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The relationship between language and reading in bilingual English-Arabic children

Lama K. Farran · Gary E. Bingham · Mona W. Matthews

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Abstract The connection between language and reading is well established across many languages studied to date. Little is known, however, about the role of language in reading in Arabic—a Semitic language characterized by diglossia—in which the oral and written varieties differ across language components. This study examined the relationship among multiple components of language, namely, phonology, morphology, and vocabulary and reading outcomes in 83 bilingual English-Arabic children. Results revealed associations between phonological awareness skills across English and Arabic. These associations did not hold for morphological awareness skills. Results also revealed that for Arabic and English, phonological awareness predicted word and pseudoword reading accuracy and vocabulary predicted reading comprehension. These findings are consistent with the tenets of the extended version of the Triangle Model of reading, which underscores the importance of multiple language components in predicting reading outcomes. Implications for future research, early intervention, and instruction with bilingual children are highlighted.

Keywords Arabic · Bilingualism · Connectionism · Diglossia · Language · Morphological awareness · Phonological awareness · Pseudoword decoding · Reading comprehension · Triangle model of reading · Vocabulary · Word reading

Introduction

Reading is a language-based process (Catts & Kamhi, 2005; Nation & Snowling, 2004). Essentially, the speech children hear and the language they use in their everyday communication form the foundation for reading development. Perfetti

L. K. Farran (✉) · G. E. Bingham · M. W. Matthews
Department of Early Childhood Education, Georgia State University,
30 Pryor Street, Suite 550, Atlanta, GA 30303, USA
e-mail: lama_farran@bellsouth.net

(2003) illustrates this distinctive relationship between language and reading through the *language constraint* on reading, which posits that all writing systems represent spoken language. Accordingly, the process of learning to read entails mapping of graphemes onto phonemes (speech) as well as graphemes onto meaning (language). This holds true for learning to read across languages studied to date including alphabetic languages such as English and Arabic, as well as morphosyllabic languages such as Chinese and Japanese (Perfetti & Dunlap, 2008).

In spite of the importance of both speech (phonology) and language (meaning) in reading, the overwhelming majority of the research evidence stresses the fundamental role speech skills (phonology) play in reading development (Adams, 1990; Brady & Shankweiler, 1991; Goswami & Bryant, 1990; Liberman, 1973; Wagner & Torgesen, 1987) with comparatively little attention paid to other language components. Although the importance of phonology is incontestable, research that links phonology to reading is insufficient to explain reading comprehension. As reading comprehension is conceptualized by many researchers as the ultimate goal of reading (Cain & Oakhill, 2007), examining the connection between multiple components of language and reading outcomes (e.g., word reading and reading comprehension) is needed for an all-encompassing account of reading development.

The present study supports the hypothesis that reading development depends on the orchestration of multiple language components as opposed to a single language component (Nation & Snowling, 2004). It examines the relationship between language (phonology, morphology, and vocabulary) and reading (word reading and reading comprehension), and extends the work of Saiegh-Haddad and Geva (2008) by investigating this relationship in young bilingual English-Arabic children in the US. The children in this study learn English and Arabic as their first and second language, respectively.

Theoretical framework

This study is cast in an interactive model of reading—an extended version of the Triangle Model of reading (Bishop & Snowling, 2004) that relies on the role experience plays as a mechanism for reading and language development. This model explains how different populations of children learn to read under various conditions (e.g., typical development, language delay, dyslexia, bilingualism). It is a dynamic model, allowing for a bidirectional relationship between two interacting subsystems: the phonological pathway that maps orthographic representations to phonological ones, and the semantic pathway that connects phonological and orthographic representations via semantics. This bidirectional relationship between the two pathways occurs simultaneously in a single system and incorporates interactions between semantic representations and other components of language namely grammar (e.g., morphology and syntax) and discourse language processes (e.g., inference making, use of context, comprehension monitoring ability, and knowledge about story structure). The model's strength lies in its ability to account for developmental differences in how children use grapheme-phoneme correspondence to activate semantic, morphological, and phonological representations. Further, it illustrates the dynamic division of labor among these language components based upon the reading task and difficulties. It also accounts for the various compensatory strategies children use when reading under a variety of conditions such as reading two languages that differ in their orthographic transparency or dyslexia.

Study background

Next, we provide background for the study in three main sections: (a) the points of convergence between oral language and written language, (b) how diglossia manifests itself in Arabic, and (c) the similarities and differences between reading Arabic and reading English.

Where oral language and written language converge

The ultimate goal of reading is comprehension of words and text. According to Perfetti's *universal language principle* (2003), comprehension entails that written language encodes oral language at the word, sentence, and text levels. As such, across languages studied to date, readers must solve two problems: the first is a phonological problem whereby they map characters (e.g., graphemes) to phonemes. The second is a semantic problem, whereby they map characters (e.g., graphemes) to meaning (Perfetti & Dunlap, 2008). Therefore, both phonology and semantics (meaning) are implicated in reading development. What remains unknown, however, is how phonology and semantics (meaning) interact with other components of language (e.g., morphology, syntax, pragmatics) and the extent to which they develop in a sequential manner (Pinker & Prince, 1988) or a simultaneous manner (Perfetti, 2003; Seidenberg & McClelland, 1989).

In the present study, children's ability to map written language onto oral language consists of parallel mapping of phonology and semantics in the service of reading comprehension, and thus, interacts with the transparency of language. Transparency refers to the extent to which the orthography of a writing system maps onto its phonology (e.g., grapheme-to-phoneme correspondence), which may differ across, as well as within, languages (Koda & Zehler, 2008; Share, 2008; Ziegler & Goswami 2005). In transparent languages like German, this grapheme-to-phoneme correspondence is straightforward as evidenced in the early mastery of phonological processing skills during the early years of reading development (Wimmer & Goswami, 1994). Conversely, in non-transparent languages such as English, grapheme-to-phoneme correspondence is one-to-many and typically mastered later in the early school years, which could interfere with the development of reading (Ziegler & Goswami, 2005).

Although languages are typically classified as either transparent or non-transparent, the Semitic language of Arabic is unique because of the following characteristics: First, Arabic is both transparent and non-transparent. Arabic is transparent when it is vowelized using diacritical markers to denote short vowels (e.g., *Kataba*), with a one-to-one sound-symbol correspondence between letters and their sounds. Changes in short vowels often signal changes in lexical meaning. Arabic is also nontransparent when it is unvowelized, without diacritical markers or short vowels (e.g., *ktb*), whereby a one-to-many correspondence exists between letters and their sounds. Second, non-transparency in Arabic is attributed primarily to the lack of phonological information in the absence of diacritics as compared to irregular spelling-sound relationship and grapheme-to-phoneme conversion (GPC) rules as seen in other alphabetic languages such as English. Third, non-transparent Arabic words have an internal morphological structure—a root pattern—that renders the relationship between spelling and sound consistent: once the reader identifies the morphological pattern, the missing phonological information can be reliably inferred (Frost, 2006). Finally, Arabic is characterized by diglossia, one manifestation of which is the co-existence of two varieties within the same language. Together, the transparency issue and diglossia (discussed next) contribute to the complexity of reading Arabic.

