John Effect in Literacy Acquisition: The Role of Morphological Awareness in Literacy Acquisition in Different Orthographies

Shuai Zhang, Bing Han, Alida K. Hudson, Karol A. Moore, and R. Malatesha Joshi

Abstract Morphological awareness (MA) is a fundamental metalinguistic awareness that contributes to literacy development across orthographies. Investigating MA may help educators and researchers understand morphological processing in reading and writing, design assessment tools, and implement interventions to striving readers and writers. In this chapter, we focus on reviewing the developmental contribution of MA to reading and writing in different orthographies and discuss unique morphological structures in specific orthographies. Specifically, we examine how MA influences reading and writing in English, German, French, Spanish, Arabic, Hebrew, and Chinese. Also, we review how MA's contribution to literacy differs by the morphological structure of an orthography, such as the linear combination of affixes and roots in Indo-European alphabetic orthographies, some nonlinear affixations in Arabic and Hebrew, and the dimensionality of MA in Chinese. Future MA studies are suggested to empirically test the unique morphological structures in different orthographies.

Keywords Morphological awareness · Orthography · Reading · Writing

S. Zhang
Department of Reading Education and Special Education, Appalachian State University, Boone, NC, USA

B. Han · K. A. Moore · R. M. Joshi (✉)
Department of Teaching, Learning, and Culture, Texas A & M University, College Station, TX, USA
e-mail: mjoshi@tamu.edu

A. K. Hudson
College of Education and Human Ecology, Crane Center for Early Childhood Research and Policy (CCEC), Ohio State University, Columbus, OH, USA

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1 Introduction

The role of morphology in language processing is based on its ability to represent meaning across oral and written forms through morphemes, the smallest units of meaning in a given language. A great body of research has linked literacy outcomes in word reading, reading comprehension, and spelling to morphological skills. We offer thanks to Dr. Dorit Ravid, who has made significant contributions regarding the critical role of morphological awareness (MA) in learning to read and spell. Her study of the rich and complex history of Hebrew has provided a unique and valuable perspective for the study of morphology. Specifically, Dr. Ravid contributed to the investigation of linear and nonlinear morphology in Hebrew, noting that nonlinear morphological awareness developed later than linear morphological awareness (Ravid & Malenky, 2001). Dr. Ravid and colleagues also have examined the inflectional and derivational morphological patterns in Hebrew, indicating that derivational skill was more challenging than inflectional skill (Levin et al., 2001). Further, Dr. Ravid has probed the role morphological factors play in Hebrew spelling. She has observed that accuracy in spelling grammatical words develops earlier than in content words, and accuracy for spelling function letters is acquired earlier than for root letters within content words (Ravid, 2001).

Most notably, Ravid published the first book about spelling acquisition in Hebrew, highlighting the significant correlation between morphology and orthography related to consistency between grammatical and lexical representation and spelling components as a focus of further research (Ravid, 2013). Dr. Ravid's research on Hebrew morphology has extended our understanding of morphology and morphological awareness development across orthographies.

As the beneficiaries of such a great body of work, we would like to dedicate this chapter to Dr. Ravid in honor of her contributions to our understanding of morphological principles in different orthographies. Following a review of the research on the role of MA in reading and spelling in various orthographies, we emphasize that while MA plays an important role in various orthographies, its contribution is dependent on the depth and complexity of the orthography.

"In the beginning was the Word…" (John 1:1). Beginning with Pāṇini's advanced treatise on morphological awareness around the fourth century BCE, linguists have investigated written words and their inner meaning structures (Weisler & Milekic, 2000). These early efforts include Xu Shen's *Shuo Wen Jie Zi* [An Explication of Written Chinese Characters], published around 100 ACE, Sibawayh's *Al Ketab* [The book of Arabic Grammar], published around 800 ACE, and German linguist August Schleicher coined the term "morphology" in 1859 to refer to the study of the *morpheme*, which is defined as the smallest unit of meaning in a word (Booji, 2012). Acknowledging this early awareness and these early studies on morphology, we have coined the term "John Effect" to refer to the influence of morphology on reading and writing in different orthographies.

