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# The Effects of Morphological Instruction on Literacy Skills: A Systematic Review of the Literature

**Peter N. Bowers and John R. Kirby**
*Queen's University*

**S. Hélène Deacon**
*Dalhousie University*

*The authors reviewed all peer-reviewed studies with participants from preschool to Grade 8 for this meta-analysis of morphological interventions. They identified 22 applicable studies. Instructional effects (Cohen's* d*) were averaged by linguistic outcome categories (morphological sublexical, nonmorphological sublexical, lexical, and supralexical) and comparison group (experimental group vs. control or experimental group vs. alternative training). The authors investigated the effects of morphological instruction (a) on reading, spelling, vocabulary, and morphological skills, (b) for less able readers versus undifferentiated samples, (c) for younger versus older students, and (d) in combination with instruction of other literacy skills or in isolation. Results indicate that (a) morphological instruction benefits learners, (b) it brings particular benefits for less able readers, (c) it is no less effective for younger students, and (d) it is more effective when combined with other aspects of literacy instruction. Implications of these findings are discussed in light of current educational practice and theory.*

**KEYWORDS:** meta-analysis, instructional practices, literacy, reading, elementary schools.

Our purpose in this article is to provide a systematic review of the evidence about the effects of instruction about the morphological structure of words on literacy learning. Morphology is the conventional system by which the smallest units of meaning, called morphemes (bases, prefixes, and suffixes), combine to form complex words.[1] For example, the word *unhelpful* has three morphemes that can be represented orally, /ən/ + /hɛlp/ + /fəl/, or in writing, <un-> + <help> + <-ful>. The English orthography is considered to be morphophonological (Chomsky & Halle, 1968; Venezky, 1967, 1970, 1999), in that both units of meaning and of sound are represented in print. Morphology has received far less attention in literacy research than has phonology (National Reading Panel, 2000). As we see in the review that follows, there is growing evidence of the role of morphological

knowledge in literacy development (Carlisle, 2003; Deacon & Kirby, 2004; Nunes, Bryant, & Bindman, 1997; Roman, Kirby, Parrila, Wade-Woolley, & Deacon, 2009).

Morphological knowledge is referred to in various ways in the literature, including as morphological awareness and morphological processing. Morphological awareness has a specific meaning, referring to "awareness of morphemic structures of words and the ability to reflect on and manipulate that structure" (Carlisle, 1995, p. 194). Morphological processing on the other hand can include less conscious or implicit processing of morphological information (e.g., Deacon, Parrila, & Kirby, 2008). For the purposes of this review, because it was not always clear what the participants were learning, we use the more general term *morphological knowledge*.

Morphological knowledge has the potential to affect literacy skills in at least three ways, through word recognition, comprehension, and motivation. A great deal is known about the factors supporting word recognition: These include phonological awareness, rapid automatized naming, orthographic processing, and vocabulary knowledge (for a review, see National Reading Panel, 2000). Morphological knowledge is a further factor supporting efficient and accurate word recognition (Carlisle, 2003). For example, morphemic boundaries affect the pronunciation of letter sequences: *ea* is pronounced as one phoneme in *reach* because it occurs in one morpheme but as two phonemes in *react* because the two letters are in different morphemes. The relationship between morphological knowledge and word reading has been shown to be independent of the other factors mentioned above (Deacon & Kirby, 2004; Roman et al., 2009). Morphological knowledge may also contribute to reading comprehension, through improved word recognition, but also by helping readers understand the meanings or syntactic roles of unknown words (Carlisle, 2003). A number of the authors of the intervention studies reviewed here commented that morphological instruction may contribute to literacy by increasing motivation to investigate words (e.g., Berninger et al., 2003; Bowers & Kirby, in press; Tomesen & Aarnoutse, 1998). We found no studies that included outcome measures of motivation, so this interpretation is still speculative.

Given the increasing evidence of the relationship between morphological awareness and reading outcomes (e.g., Carlisle, 2003), there is a parallel increase in interest in teaching children about morphology. By its nature morphological instruction addresses sublexical features of a language. The ultimate goal of this instruction, however, is not for children to learn about morphemes. Rather, it is hoped that explicit morphological instruction will increase understanding about oral and written features of morphology at the sublexical level that, in turn, will influence literacy skills at the lexical level (e.g., word reading, spelling, and vocabulary) and the supralexical level (e.g., reading comprehension). For sublexical morphological instruction to result in literacy gains at higher linguistic layers, there must be some transfer beyond that sublexical content. Presumably this transfer would occur through improved word recognition, which in turn might facilitate text comprehension. It can be expected then that any gains found for lexical measures would be less than gains found for morphological sublexical tasks. Similarly, it may be that increased knowledge of morphemes as meaning cues for words could affect reading comprehension, the supralexical layer. Transfer to reading

comprehension may be less immediate and weaker than that found for the lexical layer and may require the integration of morphological knowledge with other literacy skills.

The merits of new instructional content cannot be effectively investigated in isolation from questions about how that content is taught and the individual differences among those who receive the instruction. Any benefits of morphological instruction may differ greatly based on a variety of factors. Developmental issues such as the learner's age and language ability at the point of instruction may have instructional consequences. Instructional design questions include the ideal length of interventions and the optimal manner of presentation of morphological content. These instructional questions also provide structure to our investigation of morphological intervention studies.

### *Importance of Morphological Knowledge in Reading Outcomes*

Before reviewing the studies of morphological instruction, it is helpful to briefly review evidence for the correlation between morphological knowledge and literacy in students who have not received special morphological instruction. Morphological knowledge (assessed in the absence of specific instruction) has been found to predict unique variance in sublexical tasks such as pseudo-word reading after controlling for factors including phonological awareness, orthographic processing, and naming speed (e.g., Deacon & Kirby, 2004; Fowler & Liberman, 1995; Roman et al., 2009). An influence of morphological knowledge on lexical tasks has been shown in studies of word reading accuracy (e.g., Carlisle, 1995, 2000; Carlisle & Katz, 2006; Elbro & Arnbak, 1996; Fowler & Liberman, 1995; Leong, 1989; Roman et al., 2009; Singson, Mahony, & Mann, 2000). Also at the lexical layer, morphological knowledge has been shown to predict unique variance in vocabulary knowledge (Bertram, Laine, & Virkkala, 2000; Carlisle, 2007; Mahony, Singson, & Mann, 2000; Wysocki & Jenkins, 1987) and spelling (e.g., Deacon, Kirby, & Bell-Casselman, 2009). Finally, evidence at the supralexical level can be found in research showing a unique contribution of morphology to reading comprehension after controlling for other variables associated with reading (e.g., Carlisle, 1995, 2000; Deacon & Kirby, 2004; Elbro & Arnbak, 1996). Although the correlational or predictive studies offer strong support for the role of morphological knowledge in literacy development, correlational studies can never completely answer the question of causation.

### *Developmental Trends and the Timing of Instruction*

There is some suggestion of changes in the role of morphological knowledge for literacy skills in different age groups. Early research established that children as young as 4 years had morphological knowledge (e.g., Berko, 1958). Evidence for morphological cues influencing spelling has been shown for 5- and 6-year-old children (Deacon & Bryant, 2006; Kemp, 2006; Treiman, Cassar, & Zukowski, 1994). Carlisle and Stone (2005) found that children aged 7 to 10 years made use of morphological structure in reading derived words (also see Deacon, Whalen, & Kirby, 2010). There is some suggestion that the role of morphological knowledge in reading increases with age whereas that of phonological awareness decreases (Singson et al., 2000), but that does not appear in all analyses in all studies (e.g., Deacon & Kirby, 2004; Roman et al., 2009). Certainly, an increase in the impor-

tance of morphological knowledge is the prediction of some prominent models of literacy development (e.g., Ehri, 1995, 1997; Ehri & McCormick, 1998); children are expected to become more fluent readers later in reading development as they increasingly use commonly recurring letter patterns (e.g., *–ight* and *–ed*) as units. Notably, these units include morphemes. The question of the developmental pattern of the contributions of morphological knowledge to reading outcomes clearly has substantial empirical and theoretical implications.

Accordingly, the most effective point at which to introduce this content to classroom instruction remains an important unresolved question. Adams (1990) recommended avoiding explicit morphological instruction until upper elementary years. More recently, researchers have called for early instruction about morphology along with other oral and written features of language (e.g., Carlisle & Stone, 2005; Henry, 2003; Nunes & Bryant, 2006). Results from intervention studies are needed to shed light on when this instruction is most effective.

### *Differential Effects Associated With Reading Ability*

The role morphological knowledge plays for more and less able readers is another important question. A well-established source of difficulty for struggling readers is a phonological processing deficit (National Reading Panel, 2000). A number of researchers have suggested that morphological knowledge may represent a particular advantage for struggling readers (e.g., Carlisle, Stone, & Katz, 2001; Casalis, Colé, & Sopo, 2004; Elbro & Arnbak, 1996). As an example, Carlisle et al. (2001) found that both poor and average readers were better able to read morphologically transparent words than shift words (transparent words are those in which the pronunciation of the base is the same after adding affixes, whereas shift words are those in which the base's pronunciation changes). Carlisle et al. concluded that both poor and average readers must draw on morphological knowledge when they are reading. A more detailed picture comes from Casalis et al. (2004). They found that dyslexics were behind reading-age controls in morphemic segmentation but that the two groups performed equally in a morphological sentence completion task and dyslexics in fact outperformed the reading-age controls in a morphological production task. They concluded that dyslexics might take advantage of morphemes in processing, particularly given that these are typically larger units of sound that are connected to meaning. Introducing explicit morphological instruction may build on a relative strength for dyslexic learners (Deacon et al., 2008; Elbro & Arnbak, 1996).