How diglossia manifests itself in Arabic

Arabic, as a language characterized by diglossia (Ferguson, 1959), presents beginning readers with a unique challenge (Saiegh-Haddad, 2011b). Diglossia manifests itself in two varieties of Arabic: Modern Standard Arabic (MSA), acquired via formal education and used in formal speeches, media, and for various written purposes; and Spoken Arabic Vernacular (SAV), used as the primary mode of communication at home and in informal ordinary conversation. The result is social-functional complementarity (Ferguson, 1959) between the two varieties, each serving mutually exclusive functions, such that when MSA is used, SAV is typically not used. Further, a distinguishing feature of diglossia is the presence of a linguistic distance between the two (SAV and MSA) which affects all components of language, including phonology, morphology, and vocabulary; and consequently interferes with the acquisition of high-quality phonological representations (Saiegh-Haddad, 2011a), phonological awareness (Saiegh-Haddad, 2004, 2007), word reading (Saiegh-Haddad, 2003) and reading comprehension.

Within Arabic, differences between specific SAV and MSA manifest themselves in the phonological component. For example, MSA and SAV share most consonant speech sounds except three: voiceless emphatic stop /q/ as in *qaraa* (*read*); voiceless fricative /θ/ as in *thawb* (*dress*); and voiced emphatic fricative /θ/ as in *thala:m* (*darkness*). These differences between MSA and SAV may result in poorly specified phonological representations in Arabic, whereby the language system concerned with sound-symbol mapping may be degraded.

At the morphological level, MSA and certain SAVs differ as well with respect to the presence or absence of morphemes, which influences the structure of words in Arabic. Inflectional morphemes, especially case markers for nouns and mood markers for verbs, characterize MSA but are dropped in certain SAVs (Saiegh-Haddad, 2003). To illustrate, the following MSA words (/*akal-a*/; *he ate*), (/*lwalad-u*/; *the boy*), (/*tuffaha-tan*/; *an apple*) possess the inflectional morphemes /*a*/, /*u*/, and /*tan*/, respectively. These same words sometimes lose their inflectional morphemes in SAV and become (*akal; he ate)*, (*/lwalad/*; *the boy*), (*/tuffaha/*; *an apple*) (Saiegh-Haddad, 2003).

In addition to morphology, differences exist between MSA and certain SAVs in the domain of vocabulary. For instance, some words that mean the same in MSA and SAV may share the root morpheme but differ in their vowel sound composition (e.g., *Ku: b and kibbeyi* [*glass*]); other words may differ substantially along both consonant and vowel sound composition (e.g., *na: fitha* and *shubba: k* [*window*]).

The linguistic distance between MSA and SAV is not identical across all dialects of Arabic, and depends on the specific SAV used. Several spoken versions (SAVs) exist whereas only one written version (MSA) is predominantly used. All speakers of Arabic, regardless of their SAV, use MSA for formal spoken and written purposes. In the case of bilingual English-Arabic children in this study, two main sources of difficulty exist: the linguistic distance within Arabic between MSA and SAV and the differences across Arabic and English, which we present next.

Similarities and differences in reading in Arabic versus English

Understanding cross-linguistic linkages in reading development between English and Arabic requires an examination of their similarities and differences. One important similarity is that children gain, via direct experience with oral language, the ability to acquire vocabulary, syntactic, morphologic, and pragmatic knowledge, as well as phonological representations of lexical items. However, learning to read in Arabic is different from learning to read in English. Children learning to read English learn a language they speak. Conversely, children who learn Arabic are first exposed to one version, SAV, and as they enter school, they must learn to read and write another version of their language, MSA. Such lack of familiarity with the written form of the language, coupled with the pronounced differences between SAV and MSA, renders learning MSA similar to learning a second language (Ayari, 1996).

In the present study, in addition to English, the bilingual children are exposed to at least two variants of Arabic, MSA (main form of Arabic used for reading in books and used sometimes by teachers in the classroom) and SAV (spoken form used in the classroom along with MSA). Moreover, English and Arabic differ in their transparency: English is phonologically opaque (one-to-many correspondence between graphemes and phonemes; e.g., *mint* and *pint*); and Arabic is phonologically transparent (in vowelized Arabic, a one-to-one correspondence exists between graphemes and phonemes, whereby each diacritic marker denotes a single speech sound (e.g., *kutiba*). Within MSA, children are exposed to vowelized and unvowelized words and texts. For example, they may encounter vowelized words more than unvowelized words in books. However, they are taught sight word reading using unvowelized words. As these bilingual children learn to read, they must map different written forms (vowelized Arabic; unvowelized Arabic; and English) onto different forms of oral language (SAV, MSA, and English). Combined, these factors render learning to read in two languages when one is Arabic, a complex process.

Next, we present evidence regarding the differences across English and Arabic in three components of language that are relevant to this study: phonology, morphology, and vocabulary. Within each component, we highlight current research findings regarding cross-linguistic transfer across English and Arabic.

Phonology

Phonological awareness is the ability to become aware of and to manipulate the phonological structure of one's language. Children rely on phonological processing skills, including phonological awareness, phonological memory, and naming speed (Wagner & Torgesen, 1987; see Bowers & Wolf, 1993 for a different conceptualization in which phonological awareness and naming speed are not subcomponents of phonological processing but rather two distinct sources of reading difficulties) (Stanovich, 2000; Ziegler & Goswami, 2005). In addition, evidence suggests that phonological processing skills are the manifestations of comparable underlying cognitive processes in the two languages (L1 and L2) of bilingual children (Anthony et al. 2006) and can be assessed in either L1 or L2.

As children read two or more languages, they might experience cross-linguistic transfer of skills. This refers to the extent to which skills from the first language (L1) transfer to the second language (L2). The degree to which transfer occurs between linguistic (e.g., phonological) components depends on the languages under consideration. Examples of languages in which transfer of phonological processing skills occur include English and Turkish (Durgunoglu, 2002), English and Chinese (Perfetti, 2003), and English and Arabic (Saiegh-Haddad & Geva, 2008).

Morphology

Morphological awareness refers to the ability to become aware of and operate on the morphological structure of words (Carlisle, 1995). Morphological awareness continues to develop throughout the elementary school years (Ku & Anderson, 2003) and contributes independently to reading above and beyond phonological awareness in English and Hebrew (Fowler & Liberman, 1995). Further, morphological awareness correlates with language and reading measures such as word reading (Deacon & Kirby, 2004), pseudoword reading (Nagy, Berninger, & Abbott, 2006), reading morphologically complex words (Saiegh-Haddad & Geva, 2008), vocabulary (Ku & Anderson, 2003), and reading comprehension (Deacon & Kirby, 2004).

The substantiated importance of morphological awareness becomes increasingly robust when examining the development of reading in bilingual children (Ku & Anderson, 2003), especially in children with reduced vocabulary. Bilingual children often resort to morphological abilities to bootstrap their language skills as they search for word meanings (Droop & Verhooven, 2003), resulting in vocabulary expansion in L1 and L2 (Ku & Anderson, 2003), improved reading comprehension across languages such as English (Carlisle, 2000; Mahoney, Singson, & Mann, 2000) and Arabic (Abu-Rabia, Share, & Mansour, 2003; Abu-Rabia & Taha, 2004), and reading fluency of morphologically related words (Saiegh-Haddad & Geva, 2008).

In terms of how morphological awareness develops, research indicates that implicit awareness of morphological forms precedes explicit awareness of those forms (Gombert, 1992), especially in bilingual children who vary in their language skills (Ku & Anderson, 2003). Thus, this study used a morphological task that tests children's implicit awareness of morphologically related word pairs (see measures).