Earlier educational researchers found that the manipulation of morphemes and morphological structures (i.e., MA), is part of new vocabulary learning (e.g.,

Carlisle, 1995; McBride-Chang et al., 2005; Tyler & Nagy, 1990). For example, knowledge of the morpheme *-struct* meaning *to build* helps a student to learn a series of derived words such as *structure, construct, construction, destruction, instruct*, and *instructor*. Another example is lexical compounding structures in Chinese. With the knowledge of five compounding structures (i.e., subject-predicate, verb-object, subordinate, coordinate, and verb/adjective-complement), children can generate new words for novel concepts (e.g., Cheng et al., 2015; Liu & McBride-Chang, 2010). More recently, across orthographies, researchers have found that MA plays an essential role in reading and writing (see Ruan et al., 2018, for a meta-analysis). Further, MA interventions have been found to be effective in literacy acquisition in addition to phonological awareness and phonics training (see Galuschka et al., 2020; Goodwin & Ahn, 2013, for meta-analyses).

Meanwhile, MA's contribution to reading and writing varies by the linguistic properties of different orthographies (Ruan et al., 2018). In this chapter, we begin by reviewing the developmental contributions of MA to reading and writing and then examine how the nature and contribution of MA vary in different orthographies. Finally, we aim to provide future directions to researchers about the role of morphology in different orthographies.

2 Developmental Contributions of MA to Reading and Writing: An Overview

The role of MA has been explicitly addressed in the Lexical Quality Hypothesis (LQH) model (Perfetti, 2007). In the LQH model, morpho-syntax is one of the four constituents of word identity. Furthermore, MA has been specified in the second phase of the Triplex Model of learning to read Hebrew (Share & Bar-On, 2018). In the Triplex Model, the second phase is called lexico-morpho-orthographic processing, during which children rely heavily on lexical and morpho-orthographic knowledge for word reading. In addition, MA is easily integrated into the cognitive components of reading addressed in prevalent reading theories such as the Simple View of Reading (SVR), which suggests that reading is the product of decoding and language comprehension (Gough & Tunmer, 1986). Among metalinguistic skills (e.g., phonological, orthographic, and morphological awareness), phonological and orthographic awareness build foundations for word decoding and decoding fluency (Song et al., 2016; Swanson et al., 2003; Wu et al., 2012). On the other hand, MA contributes to successful decoding and comprehension (Kearns et al., 2016; Kim, 2017; Perfetti, 2007, Perfetti & Hart, 2002). When students decode polymorphemic words, they need MA in addition to phonological awareness, phonics, and orthographic knowledge. For example, when reading *chirping* in the sentence *the bird is chirping on the tree*, students decode *ch* with /tʃ/, *ir* with /ɜːr/, and *p* with /p/; then the recognition of the inflectional ending *ing* facilitates the efficiency of the word decoding. For comprehension, once the word is successfully decoded, the suffix *-ing*

and its preceding referential verb (*is*) help typical readers to comprehend that the event (*birds chirping*) is happening right now rather than in the past. In older students, more advanced MA contributes to successful syllable division, word comprehension, and text reading comprehension. Examples of these skills include the awareness of derivational suffixes in English and differentiating semantic radicals in complex Chinese words (Foorman et al., 2012; Kieffer & Lesaux, 2007; Levesque et al., 2017; Tong et al., 2011).

The role of MA is clearly addressed across word writing stage theories but is less attended to in the early writing stages. For example. Ganske (1999, 2014) suggested five stages of word writing (*Emergent, Letter Name, Within Word, Syllable Juncture, and Derivational Constancy*) and designed word writing assessment lists for each stage. Among those lists, polymorphemic words were not covered until the Syllable Juncture and Derivational Constancy stages (see Ganske, 1999, 2014). In standardized spelling assessments such as Wechsler Individual Achievement Test-IV (WIAT-4, 2020), the first appearance of a polymorphemic word for dictation was in the Grades 4–8 list (*camped*). The reason is that researchers tend to focus on phoneme-to-grapheme correspondence during initial spelling development (Bayersmann et al., 2019). However, Treiman and Kessler (2014) proposed the Integration of Multiple Patterns (IMP) theory and suggest that MA develops early via implicit statistical learning from accumulated reading and writing experiences. Thereafter, individual differences in MA were observed in young children and were predictive of future polymorphemic word writing accuracy (Egan & Tainturier, 2011; Hauerwas & Walker, 2003; Kemp et al., 2017).