### *Rationale for Studying Morphological Instruction*

Typical classroom instruction includes very little, if any, systematic and sustained attention to the morphological structure of words (Henry, 2003; Moats, in press; Nunes & Bryant, 2006). Therefore, virtually all the findings outlined in the preceding sections are based on uninstructed morphological knowledge. Only examination of evidence from morphological interventions can shed light on the causal role of morphological knowledge and whether the existing research accurately represents the role morphology plays in literacy development.

The distinction between taught and untaught morphological knowledge may have special relevance for some of the questions addressed in the preceding sections. If uninstructed morphological knowledge provides some struggling readers

with a compensation strategy, as suggested by Casalis et al. (2004), deliberate morphological instruction may help them harness this strategy more effectively. Deliberate morphological instruction may create knowledge that is different from the untaught knowledge examined in existing correlational or predictive studies. Deliberate instruction should lead to more accurate and quicker learning and more explicit knowledge. If morphological instruction were introduced early in literacy learning, morphological knowledge would have time to become consolidated and have more opportunities to contribute to literacy learning.

Intervention studies are necessary to investigate the causal links between morphological knowledge and literacy development, just as studies such as Bradley and Bryant's (1983) were needed to establish a causal link between phonological awareness and later reading ability. The predictive or correlational studies are important but fail to address the directionality of influence between morphological knowledge and literacy skills. It may be that morphological knowledge builds literacy skills or that developing literacy skills build morphological knowledge or that there is some mutually supportive relationship. Evidence from morphological interventions is needed to determine whether an increase in morphological knowledge will influence the development of literacy skills. Also, as we revisit in more detail in the discussion, the question of whether morphological instruction is helpful for younger and/or less able readers has clear implications for current models of reading development (e.g., Ehri, 1995).

### *Current Morphological Instruction Research*

A small but growing body of research has investigated the effects of morphological instruction on reading (e.g., Abbott & Berninger, 1999; Berninger et al., 2003; Berninger et al., 2008), spelling (e.g., Nunes, Bryant, & Olsson, 2003; Robinson & Hesse, 1981), and vocabulary (Baumann, Edwards, Boland, Olejnik, & Kame'enui, 2003; Baumann et al., 2002; Bowers & Kirby, in press). The meta-analysis described here synthesizes results from morphological interventions that have examined the effect of instruction both with participants identified with reading difficulties (e.g., Arnbak & Elbro, 2000; Tyler, Lewis, Haskill, & Tolbert, 2003) and spelling difficulties (e.g., Kirk & Gillon, 2009) and with undifferentiated participants (e.g., Baumann et al., 2002; Baumann et al., 2003; Bowers & Kirby, 2006, in press). We investigate results from instructional studies with age groups from preschool (e.g., Lyster, 1998, 2002) to upper elementary (e.g., Robinson & Hesse, 1981) and across a variety of languages (English, Danish, Dutch, and Norwegian). A meta-analysis will allow patterns to be seen on a larger scale than is possible in separate studies and will to some extent overcome limitations because of sample size, instructional methods, and variable selection.

Reed (2008) published the only quantitative synthesis of morphological interventions that we have been able to identify. Her study investigated morphological intervention studies conducted in English between 1986 and 2006 with students from kindergarten to Grade 12. Reed identified seven studies that met her inclusion criteria and provided a descriptive account of the effect sizes for all outcome measures. In her sample, three studies focused on word identification, three on vocabulary, and one on spelling. Reed reported a wide range in effect sizes and concluded that stronger effects were associated with instruction focused on root (base) words compared to affixes alone. Three studies from two publications in her

review (Abbott & Berninger, 1999; Vadasy, Sanders, & Payton, 2006) specifically selected low achieving readers. Reed reported medium effect sizes on reading and reading-related outcomes from these studies and found these effects to be larger in general than those for the other intervention studies. She concluded that morphology instruction should be tailored to students' developmental age and that it should include instruction about root (base) words.

### *Purpose of the Current Study*

Our study is designed to provide a comprehensive systematic review of available data on the impact of morphological instruction on literacy outcomes. To do so, we included a wide search range (expanding on that offered in Reed, 2008). We included studies reported prior to 1986 and unpublished studies presented at peer-reviewed scientific conferences. To identify all relevant studies, we included studies even if they did not explicitly state they were investigating morphology (unlike Reed), as long as the focus on morphology was clear from the description of the studies' methods. We included studies that took place in other alphabetic orthographies (as it turned out, there were studies in Danish, Dutch, and Norwegian), extending Reed's exclusive focus on English.

Interpreting results from interventions across languages should be done cautiously because languages differ in terms of oral and written features. One criterion the literature uses to distinguish alphabetic languages is the complexity of grapheme to phoneme correspondences. Languages with consistent grapheme–phoneme correspondences are considered *shallow*. Languages in which the grapheme–phoneme correspondences are complex and inconsistent are labeled *deep*. Although English is seen as deep for both spelling and reading, Danish, Dutch, and Norwegian are seen as moderate on these dimensions (e.g., Borgwaldt, Hellwig, & de Groot, 2004, 2005; Bosman, Vonk, & van Zwam, 2006; Seymour, Aro, & Erskine, 2003; Stone, Vanhoy, & Van Orden, 1997). Although there are too few studies in languages other than English to compare languages statistically, we judged it more advantageous to include all these languages in our review to provide a wider sample of studies for this early assessment of morphological interventions. As noted regarding study selection criteria, we did limit the studies to those conducted in alphabetic orthographies.

Our study employed a design to facilitate synthesis of this wide variety of data according to three linguistic layers. Outcomes for all studies were coded as sublexical, lexical, or supralexical in nature. This categorization system (which is described in more detail in the method section) allowed us to draw a more fine-grained picture of the effects of instruction. Our design allows us to investigate the degree to which sublexical instruction transfers up to lexical and supralexical measures. We expect high variability within and between these categories because of the application of different treatments to different students and a wide variety of outcomes. Nevertheless, analyzing effect sizes by these linguistic categories allows for a principled synthesis of results across a variety of studies to investigate pertinent theoretical and practical questions. To investigate ability and age effects, we categorize studies on those characteristics.

If morphological instruction does transfer from the sublexical to the lexical and supralexical levels, this transfer is likely to be facilitated by instructional methods that integrate morphological instruction with other aspects of literacy instruction

(cf. Salomon & Perkins, 1989). This type of integrated instruction, as opposed to that which presents morphological knowledge in a more isolated fashion, should provide more opportunities for guided application of morphological knowledge at the lexical and supralexical levels. It is also possible that greater application at the higher levels will work backward to strengthen sublexical skills. To investigate this, we also categorize the studies with respect to this characteristic.

In summary, this systematic review assesses the evidence for literacy and morphological gains for elementary students (preschool through Grade 8) through explicit instruction about morphology. Our research questions are the following: (a) What are the effects of morphological instruction for sublexical, lexical, and supralexical measures of reading, spelling, vocabulary, and morphological skills? (b) Is the effect of morphological instruction different for less able than undifferentiated children? (c) Does the effect of morphological intervention differ when conducted with older versus younger students? and (d) Is morphological instruction more effective when taught in isolation or integrated with other literacy knowledge and skills?

## Method

### *Study Selection*

To identify the relevant studies, the EBSCO Research Complete, PsycINFO, and WorldCat electronic databases were searched with the following descriptors: *morpholog**, *morphem**, *interven**, *teach**, *train**, *instruct**, *vocabulary*, *spell**, *read**, *base**, *root**, *prefix**, *suffix**, *affix**, *litera**, *dyslex**. More than 1,000 abstracts were identified by December 7, 2009. To be included in the analysis, studies needed to meet all the following criteria:

1. Published in English, reporting on research carried out in an alphabetic orthography
2. Investigated instruction with elementary school students (preschool to Grade 8)
3. Investigated instruction about any element of oral or written morphology (including prefixes, suffixes, bases or roots, compounds, derivations, and inflections; studies did not need to mention morphology explicitly, as long as the role of morphology was clear in the description of the intervention)
4. At least one third of the instruction was focused on morphology, based on the intervention description
5. Reported literacy outcome measures (including morphological measures) with means and standard deviations for comparison
6. Used either an experimental and control or comparison group or a training group with pre- and posttests using measures that could be compared to established norms (no studies were identified that used a pretest–posttest design without a comparison group, so this last criterion was not implemented)

Once studies meeting these criteria were identified, experts in the field were contacted to inquire whether they could identify additional relevant published or unpublished studies. Reference lists from identified studies were examined for still more potentially relevant studies. In all, 22 studies met the inclusion criteria; these are identified with an asterisk in the reference list.

### Coding the Studies and Outcome Variables

Studies and outcome variables were coded for characteristics of type of linguistic outcome measure, participants, and instructional design. We describe each in turn.

