Language Predictors of Word Reading in Bilingual English-Arabic Children

Lama K. Farran[1],Gary Bingham[2]&Mona Matthews[3]

Abstract

Word reading fluency and word reading accuracy play a critical role in reading development (Perfetti, 1985; Stanovich, 1986) and are related to multiple language components such as phonological, morphological, and vocabulary skills in monolingual children. Our knowledge about this relation remains limited in bilingual children, however. This study investigates language predictors of word reading fluency and word reading accuracy in bilingual English-Arabic children. We conducted hierarchical regression analyses to examine the relation among phonology, morphology, vocabulary, word reading accuracy, and word reading fluency. Results revealed that Arabic language components differentially predicted Arabic word reading accuracy and Arabic word reading fluency. These findings lend support for the extended triangle model of reading (Bishop & Snowling, 2004), which highlights the paramount role of multiple components of language in reading development. Implications for research and pedagogy are presented.

Keywords: Arabic, bilingual, language, reading, word reading accuracy, word reading fluency, phonological awareness, morphological awareness, vocabulary, triangle model of reading.

[1]Communication Sciences & Disorders, University of West Georgia, USA
Address for correspondence:
Lama K. Farran, 1601 Maple Street, Carrolton, GA 30118
Email lfarran@westga.edu

[2]Early Childhood Education, Georgia State University, USA
[3]Early Childhood Education, Georgia State University, USA

Introduction

Learning to read is a developmental process that rests on a foundation of language (Bishop & Snowling, 2004; Scarborough, 2001) and draws from multiple component skills including print-related skills (Sénéchal& LeFevre, 2002) and word reading (Catts & Kamhi, 2005). Evidence suggests that word reading accuracy and word reading fluency are foundational components in reading development. Specifically, word reading fluency is thought to enable children's accurate, fast, and efficient reading, thus freeing attentional resources to be allocated to higher order processes such as reading comprehension in monolingual (LaBerge & Samuels, 1974; Perfetti, 1985) and bilingual children (Pasquarella, Chen, Gottardo, & Geva, 2015).

Many cross-linguistic studies point to multiple predictors of reading fluency in monolingual and bilingual children, including phonological awareness (Landerl & Wimmer, 2008; Saiegh-Haddad & Geva, 2008), and vocabulary (Gottardo, 2002; Jean & Geva, 2009), with the relative contribution to reading varying as a function of the specific orthography and children's developmental level. Overwhelmingly, however, studies examining reading have conceptualized and measured word reading differently, often failing to distinguish between *word reading accuracy* (number of words read correctly) and *word reading fluency* (number of words read correctly per unit of time, e.g., one minute).

The importance for delineating distinct factors associated with word reading accuracy versus word reading fluency is well substantiated on both theoretical and empirical grounds (Wolf & Bowers, 1999; Landerl & Wimmer, 2008). Notably, each has been differentially related to the identification of typical and atypical reading development across languages that vary in transparency and orthographic depth (Ziegler & Goswami, 2005). While reading accuracy predicts reading outcomes in less transparent languages such as English, it is not equally predictive of such outcomes in more transparent languages like German. Rather, it is word reading fluency-fast and accurate word reading-that determines risk for reading disabilities in transparent languages. The case of Arabic is unique in that Arabic can vary anywhere along the transparency continuum: It is more transparent when vowelized or presented with diacritics, and less transparent when unvowelized or presented without diacritics, based upon the orthography used; thus offering a unique opportunity for examining reading development across transparency levels and grain sizes (Ziegler & Goswami, 2005). Relatively few studies have investigated word reading accuracy, word reading fluency, and language factors that are implicated in their development in Arabic (Abu-Leil, Share, & Ibrahim, 2014). This is of particular importance in the context of learning Arabic as a second language, whereby Arabic linguistic representations may be less-than-optimal. This study aims at examining the relationship among language components, namely, phonology, morphology, and vocabulary; and word reading, including word reading accuracy and word reading fluency in children in grades 3 through 5. The sample consists of bilingual children who learn Arabic as their second language.

In the following section, we present the theoretical framework that guides this study followed by a brief background of the Arabic language. Next, we review the research evidence that addresses the role of select language components that have been implicated in word reading accuracy and word reading fluency in diverse languages, including Arabic. Lastly, we offer a brief review of language and reading in bilingual children who learn Arabic.