With respect to cross-linguistic transfer, the minimal available evidence points to a lack of transfer of morphological skills from Arabic to English especially when considering the different morphological processes used in these two languages (English and Arabic; McCarthy, 1985; Saiegh-Haddad & Geva, 2008). For example, English has a transparent morphology, whereby the sound and meaning of a complex word are inferred from its internal morphological structure (Elbro & Arnbak, 1996). In addition, English is a concatenative language with a linear morphological structure. Therefore, children who learn English use linear morphological processes to generate new words from free stems (e.g., *light, lighting)*, such as prefixes and suffixes, often retaining the structure of the stem and sparing the continuous representation of the root.

Unlike English, Arabic is a non-concatenative language with an opaque morphology. Word derivation is linear and non-linear, and word formation involves the simultaneous affixation of a consonantal root that carries the meaning of the word, and a pattern that consists of a vowel template and an orthographic template (prefixes or suffixes) (Holes, 2004). The root and pattern, as bound morphemes, cannot stand as independent words; for instance, the consonantal root *KTB,* which conveys the concept *to write*, when combined with the vocalic pattern template *aa*, make the word *kataba*. The affixation of the root into fixed slots in word patterns results in a discontinuous representation of the root. Importantly, however, while Arabic morphological structure is opaque, it is readily available in all words; thus highly accessible to young children as they engage in reading.

Vocabulary

Vocabulary, as demonstrated with phonology and morphology, plays a paramount role in word reading (Cunningham & Stanovich, 1991; Stahl, 1999; Stanovich, 2000), and reading comprehension (Cain & Oakhill, 2007; Hammer, Lawrence, & Miccio, 2004; Nation, Snowling, & Clark, 2007; Proctor, August, Carlo, & Snow, 2006; Roth, Speece, & Cooper, 2002; Stahl, 1999; Stanovich, 1986, 2000; Thorndike, 1973).

Generally, research examining the development of vocabulary in bilingual children suggests that vocabulary develops more slowly in each language spoken by bilingual children than in the single language spoken by monolingual children (Droop & Verhooven, 2003). Nonetheless, such exposure to two languages potentially enhances bilingual children's total vocabularies (Poulin-Dubois, Blaye, Coutya, & Bialystock, 2010; Proctor et al., 2006) despite the fact that they devote significantly less time learning each language than monolingual children do. However, accurate estimates of the influence of bilingualism on vocabulary development are determined by the speed with which bilingual children develop vocabulary, as well as the typology of the specific pairs of languages learned. As such, children learning two structurally similar languages (e.g., English and

Spanish) will likely progress more rapidly in each language (Durgunoglu & Goldenberg, 2011) than children learning two structurally dissimilar languages (e.g., English and Arabic).

With respect to cross-linguistic transfer, research suggests that, for bilingual children, vocabulary tends to transfer less from L1 to L2 (Hammer et al., 2004), thereby leading to reading difficulties and impoverished reading experience beyond the primary grades. In a related vein, Stanovich (1986) proposed the Matthew effect phenomenon, positing that children who struggle in reading, typically read less, and as a result, learn fewer words. This diminished vocabulary adds to their reading challenges. For bilingual children, who likely experience less transfer of vocabulary from their first to their second language, the potential is increased for a negative effect in language and literacy development.

In summary, the connections between oral language components—phonology, morphology, and vocabulary—and reading outcomes at the word and text levels are well established. However, how the language components interact and the role each component plays in the reading process in English and Arabic remains largely under-investigated.

The present study

The current study was designed to extend a study by Saiegh-Haddad and Geva (2008) by examining the link between language and reading in bilingual English-Arabic children in the US. Saiegh-Haddad and Geva investigated the contribution of phonological awareness and morphological awareness in word reading and found that while phonological skills predicted word reading across English and Arabic, only Arabic morphological awareness predicted English word reading. They also found that morphological awareness within both languages predicted complex word reading fluency (i.e., Arabic morphological awareness on Arabic word reading fluency; English morphological awareness on English word reading fluency). Their study sheds light on the cross-linguistic relationship between language and reading in Arabic and English. However, their sample size was small and they did not assess vocabulary in either language. Further, their study only assessed word reading accuracy and complex word reading fluency, but not reading comprehension. In addition, although they assessed phonological awareness, Saiegh-Haddad and Geva did not consider other related subskills such as phonological memory and naming speed. Finally, within phonological awareness, they only administered the Elision subtest.

Building on Saiegh-Haddad and Geva's study (2008), the current study sought answers to four research questions: (1) is there a relationship between children's phonological awareness in English and Arabic? (2) Is there a relationship between children's morphological awareness in English and Arabic? (3) Does the contribution of children's phonological skills versus their morphological skills vary as a function of the reading task in English and Arabic? (4) Does children's grade level moderate the relationship between language and reading comprehension in Arabic?

Method

Study context

This study was conducted in the spring of 2010 at a school located in a suburb of a major city in the Southeastern portion of the US. This school is a charter school that adopts an expeditionary learning model with a focus on hands-on activities and projects as a means for learning. It attracts teachers and parents interested in diversity in home language, ethnicity, and culture. One unique aspect of this school is its emphasis on teaching Arabic as a second language in the primary and elementary grades. In terms of instructional method, the school's Arabic department consists of four Arabic teachers who focus daily on oral language use in MSA, with infusion of SAV, though writing and spelling are sometimes used. Teachers also introduce spelling and reading simple paragraphs or stories using pictorial stimuli to aid children's comprehension of text. Limited emphasis is placed on reading and writing, especially with emergent readers or those who are considered beginners in the Arabic language.

As indicated by school demographic data, the school serves children from various socioeconomic and middle-high educational backgrounds; the majority of parents have at least a college degree. Furthermore, not all parents are speakers or users of Arabic. Many parents report being native speakers of English, Urdu, Turkish, Tamil, or French (see Table 1). Table 2 shows frequency of parent and partner education and parent and partner home language use variables ($n = 64$). Frequency is followed by percentage in parentheses. As this table indicates, the majority of parents and their partners were highly educated and spoke English in the home. Comparatively, only 14% of mothers and 16% of mothers' partners spoke Arabic.

Table 1 Demographic characteristics of the children in the study

Variable	*M* (*SD*) or frequency (percentage)
	Total children ($n = 83$)
Grade	
3	33 (39.8%)
4	28 (33.7%)
5	22 (26.5%)
Age in years	9.84 (.91)
Gender	
Female	48 (57.8%)
Male	35 (42.2%)
Ethnicity	
Asian	29 (34.9%)
Black	14 (16.9%)
Hispanic	1 (1.2%)
Mixed	9 (10.8%)
White	30 (36.1%)

Table 2 Demographic characteristics: parent and partner education and home language use by frequency or percentage

Variable	Frequency (percentage)	Variable	Frequency (percentage)
	Total parents ($n = 64$)		
Parent education		Partner education	
Elementary	0 (0%)	Elementary	1 (1.6%)
High school or equivalent	5 (7.8%)	High school or equivalent	7 (10.9%)
Community college	4 (6.3%)	Community college	7 (10.9%)
4-Year college	32 (50%)	4-year college	24 (37.5%)
Graduate school	23 (35.9%)	Graduate school	25 (39.1%)
Mother home language use (percent of mothers)		Partner home language use (percent of partners)	
Arabic	9 (14.1%)	Arabic	10 (15.6%)
English	39 (60.9%)	English	38 (59.4%)
Other	16 (25%)	Other	16 (25%)
Frequency of home Arabic use	100% of time	3.1	
	75% of time	10.9	
	50% of time	7.8	
	25% of time	12.5	
	Less than 25%	65.6	

Participants

The participants were 83 bilingual English-Arabic children in third, fourth, and fifth grades (35 males and 48 females). Participants were children (a) who had attended the school for at least three consecutive years, (b) who had received formal Arabic instruction for 40 min per day, 4 days per week, (c) whose parents signed a consent form to participate in the study; and (d) who signed their own assent to participate. Children were excluded from the study if they were identified (a) with known developmental disorders or learning disabilities, (b) as at risk for learning disabilities, and (c) as English language learners based on school classification found in school demographic data. A total of 11 children who met inclusionary criteria did not participate in the study; three children whose parents returned the signed consent forms and declined to participate and eight children whose parents did not return the signed consent forms.