*Coding outcomes by linguistic layer*. An overarching system of coding outcome measures was designed to facilitate the synthesis of a wide array of outcomes from the 22 studies along the dimensions relevant to our research questions. Sublexical outcomes were defined as tasks that require students to process sublexical features and that were scored on the basis of sublexical features, even if the stimulus and/or responses were at the lexical level. Sublexical tasks were further subdivided into *morphological sublexical tasks* and *nonmorphological sublexical tasks*. Morphological sublexical tasks included oral tasks such as morphological analogy (*walk* : *walked* :: *shake* :_____ *(shook)*; Nunes et al., 1997) or written morphological tasks in which students select words linked by the base to a cue word (e.g., identifying which of the following words "have a real connection" to the cue word *create*: *creative, cream, creature, ate, recreation, crease*; Bowers & Kirby, 2006). Nonmorphological sublexical tasks included phonological awareness, syllable segmentation, pseudo-word reading, and rhyme recognition.

Lexical outcomes included tasks that target linguistic processing at the word level, even though participants must process sublexical features to complete them. Lexical outcome tasks include vocabulary, word reading accuracy or efficiency, spelling, and word-level orthographic processing tasks such as those in which students choose the correct spelling of two phonologically plausible options (e.g., *rain* or *rane*). Lexical outcomes were further coded as measures of reading, spelling, or vocabulary.

Supralexical outcomes included tasks that required oral or written processing beyond the word level. Examples include reading comprehension tasks, syntactic awareness, and listening comprehension.

*Coding of participant characteristics*. Studies were first coded to indicate whether they investigated *less able* or *undifferentiated readers.* The authors' formal identification of participants (e.g., those with dyslexia or specific language impairment) or informal designations such as "students achieving below expected levels" resulted in the coding of "less able." Samples that failed to select for different ability levels were coded as "undifferentiated." Studies were then coded according to participants' grade level, either from preschool to Grade 2 or from Grade 3 to Grade 8. This division is consistent with models of reading development (Ehri, 1995, 1997; Ehri & McCormick, 1998) cited earlier.

*Coding of instruction and study characteristics*. To investigate our question about instructional design, each study was coded as using either *integrated* or *isolated* morphological instruction. Studies that combined morphological instruction with instruction about literacy strategies and knowledge were coded *integrated.* Interventions that solely focused on morphological content were coded *isolated*. For descriptive purposes, we also coded various aspects of the instruction.

Studies were also coded on two study characteristics to aid analysis of the reported effects: (a) *experimental versus quasiexperimental*—that is, random or

not random assignment of participants to conditions—and (b) *comparison group type*—whether treatment groups were compared to untrained control groups (termed E vs. C comparisons) or to comparison groups which received alternative treatment (E vs. AT). None of the alternative treatments included any explicit morphological instruction.

### *Effect Size as an Index of Treatment Efficiency Across Studies*

The effect size statistic used in this study is Cohen's *d*, which is calculated as the difference between the mean posttest score of the treatment group and that of the comparison group, divided by the pooled standard deviation. An effect size of 1.0 represents a difference of 1 standard deviation between the treatment and comparison groups. Cohen (1988) provided general benchmarks for effect sizes of 0.2 as small, 0.5 as medium, and 0.8 as large but emphasized that this guideline is subject to judgment. Thompson (2006) explained that depending on the potential consequences of a given outcome, small effect sizes could be of large practical importance, just as large effect sizes could be of little practical significance.

One concern with meta-analyses is that there may exist unpublished studies with null findings that, if they were included in the calculation of the overall effect size, would reduce it below the level at which it would be meaningful or useful (the so-called "file drawer" problem). Therefore, we indicate in the analyses the number of null effects (i.e., $d = 0.0$) that would be required to reduce the effects found below $d = 0.2$ (Hunter & Schmidt, 2004). We chose the 0.2 criterion on the basis of Cohen's (1988) benchmarks.

## Results

### *Sample Characteristics*

Table 1 presents basic information about each study analyzed. This table is organized by the sample populations studied rather than by publication. Some publications reported on more than one study (Hurry et al., 2005; Tyler et al., 2003; Vadasy et al., 2006), and some samples or interventions were used for more than one study (Bowers & Kirby, 2006, in press; Lyster, 1998, 2002). Table 1 also provides the identification numbers assigned to each study as a shorthand when discussing groups of studies. A total of 2,652 students participated across the included studies, with a range of 16 to 686 participants per study. The 22 studies involved 18 distinct samples; 8 included only less able children, 8 included only undifferentiated students, and 2 studies (Studies 17 and 18) assessed broad samples of students and then also divided these samples into more and less able students. Of the 18 samples, 5 participated in experiments in which individuals were randomly assigned to conditions; the remainder participated in quasiexperimental designs in which, for instance, intact classes were assigned to conditions. Most of the interventions were carried out in English (18 studies), 2 were in Norwegian, 1 was in Danish, and 1 was in Dutch.

### *Characteristics of Instruction*

Table 2 provides descriptive information about the nature of the morphological instruction the studies in our sample used. The studies needed to show a substantial focus on a given aspect of instruction to be identified for that characteristic. Thus, the absence of a check should not be interpreted to indicate that a given item was

**TABLE 1**
*Basic study features*

| Study | Reference | Instructional characteristics: Language | Duration | Instructional group size; instructor | Isolated or integrated instruction | Grades | *N* | Ability level |
|---|---|---|---|---|---|---|---|---|
| 1 | Abbott and Berninger (1999) | English | Total time: 400 min; 16 25-min sessions; 1 session per week | Individual tutoring; researcher instructor | Integrated | 4, 5, 6, 7 | 20 | LA |
| 2 | Arnbak and Elbro (2000) | Danish | Total time: 540 min; 36 15-min sessions | Small group (3–4); regular remedial teacher | Isolated | 4, 5 | 60 | LA |
| 3 | Baumann, Edwards, Boland, Olejnik, and Kame'enui (2003) | English | Total time: 450 min; 30 45-min sessions | Large group (classroom); regular classroom teacher | Integrated | 5 | 157 | UD |
| 4 | Baumann et al. (2002) | English | Total time: 600 min; 12 50-min sessions; | Large group (classroom); researcher instructor | Integrated | 5 | 88 | UD |
| 5 | Berninger et al. (2003) | English | Total time: 1,680 min (700 min of morphology or orthographic instruction); 2-hr sessions on; 14 consecutive weekdays | Groups of 10 (with main teacher and 2 assistants); teachers trained by researchers | Integrated | 4, 5, 6 | 20 | LA |
| 6 | Berninger et al. (2008) | English | Total time: 1,680 min (840 min of morphology or orthographic instruction); 14 2-hr sessions over 3 weeks | Groups of 10 (with main teacher and 2 assistants); teachers trained by researchers | Integrated | 4, 5, 6, 7, 9 | 39 | LA |
| 7 | Bowers and Kirby (2006) | English | Total time: 1,000 min; 20 50-min lessons (3–4 sessions a week) | Large group (classroom); researcher instructor | Isolated | 4, 5 | 82 | UD |
| 8 | Bowers and Kirby (in press) | English | Total time: 1,000 min; 20 50-min lessons (3–4 sessions a week) | Large group (classroom); researcher instructor | Isolated | 4, 5 | 82 | UD |

*(continued)*

**TABLE 1 (continued)**

| Study | Reference | Instructional characteristics: Language | Duration | Instructional group size; instructor | Isolated or integrated instruction | Grades | *N* | Ability level |
|---|---|---|---|---|---|---|---|---|
| 9 | Henry (1989) | English | Total time: Group 1: 1,000 min; Group 2: 2,000 min; 20 40-min sessions | Large group (classroom); classroom teacher | Integrated | 3, 4, 5 | 443 | UD |
| 10 | Hurry et al. (2005) Study 1 | English | Total time: NR; 7 sessions, 1 per week | Large group (classroom); classroom teacher | Isolated | 3, 4, 5, 6 | 686 | UD |
| 11 | Hurry et al. (2005) Study 2 | English | Total time: NR; 13 sessions 1 per week | Large group (classroom); classroom teacher | Isolated | 4 | 68 | UD |
| 12 | Kirk and Gillon (2009) | English | Total time: 870 min (approx.); 1 individual and 1 group session per week; range of 16 to 20 sessions | Half individual and half small group sessions; researcher instructor | Integrated | ages 8–11 years | 16 | LA |
| 13 | Lyster (1998) | Norwegian | Total time: 510 min; 30 min sessions 1 per week; 17 sessions | NR | Isolated | preschool | 225 | UD |
| 14 | Lyster (2002) | Norwegian | Total time: 510 min; 30 min sessions 1 per week; 17 sessions | NR | Isolated | preschool | 225 | UD |
| 15 | Nunes, Bryant, and Olsson (2003) | English | Total time: 360 min; 12 30-min sessions over 12 weeks | Small group (4–8); researcher instructor | Isolated | 3, 4 | 457 | UD |
| 16 | Parel (2006) | English | Total time: NR; 8 classes over consecutive school days | Large group (classroom); instructor: NR | Isolated | 3 | 77 | UD |
| 17 | Robinson and Hesse (1981) | English | 140 lessons over a full school year | Large group (classroom); instructor: NR | Isolated | 7 | 172 | LA and UD |