Theoretical Framework

The theoretical framework for this study is an extended version of the Triangle Model of reading (Bishop & Snowling, 2004) that relies on the role experience and contextual influences play in language and reading development. This dynamic model depicts 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 through semantics (see figure 1). One strength of this model is that it takes into account developmental differences in children's use of grapheme-phoneme correspondence to activate semantic and phonological
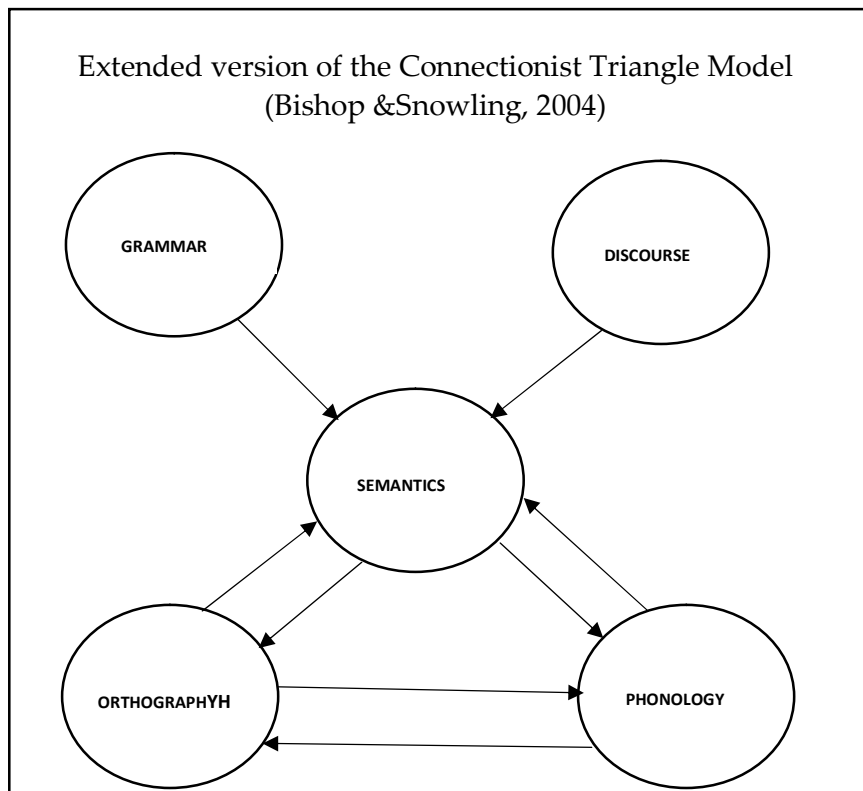

Figure 1. Extended Version of the connectionist Model of Reading (Bishop & Snowling, 2004 adapted from Seidenberg & McClelland, 1989)

representations. Moreover, this model highlights the dynamic division of labor among these language components that shifts as a function of the demands of the reading task and the various compensatory strategies bilingual children might resort to under different conditions. This model highlights the role of multiple components of language and contextual factors (e.g., transparency) in the development of word reading accuracy and word reading fluency.

Overview of Arabic

Arabic presents a case of diglossia (Ferguson, 1959), requiring beginning readers to navigate two varieties of the Arabic language: Modern Standard Arabic (MSA), known as fusha, acquired via formal education and used in formal speeches, media, and for various written purposes; and Spoken Arabic Vernacular (SAV), known as ammiya, used as the primary mode of communication at home and in informal ordinary conversation. The two forms of Arabic are used for mutually exclusive functions, such that when MSA/fusha is used, SAV/ammiya is typically not used, creating a linguistic distance between the two (SAV and MSA) (Saiegh-Haddad, 2003) that impacts all components of language, including phonology and vocabulary; and compromising the optimal acquisition of high-quality linguistic representations.

In the present study, the bilingual children are exposed to at least two varieties of Arabic, MSA/fusha (main form of Arabic employed for reading and writing and used sometimes by teachers in the classroom) and SAV/ammiya (spoken form used in the classroom along with MSA/fusha). In addition, 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., *kalima*). When learning MSA/fusha, children are presented with vowelized and unvowelized text. Therefore, children learning to read Arabic are required to map different written forms (vowelized Arabic and unvowelized Arabic) onto different forms of oral language (SAV/ammiya and MSA/fusha). Combined, these factors contribute to the complexity of learning to read in Arabic.