Data collection

Assessment tasks were administered in both English and Arabic and consisted of individual and group assessments. Each child was assessed on two different days within the same week. English tasks were administered on the first day by the two university researchers and two graduate research assistants. Arabic tasks were administered on the second day by the first author. The order of the tasks within the same language was counterbalanced to maximize random distribution of measurement error and to ensure that the order of administration of the measures did not influence student performance in either language. Student verbal responses were audio recorded to ensure the accuracy of manual scoring.

Administration of the individual assessments took place in a quiet room inside the school and near the classrooms. Children were given breaks during the testing session as needed. The group assessment took place in the children's classrooms. Children were tested in small groups, with each group consisting of approximately ten children.

To examine the relationship between oral language and reading, seven domains were assessed in both English and Arabic: (1) phonological processing (all three aspects of phonological processing were administered in English; only phonological awareness aspect was administered in Arabic); (2) morphological awareness; (3) word reading; (4) pseudoword reading; (5) complex word reading fluency; (6) vocabulary; and (7) reading comprehension.

English measures

Six English measures assessed the children's English language and reading competencies. Five of the six measures were administered individually to each child. For the first two measures (i.e., phonological processing and morphological awareness), the examiner orally presented the stimuli to the child and the child provided oral responses. For the other three measures (i.e., word reading, pseudoword reading, and complex word reading fluency), the examiner provided the child with a list of words or pseudowords and the child read them aloud. A raw score was calculated based on the correct number of words read or identified. Total administration time for the five English individual measures was approximately 40 min. A brief description of each measure follows.

English phonological processing

Blending, elision, phonological memory and naming speed subtests of the Comprehensive Test of Phonological Processing (CTOPP; Wagner, Torgesen, & Rashotte, 1999) were used to assess students' English phonological processing. The CTOPP is a published, norm-referenced test with high internal reliability estimates of composite scores exceeding .83. Test–retest reliability estimates gathered over a 1-year period ranged from .70 to .97 for individual subtests and from .78 to .95 for composite scores. Inter-scorer reliability ranged from .97 to .99. A score of 0 was given for incorrect or partially correct responses, and a 1 for correct responses on all subtests.

The Blending subtest required the child to blend individual phonemes to make syllables or words. The examiner presented orally each set of individual phonemes and asked the child to produce a whole word by combining the speech sounds (e.g., */k/*, */a/*, */n/*, */d/*, */i/* are combined to produce the word *candy*).

The Elision subtest assessed the child's ability to repeat verbally presented words back to the examiner. The child was required to repeat a target word (s) while omitting a specified phonological unit such as a speech sound or a syllable (e.g., say the word *toothbrush* without saying /tooth/ or say the word *cup* without saying /*k*/). A phonological awareness composite score was computed with standardized values of blending and elision scores. This composite was used in all subsequent analyses.

The Phonological Memory subtest was administered using two tasks: forward-digit span and nonword repetition. In the forward-digit span, a series of numbers was presented in a specified forward order via an audio recording, progressing gradually in length. The child was asked to repeat the series of digits as presented (e.g., say *8 3 6*). In the nonword repetition, a list of nonwords was presented via an audio recording. The child was asked to repeat the list of nonwords as presented (e.g., say *nigong*). For this measure, raw scores were computed based on correct responses.

The Naming Speed subtest, a timed task, consists of Rapid Color Naming and Rapid Object Naming subtests. The Rapid Color Naming subtest required the child to rapidly name a series of different colored blocks presented in rows on two pages (e.g., *blue red green black brown yellow red black blue*). Two forms were used: Form A and Form B. Each form consists of four rows, each of which depicts a sequence of nine colored blocks. The Rapid Object Naming subtest required the child to rapidly name a series of objects presented in rows on two pages. Two forms were used: Form A and Form B. Each form consists of four rows, each of which depicts a sequence of nine objects. A raw score was computed based on the time it took the child to name a page of colors or objects.

English morphological awareness

This test consists of a list of 20 high-frequency word pairs used in Duncan, Casalis, and Cole (2009) and adapted from Mahoney et al. (2000). This experimental measure assesses the child's implicit ability to determine if word pairs are morphologically related. In each word pair, the child was given the following directions: "In this game, I'm going to give you two words that are a little bit like each other. Tell me each time if the words I say are from the same family or not. Let's practice: *kind* and *kindness*, are they from the same family? *Teach* and *teacher*?" (Duncan et al., 2009, p. 413). The examiner provided the child with corrective feedback for the three practice items. Three additional trials were provided to children who experienced difficulty understanding the task.

The Wide range achievement test: revised (WRAT-R; Wilkinson & Robertson 1984; word reading subtest)

This norm-referenced test assesses word-decoding ability through word recognition. The examiner presented the child with a list of 42 isolated words (e.g., *how, animal, even, spell*) that progressed gradually in phonological complexity in terms of syllabic structure and length. The child was required to read all words and received a 0 for partially correct or incorrect items, and a 1 for correct items.

The woodcock reading mastery test-revised/normative update (Woodcock 1987/1998; word attack subtest)

This subtest, part of a published, norm-referenced assessment test, assesses children's ability to read pseudowords using decoding and structural analysis skills. The examiner presented the child with a list of 45 isolated pseudowords (e.g., *weaf, depine*) that progressed in length and complexity of syllabic structure. The child was required to read all pseudowords and received a 0 for partially correct or incorrect items, and a 1 for correct items.

English complex word reading fluency

This measure employs stimuli from the morphological relatedness task developed by Duncan et al. (2009) and the elicitation method used in the morphological awareness test, which was developed by Saiegh-Haddad and Geva (2008). It assesses the child's rate and accuracy of reading morphologically related words. For this task, the examiner asked the child to read a list of 20 high-frequency morphologically related or unrelated words accurately and rapidly. Stimuli for this measure consisted of the word pairs in the English morphological relatedness measure used in Duncan et al. (2009), described in the preceding section. Accuracy scores were computed by summing the total number of correctly read words. Fluency scores were computed by measuring the time it took the child to read the word pairs from the list. A total score on this measure was obtained by computing the total number of correctly read words per minute.

Vocabulary and reading comprehension

The remaining English measure was the Iowa Tests of Basic Skills (ITBS), a norm referenced achievement test. Student scores were obtained from the school's archival data. Because this study was designed to examine the relationship between language (e.g., vocabulary) and reading, only the Vocabulary and Reading Comprehension subtests of the ITBS were used. For the vocabulary subtest, the examiner presented the child with a word in a sentence or phrase context and asked the child to select the word that means the same as the target word from an array of four choices (multiple-choice format). For the Reading Comprehension subtest, the child was asked to read passages that varied in length and topic. Then the child was asked to select the correct answer to comprehension questions from an array of four choices (multiple-choice format). At least two-thirds of the passages required the child to draw inferences and generalize about what he/she had read. The school staff administered the ITBS in September, 2009. Scores were obtained from the school's records in May 2010.