*(continued)*

**TABLE 1 (continued)**

| Study | Reference | Instructional characteristics: Language | Duration | Instructional group size; instructor | Isolated or integrated instruction | Grades | *N* | Ability level |
|---|---|---|---|---|---|---|---|---|
| 18 | Tomesen and Aarnoutse (1998) | Dutch | Total time: 540 min; 2 45-min sessions per week; over 6 weeks | Group: NR; researcher instructor | Integrated | 4 | 31 | LA and UD |
| 19 | Tyler, Lewis, Haskill, and Tolbert (2003) Study 1 | English | Total time: 900 min; 2 sessions per week (1 30 min and 1 45 min); over 12 weeks | Small group (2 or 3); researcher instructor | Alternative treatments: isolated and integrated | preschool | 27 | LA |
| 20 | Tyler et al. (2003) Study 2 | English | Total time: 1,800 min; 2 sessions per week (1 30 min and 1 45 min); over 24 weeks | Small group (2 or 3); researcher instructor | Integrated | preschool | 27 | LA |
| 21 | Vadasy, Sanders, and Peyton (2006) | English | Total time: 2,400 min; 4 30-min sessions per week; over 20 weeks | Small group; community tutors (researcher trained) | Integrated | 2 | 31 | LA |
| 22 | Vadasy et al. (2006) | English | Total time: 2,160 min; schedule: NR | Small group; community tutors (researcher trained) | Integrated | 2, 3 | 21 | LA |

*Note.* LA = less able students; UD = undifferentiated students; NR = not reported. Studies 7 and 8 are based on the same intervention and sample. Studies 13 and 14 are based on the same intervention and sample. Study 13 reported outcome measures at the end of Grade 1 of children taught before school entrance, whereas Study 14 measured a subgroup of those students in Grades 2 and 3. Study 11 was a substudy ($n = 68$) of participants in Study 10 ($n = 686$). Studies 19 and 20 investigated students at two different times of an intervention. Studies 21 and 22 were from the same published article but reported on separate intervention students.

omitted from the instruction completely, but rather that it was not a substantial focus of instruction for that study. For example, the instruction in all of the studies in our sample targeted affixes, but 8 of the 21 studies targeted bases or stems. The nature of affixes is that they attach to bases and stems, so studies that chose to focus on instruction about affixes (e.g., Baumann et al., 2002; Baumann et al., 2003) also addressed bases during instruction, but our table reflects the fact that the main target of instruction for those studies was affixes.

The information in Table 2 is provided for descriptive purposes. We did not attempt to quantitatively compare the effectiveness of the various instructional characteristics because they were not systematically varied and because characteristics may interact with each other in complex ways. We provide the descriptive information to clarify the nature of existing research and as a guide for those designing future studies. Some instructional categories require further clarification. We distinguished between studies in which instruction merely drew attention to bases or stems and those in which instruction targeted the meaning of bases or stems. Drawing attention to the meaning of a base or stem was often the focus of instruction that helped students identify the base or stem of words, but this was not always the case. For example, Robinson and Hesse (1981) used tasks that had students identify the base or stem in complex words, but their focus was spelling rather than meaning.

The "morphological tasks" heading in Table 2 identifies specific types of tasks in which participants engaged. All studies used morphological analysis tasks in which participants identified morphemes in morphologically complex words. Some studies also used morphological synthesis tasks in which students were given morphemes and asked to combine them to form words.

We use the term *morphological recognition* to describe tasks that had students find common morphemes that linked sets of two or more words. For example, Berninger et al. (2003) presented word pairs to students (e.g., *respectfully/respect* and *pillow/pill*) and asked them to identify which word "came from the other word." This task also provides an example of morphological analysis with morphological foils, as it requires a child to recognize when a letter or sound sequence that is common to two or more words does not mark a common morpheme (e.g., as is the case for *pill* and *pillow*).

Morphological production tasks asked students to generate derivations or inflections without providing the needed morpheme. For example, Nunes et al. (2003) used an analogy task (e.g., *sing* : *singer* :: *magic* : ?) that required students to produce a specific derivation of a word but did not provide the needed suffix.

The morphological problem-solving category attempts to indicate tasks that required students to engage in deeper level processing (Edwards, Font, Baumann, & Boland, 2004; Templeton, 2004). These tasks require students to apply knowledge in novel contexts, often with more than one possible route to a solution and involving the use of deductive or inductive reasoning. For example, Bowers and Kirby (2006, in press) presented students with sets of morphologically related words with characteristics which help them deduce morphological suffixing pattern rules for dropping the silent *e*, doubling consonants, and changing *y* to *i*.

**TABLE 2**

*Characteristics of morphological instruction*

| | Morphological content | | | | | | | | | | | | | Morphological tasks | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Study | Main outcome focus of instruction | Integrated morphology with other literacy instruction | Targeted affixes (prefixes and/or suffixes) | Targeted bases or stems | Targeted base or stem for word meaning | Targeted bound bases (e.g., rupt for break) | Targeted compound words | Targeted word origin | Oral morphology only | Oral and written morphology | Targeted consistent spelling of morphemes despite phonological shifts | Targeted patterns of orthographic shifts in suffixing patterns | Explicit link of morphology and grammar | Morphological analysis | Morphological synthesis | Morphological recognition: sorting/ selecting | Morphological production: cloze/analogy | Morphological analysis with morphological foils (e.g., Is there a re- prefix in renter?) | Morphological problem solving |
| 1 Abbott and Berninger (1999) | R/S | √ | √ | √ | √ | √ | | √ | | √ | | | | √ | | | | | |
| 2 Arnbak and Elbro (2000) | R | | √ | √ | √ | | √ | | √ | | | | | √ | √ | √ | | √ | |
| 3 Baumann, Edwards, Boland, Olejnik, and Kame'enui (2003) | V | √ | √ | | | | | | | √ | | | | √ | | √ | | | |
| 4 Baumann et al. (2002) | V | √ | √ | | | | | | | √ | | | | √ | | | | | |
| 5 Berninger et al. (2003) | R/S | √ | √ | √ | √ | | | | | √ | | | | √ | √ | √ | | √ | √ |
| 6 Berninger et al. (2008) | R/S | √ | √ | √ | √ | | | | | √ | | √ | | √ | √ | | √ | | |
| 7 and 8 Bowers and Kirby (2006, in press) | M | | √ | √ | √ | √ | √ | | | √ | √ | √ | | √ | √ | √ | | √ | √ |
| 9 Henry (1989) | R/S | √ | √ | √ | √ | √ | √ | √ | | √ | | √ | | √ | √ | √ | | | √ |
| 10 and 11 Hurry et al. (2005) Study 1 and 2 | S | | √ | √ | √ | | | | | √ | | √ | √ | √ | √ | | √ | | √ |
| 12 Kirk and Gillon (2009) | R/S | √ | √ | √ | √ | | | | | √ | √ | √ | √ | √ | √ | √ | | | |
| 13 and 14 Lyster (1998, 2002) | R/S | | √ | | | | √ | | | √ | | | √ | √ | √[a] | | | √ | |
| 15 Nunes, Bryant, and Olsson (2003) | R/S | | √ | √ | | | | | √[b] | √[b] | √ | | √ | √ | √ | √ | √ | | √ |
| 16 Parel (2006) | V | | √ | | | | | | | √ | | √ | | √ | | √ | | | |

*(continued)*

## TABLE 2 (continued)

| Study | Morphological content | | | | | | | | | | | | | Morphological tasks | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Main outcome focus of instruction | Integrated morphology with other literacy instruction | Targeted affixes (prefixes and/or suffixes) | Targeted bases or stems | Targeted base or stem for word meaning | Targeted bound bases (e.g., rupt for break) | Targeted compound words | Targeted word origin | Oral morphology only | Oral and written morphology | Targeted consistent spelling of morphemes despite phonological shifts | Targeted patterns of orthographic shifts in suffixing patterns | Explicit link of morphology and grammar | Morphological analysis | Morphological synthesis | Morphological recognition: sorting/ selecting | Morphological production: cloze/analogy | Morphological analysis with morphological foils (e.g., Is there a re- prefix in renter?) | Morphological problem solving |
| 17 Robinson and Hesse (1981) | S | | √ | √ | | | | | | √ | | √ | | √ | √ | | | | |
| 18 Tomesen and Aarnoutse (1998) | V | √ | √ | √ | √ | | | | | √ | | | | √ | | | | | √ |
| 19 Tyler, Lewis, Haskill, and Tolbert (2003) Study 1 | OL | √ | √ | | | | | | √ | | | | | √ | | | √ | | |
| 20 Tyler et al. (2003) Study 2 | OL | √ | √ | | | | | | √ | | | | | √ | | | √ | | |
| 21 Vadasy, Sanders, and Peyton (2006) Study 1 | R/S | √ | √ | | | | | | | √ | √ | √ | | √ | √ | | | | |
| 22 Vadasy et al. (2006) Study 2 | R/S | √ | √ | | | | | | | √ | √ | √ | | √ | √ | | | | |

*Note*. R = reading; S = spelling; V = vocabulary; M = morphology; OL = oral language.

a. Morphological synthesis conducted only in the context of compounds.

b. Study included a condition with only oral morphological instruction and another with written morphological instruction.

### *Calculation, Reporting, and Interpretation of Effect Sizes*

Outcomes were categorized by linguistic layer and by type of comparison group, producing eight distinct average effect sizes. The four linguistic layers are (a) morphological sublexical, (b) nonmorphological sublexical, (c) lexical, and (d) supralexical. The first comparison type was experimental morphology treatment (E) versus untrained comparison group (C) that received typical classroom instruction. The other comparison type was E versus a comparison group for which the researchers provided special alternative training (AT).