In addition to its diglossic nature, Arabic is characterized by a complex, visually dense orthography, which often includes diacritics to denote short vowels, resulting in a busy script whereby each letter and diacritical marker occupy one slot, compared to English in which letters and vowels occupy different slots. Arabic is also characterized by a pronounced variation in letter shapes as a function of word position, such that each letter may take on a different shape based upon whether it is written in the beginning, middle, or end of the word. Unlike English and other European languages, Arabic is read and written from right-to-left. Collectively, these factors contribute to the challenges of learning to read and use Arabic, especially in the context of a second language.

Language and Reading

Phonology

Phonology is one component of language concerned with the study of the sound system in a given language.Phonological awareness (PA) is the ability to manipulate the sound units of a language such as words, syllables, rimes, and phonemes. PA has been found to play a causal role in reading development across diverse orthographies (for a review, see Dickinson, McCabe, Anastasopoulous, Peisner-Feinberg, & Poe, 2003). Studies have shown PA as a predictor of word reading (Muter, Hulme, Snowling, & Stevenson, 2004) that has a reciprocal relationship to word reading accuracy and fluency both concurrently and longitudinally (Hogan, Catts, & Little, 2005). Further, deficits in phonological awareness have been linked to word reading difficulties that are central in diagnosing reading disabilities (Lyon, Shaywitz, & Shaywitz, 2003).

A central role of PA is its ability to predict word reading fluency, particularly in Semitic languages such as Arabic and Hebrew (Saiegh-Haddad & Geva, 2008). In their longitudinal study of early reading acquisition in Hebrew, Shatil and Share (2003) found that Kindergarten PA predicted first grade word reading accuracy and fluency, and that the relationship between PA and reading is particularly strong in the very early stages of reading acquisition.

Morphology

Morphology is another component of language concerned with the study of the smallest units of meaning (morphemes). The Arabic language is characterized by a non-concatenative, productive morphology, whereby readers derive words by inserting a consonantal root onto a phonological-morphological pattern or template. The root and pattern are abstract entities that do not function independently from each other, but are combined to form words (Boudelaa & Marslen-Wilson, 2015).

Morphological awareness (MA)—the awareness of and ability to manipulate morphemes is closely related to word reading (Carlisle, 2000; 2010) and contributes uniquely to reading above and beyond the contribution of other language components such as phonology or vocabulary (Deacon & Kirby, 2004;Goodwin, Huggins, Carlo, August, & Calderon, 2013), especially in morpheme-based languages such as Arabic (Boudelaa & Marslen-Wilson, 2015). Further evidence for the importance of morphology comes from intervention research in English- (Katz & Carlisle, 2009) and Arabic-speaking children with and without learning disabilities (Mahfoudhi, Elbeheri, Al-Rashidi, & Everatt, 2010; Reed, 2008; Taha & Saiegh-Haddad, 2016); and comparative work across formal and spoken dialect varieties of Arabic (Boudelaa & Marslen-Wilson, 2013).

MA tasks vary in the extent to which they tap surface as opposed to deep morphological knowledge and reflect linguistic knowledge requiring the reader (or the listener) to either unconsciously identify morphemic units through implicit (epilinguistic) morphological awareness tasks that reflect automatic lexical processing, or consciously identify those units through explicit (metalinguistic) morphological awareness tasks in young children (Gombert, 1992). The limited research that investigated children's implicit morphological knowledge found that children's ability to automatically identify morphemic units is associated with improved word or sentence reading outcomes in different orthographies (Casalis & Louis-Alexandre, 2000; Gombert, 1992; Saiegh-Haddad & Geva, 2008).

Vocabulary

Vocabulary skills are strongly related to word reading directly (Muter et al., 2004; Nation & Snowling, 1998; Ouelette, 2006; Plaut, McClelland, Seidenberg, & Patterson, 1996; Scarborough, 2001) or indirectly mediated by phonological processing (Whitehurst & Lonigan, 1998) —a connection that is central to the lexical restructuring hypothesis (Metsala & Walley, 1998). According to this hypothesis, vocabulary knowledge is paramount in the development of phonological awareness, which in turn impacts word reading. This is due to the fact that vocabulary size and growth call for the detection of similarities and differences among words, including their phonological structure. Lexical restructuring is thus causal to the development of highly specified phonological representations, which directly impact word reading. In addition to its relation to phonological awareness, vocabulary is strongly connected to reading comprehension (de Jong & van der Leij, 2002; Ouelette, 2006; Roth, Speece, & Cooper, 2002), playing a critical role for comprehending meaning of text (NICHD, 2000).

