.138	.225*	.404
	2		.446**	.053	-.138	.228*	.204*
Wordchains	1	.392	-.017	-.004	-.140	.196	.089
	2		-.035	.004	-.131	.171	.416***

Note. 1 = first regression model including interaction term. 2 = second regression model with the interaction term dropped. This model was only run if the interaction was not significant.

[a]Group by Word Identification interaction term.

†$p < .1$, *$p < .05$, **$p < .01$, ***$p \leq .001$

Overall Summary of Results

Aptitude-treatment interaction regression analyses provided strong evidence of near and medium transfer of instruction, but weaker evidence of far transfer. After deleting the non-significant interactions and accounting for the control measures, Group explained a significant amount of variance for at least one subset of each of the experimental measures. An instructional effect was most clearly evident for both experimental written MA measures, and the experimental spelling measure, but also appeared on the experimental word reading measure. In general, initial levels of reading as measured by Word Identification did not moderate the instructional effects. Interactions of treatment by Word Identification were confined to one experimental written MA measure. The interaction graphs for those measures indicate that all but the weakest readers benefited from instruction on near, medium and far word categories, and the combined measure.

Non-experimental measures looked for evidence of the farthest transfer. There were no interactions with word reading as measured by Word Identification on these measures. After controlling for the pre-test reading and reading-related measures, Group did not account for significant variance in any standardized reading or spelling outcome measure. Group did account for significant variance in the two non-experimental measures of orthographic processing, but it failed to do so for any of the three measures of oral MA. It should be kept in mind that two of these three oral MA measures had low reliability scores. The reliability scores for these measures are addressed further under the heading *Theoretical Implications* in the *Discussion* chapter.

Chapter 4: Discussion

This study builds upon the major line of scientific reading research over the past 20 years that has shown "…a strong connection between children's linguistic knowledge and the progress that they make in learning to read and write" (Bryant, 2002). The current study investigated the effect of instruction about morphological structure, including its oral and written manifestations, in the regular Grade 4 and 5 classroom setting. One reason interventions are important to this area of research is that our current understanding of MA is based largely on the role of uninstructed MA. As English words are commonly morphologically opaque to some degree, access to meaningful morphological cues of many words may be hindered by lack of explicit instruction about morphological structure (Carlisle, 2003). The current intervention investigated whether the effects of morphological opacity could be reduced through instruction, and whether that effect was moderated by initial reading ability. Morphological instruction also offered a productive context from which to consider the relationship between oral and written MA. Finally, as detailed morphological study in the classroom is relatively unstudied, it was important to look at how students responded to this instructional content and approach in the regular classroom.

With these issues in mind, this study investigated two basic questions. First, does morphological instruction bring gains to literacy? Secondly, does initial reading ability moderate gains from morphological instruction?

Treatment Effects

Specifically, this study asked if instruction about written morphological structure and its relation to the representation of phonology in English orthography affects literacy skills, and if so, how far does the effect extend? Most analyses of experimental measures

showed no interaction between treatment and word reading. Results from these measures demonstrated that after controlling verbal intelligence, word reading, PA, and naming speed (hereafter referred to as *control measures*), there was an instructional effect across the three areas measured: written MA, spelling, and reading. To understand the extent of these effects, the underlying structure of the experimental tests needs to be kept in mind. Each experimental test used proportionally equal sets of words that varied in the degree to which they had been taught. These sets, labelled *Word Taught*, *Base Only Taught*, and *Affixes Only Taught* represented near, medium, and far transfer respectively. Because of the interest to discover if instruction could reduce the effect of morphological opacity, all measures were rich in words with phonological, orthographic, and/or semantic shifts.

Two of the experimental measures were explicitly tests of written MA. Although the experimental reading and spelling tests were not specifically written MA tasks, they both used words reflecting morphological features emphasized in the instruction. For example, the words of all three subsets included orthographic shifts based on the suffixing patterns that had been taught. Thus, effects of instruction on these tasks are assumed to reflect, at least to some degree, the application of instructed morphological knowledge.

Of the four experimental measures, the two written MA measures and one spelling measure showed the clearest treatment effect after accounting for the control variables. Treatment accounted for a significant amount of the variance in Morphological Choice and Spelling Choice for the near and medium transfer subsets, but not the far transfer subset. Significant interactions of word reading skill by treatment were found for one measure of written MA, Base Identification. Inspection of the graphs of the interactions of treatment by word reading skill on Base Identification suggests that for this task, all but the weakest students gained from instruction, even on the far transfer measure, which

used words built on bases that had not been taught during the instruction. No other tasks had interactions of treatment with reading level, indicating equivalent gains for students of all levels of reading skill. The Base Identification task followed immediately after reading this same set of challenging words, and was the final test of the session. A combination of testing fatigue, word difficulty, task length, and the analytical demands of this task appears to have been too much for the poorest of the readers.

There was a trend for significance for the near transfer reading measure ($p < .1$), but the only subset that demonstrated a significant effect of treatment was the medium transfer sub-set Base Only Taught. This provides evidence of transfer from written MA instruction to reading, but especially in light of the lack of effects on standardized reading measures, it is disappointing that stronger effects of instruction on reading for these experimental measures were not found. One possible reason for this weak result is that the 30 words used for this task were long, challenging, multi-morphemic words that may have been too difficult for many students. Another point to consider is that the morphological instruction of this intervention focused more on word building (e.g., spelling patterns) than word recognition (e.g., reading). Much of the 20 lessons of this intervention focused on teaching suffixing patterns and how to use those patterns to build words from morphemes. Stronger transfer to reading tasks may require more frequent and explicit linking of morphological skills to the reading process. For example, difficult words could be presented in a reading activity, with the instructor modelling the application of morphological concepts taught in previous lessons to the task of how to read such words. To achieve the desired transfer from teaching about sub-lexical morphological units to reading, it might have been wiser to teach that transfer of these skills more directly and more frequently. Teaching about morphological structure requires

time specifically focused on word production tasks that bring children's attention to how the morphological units combine to form words. However, the benefit of this type of instruction may be more fully realized by following up that instruction with practice applying newly gained morphological knowledge explicitly to the reading process.

The evidence of a treatment effect was clear for the experimental measures, but more limited for the non-experimental measures. Word Identification, TOWRE and WRAT Spelling (hereafter standardized reading and spelling measures) were not affected by the instruction. Although disappointing, it is not uncommon for interventions, even those based on more established teaching practices, to have difficulty showing their effectiveness on standardized measures. Lovett and Steinbach (1997) argued that standardized measures seem to be less sensitive to the treatment effects that can be achieved over the shot-term. Steep item gradients with relatively few items at each level of difficulty offer fewer opportunities to demonstrate success with for new skills.

The lack of a treatment effect on standardized reading and spelling measures as a result of the current intervention, however, needs to be considered in light of the morphological intervention by Nunes, Bryant and Olsson (2003). Although their treatment only managed a trend for a positive effect of treatment on the Schonell Spelling test, they did have a significant positive effect on the Schonell Word Reading test, even with morphological instruction limited to the oral domain. The result for reading is striking in comparison to the current study in light of the fact they had significant effects with instruction that was oral, limited to specific suffixes, and conducted over only twelve weekly sessions. The current study targeted a wider understanding of written morphological structure over twenty sessions.

Instructional group size of the intervention by Nunes et. al (2003) may have contributed to their positive results. Their instruction was in small groups of 4 to 8 children whereas the current intervention was applied in the regular large class setting (28-30 students). It is also possible that despite fewer sessions, conducting the intervention over a longer period brought advantages. Nunes, Bryant and Olsson's teaching spanned 12 weeks instead of the 5 weeks for the current intervention. It may be that the facility with MA developed through Nunes, Bryant and Olsson's teaching was deepened with the longer time from the start to finish of the intervention, and the extended time between sessions in which students could apply that developing linguistic knowledge to the written word. Their instruction schedule offered more opportunity for that linguistic awareness to become instantiated as a reading skill. Finally, the other distinction that has to be considered between these two interventions is the role of written and oral morphological instruction. It may be that something about their oral morphological instruction supported greater transfer to reading than the written morphological instruction of the current study.

The non-experimental measures also included three oral MA tasks and two orthographic processing tasks. The results for these measures presented a clear distinction between the effects of instruction on oral vs. written tasks. Both measures of orthographic processing had significant variance accounted for by the treatment after accounting for the control variables, but none of the oral MA measures did. The distinction between written and oral measures is highlighted by the fact that both written MA measures (experimental tasks), but no oral MA measures (non-experimental tasks) were affected by instruction. The effects of the intervention that focused mainly on written morphological structure did not transfer to oral measures.