It is difficult to generalize about the ATs because they were different from each other and need to be considered with respect to the linguistic level of the outcomes. Across the 22 studies, there were 22 nonmorphological, sublexical outcomes for E versus AT comparisons. In 16 of those 22 instances, the AT emphasized phonologically oriented instruction, for example, in phonological awareness. Of the 75 lexical outcomes for E versus AT comparisons, 31 involved ATs with a phonological focus and 32 involved vocabulary instruction. There were 9 outcomes in the supralexical linguistic layer that used ATs. Of these, 5 emphasized phonological instruction, 3 vocabulary instruction, and 1 study skills. In general, the ATs represented established intervention methods with a record of positive outcomes rather than placebo-like attempts to control for instructional time and teacher attention that were not expected to produce positive results. Performing equivalently to these ATs would indicate that morphological instruction is as successful as other more established methods. Furthermore, it is important to acknowledge that almost all of the "control" groups received some form of regular classroom instruction during the times when the E children received morphological instruction; thus, each C group is also an AT group to some extent, representing a standard practice comparison group. We would argue that the E versus C comparisons represent the cleanest test of the effect of adding morphological instruction to regular classroom instruction, whereas the E versus AT comparisons test the effects of morphological instruction against those of other established experimental methods that may not be typical of regular classrooms.

Average effect sizes for these categories are reported in Table 3, as are the standard deviations of the effect sizes, the number of effects included in the average, the range of effect sizes, and the number of null effects that would be required to reduce the average effect to 0.2. Posttest means and standard deviations reported in the studies were used to calculate effect sizes with an effect size calculator (Coe, 2000).[2] Random assignment was used with six of the samples investigated by 7 of the 22 studies (Studies 1, 5, 6, 12, 13, 14, and 20 in Table 1). Where possible, effect sizes were calculated with adjusted posttest means that statistically controlled for group difference at pretest.[3]

### *Effects of Morphological Instruction*

We begin addressing our first research question by reporting the overall average instructional effects by linguistic layer. Then we present the instructional effects within the literacy areas of reading, spelling, and vocabulary for the lexical layer.

*Overall effects by linguistic layer*. Table 3 presents the overall average effect sizes because of morphological instruction for each linguistic category. For E versus C comparisons, the strongest average instructional effects were for morphological

**TABLE 3**

*Overall average effect sizes by linguistic categories and comparison group*

| | Linguistic category of outcome variable | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Sublexical | | | | | | | |
| | Morphological | | Nonmorphological | | Lexical | | Supralexical | |
| Comparison groups | E vs. C | E vs. AT | E vs. C | E vs. AT | E vs. C | E vs. AT | E vs. C | E vs. AT |
| Cohen's *d* | 0.65 | 0.51 | 0.34 | 0.08 | 0.41 | 0.12 | 0.28 | –0.08 |
| *SD* | 0.72 | 0.55 | 0.37 | 0.34 | 0.48 | 0.47 | 0.26 | 0.30 |
| Number of effects | 37 | 11 | 26 | 22 | 93 | 75 | 12 | 9 |
| Range | –0.13, 3.56 | –0.34, 1.55 | –0.37, 1.22 | –0.53, 0.97 | –0.58, 1.88 | –0.78, 1.59 | –0.02, 0.97 | –0.54, 0.39 |
| Null effects | 83.3 | 17.1 | 18.0 | — | 97.5 | — | 4.8 | — |

*Note.* E = experimental group; C = control group; AT = alternative treatment group. Null effects indicates the number of effects with $d = 0.0$ required to reduce $d$ to 0.20 (not calculated if $d$ is already 0.20 or less).

sublexical outcomes, followed by lexical and then supralexical outcomes. The null effects calculation reinforces the strength of the sublexical morphological and lexical effects. In E versus AT comparisons, the sublexical morphological effect remained substantial, but the others were much weaker. These findings are corroborated by null effects statistics.

Morphological sublexical outcomes showed the highest average effect size, 0.65 (*SD* = 0.72). This average, drawn from 37 outcomes, is halfway between Cohen's (1988) benchmarks for medium and large effects. The high *SD* reveals a wide variety of scores. For E versus AT, *d* is 0.51, still a medium effect size. A smaller effect (*d* = 0.34, *SD* = 0.37) was found for nonmorphological sublexical measures in E versus C comparisons (26 outcomes). The lexical category (E vs. C) approached the medium benchmark with an average instructional effect of 0.41 (*SD* = 0.48) based on 93 outcome measures. The average instructional effect for the far transfer category of supralexical effects, based on 12 outcome measures, was small (0.28, *SD* = 0.26). The E versus AT *d*s for the last three linguistic levels were close to 0, indicating that morphological treatments were roughly equal in their effectiveness to the alternative treatments.

*Reading, spelling, and vocabulary outcomes at the lexical layer*. The overall effects at the lexical linguistic layer reported in Table 3 and addressed in the previous section reflect the combined average of effects across word reading, spelling, and vocabulary tasks. Table 4 pulls these effects apart to reveal effects on these different literacy outcomes.

Word reading tasks such as word identification, speed of real word reading, and orthographic tasks including real words (e.g., choosing the correct spelling of two phonologically plausible spellings such as *taik* and *take*) were considered lexical reading tasks. Results under the "reading" heading in Table 4 show that lexical reading measures for E versus C comparisons had a modest instructional effect (*d* = 0.41, *SD* = 0.45) and that the E versus AT effect was close to 0. The average instructional effect for lexical spelling outcomes (*d* = 0.49, *SD* = 0.48) is approximately the same, and again the E versus AT effect is close to 0. The instructional effects for vocabulary measures (*d* = 0.35, *SD* = 0.51) were slightly lower than those for the lexical reading and spelling outcomes, but the E versus AT effect was larger at *d* = 0.20. A substantial number of null effects would be needed to reduce the moderate effects for E versus C comparisons; the E versus AT comparisons were already at the *d* = 0.20 level or lower.

### *The Effects of Morphological Instruction for Undifferentiated and Less Able Children*

Table 5 presents the results for undifferentiated and less able students according to the four linguistic levels (see Table 1 for the ability level coding for each study and study reference numbers). Effect sizes for less able students were drawn from 11 studies (1, 2, 5, 6, 12, 17, 18, 19, 20, 21, and 22). Effect sizes for "undifferentiated" samples were drawn from 13 studies (3, 4, 7, 8, 9, 10, 11, 13, 14, 15, 16, 17 and 18).

Results in Table 5 show that average effect sizes for every linguistic level and for both E versus C and E versus AT comparisons were higher for the less able

**TABLE 4**

*Average instructional effect sizes by comparison group for literacy outcomes*

| | Literacy outcome (lexical variables) | | | | | |
|---|---|---|---|---|---|---|
| | Reading | | Spelling | | Vocabulary | |
| Comparison groups | E vs. C | E vs. AT | E vs. C | E vs. AT | E vs. C | E vs. AT |
| Cohen's *d* | 0.41 | 0.05 | 0.49 | 0.05 | 0.35 | 0.20 |
| *SD* | 0.45 | 0.32 | 0.48 | 0.37 | 0.51 | 0.60 |
| Number of effects | 39 | 34 | 21 | 9 | 34 | 32 |
| Range | –0.58, 1.88 | –0.52, 0.76 | –0.31, 1.88 | –0.48, 0.78 | –0.20, 1.76 | –0.78, 1.59 |
| Null effects | 40.9 | — | 30.4 | — | 25.5 | — |

*Note*. See note to Table 3 for notes regarding abbreviations.

readers than those found for undifferentiated students. For the comparison of E versus C, effects favored the less able for morphological sublexical (0.99 vs. 0.65), nonmorphological sublexical (0.63 vs. 0.27), lexical (0.58 vs. 0.40), and supralexical (0.67 vs. 0.27). E versus AT effect sizes were in general smaller but still favored the less able participants. This consistent advantage for the less able students needs to be interpreted carefully. One important confound is that, except for the study by Robinson and Hesse (1981), all of the data for less able students were gathered from interventions that used small group or individual instruction. Of the 13 studies from which undifferentiated student data were drawn, 8 studies used whole class instruction. Thus, the increased average effects for the less able groups may be attributable, in whole or in part, to small group instruction.

*The Effects of Morphological Instruction for Younger and Older Students*

Six studies (13, 14, 19, 20, 21, 22) from our sample of 22 interventions involved students from preschool to Grade 2. These six studies represent four sample populations. The 15 remaining studies involved students in Grades 3 to 8. Although our sample has fewer studies coded as "younger" than "older," we judged this distribution to be sufficient to shed light on our third research question, particularly given its theoretical importance.