Language and Reading in Bilingualism

Phonology

Similar to monolingual children, bilingual children's phonological skills are key predictors of word reading accuracy (Gottardo, 2002). PA skills show higher L1 to L2 relationship, suggesting an underlying language-general ability, and thus, may need to be acquired only once when learning to read in L1 (Durgunoglu, 2002). Evidence indicates that these skills are not completely overlapping, however (Gottardo & Muller, 2009), calling for the need to examine PA in less investigated languages such as Arabic. Cross-linguistic research shows that PA skills are positively related to language and reading in Chinese-English and Korean–English (McBride-Chang, 2004), Spanish-English (Anthony et al., 2009; Durgunoglu, 2002), and English-Arabic bilinguals (Saiegh-Haddad & Geva, 2008), and that

these skills tend to transfer across the languages of bilingual children, including alphabetic and non-alphabetic languages (Durgunoglu, 2002; McBride-Chang, 2004).

Morphology

MA has a central function in the development of word reading and reading comprehension in bilingual children (Saiegh-Haddad & Geva, 2008). Robust evidence indicates that MA predicts word reading across alphabetic languages (Carlisle, 1995, 2000; Deacon & Bryant, 2005; Ravid, 2004) and non-alphabetic (Kim, 2012; McBride-Chang, 2004). In their cross-cultural study, Ku and Anderson (2003) show that MA is related to reading ability in both languages of Chinese-English bilinguals, accounting for 25% - 32% of the variance in Chinese reading, after controlling for vocabulary. In contrast, English MA did not account for much of the variance in English reading. This difference, Ku and Anderson argue, may be due to the difference between the orthographies, as well as the way in which MA is measured. Similar findings were also reported by Saiegh-Haddad and Geva (2008), who studied bilingual English-Arabic bilinguals in Canada. The results of their study indicate the joint contribution of MA and PA in word reading, with MA playing a particularly key role in word reading fluency and reading unvowelized words. Moreover, a recent meta-analysis of studies addressing morphological awareness indicated the central role of morphology in reading, surpassing that of other components of language like phonology and semantics (Goodwin & Ahn, 2010).

Vocabulary

The role of vocabulary is paramount in the development of reading in bilingual children (August, Carlo, Dressler, & Snow, 2005). Little research has examined the relationship between language-specific vocabulary and word reading in bilingual children (Castro, Paez, Dickinson, & Frede, 2011). The available evidence suggests that both vocabulary and word reading are positively linked in first and second language in bilingual children (Dressler, Carlo, Snow, August, & White, 2011). In their study of bilingual Canadian English language learners (ELLs) whose L1 was Cantonese, Punjabi, Portuguese, or Tamil, Geva and Zadeh (2006) found that the size of L2 oral vocabulary was a significant predictor of L2 word reading accuracy, explaining 7% of the variance in both L2 word reading accuracy and fluency. Similar findings were reported by Uchikoshi (2006), showing that L2 vocabulary size had a positive effect on L2 word reading in a sample of 150 Spanish-speaking ELLs kindergarteners. Furthermore, ELLs who demonstrated sizeable vocabulary at the start of the school year had a better ability to read words in kindergarten and their superior performance was maintained until the end of Kindergarten school year.

While the above mentioned factors have been identified and substantiated in word reading accuracy and word reading fluency across languages (de Jong & van der Leij, 2002), research shows that language–specific variables may also be at play (Farran, Bingham &

Matthews, 2012; McBride-Chang, 2004). Further, the relation among these variables likely differs when reading vowelized (with diacritics) as compared to unvowelized (without diacritics) Arabic text, with an anticipated direct link between vocabulary and reading accuracy, particularly in the case of missing phonological information (e.g., unvowelized words).