Previous research studies have found that MA contributes to reading and writing, whether in shallow and transparent orthographies like Spanish or deep and opaque orthographies like English and Chinese. However, current MA literature has predominantly focused on English. There is much less research targeting MA in other orthographies, including a lack of studies on the less opaque orthographies, alphabetic orthographies embedded in Semitic languages (e.g., Arabic and Hebrew), and non-alphabetic orthographies (e.g., Chinese). In the following sections, we first review the roles of MA in reading and writing of Indo-European alphabetic orthographies and then discuss MA in other orthographies of various morphological structures.

3 MA in Indo-European Alphabetic Orthographies

MA varies in the extent of its influence on word reading and writing in different Indo-European alphabetic orthographies (or *spelling*; Seymour, 2013). The relationship between MA and learning to read and write in these orthographies is based on the idea that morphemes have semantic, phonological, and syntactic properties (Mahony et al., 2000). Additionally, studies have shown that adults rely on morphological information to process more complex words, suggesting a higher degree of organization within their storage system for vocabulary (Nagy et al., 1989).

Polymorphemic words are common in many Indo-European alphabetic orthographies. For example, approximately 60–80% of the new words that school-aged children will encounter in English (Nagy & Anderson, 1984) and around 75% of French words are polymorphemic (Rey-Debove, 1984). Elbro and Arnback (1996). Nagy et al. (2014) highlighted several reasons why MA may be critical to proficient reading and writing in alphabetic orthographies, including contributions at both the sound level for decoding and encoding and the comprehension level for vocabulary reading comprehension. For example, studies show that MA promotes decoding after children have moved beyond the beginning stages of learning to read (e.g., Angelelli et al., 2017; Bayersmann et al., 2019; Hasenacker & Schroeder, 2017; Quémart et al., 2012). This finding may be attributed to students using two different methods to access morphologically complex words, with whole word representations used for familiar words and component morphemes used for unfamiliar words (Caramazza et al., 1988). Moreover, regardless of the transparency of the orthography, the significance of MA to reading achievement increases as students grow older (e.g., Carlisle & Stone, 2005; Fleischhauer et al., 2021). However, MA's contributions to reading and writing may vary based on the language's orthography; thus, theoretical conceptualizations of reading and writing development should consider cross-linguistic differences.

Much research has been done on the connection between MA and reading in English (Carlisle, 1995, 2000; Carlisle & Fleming, 2003; Deacon & Kirby, 2004; Kemp, 2006; Nagy et al., 2006), due to the complexity and depth of its orthography often leading to slower reading development when compared to that of more transparent orthographies. Nagy et al. (1994) observed that Grade 5 students encounter approximately 10,000 unfamiliar words in English reading over a school year. About 4000 of those words can be considered derivatives of more frequent words. Anglin (1993) estimated students' vocabulary growth in derived words between Grade 1 and Grade 5 to be more than three times greater than the increase in the number of root words for the same students (e.g., 14,000 derivatives: 4000 root words; Ku & Anderson, 2003). Thus, MA plays a significant role in more advanced reading development when working in a deep orthography such as English.

MA "brings an important degree of regularity" to the mapping of grapheme-phoneme correspondences in deep orthographies such as English, despite it being less morphologically complex (Rastle, 2019, p. 46). Unlike most transparent orthographies, MA and other sublexical units (e.g., syllables, rimes) may be equally relied upon when reading in a deep orthography (Mousikou et al., 2001), with proficient readers being more aware of morphological structure than poor readers. Moreover, Goodwin and Ahn (2013) noted that both lexical (i.e., definitional) and syntactic (i.e., grammatical) roles of morphemes could support students' reading and word writing in English. Nagy et al. (2006) found that the variance in word writing could be predicted by a students' MA, even after taking the effect of phonological awareness into account. The fact that English word writing prioritizes morpheme consistency over the consistency of phonemes may explain this finding (Bowers & Bowers, 2018).

