Effects of Instruction in Morphological Awareness on Literacy Achievement: An Integrative Review

Joanne F. Carlisle
University of Michigan, Ann Arbor, USA

Consulting Editors:
Catherine McBride-Chang, *Chinese University of Hong Kong, Hong Kong*
William Nagy, *Seattle Pacific University, Washington, USA*
Terezinha Nunes, *University of Oxford, UK*

ABSTRACT

As many studies have now demonstrated that morphological awareness contributes to students' literacy development, there is growing interest in the educational value of instruction in morphological awareness. This review was undertaken to integrate findings of studies that sought to determine whether such instruction contributed to improvement in literacy. Analysis of the 16 studies that met selection criteria is organized around researchers' purpose(s) in studying the relation of morphological awareness instruction to key components of literacy development (i.e., phonology, orthography, word meaning). Results indicate that morphological awareness has the potential to contribute to students' literacy development in all three areas—most notably when it deepens students' understanding of the morphemic structure, spelling, and meaning of written words. However, examination of the design and quality of the studies of instruction in morphological awareness suggests that this is an emerging area of research. Much needs to be done to provide a clearer understanding of how, when, and why morphological awareness instruction contributes to students' literacy development.

In recent years, we have seen a growing interest in the role of morphological awareness in literacy acquisition, judging from the large number of articles in scholarly journals, including special issues of *Scientific Studies of Reading* and *Reading and Writing: An Interdisciplinary Journal*. Further, recommendations for instruction in morphological awareness have been included in recently published books on reading and spelling instruction (e.g., Ganske, 2000; Henry, 2003; Moats, 2000). Given the current emphasis on educational research to identify effective practices, educators might want to know whether teaching morphological awareness holds promise for improving the reading and writing of school-age students and, if so, why this might be.

What is needed is a review of studies of instruction in morphological awareness; in particular, the goal of this article is to provide an integrative review of the features and results of these studies in a way that might be useful to educators and researchers. I begin by providing an overview of the results of descriptive or correlational studies that suggest that morphological awareness contributes to students' literacy development. Then I discuss the nature of morphological awareness—in particular, different views of the ways that instruction in this area might contribute to significant improvements in literacy development.

Relatively few models of reading development suggest specific ways in which morphological awareness affects literacy development, so it seems important to understand how researchers studying morphological awareness instruction conceptualize morphological awareness as it is related to three common components

of such models—namely, phonology, orthography, and meaning (or vocabulary).

Empirical Support for the Contribution of Morphological Awareness

Interest in morphological awareness instruction has undoubtedly been fueled by results of the many descriptive studies that examined the relation between morphological awareness and literacy development. Morphological awareness has been found to contribute to school-age students' performance reading and spelling words or pseudowords in English (e.g., Carlisle & Stone, 2005; Deacon & Kirby, 2004; Fowler & Liberman, 1995; Nunes, Bryant, & Bindman, 2006; Singson, Mahoney, & Mann, 2000; Templeton & Scarborough-Franks, 1985; Treiman & Cassar, 1996). Similar findings come from studies in other languages—French (e.g., Casalis & Louis-Alexandre, 2000; Sénéchal, 2000), Dutch (e.g., Assink, Vooijs, & Knuijt, 2000), and Chinese (e.g., Chung & Hu, 2007; Ku & Anderson, 2003)—to name a few.

Furthermore, performance on measures of morphological awareness contributes to reading comprehension, after accounting for the effects of performance on tasks of word reading, vocabulary, or phonological awareness (e.g., Carlisle, 2000; Kieffer & Lesaux, 2008; Nagy, Berninger, & Abbott, 2006; Singson et al., 2000). For example, in a cross-sectional study with students in three grade-level groups (grades 4–9), Nagy et al. (2006) found that morphological awareness influenced reading comprehension directly, but it also contributed to reading comprehension indirectly—that is, it contributed significantly to vocabulary, which in turn contributed significantly to reading comprehension.

These descriptive studies have been designed with a wide variety of purposes, and they collectively suggest a variety of ways that morphological awareness might contribute to achievement in word reading, reading comprehension, spelling, and vocabulary. This being the case, it is not surprising that researchers studying instruction in morphological awareness have also focused on different ways in which such instruction might affect key components of literacy development, as we shall see.

Development of Morphological Awareness

Morphemes are the smallest units of meaning in a language—units that can serve as freestanding words (e.g., *hard*) or that are "bound" to such words (e.g., *-en* in *harden*). Morphemes are combined in different ways to express particular meanings or to fill particular grammatical roles (e.g., *heal*, *health*, *healthy*). Understanding of the morphological structure of words requires processing of phonology, semantics, syntax, and with regard to written language, orthography as well.

In some languages, morphemes that mark tense, gender, or number are placed at the ends of words, while in others these appear in the middle of words. Studies have shown that morphology relates differently to reading and writing in different languages. (For a study of Cantonese, Mandarin, and Korean, see McBride-Chang et al., 2008; for a study of Chinese and English, see Ku & Anderson, 2003.) As a result, we might expect that important features of instruction in morphological awareness vary by language. Nonetheless, across languages, the central role of morphemes in word formation and lexical processing constitutes an initial argument for the potential value of instruction in morphological awareness.

Morphology plays a central role in word learning from early childhood on. Children learn morphemes as they learn language. They encode base words and affixes as phonological units that they encounter in different word and sentence contexts, gradually learning what they mean and how they are used. When children are 2 or 3 years old, they begin to experiment with ways that morphemes can be combined. They come to understand the productive use of morphemes, as we can see in their use of novel combinations of morphemes to express meanings for which they do not have readily available words. Clark (1982) gave the examples of her preschool-age children referring to an old-fashioned machine for making ice cream as a "winder" and asking when a cocoon would be "flyable."

As children experience morphemes used in different word and sentence contexts, representations of free morphemes and bound morphemes are locked away in memory. Some complex words are stored as if they were single morphemes (e.g., *forward*), but if a constituent of the word is regularly identified in other words, having similar grammatical and semantic features as in *backward* and *inward*, that morpheme (e.g., *-ward*) acquires its own separate representation (Schreuder & Baayan, 1995; Taft, 2003). Access to morphemes and the richness of linguistic information about them (e.g., grammatical roles, semantic features) affects the facility of lexical processing, including learning new words. Further, the quality of lexical representations contributes to proficiency in reading (Reichle & Perfetti, 2003). Although this explanation might make the process of learning morphologically complex words sound quite intentional, in fact, most language learning happens naturally, without conscious effort.

A major change comes about as students learn to read and spell. Becoming literate requires that students come to understand how the spoken language is put into print. Awareness of the relation of oral and written forms of language is fostered by exposure to print, but more particularly by learning to treat language as an object of thought (Cazden, 1976). Morphological awareness, defined as the ability to reflect on, analyze, and manipulate the morphemic elements in words, can be considered one form of students' developing linguistic awareness. Morphological awareness develops gradually, as students come to understand complex relations of form and meaning. Studies have found that fourth graders perform less well on tasks of morphological awareness than sixth and eighth graders (e.g., Tyler & Nagy, 1989; Wysocki & Jenkins, 1987).

This development of morphological awareness is effectively illustrated in Anglin's (1993) report of a study he designed to estimate the number of words known by first-, third-, and fifth-grade students. In this study, students were asked to define or select (from a set of options) the meaning of base words and morphologically complex words of various types (e.g., compounds, derivations). Results show a very significant increase between first and fifth grades in the number of derived words students correctly defined. This increase reflects students' growing knowledge of base words and affixes, but to a large extent, it comes about because students are more able to infer word meanings through analysis of the constituent morphemes (e.g., recognizing "priest" and "hood" in *priesthood*). Through qualitative analysis of students' explanations of their reasoning, Anglin demonstrated what he called their morphological problem solving. The following excerpt, in which a fifth grader was asked to define *priesthood* (Anglin, 1993, p. 101), is a good example:

> [Interviewer] *I.* What does the word *priesthood* mean?
>
> [Child] *C.* Priest, I know what a priest is.
>
> *I.* Mmm.
>
> *C.* It's like a pastor or somebody like that. And *-hood,* a childhood.
>
> *I.* Mmm.
>
> *C.* Maybe when you grow up you have a good childhood. Oh. *Priesthood*. Um. Like you might grow up when you're a child with a priest, and you'll have a good prie-, priesthood. And you'll know lots of stuff from the Bible and everything. Like you'll know verses and chapters, and you'll know all the days, and you'll go to church, and stuff like that.
>
> *I.* OK. I'm not sure I understand what you're saying. Are you saying like if you're a child and you grow up with a priest, that's priesthood?
>
> *C.* [*Nods yes.*]

The fifth grader gave a synonym for the base word *priest* and relied on another known word that has *-hood* as a suffix to try to figure out the meaning of the whole. Although the student's effort was not successful, this response illustrates the kind of reasoning that signals morphological problem solving. Younger students sometimes make use of such reasoning, although only with words that contain familiar morphemes—and even then, with less success. Using Anglin's definition task, Carlisle and Fleming (2003) found that first graders were much less likely than third graders to look for familiar meaning-bearing units within unfamiliar words or to use analogy to infer the meaning of the word. Few first graders attempted to define *treelet*, whereas third graders were likely to come up with a possible meaning (e.g., "a part of a tree"; p. 250). As these examples suggest, what is acquired over time is not just the meanings of individual morphemes (bound or free) but also an awareness that words might be made up of familiar morphemes and that analysis of these helps one understand unfamiliar words.

Few models of literacy development specify any role for morphological awareness. One exception is a model proposed by Seymour (1997), which focuses on phonology and morphology as contributors to orthographic development, a critical phase being development of what he calls the morphographic framework. Because the English script is morphophonemic, both phonemes and morphemes function as the units that represent the relation of oral and written language. To Seymour, "distinctions of spelling are used to indicate lexical identities, word derivations, and morphological structure" (p. 319). Although based on foundational knowledge (e.g., phonological awareness, alphabetic principle), the morphographic framework represents an advanced level of development. Similarly, decades earlier, Chomsky (1970) used the term *lexical spelling* to refer to the way that English spelling preserves the identity of morphemes and aids students in negotiating phonological shifts in the formation of complex words; the lexical components of written words convey meaning efficiently to those sensitive to the morphemic composition of words, despite phonetic variation (e.g., *grade*, *gradual*).

Focused more on the processes involved in learning to read, Adams (1990) proposed a model in which early stages of literacy development involve children's learning how sound and meaning map onto the written representations of words—emphasizing the collective contributions of the phonological processor, orthographic processor, and meaning processor. With regard to the contribution of morphological awareness, she had this to say:

> The idea of teaching students about the spellings and meanings of the roots and affixes of derivationally complex words

> seems promising but unproven. My own belief is that such knowledge is valuable on both orthographic and semantic dimensions. For example, once one sees that *concurrent* consists of "with" (*con-*) plus *current*, the word is no longer a spelling problem. I further sense that my appreciation of the meaning of such words changes qualitatively and profitably from appreciation of their derivations. Somehow, the insight that *fid* means "trust" or "faith" significantly alters and connects my understanding of words like *confidence*, *fidelity*, *fiduciary*, and *bona fide*; the discovery that *path* means "suffering" alters and connects my understanding of words like *sympathy, psychopath*, and *pathologist*; and so on. (p. 155)

Adams also suggested that connections between the three types of processors are sufficiently beneficial so as to provide a strong rationale for instruction in morphological awareness.

> The direct linkage between the Orthographic and Meaning processors may also be responsible for skilled readers' perceptual sensitivity to the roots of meaning-bearing fragments of polysyllabic words and nonwords. It moreover raises the prospect that it might be a good idea to teach students about the derivational morphologies of polysyllabic words.... By sharpening the connections leading from the Meaning to the Orthographic processor, such instruction might be expected to improve both spelling and visual word perception. Conversely, by refining the connections from the Orthographic to the Meaning processor, such instruction should strengthen students' vocabularies and refine their comprehension abilities. (Adams, 1990, p. 151)

In her view, morphology contributes to understanding of spelling–meaning connections only after children acquire basic reading skills and reach the point where they encounter morphologically complex words in their reading. Lessons on morphological awareness might be most appropriate for "later grades of schooling when the students' knowledge of frequent spelling patterns has been thoroughly established and automated" (p. 156). It is also in the late elementary years that most of the unfamiliar words students encounter in written texts are morphologically complex (Nagy & Anderson, 1984); at that time, morphological analysis should be useful in making sense of unfamiliar words during reading.