Current Study

The current study examines the relation among multiple components of language, word reading accuracy, and word reading fluency in a sample of bilingual children who speak Arabic as their second language. The study aims to answer the following research questions:

1. Do the language components predict word reading accuracy?
2. Do the language components predict word reading fluency?
3. Does the relationship between language (phonology, morphology, vocabulary) and reading (word reading accuracy, word reading fluency) differ as a function of the reading context (vowelized versus unvowelized words)?

Method
Context of the Study

The context for this study was a charter school in a suburb of a major city in the Southeastern portion of the U.S. This school is characterized by its emphasis on teaching Arabic as a second language in the primary/elementary grades. The school's Arabic department consists of four Arabic teachers who focus on oral language in their instruction using (1) MSA/Fusha and (2) SAV/Ammiya, 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. In the early grades, more limited emphasis is placed on reading and writing activities in comparison to heavy reliance on oral language.

In terms of the sample's demographics, the children come from various socioeconomic and middle-high educational backgrounds (see Table 1), with the majority of parents possessing a bachelor's college degree or higher. Notably, not all participating parents are speakers or users of Arabic, but rather native speakers of English, Urdu, Turkish, Tamil, or French (see Table 2).

Participants

The participants were 83 bilingual English-Arabic children in third, fourth, and fifth grades (35 males and 48 females) who had attended the school and received instruction in Arabic for three or more consecutive years. Children received formal Arabic instruction for 40 minutes per day, four days per week. All parents signed a consent form and children signed an assent form to participate in the study. To be included in the study, children had to have no history of developmental disorders or learning disabilities and were learning English as their primary (or one of their primary) language (s). Eleven children who met inclusionary criteria initially did not participate in the study due to a parent declining to participate or failing to return the signed consent forms.

Table 1 Demographic Characteristics of the Children in the Study

Variable	*M* (*SD*) or Frequency (Percentage)
Grade	Total children *(n = 83)*
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%)

Measures

Language and reading measures were developed by Taha and Saiegh-Haddad (2016),

Saiegh-Haddad and Geva (2008), or adapted (vocabulary measure) for this study based on published English assessments. A total of five Arabic measures were administered. Four of the five measures were administered individually to each child and took approximately 30 minutes. The fifth measure was adapted by the first author and administered to the children in groups. Each group administration took 20 minutes to complete. For all Arabicassessments, a score of 0 was given for incorrect or partially correct responses and a 1 for correct responses and raw scores were computed based on correct responses on each subtest. The examiner presented assessment instructions in English followed by Arabic to ensure the children understood the task at hand. Table 3 presents descriptive statistics of children's performance on these language and reading measures. A brief description of these measures follows.

Table 2Parent Education and Home Language Use by Frequency or Percentage

Variable	Frequency (Percentage)	Variable	Frequency (Percentage)
	Total Parents *(n* = 64*)*		
Parent Education		Spouse 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)		Spouse Home Language Use (percent of spouses)	
Arabic	9 (14.1%)	Arabic	10 (15.6%)
English	39 (60.9%)	English	38 (59.4%)
Other	16 (25%)	Other	16 (25%)

Arabic Phonological Awareness

The Blending and Elision subtests assessed phonological awareness skills. They parallel the English Comprehensive Test of Phonological Processing (CTOPP; Wagner, Torgesen, & Rashotte, 1999). 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 Taha and Saiegh-Haddad (2016), 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/, /a/, /j/, /t/ are combined to produce the word *bait* [*house*]). A score of 0 was given for incorrect or partially correct responses and 1 for correct responses.

The Elision subtest required children to verbally repeat words that the examiner presented. 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 verbally 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*/). A phonological awareness composite was created and consisted of children's scores on both blending and elision subtests.

Table 3Descriptive Statistics: 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	0.00	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
Word Reading Fluency	12.44	10.14	0-58.82

Arabic Morphological Awareness

This measure, developed by Saiegh-Haddad and Geva (2008), assessed implicit morphological 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, p. 488). 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 Vocabulary

To assess children's vocabulary in Arabic, the *Gates-MacGinitie Reading Test, Fourth Edition, Level 2* (GMRT; MacGinitie, MacGinitie, Maria, & Dryer 2000) was adapted and used. Compared to other reading measures, the GMRT tends to be more sensitive to oral language proficiency compared to other reading measures (Cutting & Scarborough, 2006). We selected Level 2 of the GMRT to adapt into Arabic because it parallels the instruction children received in school, which relies on pictures to guide the child as he read the words and text. The examiner provided the children with a response form with multiple-choice questions. Vocabulary was assessed using 64 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.