Moderators of Treatment Effects

The second research question was whether initial reading ability was a factor in moderating the effects of treatment. Overall, the results suggest that the gains from this instruction were largely unrelated to the initial reading skills of students. The only measure found to have a significant interaction of treatment by word reading was the written MA task, Base Identification. Further, there were no interactions with treatment by PA or naming speed, and only a few with verbal intelligence. These are all measures regularly correlated with reading. If indeed these experimental measures reflect abilities relevant to success in learning to read well, the relative lack of interactions provides evidence that written morphological instruction provided many students a base for learning that typical instruction fails to offer. This view finds additional support from Arnbak and Elbro's (2000) oral morphological intervention with Danish dyslexics. Gains in traditional reading and spelling measures found in their study were not related to the level of phonological deficit before instruction.

Theoretical Implications

One important implication arising from the results of this study is the need for a better understanding of the oral and written manifestations of MA. Research on the role of MA in learning to read does not always make a clear distinction between these facets of this linguistic awareness. Often, in an effort to avoid confounds with reading, studies measure MA purely with oral tasks. Thus, conclusions about MA as a whole (oral and written) may be based on studies that tap only one aspect of the construct. The fact that the written morphological instruction in this study brought clear effects for written MA tasks, but not for measures of oral MA suggests that these manifestations of MA may be

more distinct than is often assumed. Given the low reliabilities of two of the three oral MA tests, this must be a tentative suggestion.

Despite lack of effect on oral measures, the instruction did extend to various types of written measures. Treatment effects were found for each of the experimental tasks, all of which involved the written word. The written MA tasks, but also the spelling, and reading experimental measures, were all based on multi-morphemic words that were rich in morphological opacity. In the non-experimental measures, the juxtaposition of significant effects for orthographic processing, but not for oral MA measures underscores the distinction of the significant results along written and oral lines. Any attempt to understand the mechanism by which this instruction brought gains to children's literacy skills needs to be considered in light of these clearly delineated results. Interpreting these results may depend on the nature of English orthography, and the importance of instruction about sub-lexical structures.

English orthography sacrifices consistent phonological representation for consistent morphological representation. "The present [orthographic] system, short of misleading the voice, favors the eye over the tongue and glottis" (Venezky, 1999, p. 9). Written morphemes provide concrete visual cues of base words and sub-lexical units, reducing the demands on working memory for morphological analysis into word parts, or synthesis of word parts into multi-morphemic words. The intervention was designed to draw students' attention to this underlying structure for how meaning is represented in print. Being able to recognize a morphemic sub-lexical unit helps a child segment a word into manageable, meaningful parts.

Results from the Reading MA and Base Identification tasks may provide important insight into the emergence of this sub-lexical skill, supported by the

introduction of explicit morphological instruction. Students always completed the reading task before beginning the task of identifying the base, but both tasks used the same set of words. The treatment did have a significant effect on reading of the mid transfer sub-set of words, but the effect of instruction was much stronger for the task that measured the sub-lexical skill of identifying the base in these multi-morphemic words. Graphs of the interaction of treatment by word reading showed that on this sub-lexical task, all but the weakest readers gained from instruction, even for words that used bases that were not taught during instruction.

It may be that although these words were too difficult for many students to read, even with the support of morphological instruction, that same instruction was able to help students work with these words at a sub-lexical level. The treatment group used knowledge from the instruction to peel affixes from words so they could more accurately circle the base of the same words that they had trouble reading. Successfully peeling affixes from words brings the base or stem of that word to the fore (a stem is a base with at least one affix). The student may or may not immediately recognize the meaning of this base or stem, but the process of peeling the affixes allows the student to attend to the part of the word that carries the core meaning. Learning how to work with the consistent morphological structural patterns of English orthography (e.g., the three suffixing patterns, twin, and bound bases) provides a strategy of morphological deconstruction that can be applied to any multi-morphemic word. This may offer a type of scaffolding toward learning how to gain meaning from print, even of unfamiliar words. Looking at the Reading MA and Base Identification results together suggests that morphological instruction offers students, even with modest reading skill, a potentially productive strategy to attack words that is just starting to realize its effect for reading. This

instruction gives students access to meaningful sub-lexical units, even in words that they have difficulty reading. The significant result for Reading MA (Base Only Taught) suggests that in 20 sessions this new sub-lexical skill begins to transfer to word reading. It may be that with increased time, and/or modified teaching strategies a stronger effect on reading would be realized.

The suggestion that this intervention taught children to segment words by meaningful strings of letters finds additional evidence from the treatment effects found for both non-experimental measures of orthographic processing. The Wordchains task parallels this aspect of the morphological instruction in that it asked children to segment lines of print into smaller meaningful parts (words). The experimental task Spelling Choice also provides insight into how morphological instruction might help children segment words into meaningful units. For this task, children selected the correct spelling of multi-morphemic words from a list of five plausible spellings. For example, a cue sentence for one of these items was, "It took a long time, but I _____ finished my homework." Consider the process of identifying the correct choice out of this list of possible spellings: *finelly*, *finnely*, *finaly*, *finally*, and *finnaly*. Letter-sound patterns on their own are not enough to be confident in the correct spelling since each spelling is phonologically possible. How did the instruction help with such choices? Possibly, students applied instructed morphological knowledge about sub-lexical units to identify the correct spelling. For example, a student who has been taught to create word sums as a strategy to work out difficult spellings, and who has been working with the suffix *–ly* could use that knowledge to work out the word structure: *final+ly* → *finally*. This structure points to the familiar *ly* letter string as a suffix, and suggests the logical meaning link between the words *final* and *finally*. If the student has used this morphological

analysis to peel the suffix *–ly* off the word *finally* and recognizes the stem *final* (*fine/+al* is the structure of this stem), the student has a reason to discard any spelling with the single letter *l.* Spelling Choice was an experimental measure that emphasized morphological features. However, the treatment affected both non-experimental orthographic processing measures that are not clearly morphological. Apparently the increased attention to letter patterns in words brought by morphological instruction gave rise to the effect on orthographic processing, a skill shown to account for variance in reading ability after controlling for PA (e.g., Cunningham & Stanovich 1990, 1993), and to correlate with MA (e.g., Roth, Lai, White & Kirby, 2006).

Researchers have pointed to the effectiveness of phonics instruction that segments words into sub-lexical units linked to the sounds of the spoken word (e.g., Ehri, et al., 2001; Rayner et al., 2001). For example emphasis on structures such as syllables, onsets and rimes, and two or three letter graphemes may all gain some benefit by reducing long strings of letters into recognizable chunks. Levy, Bourassa and Horn (1999) found that segmenting whole words into chunks of either phonemes or rimes was more beneficial for learning to read those words than presenting whole words to Grade 2 poor readers. Morphological instruction shares the benefit of segmenting longer letter strings into smaller units, but may provide important additional advantages. Letter strings based on syllables, onsets and rimes, or graphemes, are fairly abstract units with common, but not consistent links to pronunciation. Written morphemes have the advantage of consistent written representation and more frequently have an evident connection to meaning. Rayner, et al. (2001) stressed the importance of grapheme-phoneme instruction in part because of the difficulty associated with reliance on phonological units in English.

> First, phonemes are perceptual abstractions, and second, alphabets sacrifice phonological explicitness for symbol economy and morphological transparency, thereby complicating the orthography. Because of these problems, teaching methods that make the alphabetic principle explicit result in greater success among children trying to master the reading skill than methods that do not make it explicit. (p.31)

Another way to address the difficulties identified by Rayner et al. is to ensure that instruction *also* takes advantage of the consistency and meaning cues of morphological structure. Instruction targeting written morphemes offers children access to sub-lexical units that are richer in meaning cues and more consistent than the sub-lexical phonological cues. Further, regular morphological representation provides the consistency allowing problem-solving approaches that are unavailable to instruction limited to grapheme-phoneme, or onset and rime patterns. Evidence from the current study and the others already discussed (e.g., Arnbak & Elbro, 2000; Nunes, Bryant & Olsson, 2003) suggest that instruction can help students recognize, manipulate and/or otherwise make use of these fundamental units of the English spelling system. Given that morphemic patterns are consistent and contain more direct meaning cues than letter-sound patterns, adding morphological instruction may provide students a foothold for the writing system that instruction limited to the sound structures of the word cannot provide. Also, as Rayner et. al. pointed out, consistent phonological representation is sacrificed *for* written morphological transparency. Thus understanding how morphological structure works, and how it interacts with phonological structure, can make sense of spellings that otherwise appear to employ illogical letter-sound patterns that complicate learning. Morphological instruction not only develops morphological understanding, but it can also be used to teach important features of how letters and sound correspond in English orthography.

A final theme to address is how students responded to the complex linguistic content of the intervention. Capitalizing on the consistent morphological structure as an opportunity for bringing problem solving to word study instruction has been a recurring theme in this study. It is likely that both the student engagement encouraged by the problem solving approach and the morphological content of the instruction played a part in generating the instructional effects that have been discussed. It is noteworthy that the enthusiasm this instruction generated seemed to be driven in large part by revealing the surprising consistency and logic of English spelling. Not only did the intervention engage children's interest, it focussed that interest directly on the target of that instruction: how words are structured, and how that written structure links families of words of related meaning. Teachers who observed the intervention and some of their peers are continuing to work with this instruction in the school year following the intervention. Both schools have purchased the materials the intervention was based on, and have asked for follow up training so that their students can continue to gain from this form of instruction. Furthermore, a strong foundation in morphological structure is likely to continue to pay off for students as they move into upper elementary grades and encounter more morphologically complex content words (Henry, 2003).