Arabic measures

Because of the lack of norm-referenced tests in Arabic, experimental measures were developed or adapted for this study based on published Arabic and English assessments. Six Arabic measures that parallel the English measures were administered to ensure the children were tested in the same domains in both Arabic and English, thereby facilitating cross-linguistic comparisons across the two languages. All Arabic measures parallel the English measures in content, administration, and response elicitation methods. Five of the six measures –three adapted from Saiegh-Haddad and Taha (ms.) and two measures adapted from Saiegh-Haddad and Geva (2008)–were administered individually to each child and took approximately 45 min. The sixth measure was developed by the first author for this study and administered to the children in groups. Each group administration took 50 min to complete. For all Arabic assessments, a score of 0 was given for incorrect or partially correct responses and a 1 for correct responses; raw scores were computed based on correct responses on each subtest. The examiner presented instructions for all Arabic measures first in English and then in Arabic to ensure the children understood the task. A brief description of these measures follows.

Arabic phonological awareness

The Blending and Elision subtests assessed phonological awareness skills. They parallel the English CTOPP test described in the English measures section. The Blending subtest assessed the child's ability to blend individual phonemes. The stimuli for the Blending subtest, adapted from a segmentation task developed by Saiegh-Haddad and Taha (ms.), consisted of two practice items and 20 target items that progressed in length and phonological complexity. The examiner presented orally each set of individual phonemes and asked the child to blend the speech sounds to make syllables or words (e.g., /b/, /æ/, /j/, /t/ are combined to produce the word *b* æ *jt* [*house*]). A score of 0 was given for incorrect or partially correct responses and a 1 for correct responses.

The Elision subtest assessed the child's ability to repeat verbally-presented words. The stimuli for this subtest, adapted from Saiegh-Haddad and Geva (2008), consisted of two practice items and 40 target items that progressed in phonological complexity (i.e., progressed from using larger phonological units to smaller phonological units). The examiner orally presented each target word and the child repeated the target word omitting the specified phonological unit, such as a phoneme or a syllable (e.g., say the word *barmil* without saying /bar/ or say the word *samir* without saying /s/).

Arabic morphological awareness

This measure, developed by Saiegh-Haddad and Geva (2008), assessed a child's implicit morphological awareness knowledge by presenting children with 20 pairs of phonologically transparent words. Words consisted of two morphemes and had four patterns: agentive (e.g., *ka:teb* [*writer*]), passive adjective (e.g., *maktu:b* [*written*]), place adverbial (e.g., *maktab* [*office*]) and reciprocal verbal (e.g., ka:taba [*corresponded*]) (Saiegh-Haddad & Geva, 2008). These words, frequent in stem and derived forms, have a word unit of 30 or below. The child was given the following instructions: "You will hear pairs of words that sound alike. Listen carefully and tell me whether the words that I say are from the same family or not." The child responded *yes* if the word pair was morphologically related, and *no* if the word pair was morphologically unrelated. Three pairs of high-frequency words, of each stem and derived form, were presented as practice items. Alpha reliability coefficient for the Arabic morphological task was .76.

Arabic word reading

Developed by Saiegh-Haddad and Taha (ms.), this measure presents children with a list of 40 vowelized and 40 unvowelized words that progress in length and complexity. The vowelized Arabic word list consists of words without inflectional endings. The child reads words presented in six rows on one page. For unvowelized word reading, the examiner presents the child with an unvowelized Arabic word list of 40 words without inflectional endings.

Arabic pseudoword decoding

Saiegh-Haddad and Taha (ms.) developed this measure to assess a child's ability to decode pseudowords (nonwords). Children read a list of 41 pseudowords that progress in length and phonological complexity. Pseudowords are presented in vowelized Arabic without inflectional endings (e.g., *Thamir* instead of *Thamiron*).

Arabic complex word reading fluency

This measure was adapted from Saiegh-Haddad and Geva (2008) and assesses the child's rate and accuracy of reading morphologically related words. Stimuli for this measure consist of the word pairs used in the Arabic morphological relatedness measure described in the Arabic Morphological Awareness section. Accuracy scores are computed by adding the number of words read correctly. Fluency scores were computed by measuring the time it took the child to read the word pairs. The final score on this measure was computed by dividing the accuracy score by the fluency score.

Arabic vocabulary and reading comprehension

An adaptation of the *Gates-MacGinitie Reading Test, Fourth Edition, Level 2* (GMRT; MacGinitie, MacGinitie, Maria, & Dryer, 2000) was used to assess children's Arabic vocabulary and reading comprehension. The GMRT was selected because it is more sensitive to oral language proficiency compared to other reading measures (Cutting & Scarborough, 2006). Level 2 of the GMRT was selected for translation into Arabic because it includes pictures along with sentences and short paragraphs with the pictures guiding the child as the child read the words and text. This reliance on pictures as a source for extracting meaning parallels the instruction received at school. The examiner provided the children with a response form with multiple-choice questions. Vocabulary was assessed using 64 vocabulary items.

Each item included a pictorial stimulus with four word choices. The child circled the word that depicted the picture from a multiple-choice array.

The adaptation of the Gates-MacGinitie test into Arabic proceeded as follows. First, the test items were translated from English to Arabic, and then back-translated from Arabic to English and back to Arabic to ascertain that the intended meaning of each item was preserved. A panel of four native Arabic speakers, which included the first author, performed translation of the test. All members had graduate college degrees and had received Arabic instruction through college. Panel members translated sections of the test and then shared their translations. The follow up discussion focused on the commonalities and differences in their translations. Once the panel agreed upon a translation, it was deemed adequate to include in the test. On average, it took two to three rounds of discussions before the panel accepted the translation.

Reading comprehension was assessed using cloze tests. Each cloze test consisted of 28 items. For each item, one or two sentences were presented along with three pictorial stimuli. The child circled the picture that best represented the meaning of the sentence. A score of 0 was given for incorrect (e.g., did not mark the target word) or partially correct responses (e.g., marked two responses including the target word) and 1 for correct responses. Raw scores were computed based on correct responses on all subtests.

Data analysis plan

We used SPSS for data screening to inspect descriptive statistics for out-of-range values, plausibility of means and standard deviations, presence of outliers, and visual plotting of the data. Screening involved evaluating missing data, checking plots for nonlinearity and heteroscedasticity, identifying skewness and kurtosis, transforming variables as warranted, and evaluating variables for multicollinearity and singularity (Tabachnick & Fidell, 2007). We then conducted partial correlations to examine associations between language and reading measures in English and Arabic while controlling for chronological age. Finally, we performed multiple regression analyses to examine the predictors of word reading and reading comprehension in English and Arabic.