As has been pointed out by others (e.g., Tyler & Nagy, 1990), even in fourth and sixth grades, students are likely to carry out rather superficial analyses of the structure of derived words in the act of reading, relying primarily on identification of the base word and ignoring syntactic and semantic features associated with the combination of base word and affixes. Consider this mistake that a sixth grader made in writing, "I am finely going home." This student probably was familiar with the word *finally* to express a particular meaning, but he wrote two known morphemes, *fine-* and *-ly*, without considering the relation of spelling and meaning. Indeed, sensitivity to the relation of form and meaning characterizes morphological awareness. Thus, an argument for instruction in morphological awareness is that it fosters development of the habit of analyzing the relation of word structure, spelling, and meaning—a habit that is likely to contribute to the depth of students' vocabulary, word reading, and spelling, and comprehension of texts.

Morphological Awareness as Associated With Components of Literacy Development

The earlier discussion suggests a number of possible ways that instruction in morphological awareness might support literacy development—the particular concern of this literature review. Researchers who have studied instruction in morphological awareness have done so by examining the effects of morphological awareness instruction as it is related to areas of language and literacy that contribute to literacy development, as outlined by Adams (1990), Chomsky (1970), and Seymour (1997).

One of these areas is phonology. Within this area, the relative benefits of phonological and morphological awareness is a topic of particular interest. As the basic units of writing English words are phonemes and morphemes, the question of interest is whether instruction in one of these units leads to better word reading for beginning readers (Carlisle & Nomanbhoy, 1993). Another possibility, suggested by Lyster (2002), is that morphological awareness instruction might foster development of both phonological and morphological awareness, given the fact that morphemes are bundles of phonemes. A third proposal is that morphological awareness instruction might compensate for difficulties in phonological awareness and phonological processing that are characteristic of reading disabilities (Elbro & Arnbak, 1996; Siegel, 1998).

A second area focuses on the benefits of helping students acquire the habit of analyzing the morphological structure of written words as a way to advance their word reading and spelling. Chomsky's (1970) concept of lexical spelling suggests the potential benefit of understanding how orthography preserves and reveals the morphological composition of words, despite changes in pronunciation, as in *anxious* and *anxiety*. Researchers have argued that explicit instruction in principles governing such spellings would help students understand why *musician* is not spelled *musition* (Nunes & Bryant, 2006). Both Chomsky and Adams described instruction in morphological awareness as an advanced stage of students' grasp of the relations of oral language and written language. However, in Chinese, where the written

language is essentially morphemic, instruction might begin much earlier.

A third area in which morphological awareness has been linked to literacy development focuses on the connection between the orthographic processor and the meaning processor, as described by Adams (1990). In particular, instruction in word-analysis strategies (including morphological analysis) should help students work out the meanings of unfamiliar words as they read. Teaching students a strategy of morphological analysis has the potential to foster vocabulary development and reading comprehension, given the report of a very strong association between morphological awareness and vocabulary knowledge (correlation of 0.91) and between morphological awareness and reading comprehension (correlation of 0.86) for fourth graders (Wagner, Muse, & Tannenbaum, 2007). Some researchers have argued that analysis of word structure might be related to other aspects of comprehension monitoring that have the potential to foster enduring habits of constructing meaning during reading (e.g., Baumann et al., 2002).

Researchers' explorations of connections between morphological awareness and these three central aspects of language and literacy provide an opportunity to clarify the contributions of morphological awareness in theories of literacy development. At the same time, they provide a chance to consider answers to related questions such as the following: At what age is it beneficial to provide instruction in morphological awareness? What does an effective program in morphological awareness consist of, both in terms of content and instructional techniques?

Studying Instruction in Morphological Awareness

A recently published literature review by Reed (2008) examined the effects of instruction in morphology on word identification, spelling, vocabulary, and reading comprehension. Reed found only seven studies that met her selection criteria, an indication that research on morphological awareness instruction is still limited. One important characteristic Reed noted was the enormous variability in the purpose, design, and outcomes of the studies she reviewed. This finding, too, suggests that development and study of instructional programs in morphological awareness are at an early stage.

One particular challenge in undertaking an analysis of studies of morphological awareness instruction is that such instruction typically is not a freestanding, independent component but rather is wrapped into the language arts curriculum. There are good arguments to suggest that morphological awareness should be folded into a comprehensive program of literacy instruction (e.g., Bear, Invernizzi, Templeton, & Johnston, 2008; Templeton, 1989). However, for purposes of analyzing the effectiveness of instruction in morphological awareness, studies of such instruction need to include a measure of morphological awareness as well as at least one measure of literacy.

Some studies of instruction designed to improve word reading have included a morphological analysis strategy, but the effect of learning this strategy was not specifically assessed. For example, Lovett, Lacerenza, and Borden (2000) developed the word identification strategies training (WIST) program to improve word reading of students with dyslexia. One of the strategies is called "Peeling Off," which refers to identifying and taking off prefixes and suffixes so that the student can then apply other decoding strategies to identify the root word. While the WIST program was found to improve word reading, the researchers did not include a specific assessment of the effects of the Peeling Off strategy on students' knowledge of morphemic structure, and so we have no way to evaluate this component of the program. In short, for purposes of studying instruction in morphological awareness, only those studies that include an assessment of students' morphological awareness can be used.

The overarching goals of this integrative review are to examine theories of the role of morphological awareness in literacy development, evaluate the nature and effectiveness of instruction in morphological awareness, and consider the contributions of current research to evidence-based practice. Specific questions that guided the analysis and discussion of the studies are as follows: (a) Does morphological awareness improve with instruction? (b) Is instruction in morphological awareness associated with improved literacy (e.g., word reading, spelling, vocabulary, reading comprehension)? (c) How much variation is there across studies in the content and method of programs of instruction in morphological awareness?

Method

The literature review was carried out by successive searches of two electronic databases (i.e., PsycINFO; ERIC), using *morph** in combination with the following terms: *awareness*, *instruction*, *program*, and *analysis*. Searches were also carried out using the terms *morph** and *analysis*, *instruction*, or *program* in combination with each of the following: *reading*, *spelling*, and *vocabulary*. Further, I examined citations in studies that met selection criteria in an effort to identify additional papers that might meet study criteria. Each paper was reviewed to determine whether it met the following inclusion

criteria: instruction in morphological awareness or related terms (e.g., *morphemic analysis*), pre- and postintervention measures of morphological awareness, at least one literacy measure (e.g., word reading), school-age students (i.e., kindergarten through high school), and at least one comparison or control group.

Studies were not included if they did not administer both a measure of morphological awareness and a measure of word reading, spelling, vocabulary, or reading comprehension (e.g., Bowers & Kirby, 2010). Excluded also were studies that involved only oral language measures or those that provided no information about the measures used in the study (e.g., Parel, 2006). Studies carried out in languages other than English were included when papers were published in English. The sources were journals or books that reported research studies; dissertations were not included. After excluding those that did not meet selection criteria, 16 studies remained for this review[1]; these appear in Appendix A.

Preliminary examination of these studies suggested that it was not appropriate to carry out a meta-analysis. Meta-analysis provides valuable information about the relative effectiveness of different instructional programs when studies are sufficiently similar so that findings can be fairly compared (Hedges, 1986; Rosenshine, 2001). That was certainly not the case for the studies that fit the selection criteria. The 16 studies varied in purpose, outcome measures, and study design. Some studies included a control group (i.e., students or classes that received only their regular curriculum), whereas other studies included a comparison group that received an alternative treatment. Further, the studies were carried out in six languages—eight studies were carried out in English, four in Chinese, and four in other languages (Danish, Dutch, French, and Norwegian). Finally, some of the studies were exploratory in nature (e.g., an initial effort to implement a newly developed program, as in Birgisdottir et al., 2006). It is best not to try to collectively interpret results of exploratory studies and rigorously designed studies (Rosenshine, 2001). For these reasons, I chose to carry out an integrative review, in hopes that the results would be informative to researchers and practitioners.

Results

Overview of the 16 Studies

The studies were grouped by their primary focus on the relation of morphological awareness to one of the three areas of Adams' (1990) model: phonology, orthography, or meaning. The stated purpose of each study is clarified in the descriptions that follow; in some cases, the choice of a comparison condition was indicative of the possible contribution morphological awareness instruction might make to students' literacy development. The choice of outcome measures was not a guiding factor, because many researchers used multiple outcome measures (as might be expected in studies that are exploratory in nature). Grouped in this way, five studies focused on the relation between morphological awareness and phonology (or, more specifically, phonological awareness), with a particular emphasis on students' understanding of the way that oral language is represented in written form. Seven focused on students' understanding of the relation among structure, spelling, and meaning of written words, which contributes to orthographic development. Four studies focused on morphological analysis of unfamiliar words in texts with possible benefits to vocabulary development and reading comprehension.

For each of the three groups, there is a table that lists only the measures of morphological awareness and literacy (i.e., not all measures used in some studies are included in the tables). Information in the table supplements the narrative in some respects—for example, the reader can see the morphological awareness measures on which there were no significant differences between groups. Following the section devoted to examination of the design and results of studies in the three groups, I examine program content and instructional approaches and then consider the quality of the research studies and how this might affect our interpretation of the results. The appendix provides descriptive information about the 16 studies. It shows the purpose and design of the study and key features of the instructional program—helpful, detailed information not covered in discussion of the studies.

Studies of Morphological Awareness and Phonological Awareness

Of the five studies focused on the relation of morphology and phonology, three involved comparison of students' responses to instruction in phonological awareness and morphological awareness (Casalis & Colé, 2009; Lyster, 2002; Nunes, Bryant, & Olsson, 2003). In two of those studies, researchers focused on kindergartners, exploring the possibility that morphological awareness instruction—delivered largely orally—might provide a stronger foundation for first-grade word-reading instruction than phonological awareness instruction or their standard literacy instruction (Casalis & Colé, 2009; Lyster, 2002). Lyster (2002) explained that Norwegian children as young as 4 years of age are able to identify and focus on the morphemic values of print elements; further, as morphemes have phonological structure, morphological training might contribute to the development of phonological awareness and word reading (p. 263).

Both the Lyster (2002) and Casalis and Colé (2009) studies contained three conditions: phonological awareness, morphological awareness, and "no training" control. In both studies, a major concern was the effects of instruction on first-grade word reading. However, the two studies differ in a number of respects. Lyster (2002) developed program guidelines suitable for Norwegian kindergartners. Because Norwegian letter–sound correspondences are relatively regular, she expected the effect of phonological awareness instruction in learning to read to be moderate, whereas morphological awareness instruction might have a strong influence on reading. She administered a battery of 15 metalinguistic measures to compare treatment effects; only three were measures of morphological awareness. The morphological awareness program contained compound words, a variety of prefixes and suffixes, and inflections (e.g., plurals, verb tenses). Both the phonological awareness and morphological awareness treatments used game-like activities in predominantly oral lessons, although some words were presented in writing, using uppercase letters. Students were taught in small groups for 30–40 minutes once a week for 17 weeks.