In shallow orthographies, such as Spanish, Finnish, or Italian, most words can be decoded and spelled correctly using phoneme-grapheme correspondence rules (Defior et al., 2000). However, MA still plays an essential role in reading and word writing, as languages with a shallow orthography tend to be morphologically complex (Perfetti & Harris, 2013; Ramirez et al., 2011; Seidenberg, 2011). For example, there can be up to 47 different inflections for Spanish verbs and more than 40 inflected forms for Italian verbs (Job et al., 2013). Thus, morphological information may be used in shallow orthographies when processing long, unfamiliar words that are morphologically complex (Angelelli et al., 2017; Defior et al., 2008). Studies of shallow orthographies have demonstrated that MA, especially awareness of derivational morphology, promotes reading and writing accuracy as well as reading fluency (Angelelli et al., 2017; Burani et al., 1999; Müller & Brady, 2001; Ramirez et al., 2011). For example, Ramirez et al. (2011) found that, in a group of upper elementary and middle school Spanish-speaking children, MA contributed more to reading in Spanish than phonological awareness. Angelelli et al. (2014, 2017) found that Italian grade 3 students with and without dyslexia wrote morphemic pseudowords more accurately than non-morphemic pseudowords, thereby highlighting the fact that intermediate grain-size units (i.e., units larger than the single phoneme, but smaller than the word) are used in spelling regardless of the consistency of phoneme-to-grapheme correspondences.

Similar to shallow orthographies, languages with an intermediate orthography such as German and French have fairly consistent phoneme-grapheme correspondences but rather inconsistent grapheme-phoneme correspondences, leading to difficulties in writing. Therefore, morphological awareness is needed in writing tasks (Sénéchal et al., 2006). For example, in German, graphemes almost always have one consistent phoneme, yet, due to morpheme consistency, there may be several acceptable translations of a phoneme into a grapheme (e.g., *hast- hasst* ['have-hate'], ist- isst [is-eats], Meer-mehr [sea- more]; Kargl & Landerl, 2018). Consequently, reading and spelling improve in languages with an intermediate orthography when MA is employed (Quémart & Casalis, 2017). However, this may vary depending on the unique characteristics of a language's orthography. Hasenäcker and Schroeder (2017) and Fleischhauer et al. (2021) found that German-speaking fourth-graders break down morphologically complex words into their component morphemes when reading, while younger students tend to rely on grapheme-phoneme correspondences and syllables. Conversely, in French, Cole et al. (2011) found that second- and third-grade children used morphemes and syllables equally as they read multimorphemic words.

Portuguese can also be considered an intermediate orthography. The language has a simple syllabic structure; however, it is less transparent in its phonology. Portuguese is similar to English, where morphologically-based regularities with different meanings for different word forms guide the writing and reading of many words (De Freitas et al., 2018; Oliveira et al., 2020). De Frietas et al. (2018) conducted a study of Portuguese Grade 4 students to examine the role of MA in word reading and reading comprehension. Findings indicated that MA contributed to

reading comprehension and supported reading accuracy and speed through improved decoding skills (De Freitas et al., 2018).

Currently, MA intervention studies in Indo-European languages predominantly focus on English and older students (Grade 4 and up), with few focusing on shallow and intermediate orthographies. Bowers et al. (2010) conducted one of the few meta-analyses that focused on MA intervention across orthographies (Danish, Dutch, English, and Norwegian) and found that MA interventions, when integrated with other literacy instruction, effectively improved word reading, writing, and vocabulary skills irrespective of orthographic depth or student age. As young students show individual differences in MA that are predictive of future literacy achievements (Treiman & Kessler, 2014), Bowers et al.'s findings may suggest the necessity of integrating MA beyond phonics instruction in early grades. However, more studies are needed to investigate the necessity of teaching and assessing MA in the early stages of reading and writing.

4 Nonlinear Affixation: The Case of Arabic and Hebrew

Modern Arabic and Hebrew each possess two versions of the same orthography. While one is considered shallow and transparent, the other is deep and opaque (Abu-Rabia, 2007; Ravid, 2013). The transparent and shallow version is vocalized and represents both consonants and vowels (Abu-Rabia, 2007; Ravid, 2013). Arabic and Hebrew are also considered morphologically dense due to the use of long clusters of bound morphemes (inflectional and derivational affixes). The richness of morphology in Semitic languages includes (1) the many semantic notions that are expressed within a word, (2) large structural systems that organize the lexicon by morphological means, and (3) many systematic and semi-systematic morphophonological alternations. For example, in Hebrew, inflectional suffixes such as *-o* (*sus* [horse]-*suso* [his horse]) do not change the lexical category of the word and have transparent meanings. Derivational suffixes in Hebrew, however, can change a word into various meaning categories. For example, a derivational suffix can change a verb to a noun (*xofshi* [free] derived from *xofesh* [freedom]), a noun to another meaning-related noun (*mitriya*, 'umbrella' derived from *matar* [rain]), or a word from one category to another (*iriya* 'municipality', from *ir* [city]). Due to the richness of morphology, the spelling rules of these morphemes are generally unpredictable (Levin et al., 2001).