Results

Table 3 displays means, standard deviations, and range of scores for all tasks administered in this study. As Table 3 indicates, positive skew on the Arabic vocabulary measure was corrected by alternatively using standardized scores (z-scores) in the remaining analyses. None of the other measures was skewed markedly. This could be related to the fact that the majority of children come from homes in which the parents spoke English or a combination of English and another language (e.g., Arabic, Urdu, French, Tamil). Inspection of the scores on the Arabic measures reveals comparable means and standard deviation scores on the vowelized word reading accuracy and unvowelized word reading accuracy measures. This

Table 3 Variable mean and standard deviation scores

Variable	Mean	*SD*	Range
Arabic language measures			
Elision	22.63	6.76	5–37
Blending	14.17	3.53	3–20
Morphological awareness	14.89	3.55	6–20
Vocabulary	.00	1.76	−3.43–6.85
Arabic reading measures			
Vowelized reading accuracy	20.15	11.47	0–38
Unvowelized reading accuracy	21.19	11.52	0–37
Pseudoword decoding	20.93	11.41	0–39
Complex word reading fluency	12.44	10.14	0–58.82
Reading comprehension	10.73	3.16	3–20
English language and cognitive measures			
Phonological awareness composite	53.38	12.29	33–93
Phonological memory composite	5.88	1.55	3–10
Rapid naming composite	4.02	2.04	1–9
Morphological awareness	2.48	1.67	0–5
Vocabulary	200.00	29.00	134–262
English reading measures			
Word decoding (WRAT-3)	76.76	13.98	45–111
Pseudoword decoding (WRMT-R)	108.45	10.58	67–137
Complex word reading fluency	1.58	.51	0–2.86
Reading comprehension	202.78	30.84	150–268

Standardized z-scores were used to report means (Zero) and standard deviations for Arabic vocabulary

could be attributable to the instructional approach used to teach reading in the school, which focused on teaching sight words in addition to decoding skills using diacritical markers.

The first research question examined the relationship between children's phonological awareness in English and Arabic. Results revealed positive partial correlations between Arabic phonological awareness and English phonological awareness, after controlling for chronological age. As Table 4 indicates, positive correlations were found between Arabic elision and English Phonological Awareness Composite, $r = .47$, $p < .001$ and between Arabic blending and English Phonological Awareness Composite, $r = .43$, $p < .001$. Results also indicated a positive partial correlation between Arabic phonological awareness (elision and blending) and other aspects of English phonological processing. Specifically, Arabic elision was positively correlated with English phonological memory, $r = .27$, $p < .05$, and Arabic blending was positively correlated with English phonological memory, $r = .34$, $p < .01$, after controlling for chronological age.

The second research question examined the relationship between children's morphological awareness in English and Arabic. As Table 4 indicates, partial correlations between language and reading in English and Arabic indicated no

Table 4 Correlation matrix with age co-varied (N = 83)

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. AMA	–	.26*	.08	.42***	.21	.26*	.25*	.35**	.11	.15	.14	.10	−.04	.25*	.12	.12
2. AEL		–	.40***	.53***	.59***	.59***	.65***	.21	.07	.47***	.27*	.06	.05	.48***	.49***	.23*
3. ABL			–	.38***	.40***	.48***	.48***	.20	.17	.43***	.34**	.20	−.11	.31**	.34**	.29**
4. ACW				–	.58***	.72***	.72***	.39***	.26*	.28*	.26*	.28*	−.12	.31**	.36**	.25*
5. APD					–	.88***	.90***	.16	.14	.49***	.20	.00	−.02	.35**	.48***	.28*
6. AVR						–	.90***	.23*	.21	.46***	.25*	.06	−.01	.31**	.46***	.31**
7. AUR							–	.33**	.26*	.47***	.28*	.02	−.04	.36**	.49***	.28*
8. AVC								–	.33**	.08	.04	−.01	−.02	.18	.01	−.10
9. ARC									–	.20	.09	.09	.01	.18	.08	.12
10. EPA										–	.39***	.10	.16	.49***	.46***	.29**
11. EPM											–	.13	−.08	.48***	.38**	.13
12. ERN												–	−.15	.15	.14	.39***
13. EMA													–	.20	.13	.03
14. EWD														–	.53***	.17
15. EWA															–	.41***
16. ECW																–

* $p < .05$, ** $p < .01$, *** $p < .001$

AMA Arabic morphological awareness, *AEL* Arabic elision, *ABL* Arabic blending, *ACW* Arabic complex word reading fluency and accuracy, *APD* Arabic pseudoword decoding, *AVR* Arabic vowelized word reading, *AUR* Arabic unvowelized word reading, *EPA* English phonological awareness composite, *EPM* English phonological memory composite, *ERN* English rapid naming composite, *EMA* English morphological awareness, *EWD* English word decoding, *EWA* English word attack, *ECW* English complex word reading fluency and accuracy evidence of a relationship between children's morphological awareness in English and Arabic, while controlling for chronological age, $r = -.04$, $p > .05$ (see Table 4).

The third research question explored whether the contribution of children's phonological skills versus their morphological skills differs as a function of the reading task in English and Arabic. Thus, a series of simultaneous multiple regressions were conducted. For these analyses, English phonological awareness composite, English phonological memory composite, English rapid naming composite, English morphological awareness, Arabic blending, Arabic elision, and Arabic morphological awareness served as the independent variables (IVs) while English word reading, English pseudoword decoding, English complex word reading fluency, English Reading comprehension, Arabic vowelized word reading, Arabic unvowelized word reading, Arabic pseudoword decoding, Arabic complex word reading fluency, and Arabic reading comprehension served as the respective dependent variables (DVs). Results indicated that Arabic phonological skills—both elision and blending—predicted Arabic word reading and Arabic pseudoword decoding; they explained 67% of the variance in Arabic vowelized word reading accuracy, 71% of the variance in Arabic unvowelized reading accuracy, and 64% of the variance in Arabic pseudoword decoding. Furthermore, Arabic phonological awareness skills (elision) and Arabic morphological awareness skills predicted and explained 67% of the variance in Arabic complex word reading fluency. Only chronological age contributed significantly to Arabic reading comprehension skills (see Table 5).

For English, the contribution of phonological skills as an IV was examined in two ways: (1) the phonological awareness composite only (to enable cross-linguistic comparison between Arabic and English); and (2) all three aspects of phonological processing, namely phonological awareness, phonological memory, and rapid naming. Results revealed that when English phonological awareness composite and English morphological awareness were entered as IVs, predictors in English were similar to those in Arabic, with phonological awareness predicting English word reading, English pseudoword decoding, and English complex word reading fluency. However, when other aspects of English phonological processing (i.e., English phonological memory and English rapid naming) were entered into the regression equation, a slightly different pattern of results emerged. Specifically, English phonological memory, English phonological awareness, and English morphological awareness explained 39% of the variance in English word reading; English phonological memory and English phonological awareness explained 29% of the variance in English pseudoword decoding; English rapid naming, English phonological awareness, and chronological age explained 39% of the variance in English complex word reading fluency; and chronological age and morphological awareness (marginal significance) explained 63% of the variance in English reading comprehension (see Table 6).