As Table 1 shows, compared with the no-training control group, students in Lyster's (2002) morphological awareness group made significant gains on two morphological measures (both involving compound words) and on word-reading measures administered five months before school entrance and at school entrance. At the end of first grade, students in the morphological awareness condition outperformed the no-training control group on word reading, orthographic coding, word identification, and sentence reading and outperformed students in the phonological awareness condition on word reading. However, Lyster did find some evidence that parental educational level was a contributing factor,

Table 1. Results of Studies of Morphological Awareness and Phonological Awareness

Authors	Results for measure(s) of morphological awareness	Results for measure(s) of literacy
Berninger, Nagy, Carlisle, Thomson, Hoffer, Abbott, et al. (2003)[a]	• University of Washington Decoding Fluency	• Woodcock Reading Mastery Test, Word Attack • Test of Word Reading Efficiency, Pseudoword Reading Efficiency*
Casalis & Colé (2009)	*Kindergarten:* • Morphemic segmentation task* • Derivation in sentence context* • Inflectional task*	*End of first grade:* • Word reading • Text spelling • Text reading
Elbro & Arnbak (1996)	• Add inflections • Compound formation • Morphological analogies* • Morpheme subtraction and identification	• Vocabulary • Reading words of varying morphological structure • Real-word responses of misreadings* • Nonwords • Passage comprehension* • Spelling Compounds* Derivations preserved* Total correct
Lyster (2002)	*End of kindergarten:* • Word compounds* • Analysis of compound words* • Syntactic awareness	*End of kindergarten:* • Listening comprehension* *End of first grade:* • Orthographic coding* • Word identification* • Word reading* • Sentence reading* • Text reading*
Nunes, Bryant, & Olsson (2003)[b]	• Spelling derivational suffixes* • Spelling stems in pseudowords* • Reading words with morphological rules • Reading pseudowords*	*Standardized reading and spelling (Schonell):* • Reading* • Spelling

Note. Only measures of morphological awareness and literacy are included in this table. An asterisk denotes that the morphological awareness condition made greater gains than the control group.
[a]For Berninger et al. (2003), the morphological awareness and phonological awareness conditions are compared; the study did not include a no-treatment control group. [b]For Nunes et al. (2003), an asterisk is given whether the morphology only or the morphology with writing condition made significantly greater gains than the control group.

particularly benefiting students in the morphological condition.

Casalis and Colé (2009) asked a similar question about the relative benefits of phonological awareness and morphological awareness instruction for French kindergartners. They suggested that morphological awareness might play a particularly important role in French reading acquisition because French is a relatively transparent language. Their program was shorter than Lyster's (2002) study (i.e., 30-minute meetings once or twice a week for nine weeks), and unlike Lyster's study, instruction was entirely oral, and the morphological treatment focused almost exclusively on derivations.

At the end of the kindergarten year, phonological training led to greater gains in phonological awareness than was true for the morphological awareness and no-training control groups; similarly, morphological training led to greater gains in morphological awareness than was true for the phonological awareness or no-training control groups. However, at the end of first grade, statistical analyses showed no significant effect of morphological training in kindergarten on first-grade reading scores.

The third study in this group focuses on the effects of phonological and morphological instruction for somewhat older students. Nunes et al. (2003) designed their study to test a hypothesis derived from the dual-route model (Chialant & Caramazza, 1995). This model has both phonological and lexical routes to word reading. Their expectation was that students who are taught phonological awareness would do better on phonological (pseudoword) decoding and spelling, and students who are taught morphological awareness would do better on whole-word reading and spelling.

To test this idea, Nunes et al. (2003) designed a study in which 8-year-old students were assigned to morphological and phonological awareness conditions, which were further split into groups that did or did not include writing—thus, there were five conditions: phonological awareness only, phonological awareness with writing, morphological awareness only, morphological awareness with writing, and control. The activities included games that targeted specific cognitive activities (e.g., classification, segmenting). Procedures were "purely oral" for morphological and phonological training only; in the writing groups, students were taught to apply the lessons they were learning in writing.

The researchers precisely controlled the task demands of conditions that did and did not receive writing; they were given the same games in the same session. The only difference was that the groups in the writing condition also wrote many of the words down. For example, students in the morphological awareness with writing condition completed oral sentences such as "A person who does magic is a what?" but then also wrote the response, *magician*. The content included word stems as well as inflectional and derivational affixes.

Participants were administered experimental measures of reading and spelling before and after training along with standardized Schonell Word Reading and Word Spelling tests, which were administered at posttest only. The results did not clearly support the expectations of the dual-route theory. On the standardized tests (using the experimental word-reading measures as a covariate), the four treatment conditions outperformed the control group on word reading but did not differ significantly on spelling. There were also few differences on the experimental word-reading and spelling measures. For example, there was no sign of an intervention effect on the correct use of morphological rules in reading real words. However, on the experimental spelling test, analysis of correct spellings of derivational morphemes showed that the morphological awareness with writing group significantly outperformed the control group.

Although perhaps disappointing, the results provided evidence that training in morphological and phonological awareness, with or without writing, had positive effects on word identification. There appeared to be no particular benefit to including writing in phonological or morphological awareness instruction, a finding that is discussed in relation to another study carried out by this research group (Birgisdottir et al., 2006) in the next section.

The two remaining studies focus on the possibility that instruction in morphological awareness might help students with reading disabilities compensate for their deficits in phonological processing (Berninger et al., 2003; Elbro & Arnbak, 1996). Elbro and Arnbak (1996) reported three studies that investigated the possibility that morphological processing offered adolescents with dyslexia a system for reading that made use of phonology, but at the level of units of meaning. They suggested that as a supplement to the continued teaching of phonological awareness, students with dyslexia might be taught alternative strategies that would stimulate their reading development and that morphological awareness instruction might be particularly beneficial to Danish students with dyslexia because Danish is a morphologically rich language.

One of the studies in Elbro and Arnbak's (1996) research report met selection criteria for this review. In this study, the researchers asked whether oral morphological awareness training would improve the reading and spelling skills of adolescents with dyslexia, as compared with their peers who received the normal remedial program. All of the students with dyslexia attended remedial reading classes, which included substantial instruction in phonological awareness and decoding. Thus, instruction in morphological awareness was not directly compared with instruction in phonological

awareness but rather considered as a supplement to their regular instruction. The treatment group received 15-minute lessons during 36 sessions taught by their teachers; the time was taken from their remedial program, but the treatment teachers agreed not to teach any phonological analysis (e.g., syllable segmentation) for the duration of the program.

Morphological awareness instruction included oral, game-like activities such as reversing the order of morphemes in compounds and inventing new derived forms. The first phase focused on compounds, the second on derivational affixes, and the third on inflected forms. Although the researchers were interested in the effects of training on various morphological, phonological, and literacy tasks, a particularly interesting finding is that the students with dyslexia who received morphological awareness instruction made greater gains than the control group on one of the four measures of morphological awareness (i.e., analogies) and on a measure of passage comprehension. Elbro and Arnbak (1996) suggested that the significant effect on reading comprehension might indicate that the students were learning to make better use of their decoding skills by paying attention to the morphemic structure of words.

The purpose of Berninger et al.'s (2003) study was not just to compare instruction in phonological and morphological awareness on static tests but also to compare analyses of brain functioning captured through functional magnetic resonance imaging—that is, examining regions of the brain that are active or inactive while doing tasks similar to those in the treatment programs. Participating students were fourth, fifth, and sixth graders underachieving in reading, randomly assigned to one of the two conditions (i.e., morphological and phonological awareness) and taught in small groups during a summer school session. Both treatments were designed to teach active, strategic thinking. Teachers led students to investigate problems related to word sounds or word structure and arrive at generalizations, using comparable kinds of activities in phonological and morphological instruction (e.g., in a unit on word learning, activities in both conditions involved word building and unit finding).

Results showed that both groups made gains over time on measures relevant to the training condition. As Table 1 shows, the two conditions did not differ on posttest gains on the morphological measure (University of Washington Decoding Fluency), but students in the morphological awareness condition made greater gains in efficiency of phonological decoding than those in the phonological awareness condition. Berninger et al (2003) speculated that this result reflected the importance of the interaction of phonological and morphological awareness, given the lack of significant difference in the performance on the phonological awareness measures for the two groups.

Overall, the studies in this group yielded mixed results. In Lyster (2002) and Casalis and Colé (2009), kindergartners who were taught morphological awareness outperformed their peers (whether in the phonological awareness or control condition) on posttest measures of morphological awareness. However, only in Lyster (2002) was there a significant effect of morphological awareness training in kindergarten on end-of-first-grade word reading. As we are given little information about the first-grade curriculum in both studies, the effects of morphological instruction on word reading are hard to interpret. In Nunes et al. (2003) as well, the results suggest positive benefits for training in both morphological and phonological awareness, but without striking advantages for either on various measures of word reading and spelling.

The two studies that focused on students with reading disabilities are so different in design that their results cannot be directly compared (Berninger et al., 2003; Elbro & Arnbak, 1996). There were effects of morphological training on different measures of word reading in these studies. For example, there were significant effects for nonword reading fluency in Berninger et al. (2003) but not for nonword reading in Elbro and Arnbak (1996). Because it is very likely that the students with dyslexia in both studies had already received considerable instruction in phonological awareness and decoding, we need study designs that examine the additive effects of these two areas of linguistic awareness for students with dyslexia.

Studies of Morphological Awareness and Orthographic Development

Seven studies of morphological awareness instruction were undertaken to examine morphological awareness as related to orthographic development and to examine the impact on word reading and spelling. All of the studies examined the effects of instruction focused on analysis of the structure of written words, asking primarily whether improved understanding of the relation among morphemic composition, spelling, and meaning of written words contributes to word reading and spelling achievement. Three of these studies were carried out in English (Berninger et al., 2008; Birgisdottir et al., 2006; Henry, 1989) and four were carried out in Chinese (Chow, McBride-Chang, Cheung, & Chow, 2008; Nagy et al., 2002; Packard et al., 2006; Wu et al., 2009). The studies are discussed within these two language groups. As Table 2 shows, in six of the seven studies, morphological awareness instruction had a positive effect on performance on measures of morphological awareness; in all of the studies, significant effects

were found on one or more measures of word reading or spelling.

Of the studies in English, one compared instruction in morphological awareness with and without attention to spelling (Birgisdottir et al., 2006). This study (for which Nunes is the second author), appears in *Improving Literacy by Teaching Morphemes* (Nunes and Bryant, 2006). The program in morphological awareness developed by this research team is based on the premise that students need to be taught systematic relations between the spellings and meanings of words; they should not be left to infer these relations on their own. Thus, in Birgisdottir et al. (2006), activities in the program directed students to think about why the suffixes in *musician* and *nation* sound alike but are spelled differently. Instruction exploits and develops students' reasoning about words.

A particular question raised in Birgisdottir et al. (2006) was the effect of their morpheme program on elementary students' spelling. As in Nunes et al. (2003), the researchers compared morphological awareness instruction with and without spelling (although in the 2003 study, the reference was to "writing," not spelling) The researchers wanted to determine whether activities that required attention to spelling led to greater gains in spelling derived words. Participants were 9- and 10-year-old students attending five schools assigned to intervention or control conditions. Classes in the three intervention schools were assigned to one of two conditions: morphemes-only or morphemes-plus-spelling.

Classroom teachers used a CD-ROM that contained lessons and materials for seven sessions, each designed to last about 50 minutes. The morphemes-only version was designed to develop students' awareness of morphemes in spoken language. In the morphemes-plus-spelling version, the connection between morphemes and spelling was made explicit; the students worked with peers and their teacher to discuss word meanings and spellings. Each session focused on a specific principle of word formation and spelling; for example, one session contained exercises on word class, with students asked to provide the right suffix for abstract nouns (e.g., *-ment*, *-ness*). Students were administered a pretest that assessed polymorphemic words, suffixes, and pseudoword spelling. Sentences were dictated to students, who filled in the missing word, as in the following example with the missing word italicized: "On Sunday we are going to see the *magician*." The same measures were administered as a posttest and delayed posttest. As Table 2 indicates, results showed that, when controlling for group differences at pretest, both morphological awareness groups performed significantly better than the control group on the posttest on all three spelling measures, but the two intervention groups did not differ significantly. As in Nunes et al. (2003), the addition of spelling activities for the morpheme-plus-spelling group did not result in greater gains in spelling.

In Berninger et al. (2008), morphological awareness instruction was compared with instruction in orthography. The purpose was to investigate the effectiveness of small-group, supplemental instruction designed to meet the needs of students who had fallen behind grade-level expectations in writing in the general education classroom. Both morphological instruction and orthographic instruction were considered promising ways to improve the word reading and spelling of these students. Participants were students with dyslexia in two grade-level groups (4–6, 7–9). The programs of instruction were based on a stage model of spelling development in which students master phonological, then orthographic, and then morphological aspects of spelling (Bear et al., 2008).