Limitations of the Present Study and Suggestions for Further Research

Limitations of the study include a sample limited to four classes and two grade levels in experimental and control groups. As discussed earlier, the short period of time of the intervention, and instruction that emphasized word-building activities, but gave limited time to practice the application of these new skills to reading may have inhibited transfer to more general writing and reading tasks.

There is an important limitation regarding the experimental tests that needs to be addressed. The words for these tasks were selected to test participants on the three word types varying in level of transfer from instruction, and to meet various criteria. For example the tasks required sets of words that were: multi-morphemic, part of large morphological families to straddle the Word Only Taught and Base Only Taught categories, able to produce suitable morphological foils for Morphological Choice among other considerations. Word frequency, however, was not controlled across the three categories. Future MA research may benefit by using tests that balance address morphological considerations and control word frequency. Particularly when looking at MA, it is important to look beyond typical measures of word frequency. A recent article by Carlisle and Katz (2006) pointed to problems of relying on word frequency statistics for multi-morphemic words. "Each morpheme within a word has features that might contribute to or detract from the recognition and meaning of the whole word" (p. 670).

Future research should also investigate whether increased attention to the linking of morphological knowledge to reading tasks results in greater transfer to reading skills. It would be valuable to see how well such a program could be implemented by classroom teachers after a short training period. Nunes and Bryant (2006) recently reported encouraging success with this type of research. The observations of the author, and educators involved in the current study, pointed to the engagement this intervention brought classroom instruction about the written word. Future research should investigate more systematically students' and teachers' motivational and affective responses to morphological instruction.

From an instructional perspective, it seems a self-evident proposition that students should be taught how their writing system works to represent meaning. The interrelated

nature of morphological and phonological structure is central to this representation of meaning in English orthography (Chomsky & Halle, 1968; Pinker, 2000; Venezky, 1970; 1999). A logical caveat to this assertion is that the linguistic structure of the writing system might be too complicated for young students to grasp. Evidence from this and other morphological intervention studies demonstrates that children not only gain from this type of instruction, but also that this content can be presented in a way that engages their active interest. Few teachers have been trained with the knowledge needed to teach the details of the morphological structure and how this structure interacts with phonology in English orthography (Henry, 2003; Nunes & Bryant, 2006). Thus, few students learn how to read and write in English with the benefit of understanding the ordered, meaning based structure of English orthography. Researchers and teachers should work with some urgency to discover the depth and breadth of this literacy resource, and how best to present it to students learning to read and write.

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Appendix A 1: Letter of Information

Letter of Information
Queen's University, Faculty of Education
Teaching Word Structure

Dear Parent,

I am a Faculty of Education graduate student at Queen's University with over ten years of teaching experience (grades 4 to 6). Your child's class is participating in research that I am leading which seeks to develop improved literacy instruction. For this project, I will teach (along with your child's teacher) twenty 45-minute lessons that focus on word structure and its connection to meaning. The instruction is based on a literacy program I piloted in a Grade 4 classroom that brought great enthusiasm from students, parents and fellow teachers. This research has been cleared through the official ethics process at Queen's University, and also by your school board.

The content I will teach links directly to the Balanced Literacy Curriculum and is supported by recent research showing that knowledge of how words are built connects to literacy skills. Many 'irregular' words have a logical structure that can be learned. For example, the *'g'* in *sign* makes sense when we understand how this base builds words such as *signal*, *signature,* or *designate*. The word *business* is built by joining the word *busy* with the suffix *-ness* that forces the *y*/*i* shift. Understanding how words are structured makes sense of countless 'irregular' words, reveals meaning cues and can be taught. Research suggests that this type of instruction improves spelling and reading comprehension.

In conjunction with this research, we are seeking permission for children's participation in a session of pretest assessments and two posttest sessions over the course of the study. During these sessions children will be asked to complete oral and written tasks that allow us to assess the impact of the intervention. A qualified member of the research team will administer these tasks during the school day. It will take about 70 minutes to complete pretest assessments (not in one sitting), and about 40 minutes to complete the two posttest sessions. The results of these assessments are purely for research purposes, will remain confidential and have no impact on students' grades. Only members of the research team will handle these data, and they will be stored in a locked office at Queen's University. We are also asking for permission to use work that students do during the intervention classes as additional data to help assess the effectiveness of the program. Unlike the pre- and posttests, the intervention lessons are part of the language arts curriculum, and teachers will have access to this work as they would any other work students do during class time. Teachers may choose to evaluate this classwork as they would other work students do in class. It is important to add, however, that if examples from student notebooks are used as illustrations of the kind of work students did during the intervention, no individual child or school will ever be identified in publication of the research.

We do not foresee any risks connected to your child's participation in the study. Giving your permission is completely voluntary and choosing not to participate will not result in any adverse consequences. Further you are free to chose, without reason or consequence, to change you mind about your child's participation at any time.

If you have any questions regarding the research please contact Peter Bowers at (613) 546-2718 (email bowersp@kos.net) or his supervisor, Dr. John Kirby at (613) 533-6000, ext 77231. Questions, concerns, or complaints about the ethical aspects of the research can be forwarded to the Dean of Education, Dr. Rosa Bruno-Jofré, (613-533-6210) or the chair of the General Research Ethics Board, Dr. Joan Stevenson (613-533-6081 or email stevensj@post.queensu.ca).

Thank you for your consideration,

Peter Bowers
M.Ed. candidate
Faculty of Education, Queen's University

Appendix A 2: Consent Form

Consent Form for "Teaching Word Structure"

I have read and retained a copy of the letter of information and I have had any questions answered to my satisfaction.

I understand that I am being asked to allow my child to participate in the research project entitled "Teaching Word Structure" and that the purpose of the study is to test the effect of a unit of word structure instruction on children's reading and writing skills.

I understand that my child's participation in this research will take the form of (1) oral and written tasks that will take a total of approximately 150 minutes to complete over the course of three separate assessment periods, and (2) class work in the intervention lessons during his/her regular class time. My responses and signature below indicate whether or not I give permission for my child to participate in the three assessment periods and/or for work completed by my child during the instruction to be analyzed by the researcher.

I understand that confidentiality of the pre- and posttest assessments will be protected by appropriate storage of data in a locked office at Queen's University and that only members of the research team will have access to these data. No school or individual will be identified in any way in any future publication of this research.

I understand that there are no known risks, associated with my child's participation in this research.

I understand that I can withdraw my child from the study at any time and request the removal of all or part of my child's data, without consequences.

I understand that I can contact Peter Bowers, (tel: 613-546-2718 or email: bowersp@kos.net) the principal investigator with questions about the study, or his supervisor, Dr. John Kirby (613-533-6000, ext. 77231). I understand that for questions, concerns or complaints about the research ethics of this study, I can contact the Dean of the Faculty of Education, Dr. Rosa Bruno-Jofré, (613-533-6210) or the chair of the General Research Ethics Board, Dr. Joan Stevenson, (tel: 613-533-6081 or e-mail stevensj@post.queensu.ca).

Please circle *'yes'* or *'no'* to indicate your response to each statement below:

I consent for my child's participation in the oral and written assessments. Yes No

I consent for the work my child completes during the intervention lessons to be used by the researchers to assess the program. Yes No

Name of parent/guardian: (please print) _____

Signature of Parent/Guardian: _____

Date: _____

Appendix B 1.0: Morphological Choice Instructions For Tester

Morphological Choice Instructions
*"Find the **Real** Connection"*

The instructions and examples for this task are designed to show students that for this activity, the "real" connection they are looking for has to link the ***basic meaning*** of the words.

Put the sheet "Practice Page: "Find the ***Real*** Connection" on the desk facing the child. Cover everything under the words ***help, helpful, playful*** with a blank sheet. Refer to this page as you go through the instructions.

Say:
*This activity is called "Find the **Real** Connection". You may have noticed how some words are connected to other words of the same meaning. For example (*Pointing to examples), *the words **helpful** and **helps** are connected by the basic word 'help'. These words all have a "real" connection to each other because their **meanings** are connected. For this activity, the word **playful** couldn't have a "real" connection to the others because it doesn't connect to the meaning 'help'.*

Move blank sheet down to show words ***car*** and ***carpet***.

Say:
*Sometimes words look connected, but they aren't. For example, **car** is about automobiles and **carpet is about rugs, so these words are** not linked in meaning. Both use the letters C-A-R, but because the meaning is not connected, they do not have a "real connection" for this activity.*

Show page of words and say,
"You are going to look for connections in these words, but first let's do some examples."