Polymorphemic words in Indo-European languages (e.g., English, Spanish) are usually a linear combination of prefixes, roots, and suffixes (prefixes are attached to the beginning and suffixes to the end of a root). However, the cases in Semitic languages are different. Despite following patterns of alphabetic orthographies, Semitic languages such as Arabic and Hebrew share few similarities of morphological structure with other alphabetic orthographies. In many Arabic and Hebrew polymorphemic words, the root and other morpheme letters (or *word patterns*) are interwoven (Abu-Rabia, 2007; Deutsch et al., 2003). A root is usually a consonant letter cluster

(e.g., *zmr* means the concepts related to *singing* in Hebrew), and word patterns (vowel or vowel-consonant letter strings) are inserted in between these consonant letters to form derivatives (Frost et al., 1997). For example, the Hebrew root *zmr* (sing) can be derived into *zemer* (song) and *zamir* (mockingbird/singing bird). An example in Arabic is that the root *ktb* refers to *concepts of writing,* and the derivative *kateb* was combining *ktb* with _a_e_ word pattern.

Due to these linguistic properties of written Arabic and Hebrew words, virtually every content word in Arabic and Hebrew is polymorphemic (Deutsch et al., 2003; Taha & Saiegh-Haddad, 2016). Therefore, unlike alphabetic orthographies, MA plays an especially important role in reading polymorphemic words in Arabic and Hebrew. Young children (as early as second grade) use morphological pattern cues to fill in missing phonological information when reading unfamiliar words. They also start to differentiate homographs using morphosyntactic cues over time (Bar-On & Ravid, 2011). Therefore, given the high morphological density, word recognition in Arabic and Hebrew can be challenging and slower to develop with poor MA (Shimron, 2006), reinforcing the need for intervention research on this topic.

Arabic and Hebrew researchers have attempted to investigate the role of MA in typical and striving students in primary grades (Kindergarten to Grade 3) and higher grades. Levin et al. (2001) monitored the inflectional and derivational MA in Hebrew and correlated these scores with writing accuracy scores one year later (i.e., when students became first graders). They found that derivational MA posed more difficulties than inflectional MA, and the composite MA scores were strongly associated with vowel writing accuracies in Grade 1. Vaknin-Nusbaum et al. (2016b) found that Grade 2 and Grade 5 Hebrew-speaking students with poor MA tend to struggle with reading comprehension (see similar findings in Vaknin-Nusbaum, 2018 and Vaknin-Nusbaum et al., 2016a). Saiegh-Haddad and Taha (2017) found that Arabic-speaking students with dyslexia showed MA deficits as early as Grade 1, and these deficits were associated with word reading and writing difficulties beyond phonological factors (see similar findings in Schiff & Saiegh-Haddad, 2018). Mahfoudhi et al.'s (2010) study compared the predictors of reading comprehension of Arabic-speaking typical and striving readers from Grades 3–8 and found that MA was only predictive of typical readers' comprehension abilities. On the other hand, striving students in these older grades could perform as well as typical students on MA tasks, but MA did not predict their reading comprehension. The authors concluded that although Arabic striving readers were exposed to polymorphemic words early on, they could not utilize MA to facilitate comprehension tasks.