Berninger et al. (2008) reasoned that students with dyslexia might not have completed the phonological stage because of persistent problems with phonological processing that are associated with reading disabilities. The question of interest was whether those students would benefit from the orthographic or morphological instruction. Given the stage model, the younger students were seen as less likely to benefit from the morphological awareness instruction than the older students. Students were randomly assigned to one of the two conditions (i.e., morphological awareness or orthography) and participated in 14 sessions of a summer school program.

The morphological treatment focused on two strategies: building words when presented with base forms and affixes and segmenting morphologically complex words into units of meaning. Some activities involved spelling, such as exercises on suffix spelling rules. The orthographic treatment focused on recall of letters and letter sequences in words and the "proofreader's special trick" of picturing written words in the mind's eye with eyes closed. The results showed that students in both treatment groups made significant gains over time on a number of the spelling and reading measures, indicating that both programs were promising methods for students with reading disabilities. Students in the morphological treatment made greater gains than those in the orthographic treatment only on a standardized pseudoword spelling test. In addition, time-by-grade interactions showed that the older students made greater progress on the measures of morphological awareness, phonological decoding, and silent reading comprehension fluency than the younger students, suggesting that the younger students had not yet reached the morphological stage of spelling.

Henry's (1989) program was based on the premise that

> Word analysis allows the reader to use general orthographic knowledge to read words. The reader separates unfamiliar words into parts in order to determine the pronunciation of the word. These parts may be letter-sound correspondences, syllables, or morphemes (the prefixes, roots, and suffixes of the language)." (p. 136)

Experiment 2 in this study involved examination of the effects of a supplement to a previously developed program in decoding (READ); the supplemental program (READ Plus) embraced a historical–structural perspective with intensive study of analysis of relations of word structure, spelling, and meaning. Students progressed from study of basic letter–sound correspondences and syllable patterns to lessons on the "layers of language," including Anglo-Saxon, Latin, and Greek morpheme patterns. The study involved a comparison of third- and fifth-grade classes that received READ Plus, READ, or their regular curriculum. Results showed that READ Plus students made significantly greater gains on two measures of morphological awareness (Roots and Prefix/Suffix/Syllable) than READ students and control students; both READ and READ Plus students outperformed the control group on the experimental word-reading measures and spelling measures. The results suggest that, compared with the READ decoding program, Henry's (1989) instruction in layers of language and morphological analysis was associated with better reading and spelling outcomes.

The four studies in Chinese focused on explicit instruction for beginning readers in the formation of characters and the relation of characters and morphemes in the Chinese writing system (Chow et al., 2008; Nagy et al., 2002; Packard et al., 2006; Wu et al., 2009). Such instruction is roughly comparable to studies in English in which students learn how meaning is conveyed by combinations of morphemes (e.g., *form*, *formless*, *inform*). All of the studies except Chow et al. (2008) were carried out by members of the same research group and focused on the premise that raising students' awareness of the morphemic and orthographic structure of Chinese words would improve their learning to read and write. Each study was designed to address particular questions.

In the first of these, Nagy et al. (2002) compared progress in morphological awareness and literacy for first and fourth graders in four instructional conditions: a morphological awareness intervention, an increased-reading-volume intervention, an intervention that combined these two treatments, and a control group. They considered that Chinese students must acquire some morphological awareness as they learn to read and wanted to determine whether an increased volume of reading would be as effective as instruction in character and word formation. They also asked whether an intervention that combined morphological awareness and increase in reading volume might be the more effective than either one alone, reasoning that students would receive both explicit instruction and increased opportunity to apply knowledge about character and word formation during reading.

As it turned out, for both grade-level groups, students in the morphological awareness condition (with and without additional reading) made greater gains than those made by students in the reading volume and control groups on measures of graphomorphological awareness (e.g., character selection or radical meaning explanation). The treatment affected performance on measures that involved decisions about character–morpheme mapping but not other measures (see Table 2).

In the second of these studies, Packard et al. (2006) concentrated on first-grade instruction that was intended to improve students' understanding of the semantic and phonetic radicals that are part of Chinese characters and the accuracy of their character writing. The premise was that phonological and semantic knowledge is predictably and systematically conveyed within most characters and that sensitivity to morphological and orthographic information is likely to help students acquire reading and writing skills. The researchers modified the first-grade teaching guide used in both treatment and control classrooms by adjusting the method for teaching new characters; they included this instruction as part of the regular reading curriculum for the treatment group over two semesters. Results showed that the treatment group outperformed the control group on measures of copying Chinese characters and writing these characters from memory, as well as on measures of phonological and morphological awareness (see Table 2).

The third study (Wu et al., 2009) involved investigation of the long-term effects of instruction in morphological awareness that was integrated into regular first-grade language arts periods for a full school year. The intervention included direct instruction and guided discovery "to explicate the shape-to-meaning connections in pictographs and ideographs, the function of the phonetic and semantic radicals to the pronunciation and meaning of compound characters, and the contribution of component characters to the meaning of two- and three-character words" (p. 36). The students in treatment and control classes were given a large number of tests at the beginning of first, second, and third grades. When controlled for differences between the treatment and control groups, the outcome measures at the beginning of second and third grades showed that the students in the treatment group made significantly greater gains on measures of morphological awareness and literacy, particularly those that involved character and morpheme analysis (see Table 2). In third grade,

Table 2. Results of Studies of Morphological Awareness and Orthographic Development

Authors	Results for measure(s) of morphological awareness	Results for measure(s) of literacy
Berninger, Winn, Stock, Abbott, Eschen, Lin, et al. (2008)[a]	• Morphological Signals Test	• Wide Range Achievement Test-3, Spelling • Test of Word Reading Efficiency Pseudoword decoding fluency Word reading • Woodcock–Johnson III: Spelling pseudowords* • Orthographic coding • Wechsler Individual Achieve Test II, Written expression
Birgisdottir, Nunes, Pretzlik, Burman, Gardner, & Bell (2006)[b]	• Spelling suffixes in words* • Spelling polymorphemic words*	• Spelling pseudowords*
Chow, McBride-Chang, Cheung, & Chow (2008)	• Morphological identification*	• Character recognition* • Receptive vocabulary
Henry (1989)	• WORD subtests: Roots* Prefix/suffix/syllable*	• WORD subtest: Read/Spell*
Nagy, Kuo-Kealoha, Wu, Li, Anderson, & Chen, (2002)[c]	*First-grade measures:* • Character selection* • Character learning* • Odd man out from word *Fourth-grade measures:* • Character selection* • Odd man out • Radical meaning explanation* • Radical selection* • Matching character meaning	*First-grade measures:* • Circle characters • Sentence reading comprehension* • Pinyin reading comprehension • Composition • Write characters* • Copy characters* *Fourth-grade measures:* • Sentence reading comprehension • Cloze test* • Passage comprehension • Circle characters* • Composition • Writing characters*
Packard, Chen, Li, Wu, Gaffney, Li, et al. (2006)	• Morpheme transfer* • Morpheme selection* • Morpheme discrimination	• Copy characters* • Write characters*
Wu, Anderson, Li, Wu, Hong, Zhang, et al. (2009)	*Posttests administered in second grade:* • Interpret novel words* • Discriminate morphemes • Radical meaning judgment* • Make words* • Make characters* *Posttests administered in third grade:* • Interpret novel words* • Discriminate morphemes*	*Posttests administered in second grade:* • Sentence-reading comprehension* • Vocabulary* • Dictation • Copy characters • Write characters *Posttests administered in third grade:* • Paragraph comprehension* • Vocabulary • Reading fluency* • Correct wrong characters* • Dictation* • Copy characters • Interpret novel words*

Note. Only measures of morphological awareness and literacy are included in this table. An asterisk denotes that the morphological awareness condition made greater gains than the control group.
[a]For Berninger et al. (2008), the morphological awareness and orthographic conditions are compared; the study did not include a no-treatment control group. [b]For Birgisdottir et al. (2006), an asterisk is given whether the morphology only or the morphology with spelling condition made significantly greater gains than the control group. [c]For Nagy et al. (2002), an asterisk is given, whether the morphology only or the morphology with reading volume condition made significantly greater gains than the control group.

there were positive treatment effects on three of four reading measures, including reading comprehension. These treatment effects are particularly striking because they endured over a two-year period.

A noteworthy feature of this study is that Wu et al. (2009) made an effort to determine whether morphological instruction improved literacy because it improved morphological awareness, recognizing that

it was possible that literacy improved morphological awareness or that the relationship was bidirectional. Through the use of structural equation modeling, they found that the relation between morphological awareness and literacy was unidirectional in second grade but bidirectional in third grade. Thus, it seems that as Chinese students acquire reading skill, the relationship between morphological awareness and literacy becomes increasingly reciprocal.

Chow et al. (2008) took a different approach to studying the value of morphological awareness instruction for beginning Chinese readers. Specifically, they studied the effects of metalinguistic awareness training, combined with dialogic book reading. In one condition, parents were asked to use dialogic reading with their kindergarten children. In a second condition, parents provided metalinguistic training as well. That is, they were asked to direct the child's attention to the formation of characters and the relationship among characters, basic pronunciations, and meaning units as they read books to their children. There were two control conditions, one in which the same books were distributed to parents to read to the children (typical reading) and a no-treatment control. The premise was that because there are a large number of homophonic morphemes in spoken Chinese, the ability to distinguish characters (morphemes) is critical for learning to read. The researchers expected that dialogic reading, combined with morphological instruction, would foster students' oral language and literacy development better than just dialogic reading or just access to the same children's books. Results showed that students who received dialogic reading with morphological awareness instruction made significantly greater gains in Chinese character recognition than those in the typical reading and control groups (see Table 2). However, it might be important to note that the effects of morphological training and dialogic reading cannot be teased apart.

The results of the four studies carried out in Chinese consistently indicate positive effects of morphological awareness instruction on character reading or writing for students between kindergarten and fourth grade. The results of the four studies carried out in English are less consistent with regard to the benefits of morphological awareness instruction. The most positive results come from Henry's (1989) study, which showed significant effects of morphological awareness instruction on measures of morphological awareness and measures of word reading and spelling.

Birgisdottir et al.'s (2006) study showed significant gains on posttests and delayed posttests for students who received morphological awareness instruction with or without spelling, but the inclusion of an emphasis on spelling did not result in more substantial gains on the spelling measures. It is possible that the spelling component of these two studies was not intensive enough to add to the benefits of the problem-solving activities that were the highlight of these programs.

With regard to students with reading disabilities, Berninger et al. (2008) found that students benefited from both morphological awareness instruction and orthographic instruction. There were few significant differences in outcomes for students in the two treatment conditions, although it might be important to note that students in both conditions spent considerable time working on spelling.

The age of participants in the English studies might speak to Adams's (1990) view that older students are likely to benefit from morphological awareness instruction. Students in the studies carried out by Nunes and colleagues (Birgisdottir et al., 2006; Nunes et al., 2003) were anywhere from 7 to 10 years old, and students in Henry's (1989) study were approximately 9 and 11 years old (i.e., third and fifth graders). Berninger et al. (2008) found that older students with reading disabilities (i.e., seventh through ninth graders) responded to morphological awareness and orthographic instruction more positively than the younger students (i.e., fourth through sixth graders). All of these researchers might agree with Adams (1990) that students are poised to benefit from instruction in the morphological structure of words after they have learned basic aspects of English spelling. In contrast, Chinese students as early as kindergarten and first grade benefited from learning about the formation of characters and words.

Morphological Analysis as a Way to Learn the Meanings of New Words

Four studies investigated the effects of instruction in morphological awareness to provide students with strategies to infer the meanings of unfamiliar words while reading (Baumann, Edwards, Boland, Olejnik, & Kame'enui, 2003; Baumann et al., 2002; Carlo et al., 2004; Tomesen & Aarnoutse, 1998). Such instruction is seen as having the potential to foster vocabulary development and improved reading comprehension (e.g., Nagy, 2007). In all four studies, researchers provided instruction and practice in morphological analysis as a reading strategy, but in other respects, the studies are different in design and to some extent also in outcomes, as Table 3 shows.