Move blank sheet down to show ***Example 1***.

Say:
For this activity you will be given a "cue word" (Point to the word ***car***) *along with 6 other words* (Point to 6 words following ***car***). *Your job is to circle only the words that have a "**real** connection" to the cue word. Each cue word will always have at least one real connection or at least one word that is not really connected. .*

Now you try the first example.

Point to (do not read!) the cue word and 6 following words out loud while pointing before asking student to circle the "real" connections.

Appendix B 1.0: Morphological Choice Instructions Continued

Example 1:

Cue	Circle **only** the words with a "real" connection to the cue word					
car	card	carsick	cars	caring	sidecar	carat

Correct choices are *carsick*, *cars* and ***sidecar.*** **Have student explain choices, and explain correct and incorrect choices. You need to explain why each word is or is not connected.** *(e.g., **card**, **caring** and **carat** use the C-A-R string, but have nothing to do with the **car** you drive in. The word **carsick** is about being sick in a **car**. **Cars** means more than one car. A **sidecar*** is a car attached to the side of a motorcycle for a passenger.*)*
Students may not know the word ***sidecar***. This is a good time to let them know that there will likely be words in the task they don't recognize and that they should just make their best guess about whether or not those words are "real connections".
NOTE: During the practice examples, you may help the student with the meanings of words, but let the student know that <u>during the activity, you are *not allowed* to help with the meanings of any words</u>.

Say: *Let's try the next example:*

Example 2

Cue	Circle **only** the words with a "real" connection to the cue word				
healthy	health	wealthy	heal	healing	unhealthy

Correct choices are ***health*, *heal healing*** and ***unhealthy.*** First have the student explain their choices. Point out their correct choices and make sure that you explain any incorrect choices they make. *(e.g.,* It might be easiest to see that ***health,*** *and **unhealthy** are connected to **healthy.** The words **heal** and **healing** are a bit harder to see because they sound different. However, they are connected because the meanings are clearly connected. For example "After the accident it took weeks for my injuries to **heal** before I was completely **healthy**." The word **wealthy**, however, is not connected in meaning. They both end in the letters E-A-L-T-H-Y, but **wealthy** is about having money not about being sick or well. Also **theatre** matches some letters, but is not connected to the idea of **health**.*

Say:
Any questions?

OK. Let's start the activity.

Remember for each cue word there can be 1, 2, 3 or 4 words that are "really" connected

Only circle the words you think are "really" connected to the cue word.

Start the activity.

Appendix B 1.1: Morphological Choice Practice Page

Practice Page: "Find the ***Real*** Connection"

---

helps helpful playful

---

car carpet

Example 1:

Cue Circle **only** the words with a "real" connection to the cue word

car card carsick cars caring sidecar

Example 2:

Cue Circle **only** the words with a "real" connection to the cue word

healthy health wealthy heal healing unhealthy

Appendix B 1.2: Morphological Choice Test Page

Tester _____ Student Name: _____ ID #:_____
School: _____ Date: _____

Find the Real Connection

Cue Word	Circle words with a ***real*** connection to the cue word					
1. **saving**	saves	raving	saved	having	raved	craves
2. real	cereal	ideally	reality	unreal	nearly	realization
3. **create**	creative	cream	creature	ate	recreation	crease
4. **vacation**	indication	vacuum	vacate	location	evacuating	isolation
5. **sign**	signature	signs	align	singer	signal	assignment
6. **please**	ease	complete	pleasant	teasing	pleasing	pleasure
7. **using**	amusing	use	confusing	useful	amuse	fusing
8. **easy**	east	disease	tease	ease	increase	easily
9. **science**	scissors	unscientific	essence	scientist	discipline	unconsciously
10. **education**	production	produces	reduction	vacation	instruction	dedication
11. **happy**	shape	chapter	happiness	chapped	mishap	flabby
12. **busy**	busied	busier	buses	business	busily	busybody
13. **section**	dissection	inspect	reject	insect	intersection	detection

Appendix B 1.3: Morphological Answer Page

Find the Real Connection (Answer Key)

Cue Word	Circle words with a ***real*** connection to the cue word					
1. **saving** <save> 2	**saves** save/+es	raving	**saved** save/+ed	having	raved	craves
2. **real** <real> 3	cereal	ideally	**reality** real+ity	**unreal** un+real	nearly	**realization** real+ize/+ate/+ion
3. **create** <create> 3	**creative** create/+ive	cream	**creature** create/+ure	ate	**recreation** re+create/+ion	crease
4. **vacation** <vace> 3	indication	**vacuum** vace/+u+um	**vacate** vace+ate	location	**evacuating** e+vace+u+ate/+ing	isolation
5. **sign** <sign> 4	**signature** sign+ate/+ure	**signs** sign+s	align	singer	**signal** sign+al	**assignment** as+sign+ment
6. **please** <please> 3	ease	complete	**pleasant** please/+ant	teasing	**pleasing** please/+ing	**pleasure** please/+ure
7. **using** <use> 2	amusing	**use** use	confusing	**useful** use+ful	amuse	fusing
8. **easy** <ease> 3	east	**disease** dis+ease	tease **ease** ease	increase	**easily** ease/+y/i+ly	
9. **science** <sci> 3	scissors	**unscientific** un+sci+ent+ific	essence	**scientist** sci+ent+ist	discipline	**unconsciously** un+con+sci+ous+ly
10. **education** <duce/duct> 3	**production** pro+duct+ion	**produces** pro+duce/+es	**reduction** re+duct+ion	vacation	instruction	dedication
11. **happy** <hap> 2	shape	chapter	**happiness** hap(p)+y/i+ness	chapped	**mishap** mis+hap	flabby
12. **busy** <busy> 5	**busied** busy/i+ed	**busier** busy/i+er	buses	**business** busy/i+ness	**busily** busy/i+ly	**busybody** busy+body
13. **section** <sect> 3	**dissection** dis+sect+ion	inspect	reject	**insect** in+sect	**intersection** inter+sect+ion	detection
39 target words out of 78 (50% are targets)	*targets in this column:* ***6***	*targets in this column:* ***7***	*targets in this column:* ***7***	*targets in this column:* ***6***	*targets in this column:* ***7***	*targets in this column:* ***6***

Appendix B 2.0: Orthographic Choice Instructions and Practice

ID #_____ Orthographic Processing. Session # ____

Spelling Choice

"In this activity, you will see words, some written in the right way and others incorrectly. I want you to choose which of the words are right. Please circle the correctly spelled words in columns A or B. Ok?"

Let's try some practice items. Which of these are correct? After they finish say: "**OK, are you ready to do more of these now?"**

Practice examples:

	A	B
1.	rume	room
2.	young	yung
3.	clown	cloun
4.	boal	bowl

Flip to the following page for the test items. Please circle the correctly spelled words in either column A or column B.

You will have 60 seconds to complete this task.

Appendix B 2.1: Orthographic Choice Test Page

ID #_____

	A	B		A	B
1.	take	taik	26.	mussle	muscle
2.	gote	goat	27.	condence	condense
3.	pleese	please	28.	pavement	pavemant
4.	rain	rane	29.	travle	travel
5.	store	stoar	30.	assure	ashure
6.	streat	street	31.	captin	captain
7.	anser	answer	32.	engine	enjine
8.	believe	beleave	33.	mysterey	mystery
9.	chooze	choose	34.	example	exsample
10.	deep	deap	35.	several	sevral
11.	easy	eazy	36.	distence	distance
12.	evry	every	37.	sudden	suddin
13.	hevvy	heavy	38.	importent	important
14.	hurt	hert	39.	backwords	backwards
15.	keep	keap	40.	explain	explane
16.	nead	need	41.	senaters	senators
17.	roar	rore	42.	interesting	intresting
18.	scair	scare	43.	demon	deamon
19.	skait	skate	44.	harth	hearth
20.	smoke	smoak	45.	wreath	reath
21.	taip	tape	46.	applause	aplause
22.	thum	thumb	47.	sallad	salad
23.	wait	wate	48.	sensitive	sensative
24.	nostrels	nostrils	49.	liberty	libberty
25.	grown	grone	50.	culpret	culprit

Appendix B 3.0: Wordchains Instructions

Wordchains Task Instructions

Place the example sheet and a pencil in front of the participant.

Say: "It looks like somebody forgot to put spaces in between these words.
What I'd like you to do is take your pencil and put a line after each word where a space should go"
[Show the demonstration item] "See, someone has done the first one."

"Let's practice these two:" (Let child do 2 practice items. Explain if child is confused.)

On the next sheet of paper, you are going to see a whole bunch of items like the ones I've just shown you.

I'm going to give you **one minute** to find as many words as you can from the items on the page.

I'll tell you when to start and stop."

[Turn the sheet over and tell the participant to start immediately; start the stopwatch].

If they seem discouraged by how many there are, tell them that they don't have to finish.