MA intervention was found to be effective in enhancing reading comprehension and writing accuracy in both Arabic and Hebrew. Also, MA intervention seems to benefit older striving students more than phonological awareness intervention. Taha and Saiegh-Haddad (2016) compared how in Grades 2, 4, and 6 Arabic-speaking students with typical and struggling reading profiles responded to phonological and morphological word writing interventions and found that both interventions significantly improved striving and typical students' word writing accuracy. However, MA intervention showed more benefits to Grade 6 striving students than did phonological awareness intervention. Specifically, the reading and writing growth scores of

striving Grade 6 students surpassed those of typical students in the MA intervention group, whereas phonological intervention did not suggest differential benefits to different types of students. A randomized controlled trial MA intervention study conducted by Vaknin-Nusbaum and Raveh (2019) focused on Grade 5 Hebrew striving students. Their intervention package included segmentation and identification of morphemes from polymorphic words and constructing derivatives from roots. Their intervention showed clear advantages of the intervention group on reading accuracy and comprehension compared to the striving students without explicit MA instruction. These studies made strong cases of MA intervention's effectiveness on striving students' reading and writing skills in dense morphological orthographies like Arabic and Hebrew.

5 Dimensionality of MA: The Case of Chinese

Unlike the orthographies discussed above, Chinese is a morpho-syllabic orthography that cannot be further decomposed to the phoneme-grapheme level. Chinese characters are both a morpheme and a syllable and have complex visual structures (variant configurations and stroke patterns). Therefore, MA in Chinese is confounded with phonological and visual-orthographic processing but emerges as soon as students start to recognize characters (e.g., Kim et al., 2020; Ku & Anderson, 2003; Liu et al., 2013; Shu et al., 2006; Tong et al., 2017). Therefore, it is unsurprising that the fact that Chinese MA predicts reading and writing is well established (e.g., Cho et al., 2011; Han et al., 2022; McBride-Chang et al., 2003; Ramirez et al., 2011; Rispens et al., 2008; Tong et al., 2009).

However, in research studies, the dimensionality of Chinese MA as a theoretical construct is still under debate. For example, Tong et al. (2017) suggested that MA occurs at the semantic radical level (a stroke pattern within a morpheme that cannot stand alone as a character) in addition to MA at character- and compound-level (real words with two or more morphemes). By contrast, Liu and McBride-Chang (2010) suggest that MA only occurs at the character and compound levels. More recently, Han et al. (2022) examined MA at the radical, character, and word level. This chapter adopted Han et al.'s version by suggesting a 3-dimension model of Chinese MA. That is, we suggest Chinese MA occurs at the semantic radical level (within-morpheme), the character level, and the compound level (also see Li et al., 2002; Liu et al., 2013; McBride-Chang et al., 2003; Tong et al., 2017).

The first dimension of MA is at the semantic radical level. Most Chinese characters in the elementary lexicon are composed of semantic radicals and phonetic radicals (Shu et al., 2006). A semantic radical sends the meaning clue to the character, and a phonetic radical indicates the character's sound (Ho et al., 2003). For example, in the semantic-phonetic character 油 (/you2/, oil), 氵 is the semantic radical suggesting the meaning of the character 油 is relating to *water and liquid*. Meanwhile, the phonetic radical 由 (/you2/) gives the pronunciation hint to the character 油(/you2/, oil).

There are 7000 commonly used characters (morphemes) in the Chinese lexicon but only 1300 syllables (Chao, 1976). One of the reasons is related to the large number of characters sharing the same phonetic radicals. Also, phonetic radicals occupy more character space than semantic radicals, which leads to many words looking similar to each other. For example, the characters 躁 (mad, /*zao4*/) and 燥 (dry, /*zao4*/) have the same syllable and are visually similar but vary in meaning as they share the identical phonetic radical while the semantic radicals are different (the left part of the characters). Therefore, differentiating semantic radicals are critical in Chinese reading and writing and are predictive of concurrent and longitudinal reading and writing (Feldman & Siok, 1999; Ho et al., 2003; Zhang et al., 2012; Zhang et al., 2021). In a longitudinal intervention study by Wu et al. (2012), guided semantic radical instruction as part of MA instruction showed significant positive impacts on Grade 2 students' word reading and writing skills. Packard et al. (2006) found that explicit semantic radical intervention, as part of the MA intervention package, significantly improved the word writing skills of Grade 1 students as compared to the control group students.