The fourth research question was exploratory in nature and sought to examine whether children's grade level moderates the relationship between language and reading comprehension in Arabic. Specifically, in the last set of analyses, we asked whether morphological awareness uniquely contributed to children's reading comprehension scores above and beyond children's grade, phonological awareness,

Table 5 Summary of simultaneous regression analyses of language components on children's Arabic reading skills (N = 83)

Variable	Arabic vowelized word reading accuracy			Arabic unvowelized word reading accuracy			Arabic pseudoword decoding			Arabic complex word reading fluency			Arabic reading comprehension		
	B	*SE B*	*β*	*B*	*SEB*	*β*	*B*	*SE B*	*β*	*B*	*SE B*	*β*	*B*	*SE B*	*β*
Age	.12	1.08	.01	1.1	1.0	.08	.88	1.10	.07	1.60	.95	.15	.74	.38	.22[a]
Arabic morphological awareness	.39	.29	.12	.30	.27	.09	.22	.29	.07	.86	.25	.30**	.09	.10	.10
Arabic elision	.76	.16	.45***	.88	.15	.52***	.83	.17	.49***	.54	.14	.36***	−.01	.06	−.03
Arabic blending	.95	.30	.29**	.85	.28	.26**	.65	.31	.20*	.59	.26	.20*	.15	.11	.17

* $p < .05$, ** $p < .01$, *** $p < .001$

[a] Marginal significance at .054

Table 6 Summary of simultaneous regression analyses of language components on children's English reading skills (N = 83)

Variable	English word decoding			English pseudoword decoding			English complex word reading fluency			English reading comprehension		
	B	*SE B*	*β*	*B*	*SE B*	*β*	*B*	*SE B*	*β*	*B*	*SE B*	*β*
Age	−1.72	1.46	−.11	1.95	1.24	.16	.27	.11	.24*	22.75	3.14	.68***,a
English morphological awareness	2.89	1.37	.21*	1.29	1.16	.12	.02	.10	.02	5.81	2.94	.19*,a
English phonological awareness	.39	.13	.30**	.33	.11	.33**	.03	.01	.33**	.42	.27	.15
English phonological memory	.40	.11	.37***	.21	.09	.24*	.01	.01	.11	.41	.23	.17
English rapid naming	.12	.11	.11	.08	.09	.09	.04	.01	.44***	−.04	.23	−.02

* $p < .05$, ** $p < .01$, *** $p < .001$

[a] For English reading comprehension, the N was 55 instead of 83

and vocabulary within Arabic and English. We were interested in examining whether the effect of grade as an independent variable was different across English and Arabic, as this could be a proxy measure of the effect of instruction on reading comprehension outcomes. Thus, a series of hierarchical regression analyses was performed. For the first analysis, Arabic reading comprehension served as the DV, while grade, Arabic phonological awareness, Arabic vocabulary composite, and Arabic morphological awareness served as the IVs.

For the second analysis, English reading comprehension served as the DV, while grade, English phonological awareness composite, English vocabulary, and English morphological awareness served as the IVs. As mentioned earlier, only third grade and fifth grade data were available in English. Therefore, all analyses that examined English vocabulary and reading comprehension had a smaller sample size of 55 subjects instead of the whole sample of 83 subjects.

In the first analysis examining the relation between Arabic morphological awareness and Arabic reading comprehension, results revealed that at step 1, grade was entered and explained 11% of the variance in Arabic reading comprehension, F (1, 81) = 9.93, $p < .01$. At step 2, Arabic phonological awareness and Arabic vocabulary were entered, explaining 18.5% of the variance in Arabic reading comprehension, F (3, 79) = 5.90, $p < .01$. After entry of Arabic morphological awareness at step 3, the total variance explained by the model as a whole was 18.8%, F (4, 78) = 4.47, $p < .01$. Thus, Arabic morphological awareness contributed only .3% of additional variance in Arabic reading comprehension after controlling for the previously mentioned variables (see Table 7).

To determine whether morphological awareness predicts reading comprehension after the effect of phonological processing and vocabulary have been taken into account in English, a hierarchical regression was conducted for third and fifth grades. At step 1, grade was entered and explained 57% of the variance in English reading comprehension, F (1, 53) = 69.28, $p < .001$. At step 2, English phonological awareness and English vocabulary were entered, explaining 81% of the variance in English reading comprehension, F (3, 51) = 70.55, $p < .001$. After entry of English morphological awareness at step 3, the total variance explained by the model as a whole was 81%, F (4, 50) = 52.00, $p < .001$. Thus, English

Table 7 Summary of hierarchical regression analysis of Arabic language measures on Arabic reading comprehension ($N = 83$)

Variable	Model 1			Model 2			Model 3		
	B	*SE B*	*β*	*B*	*SE B*	*β*	*B*	*SE B*	*β*
Grade	.41	.13	.33**	.29	.14	.24*	.31	.14	.25*
Arabic phonological Awareness				.03	.06	.04	.03	.07	.05
Arabic vocabulary composite				.16	.06	.28*	.17	.07	.29*
Arabic morphological awareness							−.07	.12	−.07
R^2		.11			.19			.19	
F for change in R^2		9.93			3.56			.33	

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

Table 8 Summary of hierarchical regression analysis of English language measures on English reading comprehension ($N = 55$)

Variable	Model 1			Model 2			Model 3		
	B	*SE B*	β	*B*	*SE B*	β	*B*	*SE B*	β
Grade	.93	.11	.75***	.19	.12	.15	.19	.12	.15
English phonological awareness				−.02	.07	−.02	−.02	.07	−.02
English vocabulary composite				.78	.10	.78***	.77	.11	.77***
English morphological awareness							.02	.07	.02
R^2		.57			.81			.81	
F for change in R^2		69.28			31.42			.09	

*** $p < .001$

morphological awareness did not contribute any additional variance in English reading comprehension after controlling for the above-mentioned variables, R-squared change = .00, F change (1, 53) = .09, $p > .05$ (see Table 8).

Discussion

This study examined the relationship between language and reading in bilingual English-Arabic children. The results point to the importance of speech and language in predicting reading outcomes: whereas speech is critical to word recognition during the initial period of learning to read, language is paramount to reading comprehension. Furthermore, the findings suggest that for bilingual English-Arabic children, different language components may be implicated in the development of both word reading and reading comprehension. These findings are consistent with tenets of the extended Triangle Model of reading (Bishop & Snowling, 2004).

The study builds on a recent study by Saiegh-Haddad and Geva (2008) that investigated the relationship between phonological awareness, morphological awareness, and word reading in bilingual English-Arabic children in Canada. It shares with the study by Saiegh-Haddad and Geva (2008) a focus on phonological and morphological awareness as predictors of word reading, pseudoword decoding, and complex word reading fluency. This study, however, extends their findings by investigating the role of vocabulary and reading comprehension in English and Arabic. It also adds to the emerging body of evidence that bolsters the paramount role language plays, beyond phonology, in reading development.

The results of the study indicate associations between phonological awareness in Arabic and phonological awareness in English, thus lending support to the universality of phonological awareness in reading. However, no such associations were found between morphological awareness in Arabic and morphological awareness in English, which is consistent with the view that reading development may be constrained by the typology of the language. Perhaps differences in the morphological structure across English and Arabic drive this finding. Further, the results show within language relationship between phonological and morphological awareness in Arabic and English, corroborating the findings reported in previous research (Durgunoglu, 2002; Geva & Wang, 2001; Saiegh-Haddad & Geva, 2008).

This study also investigated whether phonological and morphological skills differed in their contribution to reading as a function of the reading task. The results indicated that phonological awareness explained unique variance in word reading accuracy, pseudoword decoding, and complex word reading fluency across Arabic and English; Arabic morphological awareness explained unique variance in Arabic complex word reading fluency; and English morphological awareness explained unique variance in English word reading, with only marginal statistical significance in English reading comprehension.

These findings concur with Saiegh-Haddad and Geva (2008) who found that Arabic phonological awareness predicted Arabic vowelized word reading and Arabic pseudoword decoding. Likewise, English phonological awareness predicted English word reading and English pseudoword decoding. However, unlike Saiegh-Haddad and Geva's study, the current study examined phonological and morphological contributions to *both* vowelized and unvowelized word reading accuracy and revealed that phonological awareness explained a unique amount of variance in unvowelized word reading accuracy as well. These findings align with those reported by Saiegh-Haddad (2011b) which indicated that phonological awareness skills were associated with both reading vowelized as well as unvowelized words and texts. Arguably, children who read Arabic rely on phonological processes and GPC rules when reading vowelized and unvowelized words, perhaps because similar processes—phonological processes and morphological processes—underlie reading in Arabic.