Scoring: Score this after you finish testing.
Count (a) the number of correctly placed slashes,
(b) the number of incorrectly placed slashes, and
(c) the number of slashes omitted up to the point that the subject stopped.

Appendix B 3.1: Wordchains Practice Page

Name: _____ School: _____

ID#: _____ Date: _____ (test 3)

Examples

dogcatfat → dog/cat/fat

cowcarfun

treetrycat

Appendix B 3.2: Wordchains Test Page

hatsun

goman

toydogcar

fatrunball

dollbirdhopseehe

boypenonlookname

closeflyatwatchwide

writegivefastliveold

tenwalkeathurtwhichitfar

loseonlymuchkiduslighteight

hurtunderworkafteroldopengold

showoutoncethanktenafteropen

icerichtellworldnotmixblueoutchoose

wifehowsleeplakeluckranonmilkfull

Appendix B 4: Word Analogy Instructions and Test

Word Analogy

Tell them you are going to ask them to figure out some missing words. Give the first practice item: "I say *push* and then I say *pushed*; then I say *jump*, so then I should say ??". (Only say the words in **bold**. Student guesses word in *italics.*) If they get that, keep going, explaining any practice example they miss. If they miss the first one, try to explain it. Try to administer all the practice items. Then do the inflectional ones – Do all 10 and then go onto derivational, and do all 10 of those.

Practice Task:

1	**push**	**pushed**
	jump	*jumped*
2	**walker**	**walk**
	teacher	*teach*
3	**bird**	**birds**
	goose	*geese*
4	**sleep**	**sleepy**
	cloud	*cloudy*
5	**bounce**	**bounced**
	skip	*skipped*
6	**beauty**	**beautiful**
	fun	*funny*

Test: **Inflected Analogies**

			0 / 1
1.	**run**	**ran**	-----
	walk	*walked*	
2.	**doll**	**dolls**	-----
	sneaker	*sneakers*	
3.	**good**	**better**	-----
	low	*lower*	
4.	**jumped**	**jump**	-----
	stood	*stand*	
5.	**push**	**pushed**	-----
	lose	*lost*	
6.	**help**	**helped**	-----
	say	*said*	
7.	**mouse**	**mice**	-----
	child	*children*	
8.	**heard**	**hear**	-----
	kept	*keep*	
9.	**longer**	**long**	-----
	taller	*tall*	
10.	**dog**	**dogs**	-----
	person	*people*	

Derived Analogies

			0 / 1
1.	**mess**	**messy**	-----
	fun	*funny*	
2.	**paint**	**painter**	-----
	bake	*baker*	
3.	**anger**	**angry**	-----
	sun	*sunny*	
4.	**teach**	**teacher**	-----
	work	*worker*	
5.	**high**	**height**	-----
	deep	*depth*	
6.	**decision**	**decide**	-----
	action	*act*	
7.	**science**	**scientist**	-----
	art	*artist*	
8.	**long**	**length**	-----
	wide	*width*	
9.	**warmth**	**warm**	-----
	strength	*strong*	
10.	**magic**	**magician**	-----
	music	*musician*	

Appendix B 5: Morphological Production

ORAL Morphological Production: Derivation & Decomposition

(You read to student, they don't see any writing)

Derivation

Instructions: I'm going to say a word and I want you to change it to fit the sentence. Here let's try one.

a. **Farm**. My uncle is a ____. How could you change ***farm*** to fit that sentence? [***farmer***]

*If they get that, say, "Right. My uncle is a **farmer**."*
If they miss the first one, explain that they need to change it to fit the sentence and repeat the complete sentence. Give a second example in the same way.

b. **Help**. My sister is always ____ [***helpful***]

OK. Do you have any questions? Great. Remember that you just have to change the word to fit the sentence.

		Correct? 0 / 1	Response if Incorrect
1) **Perform**. Tonight is the last ____.	[performance]	____	_____
2) **Humour**. The story was quite ____.	[humourous]	____	_____
3) **Remark**. The speed of the car was ____.	[remarkable]	____	_____
4) **Comfort**. The chair was ____.	[comfortable]	____	_____
5) **Express**. His face had a funny ____.	[expression]	____	_____
6) **Protect**. She wore a helmet for ____.	[protection]	____	_____
7) **Reason**. Her argument was quite ____.	[reasonable]	____	_____
8) **Major**. He won the vote by a ____.	[majority]	____	_____
9) **Equal**. The boys and girls were treated with ____.	[equality]	____	_____
10) **Human**. The kind man was known for his ____.	[humanity]	____	_____

Decomposition

Now we are going to try some more. Just like before, I'm going to say a word and I want you to change it to fit the sentence. Here are a couple to practice.

a. **Driver**. Children are too young to ____. [***drive***] How could you change drive to fit that sentence?

*If they get that, say, "Right. Children are too young to **drive**."*
If they miss the first one, explain that they need to change it to fit the sentence and repeat the complete sentence. Give a second example in the same way.

b. Improvement. My teacher wants my spellings to ____ [improve]

		Correct? 0 / 1	Response if Incorrect
1) **Dangerous**. Are the children in any ____?	[danger]	____	_____
2) **Enjoyable**. The boring show was hard to ____.	[enjoy]	____	_____
3) **Courageous**. The man showed great ____.	[courage]	____	_____
4) **Discussion**. The friends have a lot to ____.	[discuss]	____	_____
5) **Popularity**. The girl was very ____.	[popular]	____	_____
6) **Publicity**. His secret was made ____.	[public]	____	_____
7) **Hazardous**. Smoking is a health ____.	[hazard]	____	_____
8) **Action**. People in plays like to ____.	[act]	____	_____
9) **Agreeable**. With that decision I could not ____.	[agree]	____	_____
10) **Acceptance**. It was a gift I could not ____.	[accept]	____	_____

Appendix B 6: Words for Reading MA

Practice Page

books	making	runner
enjoyment	bookstore	

Test Booklet

Page 1:

busily	reproduce	refereeing
staring	condensed	starring

Page 2:

insensitive	architecture	socially
scarred	victoriously	decreasing
precautions	ruder	prearranged

Page 3:

adaptation	insignificance	reelected
incorruptible	stared	educated
vacuum	conscious	vacuous

Page 4:

acknowledgement	condensation
responsibilities	restructured
happenstance	accompanying

Appendix B 7.0: Base Identification Instructions

Instructions for: Circling Main Part of the Word

The student **MUST** do the ***Reading Accuracy*** task **BEFORE** this task.

Circling Main Part of the Word:
The student will be using a new booklet for this activity, but you need your **"Reading Accuracy Score Sheet"** as the student goes through these same words for the new tasks.

It is important that you do not use the words **prefix**, **suffix** or **base**, even though kids may use them. For the base you, say: *"main part of the word"*

For prefixes or suffixes, say: *parts of words, or the beginning / ending part of a word.*

***Say**:*
For this activity, I will ask you to look carefully at the words that we just read, but this time I am asking you to circle the main part of each word. Let's try the practice.

If a child is messy in their circling, try to emphasize that it is important to be as neat as possible, so that someone else can tell exactly what letters they wanted circled.

<books>

Use a blank sheet to cover all words except *books.*

What part of 'books' would you circle as the main part?

If student has trouble – go ahead and circle *book*, and say, *"Do you see now "book" is the main part of "books"?*

<making>

Ask the student to move the sheet down to next word. If the student circles anything other than m-a-k, show them the correct answer.

Say:
Can you see how m-a-k are the letters from make, which is the main part of this word?

- If the student shows the missing <e> and asks if you want them to do that, just say "*that would be fine", but don't emphasize it as a good or bad thing to do.*
- If the student wants to circle the <i> or asks about the missing <e> just say "*The <e> in the word **make** isn't in **making**, so all you can do is circle **m-a-k**.*
- If the student circles k-i-n-g. say: "***King*** is a word, but it doesn't have anything to do with the word ***making***. For this activity, you have to circle *m-a-k* from the word ***make***.

<runner>

Ask the student to move the sheet down to next word. If the student circles anything other than r-u-n, show the correct answer.

- If the student circles both <r>'s just say: "*The main part of **runner** is **run**, so you can only circle the first <r>.*

Appendix B 7.0: Base Identification Instructions Continued

<enjoyment>

Ask the student to move sheet down to next word.

Student circles <**joy**>. Say:

*Good. The word **joy** is the main part of **enjoyment**. Some people would circle **enjoy** as the main word. That would be OK, because **enjoy** is a main part of **enjoyment** too. However, since **joy** is the smallest main part of **enjoyment**, **joy** is the best answer.*

Student circles <**enjoy**>. Say:

*Good. The word **enjoy** is a main part of **enjoyment**. However,* (circle ***joy*** as you say): *can you see how **joy** is the smallest main part of **enjoyment**? While **enjoy** is a good answer, **joy** is the best answer for this activity.*

Student circles <**joyment**>. Say:

Good try. The only problem is that I don't think joyment is a word.
Circle enjoy as you say…*You could circle **enjoy** since that is a main part of enjoyment. However, there is an even better answer.* (Circle ***joy*** as you say): *Can you see how **joy** is the smallest main part of **enjoyment**? While **enjoy** is a good answer, **joy** is the best answer for this activity.*

<bookstore>

Ask the student to move the sheet down to next word. If the student circles anything other than b-o-o-k AND s-t-o-r-e, show that for this word they have to circle both. DO NOT SAY THE WORD COMPOUND WORD. It's fine if the student does.