The second dimension of MA is the meaning processing of individual morphemes. Since the number of morphemes is much greater than that of syllables (Chao, 1976), a large number of homophone characters exist in the Chinese lexicon. Some of these homophone characters have to be differentiated at the morpheme level. For example, homophones 撼 (to shake, /han4/), 旱 (dry, /han4/), 汉 (a Chinese ethnic group, /han4/), and 汗 (sweat, /han4/) all share the single syllable /han4/ but have drastically different meanings. A student with good homophone awareness differentiates the meanings based on visual-orthographic differences among these words, and then knows how to apply these words in different word contexts (旱 /han4/ in the bimorphemic word 干旱 [/gan1 han4/, drought] and 汗 /[han4/, sweat] in the bimorphemic word 出汗 [/chu1 han4/, to sweat]). Lack of character-level MA, especially homophone awareness, has been associated with poor vocabulary knowledge, reading comprehension, and word writing (Liu et al., 2013; Kim et al., 2020; Shen & Bear, 2000; Tong et al., 2017). Meanwhile, character-level MA also involves homograph awareness, defined as two morphemes written with the same character but having different meanings. For example, the character 木 (/mu4/, wood) in the word 树木 (/shu4 mu4/, trees) has a distinct meaning from the 木 (/mu4/, numb) in the word 麻木 (/ma2 mu4/, numbness). Previous studies have found that homograph awareness also contributes significantly to Chinese vocabulary and reading comprehension (Han et al., 2022; Liu et al., 2013; Xie et al., 2019).

The third dimension of Chinese MA is at the compounding word level. Most compounds in Chinese have two morphemes (e.g., 树木 /shu4 mu4/, trees). These Chinese bimorphemic compounds can be categorized into words of five compounding structures: subject-predicate, verb-object, subordinate, coordinate, and verb/adjective-complement (Liu & McBride-Chang, 2010; Zhang, 2004). Compound awareness facilitates understanding the inner relations between the two morphemes in each compound word and thus aids word comprehension and text reading comprehension (Liu & McBride-Chang, 2010). For example, in the compound word 牛奶 (/niu2 nai3/, milk), 牛 (/niu2/, cattle) is used to define 奶 (/nai3/, milk), and thus

牛奶 means *cow's milk*. However, when switching the order of the two morphemes, namely 奶 (/nai3/, milk) defining 牛(/niu2/, cattle), the compound word 奶牛 [/nai3 niu2/, (cow)] refers to *milk-producing livestock*. Therefore, at the compounding word level, proficient MA involves differentiating compound meanings based on morpheme sequences and grammatical demands.

Currently, there are very few studies conducting MA intervention. Zhou et al., (2012) was one of the few that compared homophone intervention to compound awareness intervention. They found that compound awareness training demonstrated better word reading accuracy improvements than homophone intervention. Future Chinese researchers should attempt to replicate this finding. Also, further researchers should investigate whether the intervention should target compound awareness or combine the three dimensions of MA to maximize the benefits.

6 Conclusion and Future Directions

In this chapter, we have reviewed past endeavors on MA across orthographies. In Indo-European alphabetic orthographies, most early-grade words have a monomorphemic structure. Therefore, most studies in these orthographies have concentrated on MA among older students. By contrast, Arabic, Hebrew, and Chinese words are characterized by complex morphological structures with specific phonological and orthographic properties. Irrespective of orthography, MA intervention has been shown to be effective in improving typical and striving students' literacy skills. Nevertheless, several research areas need future endeavors. In this section, we discuss the future research foci on MA.

In Indo-European alphabetic orthographies, researchers have found that implicit statistical learning and individual differences of MA emerge early on (e.g., Kidd, 2012; Treiman & Kessler, 2014). These learning experiences and individual differences in early MA knowledge are predictive of future reading and writing achievements (Deacon et al., 2014; Manolitsis et al., 2017; Pittas & Nunes, 2014). Future researchers should investigate whether assessing and instructing MA are necessary for the early grades. For Arabic and Hebrew orthographies, due to having unique morphological features (nonlinear affixations; Levin et al., 2001; Taha & Saiegh-Haddad, 2016), future studies should adjust the reading and writing development theories for these orthographies. Also, the dimensionality of Chinese MA needs to be tested with empirical data to validate the 3-dimension model.

In conclusion, much is still unknown about the nature of MA in orthographies in the early stages of reading and writing. All in all, "in the beginning was the Word," and at the beginning of classroom instruction, morphemes of words already influence reading acquisition and written communications. Therefore, literacy researchers should further investigate the nature of MA in different orthographies and at various developmental stages to provide assessment and instructional suggestions to classroom teachers.

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