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.

Arabic Word Reading Accuracy. This measure presents children with a list of 40 vowelized and 40 unvowelized words that progress in length and complexity (Taha & Saiegh-Haddad, 2016). The vowelized Arabic word list consists of words without inflectional endings. The child is presented with words in six rows on one page and is requested to read them. For unvowelized word reading, the examiner presents the child with an unvowelized Arabic word list of 40 words without inflectional endings. Accuracy scores are computed by adding the number of words read correctly.

Arabic Word Reading Fluency. This measure assesses the child's speed and accuracy of reading morphologically related words (Saiegh-Haddad & Geva, 2008). Fluency scores are computed by measuring the time it took the child to correctly read the word pairs. The accuracy score is divided by the fluency score to obtain the final score on this measure.

Results

We conducted partial correlations to examine the associations among the language and reading variables, controlling for children's chronological age (See Table 4). As this table shows, the most significant associations were observed between phonological awareness and measures of word reading accuracy and word reading fluency; morphological awareness and measures of word reading fluency; and vocabulary and measures of word reading accuracy. Interestingly, children's age only correlated significantly and positively with vocabulary and unvowelized word reading fluency.

To examine the relations between the independent variables (IVs), Arabic phonological awareness, morphological awareness, and vocabulary; and the dependent variable (DV) word reading accuracy, two separate hierarchical multiple regressions were generated. For the first regression, we examined associations among the IVs with attention to Arabic vowelized word reading accuracy (VWRA) (see Table 5). For the second regression we examined associations among the IVs and children's Arabic unvowelized word reading accuracy (UWRA) (see Table 6).

Table 4 Partial Correlational Matrix for Arabic Language and Reading Skills

Variable	AMA	APA	AVocab	AVWRA	AVWRF	AUWRA	AUWRF	CA
AMA	1	.22*	.32**	.27*	.33**	.27*	.33**	.13
APA	.22*	1	.28**	.65***	.50***	.68***	.56***	.17
AVocab	.32**	.28**	1	.28*	.17	.40***	.29**	.28**
AVWRA	.27*	.65***	.28*	1	.84***	.90***	.82***	.13
AVWRF	.33**	.50***	.17	.84 ***	1	.72***	.91***	.18
AUWRA	.27*	.68***	.40***	.90***	.72***	1	.83***	.21
AUWRF	.33**	.56***	.29**	.82***	.91***	.83***	1	.22*
CA	.13	.17	.28**	.13	.18	.21	.22*	1

* *p*< .05; ** *p*< .01; *** *p*< .001

AMA=Arabic Morphological Awareness; APA=Arabic Phonological Awareness; AVocab=Arabic Vocabulary; AVWRA=Arabic Vowelized Word Reading Accuracy; AVWRF=Arabic Vowelized Word Reading Fluency; AUWRA=Arabic Unvowelized Word Reading Accuracy; AUWRF=Arabic Unvowelized Word Reading Fluency; CA= Chronological Age.

Table 5 Summary of Hierarchical Regression Analysis of Arabic Phonological Awareness, Morphological Awareness, and Vocabulary on Vowelized Word Reading Accuracy (N =83)

Variable	Model 1			Model 2			Model 3			Model 4		
	B	$SE\ B$	β	B	$SE\ B$	β	B	$SE\ B$	β	B	$SE\ B$	β
Child Age	1.66	1.38	.13	.33	1.08	.03	.17	1.08	.01	-.02	1.11	-.00
Arabic Phonological Awareness				8 .79	1.18	.64***	8.41	1.20	.62***	8.23	1.22	.60***
Arabic Morphological Awareness							.44	.28	.14	.38	.29	.12
Arabic Vocabulary										.81	1.08	.07
R^2		.21			.42			..44			.42	
F for change in R^2		1.44			55.55			2.41			.55	

Table 6 Summary of Hierarchical Regression Analysis of Arabic Phonological Awareness, Morphological Awareness, and Vocabulary on Unvowelized Word Reading Accuracy (N =83)