Say: *This word has two main parts, so you have to circle them both.*

- If the student circles both <books>'s just say: "*There is a word <**books**> but you can't circle that one in this word because you also need to circle the other main part <**store**>.*"

"OK, let's start…"

Start Circling Task (REMEMBER to point to words, but never read them out loud!)

Turn the page and cover all but the first word.
Say: *Circle what you think is the main part of this first word.*

Student circles part, all of the word or decides to pass.

If the line of their circle goes through a letter and it is not clear, ask the student to say the letters then wanted in their circle. Carefully circle what the student tells you on your record sheet.

Appendix B 7.1: Base Identification Test Booklet

Circle the main part of the word.

Practice Page

books

making

runner

enjoyment

bookstore

Test Booklet

Page 1:	Page 2	Page 3
busily	victoriously	educated
reproduce	decreasing	vacuum
refereeing	precautions	conscious
staring	ruder	vacuous
condensed	prearranged	acknowledgeme
starring	adaptation	condensation
insensitive	insignificance	responsibilities
architecture	reelected	restructured
socially	incorruptible	happenstance
scarred	stared	accompanying

Appendix B 7.2: Base Identification Base Identification Scoring Details

The guiding principles for the scoring system were (a) to reward evidence of more accurate written morphological awareness, (b) to ensure consistency of scoring and, (c) to avoid giving an unfair advantage to the training group over the control group. The additional scoring criteria are described below.

1) There was no penalty for incorrectly including the letter *e* of the beginning of a suffix (e.g., -*ed*, or -*er*) as being part of a base or stem if that base or stem ended in a single silent *e.* Strictly speaking, in such a case the silent *e* of the base has been replaced by the vowel suffix, and therefore that *e* should not be identified as being part of the base or stem. For example, for the word *educated* (*e*+***duce***/+*ate*/+*ed*), circling *educate*, *educat*, *or duc* all score 2 points. The second *e* in *educated* is part of the vowel suffix –*ed* which has replaced the silent *e* of *educate* and, therefore, is not part the stem. However, only the experimental group would have been taught such specific information. To make the test fair to both the control and experimental group, circling *educate* was accepted as being worth 2 points even thought it leaves only the letter *d* of the –*ed* suffix uncircled and thus breaks a morphemic boundary. The bound base of *educate* is *duce* for 'lead, bring'. Here the silent *e* at the end of this bound base is replaced by the *e* of the vowel suffix –*ate*, meaning that the child who knows about bound bases can only indicate that knowledge in the word *educated* by circling *duc.*

2) If the base or stem ends in a letter *y* that has been changed to *i* due to suffixing, the letter *i* must be circled as part of the base or stem. Unlike the silent *e* of a base or stem that is replaced by a vowel suffix, the *y/i* shift occurs within the base of a word and cannot be treated as part of the suffix. For example, consider the word *busily* which uses

Appendix B 7.2: Base Identification Scoring Details Continued

the base *busy* and the suffix *–ly* as revealed by the word sum *busy/i+ly* → *busily*. For *busily*, circling *bus* is incorrect and scores 0. This response suggests the base word *bus,* which is unrelated to the word *busily* and *ily* as a suffix which it cannot be. (Despite the fact that some resources identify letter stings such as *–ily*, and *-ies* as suffixes, these are in fact the suffixes –ly or –es causing the final *y* of a stem to change to *i.*) The base of *busily* can only be accurately indicated in this activity by circling *busi.* The only possible scores for this word were 0 or 2 as only one affix could be removed by circling.

3) The scoring of compounds needed special consideration, as trained and untrained students had different levels of understanding of what a compound was. For example, to the trained student, the word *architecture* is a kind of compound word. This word contains two bases, the free base, *arch* 'leader, chief' and the bound base *tect 'carpenter, builder'.* The structure *arch* + *i* + *tect* + *ure* joins these two bases with the *i* connector vowel. Only students with explicit instruction could be reasonably expected to recognize *tect* as a base, and therefore identify *architect* as a compound word. Scoring was designed to prevent such special explicit knowledge from helping only the scores of children in the training group. As a result it was decided that for all compounds in this activity (*architecture*, *acknowledgement*, *happenstance*) circling either of the bases scored the same as circling both bases. Thus for the word *architecture,* circling the letters *arch* or *tect*, scored 2 points as did circling both *arch* and *tect.* Circling *architect* scored 1 point because it is not the smallest base or stem that can stand on its own as a word. The base *arch* is a free base that stands on its own as a word as seen it the sentence, "Superman has an *arch* enemy."

Appendix B 8.0: Spelling Choice Instructions

Instructions:
Morphological Spelling Choice

Put 3 page booklet on table in front of student.

Say, *"I'm going to read the sentence with the word that fits in the blank. Your job is to study all the spellings under that sentence and circle the one that correct. Be careful to check all the spellings before you make your final choice.*

[After reading the sentence with the cue word in the blank, you will always repeat the cue word again.]

Let's try the practice. Read out loud:

"The movie was very <u>*exciting*</u>*."* ***exciting.***

Draw your finger across all the choices, and say, *"Look at all the choices a circle what you think is correct."*

After they have chosen, show them the correct answer. Just say, *"That's how you spell 'exciting'.*

Let's start.

Turn the page over and cover all but question one with a blank page. Read the first sentence out loud, and remember to always repeat the cue word again at the end. Keep sliding the page down as you go.

If you sense that the student is not bothering to look at all the words, just give prompts such as:

"Make sure you check all the words"

If a student is taking a very long time, say, "If you are not sure, just make your best guess and move on to the next one

Appendix B 8.1: Spelling Choice Test Page

Morphological Spelling Choice

1. The bunny was _____ down the trail.
   hawping **hopping** **hauping** **hoping** **haupping**

2. She was _____ as she opened her present.
   smiling **smilling** **smileing** **smieling** **smielling**

3. My favourite actor _____in that movie.
   stared **staured** **stard** **starrd** **starred**

4. I _____ liked that movie.
   reelly **realy** **really** **realey** **reeley**

5. The puppy was so _____and soft.
   furry **fury** **firry** **furey** **firry**

6. My grandparents and other _____came to Christmas dinner.
   relitives **realatives** **relatives** **relativs** **realitives**

7. There was not enough _____room in the trunk for my hockey stuff.
   storege **storage** **storeage** **storaje** **storedge**

8. The teacher gave _____before we started the test.
   instrucshuns **instructions** **instructiones** **instrukchunes** **instruckshuns**

9. The ringing bell _____the end of recess.
   signafies **signafys** **signefies** **signifys** **signifies**

10. It took a long time, but I _____finished my homework.
    finelly **finnely** **finaly** **finally** **finnaly**

11. When the deer heard us walking in the woods, it _____by running away.
    reacted **reactid** **reeacted** **reyactid** **reyacted**

12. We had to write a _____of the story for school.
    sumary **summery** **sumery** **summary** **somery**

13. My teacher said to find the definition in the ***dictionary***.
    dikshunary **dictionairy** **dicshunary** **dicshunairy** **dictionary**

14. My missing front teeth showed when I _____.
    smilled **smield** **smiled** **smieled** **smielled**

15. The heater _____the window in my car after the freezing rain.
    deict **deist** **diced** **deiced** **deised**

Appendix B 8.1: Spelling Choice Test Page Continued

16. Her _____were so big they hung down to her shoulders!
    earings **earringes** **eeringes** **eerrings** **earrings**

17. I hike through the woods just to be in _____.
    natur **nachur** **nachure** **nature** **natchure**

18. My parents don't like _____food that is full of chemicals.
    unatural **unnatural** **unnachurel** **unachurel** **unnatureal**

19. It is a _____to wears sneakers in the gym.
    requirment **riquirement** **requiremint** **riquiremant** **requirement**

20. The corn that we eat today _____with Mayan farmers.
    origanated **origanaded** **originaited** **origanaited** **originated**

21. _____I didn't think I would like music lessons, but it turned out to be fun.
    origanully **originally** **originaly** **origanally** **origanuly**

22. The streets were too _____to drive.
    icsey **aisy** **icy** **icey** **aicy**

23. I was so angry I was in a _____when my sister broke my favourite toy.
    firry **firry** **furry** **fury** **furey**

24. My teacher said my group was very _____because we got so much done.
    preductive **productove** **pruductive** **productive** **praductove**