The two studies by Baumann and his colleagues (Baumann et al., 2003; Baumann et al., 2002) examined the effects of teaching fifth graders morphological and context analysis strategies so that they would be better able to figure out the meanings of unfamiliar words in texts. These researchers take as a launching point Nagy and Anderson's (1984) analysis of words in printed school English, stating that "if students are

Table 3. Results of Studies of Morphological Awareness and Word Learning

Authors	Results for measure(s) of morphological awareness	Results for measure(s) of literacy
Baumann, Edwards, Boland, Olejnik, & Kame'enui (2003)[a]	• Word parts immediate • Word parts delayed*	• Comprehension chapter tests • Immediate vocabulary in context • Delayed vocabulary in context* • Passage comprehension
Baumann, Edwards, Font, Tereshinski, Kame'enui, & Olejnik (2002)	• Morpheme lesson words: Production* Recognition* Delayed recognition • Morphemic transfer words: Production* Recognition* Delayed recognition	• Morpheme transfer/passage • Context transfer/passage
Carlo, August, McLaughlin, Snow, Dressler, Lippman, et al. (2004)	• Morphology	• Mastery of target words* • Word association and polysemy* • Passage comprehension*
Tomesen & Aarnoutse (1998)	• Derivation of word meaning* • Pedagogical-Didactic Analysis of Reading Comprehension	• Transfer cloze • Reading comprehension

Note. Only measures of morphological awareness and literacy are included in this table. * denotes that the morphological awareness condition made greater gains than the control group.
[a]For Baumann et al. (2003), the combined word analysis strategies and text vocabulary are compared; the study did not include a no-treatment control group.

equipped with the ability to infer word meanings by scrutinizing surrounding context clues and analyzing the meaningful parts of words (morphology), they have the power to expand their reading vocabulary significantly" (Baumann et al., 2002, p. 150).

In Baumann et al. (2002), classrooms of fifth graders were assigned to one of three treatment conditions that designated the word-analysis strategy or strategies they were taught (i.e., morpheme only, context only, morpheme and context combined); there was also an instructional (i.e., "business-as-usual") control group. The researchers provided explicit instruction appropriate for each condition in 12 sessions, following a fixed format: introduction, explicit instruction, and then practice. The morphology strategy sessions covered eight prefix families, one per session (e.g., the "not" family, including *un-*, *in-*, and *im-*, as in *impossible*). The context strategy sessions covered different context cues (e.g., synonyms, appositives) in eight sessions. The combined group received the same instruction in both strategies but with fewer examples.

Both the test results and interviews showed that the fifth graders picked up and used the context or morphological strategies they were taught. As predicted, results showed that the treatment groups learned the words taught in the lessons, based on performance on immediate and delayed tests. Of particular interest, students taught morphemic analysis with or without context analysis outperformed students in the context only and control conditions on immediate production and recognition of transfer words—words that had not been in their daily lessons.

Although the results indicate the value of teaching prefixes as a means of learning unfamiliar words, this learning degraded somewhat over time, as there were no significant effects on measures of delayed transfer. The effects of instruction in morphological analysis on reading comprehension were not significant, although it seems likely that a study of longer duration would lead to improved comprehension of texts.

Baumann et al. (2003) compared the effects of instruction in morphemic and contextual analysis strategies to instruction in specific words from fifth graders' social studies text. In the two-month period of instruction, there were 33 sessions for each condition, each linked to specific passages in the students' social studies textbook. Words for each condition were drawn from the passages. Early on, students in the combined strategy condition were taught the vocabulary rule, which included steps to carry out context and morphological analyses (e.g., look for the root word, look for a prefix or suffix).

As can be seen in Table 3, fifth graders taught the combined strategies performed better than the text vocabulary students on a delayed (but not immediate) test of morphologically decipherable transfer vocabulary. Thus, students were apparently able to generalize their knowledge of prefixes and suffixes to infer the

meanings of novel words containing taught affixes. The two groups did not differ on a comprehension measure developed by adapting a textbook passage. Other results showed the value of learning textbook vocabulary, leading the researchers to suggest that students would benefit from both learning word-analysis strategies and learning specific vocabulary in content area texts.

Tomesen and Aarnoutse (1998) also studied the effects of an instructional program that combined context and morphological analysis strategies. The goal was to improve fourth graders' ability to derive the meaning of unfamiliar words. Students in the treatment condition were taught in small groups, using a dialogic approach that combined principles of direct instruction and reciprocal teaching (i.e., questioning, clarifying, summarizing, predicting). The treatment and control groups were made up of two average and two less skilled readers that met for two 45-minute sessions each week for six weeks.

The treatment students made greater gains than the control group on a test of deriving word meaning; they also showed better performance on a test called Pedagogical-Didactic Analysis of Reading Comprehension that involved a diagnostic discussion of the meanings of unfamiliar words in short passages. However, the treatment and control groups did not differ on the transfer cloze and reading comprehension tests. Of interest also is the finding that the less skilled readers benefited at least as much as the average-achieving readers in their analysis of unfamiliar words when reading new texts.

Carlo et al. (2004) examined the effects of a program that made use of research-based methods to improve the vocabulary of English-language learners (ELLs) and English-only (EO) fifth graders, one of which was morphological analysis. Students were taught different strategies that could help them understand words in the texts they were reading. Each week had a five-day sequence of lessons on a single text; 12 words were introduced each week. On Fridays, students received explicit instruction in morphemic analysis, including cognate analysis. The ELLs and EO students in the treatment classes performed better than the control students on words taught in the program and on a reading comprehension measure but not on the morphology test, although the trend favored the experimental group.

One concern is that although this test did require extraction of the base word from derived forms, this was demonstrated through spelling the base words; for example, the students heard the word *discussion*, followed by a sentence (e.g., "What did he want to ____?"; Carlo et al. [2004, p. 195]) and were then asked to write the form of the word that fit in the sentence (i.e., *discuss*). What is tested here is not what was taught, as the program apparently did not include instruction in spelling.

Further, although the treatment group made greater gains than the control group on the reading comprehension measure, this test was a multiple-choice cloze measure that included 18 words in three passages, 10 of which were included in the weekly instruction. To some extent, then, the test assessed learning of taught words rather than application of vocabulary strategies to new words in passages. Although the results showed that teaching word-learning strategies was effective, it is not possible to tell the extent to which morphological analysis contributed to improvements on the outcome measures.

Overall, the findings of the four studies suggest that students generally do become more able to infer the meanings of unfamiliar words after receiving instruction in morphological analysis; however, to date, there is little evidence that learning to apply morphological analysis contributes to improved reading comprehension (Baumann et al., 2003; Baumann et al., 2002; Tomesen & Aarnoutse, 1998).

Program Content and Instructional Approaches

As models of literacy development seldom include morphological awareness, it is not surprising that researchers have tested hypotheses about particular ways that morphological awareness might be related to component processes and knowledge known to be critical to literacy development, such as phonological awareness. Many studies in this review represent the beginning efforts of researchers in a largely unexplored area of language and literacy instruction. Not surprisingly, therefore, programs of instruction in morphological awareness represent a diverse lot. One advantage to diversity is the opportunity it presents to examine the features of different programs that researchers have seen as promising.

My analysis suggests that instruction has involved four different approaches, often combined within particular studies; these provide different kinds and perhaps different amounts of support in the development of morphological awareness. Examination of the studies in this review indicates that some approaches to instruction were commonly used, while others were not.

The first approach is instruction and activities designed to simply heighten students' awareness of the morphological structure of words. This approach was used in most of the studies, although sometimes in combination with other approaches. Game-like activities included breaking words into constituent morphemes and finding common morphemes in words, including analysis of Chinese characters. Such activities are valuable as a starting point in acquiring morphological awareness. As an end goal, they fall short of providing

students with long-term capabilities to use morphological analysis effectively in reading and writing.

The second approach is teaching the meanings of affixes and base words; this approach, too, was used in most of the studies, although in some it is hard to tell how much emphasis was placed on actually learning the meanings of morphemes. In some studies, words and affixes subjected to analysis were drawn from particular texts (e.g., Carlo et al., 2004; Tomesen & Aarnoutse, 1998). In other studies, students learned the meanings of affixes and base words selected to represent morphological principles or affix families. For example, in Baumann et al. (2002), students were taught prefixes from eight prefix families. In Birgisdottir et al. (2006) students learned the spelling and meaning of specific affixes, such as *-ian*. This approach is important, because knowledge about morpheme meanings plays a critical role in students' use of morphemic analysis as a word-learning and spelling strategy. For example, a student might recognize *standard* in the word *substandard*, but not knowing what *sub-* means, would have little chance of inferring the meaning of the word.

The third approach involves fostering morphological problem solving, to use Anglin's (1993) term. Many, but not all, of the studies used methods and materials that pushed students to think about how the constituent morphemes contributed to a word's meaning or grammatical role. Activities included problems that required pairs of students to use analogical reasoning (e.g., Birgisdottir et al., 2006), problems that involved detecting and correcting errors in spelling (e.g., *magition* for *magician*; also from Nunes & Bryant, 2006), the creation of new words with known morphemes (e.g., Elbro & Arnbak, 1996), and examination of shifts in meaning when morphemes are used in different words (e.g., *reform*, *inform*, *information*; Henry, 1989; Henry, 2003). In the analogy game (Nunes & Bryant, 2006), students might be given the following problem: *magic* is to *magician* as *electric* is to what? This third approach supports the development of students' reasoning, thus providing options for analysis of unfamiliar words in new contexts.

The fourth approach is instruction in and application of a strategy of morphological analysis intended to help students work out the meanings of unfamiliar words as they read. Presumably, with practice, students gained confidence in their ability to determine the meanings of unfamiliar words on their own. This strategy was taught in three studies (Baumann et al., 2003; Baumann et al., 2002; Tomesen & Aarnoutse, 1998). It is exemplified by the vocabulary rule students learned in Baumann et al. (2003) and by the extensive guided practice in the dialogic system used by Tomesen and Aarnoutse (1998).

In both studies, the researchers made an effort to determine whether students could independently use the strategy—in Baumann et al. (2002) through an interview with students and in Tomesen and Aarnoutse (1998) through a diagnostic discussion of words in new passages. A key element of this approach might be providing lots of experience with words and sentences that are not part of the instruction; still, insufficient practice transferring the strategy to new contexts might explain the limited transfer effects we saw in these studies.

In short, the first of the four approaches fostered attention to the morphological structure of words but was not likely to help students become analytic morphologists. The remaining approaches were likely to result in deeper understanding of what Chomsky (1970) called "lexical spellings" (p. 288), more extensive understanding of the meanings of morphemes (particularly affixes), and strategies to carry out analyses of unfamiliar words while reading and spelling. The appropriateness of the approaches for students of different ages might be a consideration. The comparative value of the four approaches, given goals for students' literacy development, is an important topic for further study.

A second feature of instructional programs that needs consideration is the morphological content—the word types and words that researchers used in their instructional programs. Researchers usually did explain how they selected morphological word types, though these types varied widely. For example, Elbro and Arnbak (1996) designed their program for students with dyslexia by progressing from semantically transparent to less transparent forms. Henry (1989) used a progression of units (e.g., phonemes, syllables, morphemes) and word origins (e.g., Anglo-Saxon, Latin, Greek). In other studies, words were selected from the books that were used for the program. For example, Chow et al. (2008) selected Chinese characters that were present in the books given to parents to read to their children.

On the other hand, researchers have provided very little information about the characteristics of morphemes and words used in their morphology programs. Notable exceptions are Baumann et al. (2002) and Baumann et al. (2003), where the researchers provided documentation of the method for selecting words (e.g., word frequency, transparency) and listed the target or anchor words used in instruction. Lack of information about the characteristics of words is a concern, because there is considerable evidence that transparency of word structure (i.e., phonological, orthographic, semantic) and frequency of base words, affixes, and word families influence students' awareness of the morphological structure of words (e.g., Bertram, Baayan, & Schreuder, 2000; Carlisle & Katz, 2006).

A third important component of instructional programs is the use of measures to document maintenance

and transfer of learning. Researchers did not always address the importance of assessing the long-term benefits of morphological awareness instruction or the benefits of transfer of learning in presenting the design of their studies. Further, some researchers did not indicate whether the measures they administered before and after instruction included new (uninstructed) words.