Table 6 presents results by linguistic category for preschool to Grade 2 students compared to Grade 3 to Grade 8 students. In the sublexical morphological category for E versus C comparisons, there were only 2 outcome measures for younger students compared to 35 for older students. Thus, the advantage for younger students ($d = 1.24$, $SD = 0.41$ vs. $d = 0.62$, $SD = 0.72$) should be interpreted cautiously, though more than 10 null effects would be required to reduce this effect to 0.2. In the E versus AT comparison, the effect was similar for the younger children but lower for the older ones. For nonmorphological sublexical measures, younger students showed a medium effect of 0.49 compared to a small average effect of 0.24 for older students in the E versus C comparisons. The results were weakly reversed for the E versus AT comparisons. The lexical level also showed an advantage for younger students ($d = 0.57$, $SD = 0.48$) compared to older students ($d = 0.37$, $SD = 0.48$) in the E versus C comparisons but not in the E versus AT comparisons. At

**TABLE 5**

*Average instructional effect sizes by linguistic category and comparison group for less able and undifferentiated students*

| | Linguistic category of outcome variable | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Sublexical | | | | | | | |
| | Morphological | | Nonmorphological | | Lexical | | Supralexical | |
| Comparison groups | E vs. C | E vs. AT | E vs. C | E vs. AT | E vs. C | E vs. AT | E vs. C | E vs. AT |
| A. Less able students | | | | | | | | |
| Cohen's *d* | 0.99 | 1.25 | 0.63 | 0.25 | 0.57 | 0.24 | 0.67 | 0.39 |
| *SD* | 0.87 | 0.27 | 0.54 | 0.51 | 0.54 | 0.48 | 0.56 | 0 |
| Number of effects | 9 | 3 | 5 | 7 | 24 | 15 | 6 | 1 |
| Range | 0.1, 2.38 | 1.06, 1.55 | –0.04, 1.22 | –0.53, 0.97 | –0.58, 1.61 | –0.52, 0.78 | 0.17, 1.71 | 0.39, 0.39 |
| Null effects | 35.5 | 15.7 | 10.7 | 1.8 | 44.4 | 3.0 | 14.1 | 1.0 |
| B. Undifferentiated students | | | | | | | | |
| Cohen's *d* | 0.65 | 0.24 | 0.27 | 0.00 | 0.40 | 0.08 | 0.27 | –0.15 |
| *SD* | 0.77 | 0.31 | 0.29 | 0.20 | 0.50 | 0.46 | 0.29 | 0.23 |
| Number of effects | 30 | 8 | 21 | 15 | 72 | 60 | 9 | 8 |
| Range | –0.13, 3.56 | –0.34, 0.75 | –0.37, 0.71 | –0.40, 0.30 | –0.31, 1.88 | –0.78, 1.59 | –0.02, 0.97 | –0.54, 0.20 |
| Null effects | 67.5 | 1.6 | 7.4 | — | 72.0 | — | 3.2 | — |

*Note*. See note to Table 3 for notes regarding abbreviations.

the supralexical level, there were fewer outcome measures for younger and older students. The two age groups had a similar small advantage in the E versus C comparisons (older: $d = 0.29$, $SD = 0.40$; younger: $d = 0.27$, $SD = 0.14$), but very few null effects would be required to reduce this effect, and this advantage disappeared in the E versus AT comparisons. Results in Table 6 indicate that in general the preschool to Grade 2 students gain as much or more than the older students across lexical categories in the E versus C comparisons. For the E versus AT comparisons, the younger students have an advantage only in the sublexical morphological outcomes.

### *The Effects of Integrated Versus Isolated Morphological Instruction*

The fourth research question concerned the dimension of *integrated* versus *isolated* morphological instruction. Integrated morphological interventions were those in which morphological instruction was integrated with other instruction, whereas isolated morphological interventions targeted only morphological content. Table 2 indicates how each study was coded on this dimension.

The results are presented in Table 7. With the exception of the E versus C comparison for sublexical morphological outcomes, in which isolated instruction was more successful (0.67 vs. 0.55), all of the comparisons favored integrated instruction. The E versus AT comparisons for morphological sublexical linguistic outcomes showed a strong effect for integrated instruction ($d = 1.25$) compared to a small effect ($d = 0.24$) for isolated instruction, though these effects were based, respectively, on only three and eight outcomes.

## Discussion

This systematic review investigated the effects of morphological instruction on literacy outcomes categorized into sublexical (morphological and nonmorphological), lexical, and supralexical categories. We calculated the average effect sizes in these categories for (a) overall samples, (b) less able versus undifferentiated samples, (c) younger (preschool–Grade 2) versus older students (Grades 3–8), and (d) samples that received morphological instruction in isolation compared to morphological instruction integrated with other literacy instructional strategies. We considered two types of effects, those found comparing morphological instruction with a control group that received nothing other than regular classroom instruction and those found comparing morphological instruction with some alternative treatment.

Before addressing the research questions, we can make two general observations about the corpus of studies that we located. First, although research on morphology and literacy is increasing, we were able to locate only a relatively small number of instructional studies ($n = 22$). Although this number is larger than that identified by Reed (2008), there is clearly need for more studies particularly across age and ability levels. Second, with respect to research design, there were a number of examples of random assignment of individuals to instructional conditions (Abbott & Berninger, 1999; Berninger et al., 2003; Berninger et al., 2008; Kirk & Gillon, 2009; Lyster, 1998, 2002; Tyler et al., 2003), though many of the other investigators did manage to randomly assign classes. Given that most studies saw morphological instruction as a part of regular classroom instruction and that the instruction usually took place over several weeks or more, the proportion of stud-

**TABLE 6**
*Average instructional effect sizes by linguistic category and comparison group for preschool to Grade 2 versus Grade 3 to 8 students*

| | Linguistic category of outcome variable | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Sublexical | | | | | | | |
| | Morphological | | Nonmorphological | | Lexical | | Supralexical | |
| Comparison groups | E vs. C | E vs. AT | E vs. C | E vs. AT | E vs. C | E vs. AT | E vs. C | E vs. AT |
| A. Preschool–Grade 2 | | | | | | | | |
| Cohen's *d* | 1.24 | 1.25 | 0.49 | –0.16 | 0.57 | –0.07 | 0.27 | –0.22 |
| *SD* | 0.41 | 0.27 | 0.44 | 0.16 | 0.48 | 0.17 | 0.14 | 0.22 |
| Number of effects | 2 | 3 | 10 | 7 | 19 | 11 | 7 | 5 |
| Range | 0.95, 1.53 | 1.06, 1.55 | –0.37, 1.22 | –0.4, 0.03 | –0.31, 1.88 | –0.33, 0.23 | 0.09, 0.51 | –0.54, -0.02 |
| Null effects | 10.4 | 15.7 | 14.5 | — | 35.2 | — | 2.45 | — |
| B. Grade 3–Grade 8 | | | | | | | | |
| Cohen's *d* | 0.62 | 0.24 | 0.24 | 0.20 | 0.37 | 0.15 | 0.29 | 0.08 |
| *SD* | 0.72 | 0.31 | 0.28 | 0.35 | 0.48 | 0.49 | 0.40 | 0.29 |
| Number of effects | 35 | 8 | 16 | 15 | 74 | 64 | 5 | 4 |
| Range | –0.13, 3.56 | –0.34, 0.75 | –0.11, 0.71 | –0.53, 0.97 | –0.58, 1.88 | –0.78, 1.59 | –0.02, 0.97 | –0.28, 0.39 |
| Null effects | 73.5 | 1.6 | 3.2 | — | 62.9 | — | 2.25 | — |

*Note*. See note to Table 3 for notes regarding abbreviations.

**TABLE 7**

*Average instructional effect sizes by linguistic category and comparison groups for integrated morphological instruction versus isolated morphological instruction*

| | Linguistic category of outcome variable | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Sublexical | | | | | | | |
| | Morphological | | Nonmorphological | | Lexical | | Supralexical | |
| Comparison groups | E vs. C | E vs. AT | E vs. C | E vs. AT | E vs. C | E vs. AT | E vs. C | E vs. AT |
| A. Integrated instruction | | | | | | | | |
| Cohen's *d* | 0.55 | 1.25 | 0.49 | 0.27 | 0.46 | 0.22 | 0.37 | 0.39 |
| *SD* | 0.58 | .27 | 0.38 | 0.53 | 0.45 | 0.52 | 0.21 | — |
| Number of effects | 5 | 3 | 12 | 7 | 31 | 28 | 2 | 1 |
| Range | 0.11, 1.53 | 1.06, 1.55 | –0.01, 1.22 | –0.53, 0.97 | –0.58, 1.05 | –0.52, 1.15 | 0.22, 0.51 | 0.39, 0.39 |
| Null effects | 8.75 | 15.7 | 17.4 | 2.45 | 40.3 | 2.8 | 1.7 | .95 |
| B. Isolated instruction | | | | | | | | |
| Cohen's *d* | 0.67 | 0.24 | 0.20 | 0.00 | 0.38 | 0.05 | 0.26 | –0.15 |
| *SD* | 0.74 | 0.31 | 0.31 | 0.20 | 0.50 | 0.44 | 0.28 | 0.23 |
| Number of effects | 32 | 8 | 14 | 15 | 62 | 46 | 10 | 8 |
| Range | –0.13, 3.56 | –0.34, 0.75 | –0.37, 0.85 | –0.4, 0.30 | –0.31, 1.88 | –0.78, 1.59 | –0.02, 0.97 | –0.54, 0.2 |
| Null effects | 75.2 | 1.6 | — | — | 55.8 | — | 3.0 | — |

*Note*. See note to Table 3 for notes regarding abbreviations.

ies with random assignment of individuals seems reasonable. In future studies, more random assignment may be possible in small group instruction studies.

### *The Effects of Morphological Instruction*

To summarize our findings, when we consider the results across all available studies (Table 3), it is clear that morphological instruction has its greatest effects at the sublexical morphological level. This indicates that morphological instruction was successful in improving morphological abilities, whether compared to control or alternative treatments. The null effects necessary to reduce the *d* to 0.2 for morphological outcomes support this finding. At the other linguistic levels in the overall analysis, the effects ranged from small to moderate in the experimental versus control comparisons and were negligible in the experimental versus alternative treatment comparisons. There was a consistent moderate effect of morphological instruction in the experimental versus control comparisons. When effects were separated by ability and age of student and type of instruction (integrated vs. isolated), more detail was revealed. Experimental versus control effects were stronger for the younger students, but this was not true for the experimental versus alternative treatment comparisons. There were stronger effects for the less able participants in both types of comparison and also for those studies that integrated morphological instruction with other literacy instruction. The picture that emerges is that morphological instruction is particularly effective when integrated with other literacy instruction and aimed at less able and perhaps younger readers.