25. My cat _____at the goldfish in the fishbowl all day long!
    stares **stairs** **stars** **staires** **starres**

26. I was amazed my mom _____let me stay up to midnight on New Year's.
    acchuly **acchually** **actualy** **actually** **actully**

27. The children went though the wardrobe into the _____kingdom of Narnia.
    majicle **magicle** **majikal** **magickal** **magical**

28. I was _____for a new bike for my birthday.
    hoping **hopping** **hopeing** **hoaping** **hoapping**

29. _____it won't rain tomorrow.
    hopefuly **hopefully** **hopfuley** **hoapefully** **hopefulley**

30. How they built Great Pyramids of Egypt is an _____mystery.
    archatectural **arcatectural** **arcitectural** **architectural** **architectureal**

Appendix B 8.1: Spelling Choice Test Page Continued

31. The weather was _____, so I wore my raincoat in case it rained.
    unpredictable **unpredictabul** **unpradictable** **unpradictabel** **unpredictabel**

32. Many people had to be ***relocated*** after hurricane Katrina.
    reloacatid **realocatid** **relocated** **realocated** **reloacated**

33. The _____pulled a rabbit out of the hat.
    magishen **magican** **magician** **magishian** **magichan**

34. My snow fort broke so I _____it to make it stronger.
    redesined **redesigned** **redasigned** **redizigned** **redazined**

35. I was _____at the beautiful stars.
    stareing **stairring** **stairing** **starring** **staring**

36. I yelled _____at the driver who went right through the red light.
    furiousely **furiously** **furriously** **fureously** **furreously**

37. It is a _____to say one thing to one person and then say the opposite to someone else.
    contradiction **contridicshun** **contridiction** **contradicshun** **controdiction**

38. The sunset was so beautiful that it was _____.
    indiscribable **indescribable** **indiscrybable** **indescrybible** **indiscribible**

39. The waves came and ***destroyed*** my sand castle on the beach..
    distroyed **distroyd** **desstroyd** **desstroyed** **destroyed**

40. I used my meter stick to take a _____of the room.
    measurement **measuremint** **mesurement** **mesurment** **mesurmint**

41. It was getting _____cold, so I put on my jacket.
    increasinglly **increasingly** **increesingly** **incresinglly** **incresingly**

42. The Maya civilization built amazing _____out of stone.
    strukchers **structurs** **struktures** **structures** **structurres**

43. When the dog chased me, I ran _____fast!
    amazeingley **amazingley** **amazingly** **amazeingly** **amazingley**

44. We _____Ancient Egypt in the library yesterday.
    researched **reaserched** **reserched** **reaserched** **reasearched**

45. The doctor wrote a _____for the medicine I needed..
    priscription **prascription** **preascription** **prescription** **pruscription**

Appendix B 9: Word Lists for Experimental Tests by Word Category

Morphological Choice

Word Taught	Base Taught	Affixes Taught
1. creature	1. creative	1. saves
2. vacuum	2. recreation	2. saved
3. signature	3. vacate	3. reality
4. signal	4. evacuating	4. unreal
5. assignment	5. signs	5. realization
6. pleasant	6. pleasing	6. use
7. pleasure	7. unscientific	7. useful
8. scientist	8. unconsciously	8. disease
9. production	9. produces	9. ease
10. happiness	10. reduction	10. easily
11. busied	11. mishap	11. dissection
12. business	12. busier	12. insect
13. busybody	13. busily	13. intersection

Spelling Choice

Word Taught	Base Taught	Affixes Taught
1. hopping	1. starred	1. breathless
2. smiling	2. signifies	2. relatives
3. furry	3. smiled	3. storage
4. instructions	4. deiced	4. finally
5. summary	5. originated	5. reacted
6. dictionary	6. originally	6. earrings
7. requirement	7. productive	7. nature
8. icy	8. stares	8. unnatural
9. furry	9. architectural	9. actually
10. hoping	10. unpredictable	10. magical
11. hopefully	11. furiously	11. relocated
12. redisigned	12. contradiction	12. magician
13. staring	13. indescribable	13. measurement
14. destroyed	14. amazingly	14. increasingly
15. structures	15. prescription	15. researched

Appendix B 9 Continued: Word Lists for Experimental Tests by Word Category

Circle The Base & Reading MA

Word Taught	Base Taught	Affixes Taught
1. busily	1. reproduce	1. refereeing
2. staring	2. condensed	2. insensitive
3. architecture	3. socially	3. decreasing
4. victoriously	4. ruder	4. precautions
5. adaptation	5. insignificance	5. prearranged
6. educated	6. incorruptible	6. reelected
7. vacuum	7. stared	7. acknowledgement
8. conscious	8. restructured	8. responsibilities
9. condensation	9. vacuous	9. accompanying
10. starring	10. happenstance	10. scarred

Appendix C 1: Activity Sheet #1

Word Building: Using a Real Spelling Word Matrix

A WORD MATRIX USUALLY ONLY SHOWS ***SOME*** POSSIBLE WORDS, YOU CAN USUALLY FIND MORE IF YOU TRY!

Rules for reading a word matrix:

- Read a matrix from left to right
- Make only single, complete words from a matrix
- If you are unsure that a word you build is a real word, check a dictionary
- You don't have to take an element from every column of a matrix – BUT
- You must not 'leapfrog' over a column
- WATCH THE JOINS – sometimes changes happen where you add a suffix

re as		**sign**	al ing ed ment ify	
re	de		ate	ure

Build words with your cut out **prefixes** and **suffixes** on the **base** <***sign***>. Once you have built a word, write the **word sum** as modeled in 1 and 2.

Part A:

prefix(es)- **base** - suffix(es)

1) sign + al → signal

2) as + sign + ment → assignment

3) _____ → _____

4) _____ → _____

5) _____ → _____

6) _____ → _____

7) _____ → _____

8) _____ → _____

9) _____ → _____

10) _____ → _____

Appendix C 1: Activity Sheet #1Continuted

Part B: Word sums from <pack> matrix

<table>
<tr><td rowspan="3">re
un</td><td rowspan="3">pack</td><td colspan="2">s
er
ing
ed</td></tr>
<tr><td>age</td><td>es
ing
ed</td></tr>
<tr><td>et</td><td>s</td></tr>
</table>

1) _____ → _____

2) _____ → _____

3) _____ → _____

4) _____ → _____

5) _____ → _____

6) _____ → _____

7) _____ → _____

8) _____ → _____

9) _____ → _____

10) _____ → _____

Appendix C 2.0 Activity Sheet #1Continuted

Activity #2

When do Suffixing Cause Changes at the Joins?

Spelling Detectives

A) Investigation: Developing a hypothesis

Study the matrix for <move> and the word sums created from it to see if you can discover a consistent suffixing pattern.

re un	**move**	s ing ed er ment

Word Sums from <move> Matrix

move + s → moves
move + ing → moving
move + ed → moved
move + er → mover
move + ment → movement
re + move + ed → removed
re + move + er → remover
un + move + ed → unmoved

1. What is the change that sometimes occurs at the suffix join?

2. List the suffixes that cause the change: _____ _____ _____

3. List the suffixes that cause no change: ____ _____

4. How are these suffixes different from each other?

5. Our class' hypothesis to explain how you know which suffixes drop the single, silent <e> of a base or suffix:

Appendix C 2.0 Activity Sheet #2Continuted

Activity #2 Continued…

B) Testing our Hypothesis:

These matrices build on ***base words*** (a one ***morpheme*** word - no ***prefix*** or ***suffix***) that end with the letter 'e'.

- Create word sums from a variety of the matrices to test our class hypothesis. (Only build a few words from each matrix.)
- If you are unsure of the spelling of a word, check with a dictionary or ask for help.
- Be ready to share interesting discoveries with the class. Any surprising findings, or words whose sound changes when you add affixes?

dis	**please**	es ed ant ure

un	**hope**	s ing ed ful less

dis	**agree**	ing ed ment able

re	**take**	s ing en
		away

mis	be	**have**	s ing ed	
			i	our (Can) or (US)

en	**large**	es er ing ed ly ish		
		ment	s	

be	ing en

Appendix C 2.1 Some Lessons Addressed in Activity #2

<please> matrix

- Supporting our hypothesis, the final, single, silent e of the base is dropped by each vowel suffixes.
- A common use of the silent *e* is to prevent words that are not plurals, appearing as if they are. There is a word *pleas*, which is the plural of *plea* (*plea+s*).

<hope> matrix

- Supporting our hypothesis, the final, single, silent *e* of the base is dropped by all vowel suffixes, but not the consonant suffixes.
- Prefixes cause no changes.