When studies did not include a measure to assess transfer of learning from taught words to new words, we were not able to tell whether students simply learned words that they were taught or whether they have learned principles, analytic methods, and meanings of morphemes they could apply in new contexts. For example, in Carlo et al. (2004), it was helpful to know that about one third of the words had been included in instructional activities; this would make it possible to compare performance on taught and untaught words. More than half of the studies in this review did not provide documentation of maintenance or transfer—both critical for evaluating the effects of programs of instruction in morphological awareness.

Discussion

The goals I set for myself in initiating this integrative review were to examine theories of the role of morphological awareness in literacy development, evaluate the nature and effectiveness of instruction in morphological awareness, and consider the contributions of current research to evidence-based practice. What we have seen is that theories of the way or ways morphological awareness contributes to different areas of literacy are, in general, underspecified. Still, the results show that in all but 1 of the 13 studies that compared morphological awareness instruction with a control group, there were significant effects on one or more measures of morphological awareness, and for the one exception (Carlo et al., 2004), the effect on the morphology test approached significance.

Further, although there is enormous diversity among the studies in purpose and research design, the findings generally showed that morphological awareness instruction was associated with improvements in word reading or spelling and morphological analysis of unfamiliar words. Even kindergartners can acquire morphological awareness, if this is what they are taught. The results also suggest that effective morphological awareness instruction makes use of language-specific aspects of morphology in written language, as was the case for the Chinese studies. Now we need to consider the extent to which these results provide evidence of research-based practices, such that practitioners might want to implement them in their schools and classrooms.

Research in the area of morphological awareness instruction has only partially reached a maturity that we would hope to see in studies that are used to make decisions about instructional practices. However, analysis of the research designs, methods, and results provides some useful insights about what is needed to move forward.

Analysis of Research Quality

Although there are many positive results from the studies in this review, practitioners and researchers need to consider whether the study designs yield reliable and valid results—that is, whether the studies demonstrate evidence-based practices. Useful guides for evaluating the quality of studies (e.g., Gersten et al., 2005; What Works Clearinghouse, 2008) suggest that three principal aspects are critical in high-quality studies of instruction: (1) the design of the study should address the issues of the comparability of students in different conditions, (2) the instructional program and implementation of the program should be presented in detail, and (3) tests should have demonstrated validity and reliability and be appropriate measures of the content of the program and the proposed literacy outcomes. Each of these aspects deserves comment.

With regard to the study designs, seven of the studies used some form of random assignment to condition (e.g., school, classroom, student). The remaining nine studies used various quasi-experimental designs. In a number of these, selection of schools or classrooms and assignment of these to condition were based primarily on convenience or the interest of participating teachers (e.g., Elbro & Arnbak, 1996). In some studies, not enough information about the participants was presented to provide assurances that comparison groups were truly comparable. Although we were usually given the age and grade level of students, there was little or no discussion of the standard literacy curriculum for students in either treatment or control groups. Researchers seldom considered the possibility that mediating variables might affect students' response to instruction.

The intent of some studies was to use interventions to test theories of causal factors (e.g., Baumann et al., 2002). Others were clearly exploratory studies, and these are appropriate and valuable in the beginning stages of development of a program of instruction. They provide information about the feasibility of the instructional program, which can then be used to design more rigorous studies of the effectiveness of that program, but it is not appropriate to use their results to draw conclusions about the effects of morphological awareness instruction on students' literacy.

A second area critical for evaluating study quality is detailed presentation of the program of instruction and documentation of implementation. Although

exploratory studies might not meet rigorous criteria for high-quality research, they nonetheless should provide readers with a thorough explanation of the program—some researchers did so, and others did not. As noted earlier, researchers consistently reported the types of morphologically complex words they focused on, but beyond that the morphological content of the program was usually not explained in sufficient detail. Furthermore, fidelity of treatment was documented in some way in only 8 of the 16 studies. Many of the studies could not replicated, based on the research report.

The third area is the extent to which the measures are appropriate, valid, and reliable. More attention to the technical characteristics of measures is needed, as most studies provide little information other than internal consistency. Equally as important is documentation of the appropriateness of measures, given the features of the instructional program. Nunes et al. (2003) is a good example of a study in which a concerted effort was made to align the experimental measures to instruction in the phonological and morphological conditions, as well as to make measures of phonological and morphological reading and spelling comparable. We need some assurance that the measures used in a study were appropriate for answering the research questions.

This analysis of study quality shows that some studies, often the more recent ones, were rigorously designed, providing a basis for drawing conclusions about the benefits of morphological instruction for students' literacy development, whereas others were initiated to test an exploratory program or hypothesis. It was heartening to find two examples of programmatic research represented by the studies in this review. Nunes and Bryant (2006) have spent years developing and testing theories of morphological learning and methods of instruction and exploring the effects of these programs in different settings (e.g., Birgisdottir et al., 2006). Similarly, three of the Chinese studies were carried out by a research group that applied lessons learned from one study to the design and implementation of subsequent studies (Nagy et al., 2002; Packard et al., 2006; Wu et al., 2009). There is much to be learned from the programmatic endeavors of these research groups.

Moving Forward

Analysis of results of studies of morphological awareness instruction and the analysis of the quality of the research leave us in a good position to consider important questions that might be addressed in future studies. Although you have probably developed your own list, I offer the following suggestions.

First, it seems clear that researchers should take advantage of current recommendations for designing, implementing, and reporting on studies of instructional practices. This would include the use of research designs that permit causal inference, so that we have a defensible basis for determining the features of morphological awareness instruction that are most likely to lead to significant gains in literacy. It would also include more complete explanation of the implementation and method of analysis of study results.

Second, I recommend that researchers place high priority on developing more complete models or theories of the relation of morphological awareness to other components of literacy development. Third, I see room for additional exploratory studies. We need studies that carry out more fine-grained analyses of the ways that the different approaches to instruction affect students' word learning and thinking processes.

Questions that might be addressed in such studies include the following: What aspects of programs contribute to significant effects on measures of transfer of learning to new words and passages? How much guided practice is needed, and for which students? Why is it that there are so few significant effects of morphological awareness on performance on measures of reading comprehension?

Finally, I hope researchers consider carrying out cross-language comparisons of instruction in morphological awareness, as these would help us understand the extent to which the relation of morphological awareness and literacy development is language-specific.

In rereading Chomsky (1970), I realized that I had forgotten how detailed and thoughtful her suggestions were for ways that students might benefit from instruction in morphological awareness. I was further struck by how little has been done since 1970 to investigate the nature and value of instruction in morphological awareness. Now that research on instruction in morphological awareness is an area of considerable interest in many countries, the time has come to rectify this situation. Overall, although the results of the studies of instruction in morphological awareness are very promising, much work remains to be done.

Note

[1]A version of the study by Elbro and Arnbak (1996) was subsequently published in the *Scandinavian Journal of Educational Research* (Arnbak & Elbro, 2000); only the first report is included in this review.

I would like to thank the consulting editors and the journal editors for their analysis of earlier drafts of this literature review and thoughtful recommendations for improvement. Their insights provided me with both direction and support.

References

Adams, M.J. (1990). *Beginning to read: Thinking and learning about print*. Cambridge, MA: MIT Press.

Anglin, J.M. (1993). *Vocabulary development: A morphological analysis.* (Monographs of the Society for Research in Child Development, Vol. 58, No. 10). Chicago: Society for Research in Child Development.

Arnbak, E., & Elbro, C. (2000). The effects of morphological awareness training on the reading and spelling skills of young dyslexics. *Scandinavian Journal of Educational Research*, *44*(3), 229–251. doi:10.1080/00313830050154485

Assink, E.M.H., Vooijs, C., & Knuijt, P.P.N.A. (2000). Prefixes as access units in visual word recognition: A comparison of Italian and Dutch data. *Reading and Writing: An Interdisciplinary Journal*, *12*(3), 149–168. doi:10.1023/A:1008179825696

Baumann, J.F., Edwards, E.C., Boland, E.M., Olejnik, S., & Kame'enui, E.J. (2003). Vocabulary tricks: Effects of instruction in morphology and context on fifth-grade students' ability to derive and infer word meanings. *American Educational Research Journal*, *40*(2), 447–494. doi:10.3102/00028312040002447

Baumann, J.F., Edwards, E.C., Font, G., Tereshinski, C.A., Kame'enui, E.J., & Olejnik, S.F. (2002). Teaching morphemic and contextual analysis to fifth-grade students. *Reading Research Quarterly*, *37*(2), 150–176. doi:10.1598/RRQ.37.2.3

Bear, D.R., Invernizzi, M., Templeton, S., & Johnston, F. (2008). *Words their way: Word study for phonics, vocabulary, and spelling instruction* (4th ed.). Upper Saddle River, NJ: Pearson.

Berninger, V.W., Nagy, W.E., Carlisle, J.F., Thomson, J., Hoffer, D., Abbott, S., et al. (2003). Effective treatment for children with dyslexia in grades 4–6: Behavioral and brain evidence. In B. Foorman (Ed.), *Preventing and remediating reading difficulties: Bringing science to scale* (pp. 381–347). Baltimore: York.

Berninger, V.W., Winn, W.D., Stock, P., Abbott, R.D., Eschen, K., Lin, S.-J., et al. (2008). Tier 3 specialized writing instruction for students with dyslexia. *Reading and Writing: An Interdisciplinary Journal*, *21*(1–2), 95–129. doi:10.1007/s11145-007-9066-x

Bertram, R., Baayan, R.H., & Schreuder, R. (2000). Effects of family size for complex words. *Journal of Memory and Language*, *42*(3), 390–405. doi:10.1006/jmla.1999.2681

Birgisdottir, F., Nunes, T., Pretzlik, U., Burman, D., Gardner, S., & Bell, D. (2006). An intervention program for teaching children about morphemes in the classroom: Effects on spelling. In T. Nunes & P. Bryant (Eds.), *Improving literacy by teaching morphemes* (pp. 104–120). London: Routledge.

Bowers, P.N., & Kirby, J.R. (2010). Effects of morphological instruction on vocabulary acquisition. *Reading and Writing: An Interdisciplinary Journal*, *23*(5), 515–537. doi:10.1007/s11145-009-9172-z

Carlisle, J.F. (2000). Awareness of the structure and meaning of morphologically complex words: Impact on reading. *Reading and Writing: An Interdisciplinary Journal*, *12*(3), 169–190. doi:10.1023/A:1008131926604

Carlisle, J.F., & Fleming, J. (2003). Lexical processing of morphologically complex words in the elementary years. *Scientific Studies of Reading*, *7*(3), 239–253. doi:10.1207/S1532799XSSR0703_3

Carlisle, J.F., & Katz, L.A. (2006). Effects of word and morpheme familiarity on reading of derived words. *Reading and Writing: An Interdisciplinary Journal*, *19*(7), 669–693. doi:10.1007/s11145-005-5766-2

Carlisle, J.F., & Nomanbhoy, D.M. (1993). Phonological and morphological awareness in first graders. *Applied Psycholinguistics*, *14*(2), 177–195. doi:10.1017/S0142716400009541

Carlisle, J.F., & Stone, C.A. (2005). Exploring the role of morphemes in word reading. *Reading Research Quarterly*, *40*(4), 428–449. doi:10.1598/RRQ.40.4.3

Carlo, M.S., August, D., McLaughlin, B., Snow, C.E., Dressler, C., Lippman, D.N., et al. (2004). Closing the gap: Addressing the vocabulary needs of English-language learners in bilingual and mainstream classrooms. *Reading Research Quarterly*, *39*(2), 188–215. doi:10.1598/RRQ.39.2.3

Casalis, S., & Colé, P. (2009). On the relationship between morphological and phonological awareness: Effects of training in kindergarten and in first-grade reading. *First Language*, *29*(1), 113–142. doi:10.1177/0142723708097484

Casalis, S., & Louis-Alexandre, M.F. (2000). Morphological analysis, phonological analysis, and learning to read in French: A longitudinal study. *Reading and Writing: An Interdisciplinary Journal*, *12*(3), 303–335. doi:10.1023/A:1008177205648

Cazden, C.B. (1976). Play with language and meta-linguistic awareness. In J.S. Bruner, A. Jolly, & K. Sylva (Eds.), *Play: Its role in development and evolution* (pp. 603–608). New York: Basic.