We need to consider why the effects were often (but not always) greater in the experimental versus control rather than the experimental versus alternative treatment comparisons. There are basically two reasons for including alternative treatments in a research design, either (a) to control for extraneous effects (e.g., Hawthorn effects or instructor attention) that are not part of the phenomenon being investigated or (b) to investigate the effects of an alternative treatment that is meaningfully designed to affect aspects of the outcomes. Most of the comparisons that we categorized as experimental versus control did not involve true control groups in the classic sense. Instead of receiving nothing that the experimental group did not receive, these groups typically received more regular classroom instruction. As such, these groups may be considered as "alternative treatments" too. Most of the alternative treatments employed in these studies appear to have been designed to achieve the second objective; the majority addressed phonological processing or vocabulary. Phonologically oriented instruction is well developed, widely regarded as a solid basis for learning to read words, and especially recommended for students with reading difficulties (National Reading Panel, 2000; Rayner, Foorman, Perfetti, Pesetsky, & Seidenberg, 2001). Similar points could be made about vocabulary instruction (Beck, McKeown, & Kucan, 2002; Biemiller & Boote, 2006; Graves, 2004). Accordingly, it is not surprising that the alternative treatments in our sample provided effective instruction. That morphological instruction generally was as successful as these alternative treatments provides evidence that morphological instruction, a relatively new focus of instructional research, brings benefits comparable to those of instruction designed on the basis of extensive research. Our conclusion is that morphological instruction was effective at the morphological sublexical and lexical levels but that

beyond the sublexical morphological level it was often no more effective than other well-established instructional methods.

There was considerable variability associated with many of the effects, and in some cases relatively few null studies would be required to reduce the effects below the benchmark of 0.2. There were also instances of negative effects in some studies and weak negative average effects, the latter being largely in alternative treatment comparisons at the supralexical linguistic layer (see Tables 3 to 6). This high variability suggests that some studies employed methods of instruction that were better than others. It will be an important task for future research to determine which types of morphological instruction are most beneficial and how these can best be combined with other forms of instruction (e.g., in phonology and vocabulary).

### *Understanding the Effects of Morphological Instruction*

At the outset we hypothesized as to why, in theory, morphological instruction might bring additional benefits to literacy instruction. We argued that instruction about meaning bearing sublexical elements might produce word knowledge that could transfer up to lexical and supralexical skills. We found that instruction about sublexical morphological elements brought measurable literacy effects compared to controls, and those effect sizes reflected the level of transfer from instruction. Morphological instruction performed comparably to the alternative treatments at the higher linguistic levels. Morphological instruction was more effective for less able learners, and when it was integrated with other aspects of literacy instruction; there was some evidence that it was more effective for younger learners.

One way of understanding these results is to conceptualize sublexical morphological knowledge as a mechanism for strengthening learners' lexical representations (Carlisle & Katz, 2006; Carlisle & Stone, 2005). The lexical quality hypothesis (Perfetti, 2007; Perfetti & Hart, 2001, 2002) is one potentially fruitful framework through which to understand the effects of morphological instruction, as is the association of untaught morphological knowledge and literacy skills (e.g., Carlisle, 2003; Deacon & Kirby, 2004). In describing the lexical quality hypothesis, Perfetti (2007) presented five features of lexical representation that determine lexical quality. The first four, orthography, phonology, grammar, and meaning, are constituents of word identity, and the fifth, constituent binding, "is not independent but rather a consequence of the orthographic, phonological and semantic constituents becoming well specified in association with another constituent" (pp. 360–361). Knowledge of how oral and written morphology work in a given language could be understood as a binding agent that pulls together these individual features of lexical representation to enhance lexical quality. The word *binding* is an appropriate way to describe how written morphological structure links families of words with consistent orthographic patterns. The letter patterns for morphemes are associated with phonological representations, and they can also provide grammatical cues. In fact, each of the features of lexical quality identified by Perfetti has direct associations with oral and written morphological elements. If sublexical morphological knowledge acts as a constituent binding feature of lexical quality, increasing that sublexical morphological knowledge through instruction should facilitate the efficient retrieval of word identities, which in turn should result in improved scores on lexical measures, as we found in this review.

Perfetti (2007) also argued that lexical quality is important for reading comprehension (supralexical performance). He suggested that the source of the ability to efficiently retrieve the words needed during reading is the integrated orthographic, phonological, grammatical, and semantic word knowledge that the reader has for a given word—the quality of that word's lexical representation. If morphological instruction increases lexical quality, those stronger mental representations could improve reading comprehension by (a) increasing efficiency of word identification, thereby reducing the cognitive load needed for processing and integrating connected text, and (b) providing the reader with easier access to semantic information associated with that word. The reading comprehension gains from morphological instruction should be less robust than the lexical gains, at least in the short term, but if morphological instruction does improve lexical quality, it should become apparent in reading comprehension measures, and that is what we found.

The instruction investigated in this review addresses aspects of word knowledge that directly bear on efficient processing of words and meanings during reading. Perfetti (2007) stated, "Underlying efficient processes are knowledge components; knowledge about word forms (grammatical class, spellings and pronunciations) and meanings. Add effective practice (reading experience) of these knowledge components, and the result is efficiency: the rapid, low-resource retrieval of a word identity" (p. 359). The interventions reviewed in this study used instruction that explicitly targeted knowledge about oral and written morphological features of words. Morphemes are characterized by consistent spelling patterns but are also associated with pronunciations and meanings, and they may also mark grammatical cues. Explicit morphological instruction offers teachers a way of directly targeting the development of lexical quality. Such cognitive processing itself may function to strengthen mental representations and decrease cognitive load (e.g., Schnotz & Kürschner, 2007; Sweller, 1988) in reading.

However, explicit morphological instruction is not required for morphological knowledge to develop and play a role in developing lexical quality. This is demonstrated in the correlational or predictive studies we reviewed briefly at the beginning of this article (for a more extensive review, see, e.g., Carlisle, 2003). In the absence of explicit instruction in morphology, children develop considerable competence in it, and this competence is related to success in literacy. There is also evidence that simple exposure to the consistent underlying structures that integrate morphological families improves the quality of our lexical representations. Nagy, Anderson, Schommer, Scott, and Stallman (1989) found that adults read words from larger morphological families more fluently than words from small families and cited this as evidence that words are processed through morphological relationships, not as separate entities (for similar results with children, see Carlisle & Katz, 2006). Citing the work of Taft and colleagues with adult readers (e.g., Taft, 2003; Taft & Kougious, 2004; Taft & Zhu, 1995), Carlisle and Stone (2005) described the role of uninstructed experiences with morphology on lexical representations by concluding that "frequent encounters with a base word (by itself or combined with affixes in words) reinforce the mental representation of the morphemes in those words, and access to memory for the morphemes speeds identification of words containing those morphemes" (p. 431).

Untaught morphological knowledge may also lie behind the relative weakness of the instructional effects beyond the sublexical level. Some children in the con-

trol or alternative treatment groups may have developed enough morphological knowledge to support their lexical and supralexical processing, so that they perform as well as children who received explicit morphological instruction at these levels. This may also be related to the stronger effects we found for less able readers (see the next section). Morphological instruction that was sustained and integrated with other literacy instruction over an extensive period of time may show greater transfer.

### *Reading Ability Effects*

In response to our second research question, we found that the effects of morphological instruction were stronger on average in groups of less able readers than in more broadly based samples. Reed (2008) came to the same conclusion from a smaller set of studies. We see four plausible explanations for this pattern. First, the more able readers may already have known at least implicitly some of the morphological content being taught and so would not differ as much from the comparison groups as the poor readers, who initially were likely to know little of the content being taught. Less able readers may need more explicit instruction. Second, the studies involving less able learners generally used small groups rather than class-sized groups in their instruction. Although smaller group sizes are representative of remedial instruction, it is possible that this approach would also have been more successful with the more able learners.

The third interpretation is that morphology is a cognitive domain that is a relative strength for less able readers. A common characteristic of struggling readers is weak phonological awareness (e.g., National Reading Panel, 2000). Casalis et al. (2004) suggested that dyslexics may use (untaught) morphological knowledge as a compensatory strategy and that introducing explicit morphological instruction could build on a relative strength for dyslexic learners; the same may be true for other less able readers. A phonological processing deficit may be less of a hindrance to developing higher quality lexical representations if explicit instruction in morphological structure builds up an integrated lexical representation of orthographic patterns and meaning cues to which phonological associations can be linked. Making the written morphological structures more salient could scaffold more effective use of phonological knowledge for less able readers. In effect, explicit instruction about sublexical morphological structures and how they link to orthographic, semantic, phonological, and grammatical cues may activate the constituent binding quality offered by morphology (see the earlier discussion of Perfetti's, 2007, lexical quality hypothesis). Phonological processing deficits may be less of an impediment when students are explicitly shown how phonological structures link to linguistic structures for which these students have no processing deficit.