Variable	Model 1			Model 2			Model 3			Model 4		
	B	SE B	β	B	SE B	β	B	SE B	β	B	SE B	β
Child Age	2.66	1.37	.21	1.28	1.03	.10	1.14	1.03	.09	.60	1.04	.05
Arabic Phonological Awareness				9.16	1.13	.67***	8.84	1.14	.64***	8.32	1.14	.61***
Arabic Morphological Awareness							.37	.27	.12	.21	.27	.07
Arabic Vocabulary										2.24	1.01	.20*
R^2		.05			.48			.49			.52	
F for change in R^2		3.79			66.23			1.93			4.93	

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

As indicated in Tables 5 and 6, child age was entered in step 1, which did not significantly relate to Arabic VWRA, $F (1, 81) = 1.45$, $p> .05$ or UWRA, $F (1, 81) = 3.79$, $p> .05$. In step 2 Arabic phonological awareness was added to the equation and significantly contributed to Arabic VWRA, $F (2, 80) = 28.99$, $p< .001$) and Arabic UWRA, $F (2, 80) = 36.53$, $p< .001$. Arabic morphological awareness was entered in step 3 and did not contribute uniquely to VWRA, $F (3, 79) = 20.47$, $p> .05$, or UWRA, $F (3, 79) = 25.28$, $p> .05$. In Step 4, we added vocabulary to the equation, which did not made a unique contribution to VWRA, $F (4, 78) = 15.40$, $p> .05$. However, it contributed uniquely to Arabic UWRA, $F (4, 78) = 21.13$, $p< .05$.

In order to examine the relations between the independent variables (IVs), Arabic phonological awareness, morphological awareness, and vocabulary and the dependent variable (DV) word reading fluency, we conducted two separate hierarchical multiple regressions. For the first regression, we examined associations among the IVs and Arabic

vowelized word reading fluency (VWRF) (see Table 7). In the second regression, we examined associations among the IVs and children's Arabic unvowelized word reading fluency (UWRF) (see Table 8).

Table 7 Summary of Hierarchical Regression Analysis of Arabic Phonological Awareness, Morphological Awareness, and Vocabulary on Vowelized Word Reading Fluency (N =83)

Variable	Model 1			Model 2			Model 3			Model 4		
	B	$SE\ B$	β	B	$SE\ B$	β	B	$SE\ B$	β	B	$SE\ B$	β
Child Age	1.72	1.02	.18	.99	.91	.10	.79	.89	.08	.92	.92	.10
Arabic Phonological Awareness				4.96	.99	.49***	4.51	.99	.44***	4.64	1.01	.46***
Arabic Morphological Awareness							.52	.23	.22*	.56	.24	.23*
Arabic Vocabulary										-.54	.90	-.06
R^2		.03			.27			.31			.31	
F for change in R^2		2.85			25.10			5.07			.37	

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

Table 8 Summary of Hierarchical Regression Analysis of Arabic Phonological Awareness, Morphological Awareness, and Vocabulary on Unvowelized Word Reading Fluency (N =83)

Variable	Model 1			Model 2			Model 3			Model 4		
	B	$SE\ B$	β	B	$SE\ B$	β	B	$SE\ B$	β	B	$SE\ B$	β
Child Age	2.19	1.09	.22	1.30	.94	.13	.10	.92	.11	.95	.95	.09
Arabic Phonological Awareness				5.90	1.02	.54***	5.42	1.02	.49***	5.28	1.04	.48***
Arabic Morphological Awareness							.55	.24	.21*	.50	.25	.19*
Arabic Vocabulary										.63	.92	.07
R^2		.05			.33			.37			.34	
F for change in R^2		4.01			33.39			5.26			.47	

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

As shown in Tables 7 and 8, child age was entered in step 1 and did not significantly relate to Arabic VWRF, $F (1, 81) = 2.85$, $p> .05$ or UWRF, $F (1, 81) = 4.01$, $p> .05$. In step 2 Arabic phonological awareness was added to the equation and significantly contributed to Arabic VWRF, $F (2, 80) = 14.40$, $p< .001$) and Arabic UWRF, $F (2, 80) = 19.50$, $p< .001$. Arabic morphological awareness was entered in step 3, contributing uniquely to VWRF, $F (3, 79) = 11.78$, $p< .05$, and UWRF, $F (3, 79) = 15.45$, $p< .05$. In Step 4, vocabulary was added to the equation, which did not made a unique contribution to VWRF, $F (4, 78) = 8.86$, $p> .05$, or Arabic UWRF, $F (4, 78) = 11.62$, $p> .05$.