Chialant, D., & Caramazza, A. (1995). Where is morphology and how is it processed? The case of written word recognition. In L.B. Feldman (Ed.), *Morphological aspects of language processing* (pp. 55–76). Hillsdale, NJ: Erlbaum.

Chomsky, C. (1970). Reading, writing, and phonology. *Harvard Educational Review*, *40*(2), 287–309.

Chow, B.W.-Y., McBride-Chang, C., Cheung, H., & Chow, C.S.-L. (2008). Dialogic reading and morphology training in Chinese children: Effects on language and literacy. *Developmental Psychology*, *44*(1), 233–244. doi:10.1037/0012-1649.44.1.233

Chung, W.-L., & Hu, C.-F. (2007). Morphological awareness and learning to read Chinese. *Reading and Writing: An Interdisciplinary Journal*, *20*(5), 441–461. doi:10.1007/s11145-006-9037-7

Clark, E. (1982). The young word maker: A case study of innovation in the child's lexicon. In E. Wanner & L. Gleitman (Eds.), *Language acquisition: The state of the art* (pp. 390–425). Cambridge, MA: Cambridge University Press.

Deacon, S.H., & Kirby, J.R. (2004). Morphological awareness: Just "more phonological"? The roles of morphological and phonological awareness in reading development. *Applied Psycholinguistics*, *25*(2), 223–238. doi:10.1017/S0142716404001110

Elbro, C., & Arnbak, E. (1996). The role of morpheme recognition and morphological awareness in dyslexia. *Annals of Dyslexia*, *46*(1), 209–240. doi:10.1007/BF02648177

Fowler, A., & Liberman, I.Y. (1995). The role of phonology and orthography in morphological awareness. In L. Feldman (Ed.), *Morphological aspects of language processing* (pp. 157–188). Hillsdale, NJ: Erlbaum.

Ganske, K. (2000). *Word journeys: Assessment-guided phonics, spelling, and vocabulary instruction*. New York: Guilford.

Gersten, R., Fuchs, L.S., Compton, D.L., Coyne, M.D., Greenwood, C.R., & Innocenti, M.S. (2005). Quality indicators for group experimental and quasi-experimental research in special education. *Exceptional Children*, *71*(2), 149–164.

Hedges, L.V. (1986). Issues in meta-analysis. *Review of Research in Education*, *13*(1), 353–398.

Henry, M.K. (1989). Children's word structure knowledge: Implications for decoding and spelling instruction. *Reading and Writing: An Interdisciplinary Journal*, *1*(2), 135–152. doi:10.1007/BF00377467

Henry, M.K. (2003). *Unlocking literacy: Effective decoding and spelling instruction*. Baltimore: Paul H. Brookes.

Kieffer, M.J., & Lesaux, N.K. (2008). The role of derivational morphology in the reading comprehension of Spanish-speaking English language learners. *Reading and Writing: An Interdisciplinary Journal*, *21*(8), 783–804. doi:10.1007/s11145-007-9092-8

Ku, Y.-M., & Anderson, R.C. (2003). Development of morphological awareness in Chinese and English. *Reading and Writing: An Interdisciplinary Journal*, *16*(5), 399–422. doi:10.1023/A:1024227231216

Lovett, M.W., Lacerenza, L., & Borden, S.L. (2000). Putting struggling readers on the PHAST track: A program to integrate phonological and strategy-based remedial reading instruction and maximize outcomes. *Journal of Learning Disabilities*, *33*(5), 458–476. doi:10.1177/002221940003300507

Lyster, S.-A. H. (2002). The effects of morphological versus phonological awareness training in kindergarten on reading

development. *Reading and Writing: An Interdisciplinary Journal*, *15*(3–4), 261–294. doi:10.1023/A:1015272516220

McBride-Chang, C., Tardif, T., Cho, J.-R., Shu, H., Fletcher, P., Stokes, S.F., et al. (2008). What's in a word? Morphological awareness and vocabulary knowledge in three languages. *Applied Psycholinguistics*, *29*(3), 437–462. doi:10.1017/S014271640808020X

Moats, L.C. (2000). *Speech to print: Language essentials for teachers*. Baltimore: Paul H. Brookes.

Nagy, W.E. (2007). Metalinguistic awareness and the vocabulary–comprehension connection. In R.K. Wagner, A.E. Muse, & K.R. Tannenbaum (Eds.), *Vocabulary acquisition: Implications for reading comprehension* (pp. 52–77). New York: Guilford.

Nagy, W.E., & Anderson, R.C. (1984). How many words are there in printed school English? *Reading Research Quarterly*, *19*(3), 304–330. doi:10.2307/747823

Nagy, W.E., Berninger, V.W., & Abbott, R.D. (2006). Contribution of morphology beyond phonology to literacy outcomes of upper elementary and middle-school students. *Journal of Educational Psychology*, *98*(1), 134–147. doi:10.1037/0022-0663.98.1.134

Nagy, W.E., Kuo-Kealoha, A., Wu, X., Li, W., Anderson, R.C., & Chen, X. (2002). The role of morphological awareness in learning to read Chinese. In W. Li, J.S. Gaffney, & J.L. Packard (Eds.), *Chinese language acquisition: Theoretical and pedagogical issues* (pp. 59–86). Norwell, MA: Kluwer Academic.

Nunes, T., & Bryant, P. (Eds.). (2006). *Improving literacy by teaching morphemes*. London: Routledge.

Nunes, T., Bryant, P., & Bindman, M. (2006). The effects of learning to spell on children's awareness of morphology. *Reading and Writing: An Interdisciplinary Journal*, *19*(7), 767–787. doi:10.1007/s11145-006-9025-y

Nunes, T., Bryant, P., & Olsson, J. (2003). Learning morphological and phonological spelling rules: An intervention study. *Scientific Studies of Reading*, *7*(3), 289–307. doi:10.1207/S1532799XSSR0703_6

Packard, J.L., Chen, X., Li, W., Wu, X., Gaffney, J.S., Li, H., et al. (2006). Explicit instruction in orthographic structure and word morphology helps Chinese children learn to write characters. *Reading and Writing: An Interdisciplinary Journal*, *19*(5), 457–487. doi:10.1007/s11145-006-9003-4

Parel, R. (2006). The impact of training in morphological analysis on literacy in the primary grades. *The International Journal of Learning*, *13*(4), 119–128.

Reed, D.K. (2008). A synthesis of morphology interventions and effects on reading outcomes for students in grades K–12. *Learning Disabilities Research & Practice*, *23*(1), 36–49. doi:10.1111/j.1540-5826.2007.00261.x

Reichle, E.D., & Perfetti, C.A. (2003). Morphology in word identification: A word-experience model that accounts for morpheme frequency effects. *Scientific Studies of Reading*, *7*(3), 219–237. doi:10.1207/S1532799XSSR0703_2

Rosenshine, B. (2001). Issues in conducting meta-analyses of intervention studies. *The Elementary School Journal*, *101*(3), 371–377. doi:10.1086/499675

Schreuder, R., & Baayan, R.H. (1995). Modeling morphological processing. In L. Feldman (Ed.), *Morphological aspects of language processing* (pp. 131–154). Hillsdale, NJ: Erlbaum.

Sénéchal, M. (2000). Morphological effects in children's spelling of French words. *Canadian Journal of Experimental Psychology*, *54*(2), 76–86. doi:10.1037/h0087331

Seymour, P.H.K. (1997). Foundations of orthographic development. In C.A. Perfetti, L. Rieben, & M. Fayol (Eds.), *Learning to spell: research, theory, and practice among languages* (pp. 319–337). Hillsdale, NJ: Erlbaum.

Siegel, L.S. (1998). Phonological processing deficits and reading disabilities. In J.L. Metsala & L.C. Ehri (Eds.), *Word recognition in beginning literacy* (pp. 141–160). Mahwah, NJ: Erlbaum.

Singson, M., Mahoney, D., & Mann, V. (2000). The relation between reading ability and morphological skills: Evidence from derivational suffixes. *Reading and Writing: An Interdisciplinary Journal*, *12*(3), 219–252. doi:10.1023/A:1008196330239

Taft, M. (2003). Morphological representation as a correlation between form and meaning. In E.M.H. Assink & D. Sandra (Eds.), *Reading complex words: Cross-language studies* (pp. 113–137). New York: Kluwer Academic.

Templeton, S. (1989). Tacit and explicit knowledge of derivational morphology: Foundations for a unified approach to spelling and vocabulary development in the intermediate grades and beyond. *Reading Psychology*, *10*(3), 233–253.

Templeton, S., & Scarborough-Franks, L. (1985). The spelling's the thing: Knowledge of derivational morphology in orthography and phonology among older students. *Applied Psycholinguistics*, *6*(4), 371–390. doi:10.1017/S0142716400006317

Tomesen, M., & Aarnoutse, C. (1998). Effects of an instructional programme for deriving word meanings. *Educational Studies*, *24*(1), 107–128. doi:10.1080/0305569980240108

Treiman, R., & Cassar, M. (1996). Effects of morphology on children's spelling of final consonant clusters. *Journal of Experimental Child Psychology*, *63*(1), 141–170. doi:10.1006/jecp.1996.0045

Tyler, A., & Nagy, W. (1989). The acquisition of English derivational morphology. *Journal of Memory and Language*, *28*(6), 649–667. doi:10.1016/0749-596X(89)90002-8

Tyler, A., & Nagy, W. (1990). Use of derivational morphology during reading. *Cognition*, *36*(1), 17–34. doi:10.1016/0010-0277(90)90052-L

Wagner, R.K., Muse, A.E., & Tannenbaum, K.R. (2007). Promising avenues for better understanding implications of vocabulary development for reading comprehension. In R.K. Wagner, A.E. Muse, & K.R. Tannenbaum (Eds.), *Vocabulary acquisition: Implications for reading comprehension* (pp. 276–291). New York: Guilford.

What Works Clearinghouse. (2008, May). *Evidence standards for reviewing studies, Version 1.0*. Retrieved May 27, 2010, from ies.ed.gov/ncee/wwc

Wu, X., Anderson, R.C., Li, W., Wu, X., Hong, L., Zhang, J., et al. (2009). Morphological awareness and Chinese children's literacy development: An intervention study. *Scientific Studies of Reading*, *13*(1), 26–52. doi:10.1080/10888430802631734

Wysocki, K., & Jenkins, J.R. (1987). Deriving word meanings through morphological generalization. *Reading Research Quarterly*, *22*(1), 66–81. doi:10.2307/747721

Joanne F. Carlisle is a professor of education in the School of Education at the University of Michigan, Ann Arbor, USA; e-mail jfcarl@umich.edu.