<agree> matrix

- It appeared at first to some students that the word sum agree + ing → agreeing was breaking out hypothesis, until we realized that the base *agree* does not end in a single, silent *e.* This word was chosen in part specifically to reinforce the exactness of the convention.
- The word sum *agree* + *ed* → *agreed* was used to introduce the idea of a "spelling law", or a convention that is never broken. It also shows that sometimes two patterns run into each other so that only one can be represented. There is a law of English spelling that no word can have the same letter three times in a row. There is no silent *e* dropped in this word sum, but to avoid breaking the three letter rule, the word sum needs to show that the final spelling has only two letter *e*'s: *agree* + *ed* → **agreed* → *agreed*.

<take> matrix

- This matrix introduced the basic spelling pattern that compound words never cause a spelling change. The spelling <takeaway> is not breaking our suffixing rule hypothesis, because <away> is not a suffix. Only vowel suffixes drop single, silent *e*'s. (The rule for compound rules is also relevant for one of the y/i conventions that we studied later.)

<have> matrix

- This matrix that builds words like *behaviour* and helped show that morphological connections can be surprising.
- This was the first introduction of the "connector vowel" that comes up a few times in class, and is important for full morphological analysis (e.g. *arch* + *i* + *tect*)
- The word *have* introduced the idea that one of the jobs of the silent *e* is to prevent words from ending in the letter *v* because that might lead to double *v*'s (vv) that were easily confused for the letter *w*. (Words like have, love, give are examples of common words using this pattern.) This also introduced the fact that complete English words do not end in the letter *i* or use two *i*'s (confused for *u* in script). The double *i* rule also returns in the y/*i* shift lessons later in the instruction.

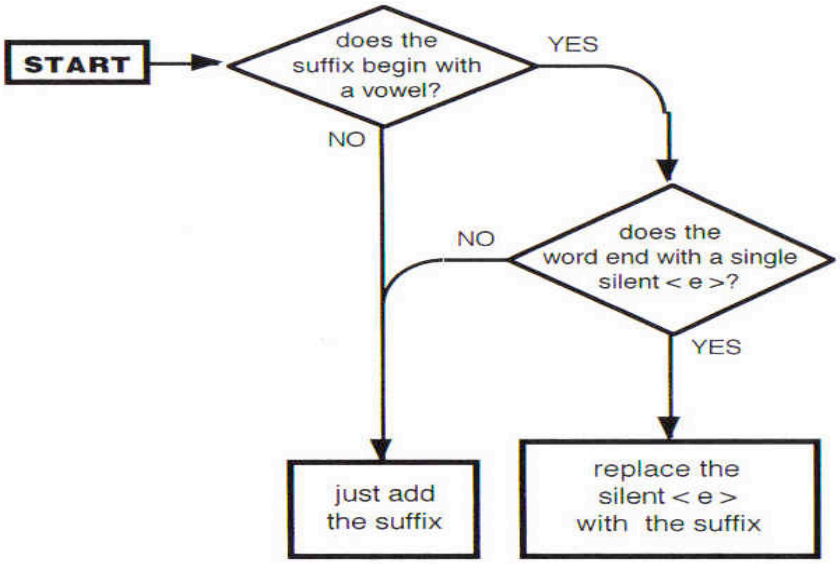
<be> matrix

- This matrix reinforces that only *e*'s that are silent are dropped in suffixing.

Appendix C 3: Activity #3 – Using a Flow Chart to Practice Suffixing Pattern

Activity #3

Flow Chart for Dropping the Single, Silent <e> During Suffixing



Instructions:

1) Glue page into your notebook.

2) Copy the word sums, then use the flow chart to complete them correctly. When a silent e is replaced, cross it out as in the example.

Example: dat~~e~~ + ing → dating

Word Sums

1. cave + ed →
2. create + or →
3. require + ment →
4. smile + ing →
5. rude + ly →
6. brave + est →
7. brave + ly →
8. include + ing →
9. lone + ly →
10. close + ness →
11. laze + y →
12. rule + er →
13. imagine + ary →
14. pure + ly →
15 please + ure →
16. operate + ion →
17. smile + ing →
18. amaze + es →
19. amaze + ment →
20 ice + y →

Appendix C 4: Flow Charts to Practice Suffixing Patterns

Figure 7: *Flow Chart for Doubling Consonants (Ramsden, 2001, p. 58) Reprinted with permission of author.*

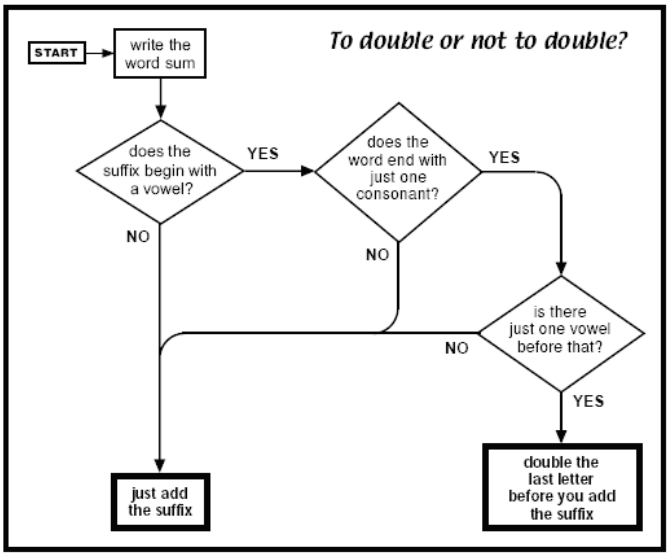
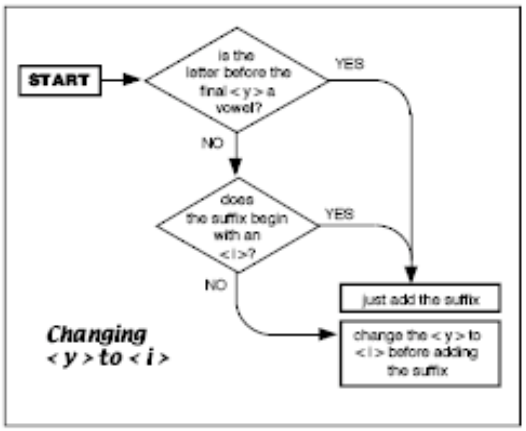


Figure 8: *Flow Chart for <y/i> shift (Ramsden, 2001, p. 56) Reprinted with permission of author.*



Appendix D 1: Correlations of Pre-Test Measures

Table 7

Correlations of Pre-Test Measures

Variable	PA	NS	PPVT-3	WID	Reading Comp.	WRAT Spell.	WRAT Arith.
PA							
NS	.246*						
PPVT-3	.127	-.001					
WID	.605**	.295**	.455**				
Reading Comp.	.367**	.391**	.245*	.485**			
WRAT Spelling	.511**	.331**	.276*	.741**	.478**		
WRAT Arith.	.220*	.212	.262*	.410	.316*	.419**	
MC[a]	.174	-.020	.168	.176	.122	.215	.451*

Note. [a]Morphological Choice; *$p < .05$, **$p < .01$

Appendix D 2: Correlation Tables

Table 8

Correlations of Post-Test Measures

Variable	WID	TOWRE	WRAT spelling	Oral MA Word Analogy	Oral MA Derivation	Oral MA Decomp.	Orth. Choice	WC	RMA Total Score	SC Total Score	MC Total Score
TOWRE	.519**										
WRAT spelling	.770**	.500**									
Oral MA Word Analogy	.574**	.258*	.507**								
Oral MA Derivation	.501**	.220*	.475**	.471**							
Oral MA Decomp.	.405**	.256*	.387**	.500**	.428**						
Orth. Choice	.464**	.490**	.579**	.409**	.203	.408**					
WC	-.096	.113	.015	.031	.063	.088	.384**				
RMA Total Score	.814**	.477**	.757**	.585**	.498**	.431**	.570**	.085			
SC Total Score	.523**	.401**	.635**	.345**	.312**	.382**	.665**	.360**	.638**		
MC Total Score	.153	.063	.221*	.230*	.090	.206	.299**	.362**	.289**	.515**	
Base ID Total Score	.318**	.121	.340**	.276*	.183	.290**	.341**	.265*	.521**	.546**	.404**

Note. WID = Word Identification, Orth Choice = Orthographic Choice, WC = Wordchains, RMA = Reading Morphological Awareness, SC = Spelling Choice, MC = Morphological Choice;

*p < .05, **p < .01

Appendix E: Reliabilities

Table 9

Cronbach Alpha Reliability Scores for Experimental Tests and Non-Standardized Measures

Measure	Cronbach Alpha	Items	N
Written MA			
Morphological Choice Pre-Test	.401	13	84
Morphological Choice Post-Test	.551	13	82
Base Identification	.844	30	81
Spelling Choice	.843	45	82
Reading MA	.885	30	82
Oral MA			
Morphological Derivation	.435	10	82
Morphological Decomposition	.386	10	82
Morphological Analogy	.714	20	82
Orthographic Processing	Split-Half Coefficient		
Orthographic Choice	.951		84
Wordchains	.888		83

Note. The variation in *n*s for control group are due to student absence and tester error.