Findings from one intervention in our review illustrate how morphology might act as a binding agent of multiple features for less able readers. Arnbak and Elbro's (2000) intervention with Danish dyslexic students was restricted to oral instruction, and yet their strongest results were for measures of spelling, and this was despite the fact that the control groups had more practice with written words in their typical remedial instruction. They hypothesized that awareness of morphemic units in words facilitated the segmenting of complex words into linguistic units they knew how to spell and that this process may have also eased the load on ver-

bal working memory. Morphological instruction may have facilitated the ability to maintain meaningful units of words (morphemes) in working memory while spelling, which may be another consequence of increased binding.

The fourth explanation of why morphological instruction was more effective for less able readers is through providing increased motivation to work with words. A number of authors of the studies in this sample commented on the enthusiasm children showed during morphological instruction; increased motivation and improved literacy skills may mutually support each other (e.g., Berninger et al., 2003; Bowers & Kirby, in press; Tomesen & Aarnoutse, 1998). Without measures for motivation, however, this explanation remains speculative. The ability and motivation to explore language independently, "word consciousness," is a frequently emphasized goal of vocabulary instruction (Graves, 2006; Scott & Nagy, 2004; Stahl & Nagy, 2006). Less able readers are likely to have had more frustrating experiences in school trying to understand how written words work. Introducing morphology as an organized system that links words even when pronunciation shifts appear irregular (e.g., *heal/health*, *sign/signal*) may motivate struggling students to study words more closely. Studying morphological families of words also has the advantage of exposing struggling older students to advanced, complex vocabulary with the support of connected words they do know. For example, studying the *sign* family can be used to introduce words such as *design*, *designate*, *insignia*, *significantly*, and *assignment*. Studying the structure and meaning connections in these words builds lexical representations in a way that does not require struggling readers to process long passages of text.

Further research will be required to select among these explanations for the greater effectiveness of morphological instruction with less able readers. It is also possible that more able readers would show increased benefit from morphological instruction if it were tailored to their strengths.

### *Grade-Level Effects*

The answer to our third research question was that morphological instruction was at least as effective for students in the early stages of formal literacy instruction as it was for students in later grades (see Table 6). These findings challenge the assertion by Adams (1990) that "teaching beginning or less skilled readers about them [roots and suffixes of morphologically complex words] may be a mistake" (p. 152). Evidence that morphological instruction brings benefits to younger students and that this instruction brings special benefits to less able students could have important practical implications. With a foundation of morphological knowledge gained with the support of instruction from the start, it is possible many students who fail in response to typical instruction could achieve much stronger success.

A striking example of the potential of early and sustained morphological instruction comes from Lyster's (1998, 2002) study with Norwegian children. She investigated the effects of morphological and phonological interventions compared to a control group with students prior to school entry. She found a very large effect of morphological instruction ($d = 1.88$) on a word reading measure 6 months after the intervention stopped. The phonological intervention group showed a gain of $d = 0.82$ on this same measure. Compared to controls, she also found a significant difference for the morphological group (effect sizes not provided) on an ortho-

graphic coding task in Grades 2 and 3. Although there were relatively few intervention studies with young children, the magnitude of the possible effects suggests that further studies be conducted.

### *Effects of Methods of Instruction*

The fourth research question asked whether instruction that integrated morphology with other aspects of literacy instruction would differ in its effects from isolated instruction. For the majority of outcome comparisons, including those with alternative treatments, integrated instruction was more effective than isolated instruction, and in the other cases the effects were similar (see Table 7). Integrated instruction should facilitate construction of lexical representations in which phonological, orthographic, grammatical, and semantic information is linked to morphological information. By generating richer lexical representations, instruction that integrates morphological and other linguistic features should facilitate lexical access and thus enhance the binding role of morphology, more so than would be accomplished by isolated instruction.

Vocabulary is one of the most obvious other areas of literacy instruction to integrate with morphological instruction. Despite the importance of vocabulary instruction cited by National Reading Panel (2000), there is a growing recognition that vocabulary instruction has received insufficient attention in classroom instruction and literacy research (Beck et al., 2002; Biemiller & Boote, 2006). Because morphemes, when encoded in print, are fundamentally orthographic representations of sublexical and lexical meaning units that occur in multiple words, written morphological instruction may provide a generative component within vocabulary instruction, supporting transfer to the learning of new words (Bowers & Kirby, in press).

The final point to be made about methods of instruction concerns the problem-solving approach adopted in four of the studies reviewed here (Baumann et al., 2003; Berninger et al., 2003; Bowers & Kirby, 2006, in press; Tomesen & Aarnoutse, 1998). Each of these studies used the theme of "detectives" to frame their instruction, designed to enhance student motivation. Although not one of our research questions, the inclusion of a problem-solving approach may be a critical feature in obtaining transfer beyond the morphological sublexical level. Although there were not enough appropriate studies to assess this possibility quantitatively, the problem-solving approach appears to be worth further investigation. This instructional strategy may have its effect in part by increasing students' focus on the working of words while fostering the deeper processing associated with more effective long-term learning. Employing problem-solving tasks about spelling–meaning connections (Templeton, 2004) should also develop the constituent binding feature in Perfetti's (2007) lexical quality hypothesis by targeting the juncture of semantics, orthography, and phonology during an engaging task.

## Limitations, Future Directions, and Conclusions

Several limitations deserve noting. First, this review was limited by the number of studies available. If there had been more studies in the literature, further research questions could have been addressed and the variability we observed in the effects may have been reduced. There is a need for more fine-grained studies of morphological instruction, to determine how to maximize its effects. We have presented a

descriptive listing of the methods used in Table 2; these are some of the instructional parameters that could be varied in future studies. One question in particular that deserves further attention is the optimal ratio of relatively procedural tasks (i.e., relatively specific tasks that have been demonstrated in class, with single correct answers and obvious strategies) to more open-ended problem-solving activities (those that require the students to go beyond tasks they have been shown, in which there may be multiple correct answers and various solution strategies). Another question lies in aptitude–treatment interactions, particularly given that particular instructional programs may suit some learners more than others. Second, we were not able to make cross-linguistic comparisons because of the relatively small number of studies in orthographies other than English. As more morphological interventions are conducted, it may be fruitful to investigate the effect of morphological instruction in different languages. It may be useful to compare the effects of morphological instruction in languages whose scripts differ in phonological transparency. Third, the decision to exclude research in nonalphabetic languages means that our review does not include morphological research in other writing systems. This is a particularly interesting question for future research, given the suggestion of the importance of morphological processing in morphosyllabic writing systems (e.g., McBride-Chang et al., 2005). Future research on the effectiveness of morphological interventions in nonalphabetic languages could be conducted and compared to see if the effects follow a similar or different pattern than we found here.

A third limitation is that most studies worked with whole classes; where there were small groups taught, these were usually within the context of remedial instruction. This difference in purpose, regular versus remedial instruction, tended to confound learner ability with group size, necessitating caution in drawing conclusions about ability effects. More studies that vary ability and group size independently are needed.

Overall, we found that morphological instruction made a positive contribution to literacy outcomes, but there are several caveats that need to be attached to this conclusion. First, as we detailed in our analyses, the effects were stronger for less able readers and for those who received integrated instruction; there was a tendency for studies with younger children to be more powerful, but there were not enough studies to state this with confidence. Second, there was only limited evidence of transfer to the lexical and supralexical levels. It is plausible that this is in part because of the relatively undeveloped state of morphological instructional methods and how unfamiliar morphological knowledge is for most children. Our evidence indicates that instruction is more effective when it is integrated with other aspects of literacy instruction; we suggest that morphological instruction needs to be embedded in the curriculum in a sustained manner rather than being added as a temporary patch. We also suggest that integration of problem-solving techniques may contribute to transfer of morphological knowledge. Finally, we suggest that morphological instruction has more potential than has yet been realized. We look forward to new attempts to refine this promising instructional method.

## Notes

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[1]The terms *base* and *root* are often used interchangeably. *Base* is used in this article because it is specifically morphological, whereas *root* also refers to word origin (etymology).

[2]For Nunes, Bryant, and Olsson (2003), standard deviations were calculated from standard error scores before calculating effect sizes. For Berninger et al. (2008), effect sizes were calculated from *F* values. No effect size calculations were conducted for the two studies from Tyler, Lewis, Haskill, and Tolbert (2003) because they reported means and standard deviations of percentage change in scores. Because they reported Cohen's *d* and significance values, those statistics were taken from their calculations. The two studies by Hurry et al. (2005) reported raw means, but they also reported effect sizes, based on regression calculations that accounted for pretest differences. Their reported effect sizes were used instead of calculating effects from raw means.

[3]A master results table, which includes (a) outcomes for each individual measure involved in the synthesis, (b) information about whether effect sizes were calculated on raw or adjusted means, and (c) what variables were controlled in the original studies, is available from the authors.

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## Authors

PETER N. BOWERS is a PhD student studying with John R. Kirby at the faculty of Education and Queen's University, Kingston, Ontario, Canada K7L 3N6; email: *peterbowers1@me.com*. Drawing from ten years of experience as classroom teacher, his research interest focuses on literacy learning, and instruction.

JOHN R. KIRBY, PhD, is a Professor of Educational Psychology at Queen's University, Kingston, Ontario, Canada K7L 3N6; e-mail: *john.kirby@queensu.ca*. His research interests concern the cognitive processes involved in word reading and reading comprehension.

HÉLÈNE DEACON, PhD, is an Associate Professor in the Department of Psychology at Dalhousie University where she directs the Language and Literacy Lab. Taking an interdisciplinary and collaborative approach, she researches the skills that children and adults bring to the reading and writing enterprise.