Appendix A

Summary of Characteristics of Studies of Instruction in Morphological Awareness

Authors (date), purpose, and design	Method (participants, treatment duration, content, and instructors)
Baumann, Edwards, Font, Tereshinski, Kame'enui, & Olejnik (2002) *Purpose:* Compare the effects of instruction in morphemic analysis only, context analysis only, combined morphemic–contextual analysis, and regular instruction (control condition) *Design:* Mixed-method study with quasi-experimental design; three treatment groups—Morphemic instruction only (MO); Context only (CO); Combined morphemic and context instruction (MC)—and one control group	*Participants:* 88 fifth graders in four heterogeneously grouped classes (three randomly assigned to one of the treatment conditions with the fourth preselected to be the instructional control). *Treatment duration:* Treatment groups received 12 50-minute lessons. *Content:* 10 lesson words with prefixes and transfer words; MO: instruction in eight prefix families and review; CO: nine lessons teaching context clue strategies; three review lessons; MC: combined MO and CO lessons. *Instructors:* Researchers; fidelity of treatment was documented.
Baumann, Edwards, Boland, Olejnik, & Kame'enui (2003) *Purpose:* Compare the effects of morphemic and context analysis instruction to text vocabulary instruction integrated in social studies lessons for fifth graders *Design:* Mixed-methods study with pairs of matched classrooms randomly assigned to treatments textbook vocabulary (TV) or morphemic and contextual analysis (MC)	*Participants:* 157 fifth graders in four classrooms receiving MC treatment and four classrooms receiving TV instruction. *Treatment duration:* 33 days (including testing and 25 days of instruction). *Content:* Vocabulary instruction in the context of social studies lessons; TV students taught meanings of words in social studies text; MC taught morphemic and contextual analysis strategies. Interventions integrated into social studies instruction. For MC, words with eight types of prefixes and suffixes; five context analysis strategies. *Instructors:* Eight trained teachers; fidelity of treatment was documented.
Berninger, Nagy, Carlisle, Thomson, Hoffer, Abbott, et al. (2003) *Purpose:* Compare response to treatment for students who received morphological awareness (MA) and phonological awareness (PA) treatments *Design:* Random assignment to treatment condition	*Participants:* 20 fourth, fifth, and sixth graders qualifying as probands for genetic study (10 in each treatment condition, PA or MA). *Treatment duration*: Three weeks, 28 hours of instruction. *Content*: Instruction delivered to students in each treatment group. Program focused on identical awareness strategies with the content either phonology or morphology. Each group received treatment specific training for first half and common components for second half of each session. Treatment activities focused on word sorts, word building; common features included oral reading, written summarization of passages. *Instructors:* Trained teachers; fidelity of treatment was monitored.
Berninger, Winn, Stock, Abbott, Eschen, Lin, et al. (2008) *Purpose*: Compare improvement in spelling and reading of students with dyslexia who received instruction in morphological awareness or orthography *Design:* Random assignment to orthographic (O) and morphological awareness (MA) treatments	*Participants:* Students with dyslexia in grades 4–6 (n = 22) and 7–9 (n = 17). *Treatment duration*: 14 two-hour sessions. *Content:* Orthographic treatment focused on word-specific spellings; MA treatment focused on awareness of word parts and rules for adding affixes to base words. Common aspects of treatment: strategies for planning, writing, and revising compositions; phonological awareness (each session, one hour for spelling and one for composition). *Instructors:* Clinicians and educators working in small groups in summer clinic; fidelity of treatment was monitored.

Appendix A *(continued)*

Authors (date), purpose, and design	Method (participants, treatment duration, content, and instructors)
Birgisdottir, Nunes, Pretzlik, Burman, Gardner, & Bell (2006) *Purpose:* Compare gains in spelling of treatment and control students when morphemic training is provided by teachers, not researchers, in a normal classroom environment *Design:* Quasi-experimental design with treatment conditions divided among five schools, including two interventions—morpheme only (MO), morpheme plus spelling (M + S), and control group	*Participants:* Intervention groups at three London schools; control at two schools. MO, n = 26; M + S, n = 100; control, n = 75 *Treatment duration:* Seven training sessions, each lasting 50 minutes *Content:* Teachers used CD-ROM with 3–4 tasks for each session, presented as word games; tasks for intervention groups were the same except for focus on making connections to spelling explicit for M + S group *Instructors:* Teachers provided instruction by using use the CD-ROM lessons in order. No additional measures of fidelity of treatment
Carlo, August, McLaughlin, Snow, Dressler, Lippman, et al. (2004) *Purpose*: Compare outcomes for students in vocabulary intervention or control (both ELL and EO) *Design:* Random assignment of classrooms with bilingual (ELL) and English-only (EO) students to treatment (n = 10) or control (n = 6)	*Participants*: 254 fifth graders; in treatment group, 94 ELL and 75 EO; in control group, 48 ELL and 37 EO *Treatment duration:* Classes received 15 weeks of instruction, 30–45 minutes, four days a week *Content:* 10–12 target words were introduced each week; a variety of vocabulary learning strategies and activities were used in an established pattern across the week; during some weeks, activities promoted word analysis (root words and derivational affixes) *Instructors:* Classroom teachers; fidelity of treatment through informal observation and statistical comparisons of classroom results
Casalis & Colé (2009) *Purpose:* Compare kindergarten outcomes in phonological and morphological awareness and first grade reading for students who received programs of phonological awareness, morphological awareness, or regular classroom instruction *Design*: Random selection of kindergarten students and random assignment to condition—phonological awareness, morphological awareness, control	*Participants:* 30 students assigned to each condition; for first-grade follow-up testing, there were 24 in the phonological and in the morphological conditions and 30 in the control group *Treatment duration*: Twelve 30-minute sessions for each condition over a period of nine weeks *Content*: For morphological awareness, focus was on derivational morphology (inflections included in one session); taught concept of suffixes and identification of base; segmentation and fusion tasks, also pseudoderivation tasks; fidelity of treatment assured by teachers following detailed written instructions and weekly meetings to assure that progression in different groups was comparable *Instructors:* Teachers in training program
Chow, McBride-Chang, Cheung, & Chow (2008) *Purpose:* Investigate the effects of parent–child dialogic reading and metalinguistic training on language and literacy of kindergartners in Hong Kong *Design:* Kindergarten parents randomly assigned to one of four conditions: dialogic reading (DR), DR + metalinguistic training (DR + MT), typical reading (TR) and control	*Participants:* 148 kindergartners *Treatment duration*: 12 weeks; treatment parents instructed to read each book twice in a week for 20 minutes *Content:* Materials provided to parents as appropriate for condition: DR 12 books, guidelines including PEER technique (i.e., prompt, evaluate, expand, repeat) and five types of prompts; DR + MT: same books but with guidelines for MT, including information about Chinese morphology, focus on sound-meaning training with items from each storybook, homophone training; TR: 12 books but no guidelines; Control: no books *Instructors:* Parents worked with the child; time spent reading was recorded; no additional method to assess fidelity of treatment

Appendix A *(continued)*

Authors (date), purpose, and design	Method (participants, treatment duration, content, and instructors)
Elbro & Arnbak (1996) *Purpose:* Examine the effects of morphological awareness training on morpheme awareness, phoneme awareness, reading, and spelling for dyslexic students *Design:* Quasi-experimental study	*Participants:* 33 adolescents with dyslexia in experimental condition and 27 adolescents with dyslexia in control group; groups were matched for age, sex, and nonverbal IQ *Treatment duration:* 36 sessions lasting about 15 minutes each (three sessions per week) *Content:* Time for training was taken from remedial teaching; for experimental group, first phase focused on compounds, the second on derivational affixes, the third on inflections; training involved games, such as inventing new words, reversing the order of morphemes, discussion of pseudomorphemes; control group received regular remediation; instruction for experimental group mostly oral *Instructors:* Regular remedial teachers, using researcher-prepared materials; no measure of fidelity of treatment
Henry (1989) *Purpose:* Compare effects of training in word reading and spelling with "historical/structural" perspective (READ Plus) to phonics (READ) and control groups *Design:* For Experiment 2, quasi-experimental—teachers in eight READ classes (4 third grade and 4 fifth grade) agreed to teach five decoding units; these classes became READ Plus	*Participants*: Third and fifth graders in three conditions: 182 READ, 97 control and 164 READ Plus *Treatment duration*: READ Plus received five additional lessons (30–45 minutes each) of supplemental small-group instruction *Content:* READ is a comprehensive spelling/reading program that includes a focus on language origins and structural units, including morphemes; for READ Plus, students were taught five additional lessons on awareness of structure of language from historical origins and new strategies for reflecting on and monitoring reading and writing *Instructors:* Teachers trained to teach READ or READ Plus; no measure of fidelity of treatment
Lyster (2002) *Purpose:* Compare the long-term effects of kindergarten morphological awareness instruction (M), phonological awareness instruction (P), and regular instruction on first-grade word reading *Design:* Random assignment of trained teachers to M and P conditions; no-training control group teachers not randomly assigned	*Participants*: 273 Norwegian kindergartners and their preschool teacher randomly assigned to treatment condition (P or M); no-training control group (C) teachers were those who did not attend the training sessions *Treatment duration:* 30 minutes per week for 17 weeks *Content:* Activities in small groups to help students discover how phonology and morphology map onto print; game-like activities (e.g., letter/sounds for phonological condition, compounds and inflected forms for morphological condition); activities were oral, some involved print (print exposure controlled for two treatment conditions) *Instructors:* Trained teachers; no measure of fidelity of treatment
Nagy, Kuo-Kealoha, Wu, Li, Anderson, & Chen (2002) *Purpose:* Investigate instructional methods beneficial to learning to read Chinese (including morphological awareness) *Design:* Quasi-experimental pretest–posttest design comparing outcomes for three of the four conditions	*Participants:* 244 first graders in eight intact classrooms; four treatment conditions: morphological awareness (MA), volume-of-reading (V), combination MA and V (MA/V), control (C); 71–80 students in each group *Treatment duration*: October to May *Content:* MA intervention focused on character and word morphology; implementation was based on principles of analyticity, multiple examples, insight rather than memorization, strategic application; instruction in how characters are used to form words *Instructors:* Regular teachers trained to deliver instruction for the three treatment conditions

Appendix A *(continued)*

Authors (date), purpose, and design	Method (participants, treatment duration, content, and instructors)
Nunes, Bryant, & Olsson (2003) *Purpose:* Compare effects of training in phonological awareness (P) and morphological awareness (M; with and without writing) for 7- and 8-year-olds in Great Britain *Design:* Quasi-experimental with four schools in experimental conditions and four assigned to control condition	*Participants*: Third- and fourth-year students, 222 in experimental treatments, 246 in control schools; five conditions: Phonological awareness alone (P) and with writing (P + writing); morphological awareness alone (M) and with writing (M + writing); control (C) *Treatment duration*: 12 weekly 30-minute sessions *Content:* Instruction was mostly oral and provided in small groups, specific goals for both P and M involved explicit understanding of rules and procedures by language unit, common elements included games, similar cognitive operations (e.g., classification, segmentation, blending); linguistic content differed by condition; P with writing worked with letters; M with writing worked with written words *Instructors:* Researchers; no measure of fidelity of treatment
Packard, Chen, Li, Wu, Gaffney, Li, et al. (2006) *Purpose:* Determine whether raising students' awareness of morphemic and orthographic structure of Chinese words led to gains in learning to write Chinese *Design:* Quasi-experimental; two classes in each of two schools in Beijing, one assigned to experimental treatment and the other to control	*Participants*: 73 first graders in two classes were given instruction in orthography and morphology; 71 control students *Treatment duration:* Two semesters (nine months) *Content:* Both treatment and control classes were taught using the standard teaching guide; no differences in time allotted to character reading and writing; only difference was the method of teaching new characters; the goal of the intervention was to increase students' understanding of semantic and phonetic radicals *Instructors:* Teachers prepared by researchers to provide instruction in these two areas; classroom observations with feedback to teachers
Tomesen & Aarnoutse (1998) *Purpose:* Study the effects of an instructional program for deriving word meanings on poor and average readers in fourth grade (Dutch students) *Design*: Quasi-experimental (pretest–posttest control group design); comparisons of treatment and control, and of average (AV) and poor (P) readers in two conditions	*Participants:* Eight schools, four experimental (E), four control (C); participants were fourth graders taught in groups of four (two average and two poor readers); 31 students (16 E and 15 C) *Treatment duration*: Instruction twice a week for six weeks; 45-minute lessons took place outside the classroom *Content*: Program called Word Detectives, introduced two methods—analysis of word forms and use of context clues to infer meanings of unfamiliar words; involved direct instruction in word-form analysis as well as a modified form of reciprocal teaching *Instructors:* Lessons taught by one of researchers; no measure of fidelity of treatment
Wu, Anderson, Li, Wu, Hong, Zhang, Zhu, et al. (2009) *Purpose:* Investigate the relation of morphological awareness and progress in learning to read and write Chinese *Design*: Quasi-experimental (pretest–posttest treatment and control group)	*Participants:* 169 first graders—84 control (C), 85 treatment (T) from six classrooms in four schools in Beijing *Treatment duration:* First-grade year; treatment was part of language arts instruction (two 40–50 minute classes a day) *Content:* Direction instruction and guided discovery to understand Chinese character formation; activities fostered insights such as making up words with newly learned characters *Instructors:* Classroom teachers trained to implement intervention. Research assistants observed one experimental class each week to monitor implementation