Another finding of this study that departs from Saiegh-Haddad and Geva's (2008) study is that phonological awareness and phonological memory were the only predictors of English pseudoword decoding. In their study, both phonological awareness (phonological memory was not assessed) and morphological awareness predicted English pseudoword decoding. Methodological considerations could account for the discrepancy in results. The two studies employed different measures of morphological awareness. The current study used a morphological relatedness measure, whereas Saiegh-Haddad and Geva (2008) used both morphological relatedness and morphological decomposition measures that were combined into a single morphological awareness composite. Perhaps this difference led to considerable variability in the morphological scores obtained within their sample of children.

Predictors of Arabic complex word reading fluency were Arabic phonological awareness (elision) and Arabic morphological awareness. However, only English phonological awareness and rapid naming predicted English complex word reading fluency. The lack of contribution of morphological awareness in English could be due to the ceiling effect obtained on this measure.

Findings related to reading comprehension differed in Arabic and English. In Arabic, neither phonological nor morphological awareness predicted reading comprehension. However, in English, morphological awareness was marginally related to English reading comprehension. There are two possible explanations for the differences in the findings. One, different derivational morphological tasks were used in the two languages. Two, the differences could be attributed to the differences in the children's proficiency in the two languages. English is the first language for most children in the study; therefore, it is likely that their vocabulary in English is better than their vocabulary in Arabic. Perhaps a certain threshold level in vocabulary is needed (better English command or language proficiency) before the contribution of any morphological processes can be observed.

Additional findings indicated that morphological awareness within each language did not predict reading comprehension above and beyond phonological awareness and vocabulary. Possibly task demands contributed to these findings. As noted previously, morphological awareness was assessed using a morphological relatedness task, a recognition task. Most children scored well in both languages on this task. The reduced variability on this measure may explain the lack of significant results. By Contrast, vocabulary predicted reading comprehension within Arabic and English. These findings concur with the extant research regarding the role vocabulary plays in reading comprehension processes across languages (Cain & Oakhill, 2007; de Jong & Van der Leij, 1999).

The results also indicated that the contribution of grade in Arabic reading comprehension remained significant even after taking into account the effect of phonological awareness, vocabulary, and morphological awareness. However, the same did not hold for English as the effect of grade disappeared once phonological awareness, vocabulary, and morphological awareness were entered into the regression equation. Perhaps, unlike English instruction, Arabic instruction was essential to Arabic reading comprehension, as it was the primary source of Arabic the children received.

Considerable differences were also noted in the amount of variance explained between English and Arabic reading comprehension models. The entire Arabic model only explained approximately 19% of the variance in Arabic reading comprehension skills while the entire English model explained 81% of English reading comprehension skills. Two reasons may account for this finding. First, the English measures were much more "parallel" in nature than the Arabic measures and may have assessed slightly more sophisticated representations of vocabulary and comprehension. For example, the ITBS was used for both comprehension and vocabulary in English, whereas a translated vocabulary and comprehension measure was used in Arabic. In contrast to the translated Arabic items, the ITBS at fifth grade presents children with a word in the context of a short phrase or sentence and children are to select the answer that has the same meaning as the target word. Hence, children are reading in context, which may be tapping into their comprehension skills more than the Arabic tasks, which tended to rely on pictorial stimuli to aid children in their semantic identification. A second reason for a discrepancy in model scores may be attributed to the sample size of each analysis. Because regression coefficients are related to the size of the sample (Tabachnick & Fidell, 2007), it is possible that the English model's r squared coefficients are slightly inflated. Additional research should attempt to use more parallel Arabic and English vocabulary and comprehension measures.

Together, the findings of this study are compatible with the developmental-interactionist theory of learning (Diamond, 2007). This theory asserts that there is neither a central executive nor a single cause of typical or atypical reading development. Rather throughout development, there exists a spectrum of abilities (Snowling, 2000) that manifests across the language components at different times as strengths and weaknesses. Viewed from this theoretical perspective, the bilingual children in this study exhibit their own strengths and weaknesses. While strengths are evident in children's ability to recruit various components of language for the purpose of word reading and reading comprehension, weaknesses are manifest in children's poorly specified phonological representations, likely due to Arabic diglossia. These strengths and weaknesses interact with developmental and environmental forces (e.g., biological, social-cultural) to shape the children's reading outcomes. Depending on task demands and children's developmental levels, different language components are called upon to aid bilingual children in the process of gaining meaning from text.

Limitations

When interpreting the results of this study, it is important to note that the study design only permits the examination of the relationship between children's current language and reading level. Because we did not utilize a preselection procedure for determining children's bilingual language and literacy competence as a condition or prerequisite for participation in this study, it is possible that findings were influenced by variance in children's basic literacy and language skills. Related to this issue, it is unclear whether children's performance on Arabic language and reading measures was a result of the specific Arabic instruction the children received in school or whether it was a direct reflection of their Arabic language proficiency and their degree of bilingualism. Equally unknown is whether differences in how some component skills were conceptualized (phonological processing as encompassing naming speed) or measured (e.g., vocabulary), and typological differences (e.g., morphological awareness) across English and Arabic influenced children's performance. Finally, the small sample size limits the generalizability of findings to other bilingual English-Arabic children in the US.

Future directions

Examining the relationship between language and reading in Arabic provides an ideal ground to test further the tenability of the extended Triangle Model of reading (Bishop & Snowling, 2004). As the findings suggest, the process of reading Arabic involves both bottom-up and top-down processes, and interaction among various language components. Additionally, given that Arabic-specific characteristics such as diacritics (Share, 2008) and diglossia (Saiegh-Haddad, 2003) are not central to English or other European languages, the study of Arabic holds the potential to inform a more comprehensive theory of reading development that does not rely exclusively on anglocentric research (Share, 2008). Future research must examine the language-reading link in Arabic using a diverse sample of monolingual and bilingual children from various socioeconomic and parent education backgrounds. Future studies should seek to develop additional Arabic measures that are representative of diverse Arabic speakers and that assess multiple language and literacy skills, such as phonological processing in Arabic.

Another major direction for future research in Arabic is to explore the broader social context and the reasons for specific patterns of language use. Because diglossia is a fundamental characteristic of Arabic and is shaped by social-cultural-historical factors that affect the linguistic distance between oral and written language, future research should focus on exploring social-cultural mechanisms of Arabic language use (e.g., opportunity to learn, availability of resources, instructional approaches, teacher development, parent education and beliefs regarding first and second language learning, and home literacy practices) to shed light on the relationship between Arabic oral and written language forms. Such an understanding of the circumstances under which children learn language and learn to read is essential for a fuller understanding of the development of reading and reading disabilities in bilingual and monolingual Arabic children.

Conclusion

This study supports the view of reading as a language-based process (Catts & Kamhi, 2005; Nation & Snowling, 2004), and bolsters the need for an all-encompassing account of reading development that extends beyond phonology. As the results suggest, depending on the reading task, the bilingual children in this study appeared to rely on a division of labor among various language components to meet the demands of the reading task (Bishop & Snowling, 2004). These conclusions support the importance of language in predicting reading outcomes in bilingual English-Arabic children; whereby enhanced language skills may be protective factors and poor language skills may be risk factors (Snowling, 2000).

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