Discussion

This study examined the language predictors of word reading in a sample of English-Arabic bilingual children. The results indicate that different components of language differentially relate to word reading outcomes, namely word reading accuracy and word reading fluency. These results align with previous research in English and Arabic that shows common as well as distinct predictors for accuracy versus fluency, and underscoring word reading accuracy as the building blocks for reading development (Perfetti, 1985; Saiegh-Haddad & Geva, 2008; Stanovich, 1986).

This study aimed at answering three research questions. The first question sought to answer whether language components are implicated in word reading accuracy. The results show that phonology predicted both vowelized and unvowelized word reading accuracy, while vocabulary only predicted unvowelized word reading accuracy. This finding suggests that children relied fully on phonology, which was provided by the context of vowelized words (Jabbour, Ibrahim, & Shany, 2015). When such phonological information was minimized or absent, however, as in the case of unvowelized word reading, children had to recruit other language components (e.g., vocabulary) to assist them in the word reading task (Farran et al., 2012). Similar observations have been put forward by Plaut et al. (1996), suggesting that semantic (vocabulary) knowledge is paramount for words that have inconsistent orthographic-phonological mappings, and may help children in the process of disambiguating the words they read. This finding also coincides with Hansen (2014), who posits that word reading in Arabic and other Semitic languages calls for a host of additional linguistic resources beyond phonology, including lexical information to facilitate reading of unvowelized words (Hansen, 2014).

The second research question explored language predictors of Arabic word reading fluency. Our results indicate that both Arabic phonological and Arabic morphological awareness predicted Arabic vowelized and unvowelized word reading fluency, with phonology contributing most of the variance in word reading. This differential role of phonology versus morphology within Arabic may be attributed to two reasons: (1) based on extant research, it seems likely that phonological but not morphological awareness transferred from children's L1 (English) to L2 (Arabic), especially given that L1 and L2 differ in their morphological structures (Saiegh-Haddad & Geva, 2008); and (2) the limited contribution of morphology to the regression equation could be a reflection of task difficulty and measurement issues. The morphological relatedness task we used in this study likely targeted surface (implicit) as opposed to deep (explicit) morphological awareness, as it asked children to indicate whether pairs of words were related or not by providing a "yes" or "no" answer to the question "are they two words related?" Thus, children were not asked to manipulate or decompose words into constituent morphological parts, but rather to recognize relatedness among words, a relatively easier task compared to tasks employed in other studies. Despite these differences, when phonological information was incomplete or missing as it might be the case with unvowelized words, morphology was called upon and seemed to bootstrap phonology, granting children the help they need

to read unvowelized words. Our findings concur with those of Saiegh-Haddad & Geva's (2008) regarding the central role of morphology in addition to phonology in reading outcomes in English-Arabic children, but differ in terms of the variance morphology contributes to word ready fluency—a finding likely due to a difference in the measures used in the two studies. Saiegh-Haddad and Geva (2008) used a composite of morphological awareness that consists of a morphological relatedness task and a morphological decomposition task, whereas we only used a morphological relatedness task only in the current study.

Our third research question investigated whether language predictors of reading differed as a function of the context (vowelized versus unvowelized words). The results show that the vowelized versus unvowelized word reading tasks called for different language components to work in concert to enable children's reading under untimed and timed conditions. This finding points to the importance of considering not only the measures used to assess specific skills, but also task demands (Plaut et al, 1996). The list of words presented were morphologically complex. When asked to read these words rapidly, children recruited morphology in addition to phonology for both vowelized and unvowelized words. For timed tasks, children presumably relied on morphological information to help them recognize word patterns even when phonological information was present. When no time constraints were imposed, children tended to rely only on phonology for reading vowelized words, and on phonology and vocabulary for reading unvowelized words, with no contribution from morphology. Together, these findings suggest that task demands are critical in determining the language components that might be called upon to enable children to be successful at reading, especially in the early stages of reading development.

A noteworthy finding concerns the heavy reliance on phonology that children evidenced across tasks and reading contexts. We conjecture one reason could be attributed to the diglossic nature of Arabic, the linguistic distance between MSA/Fusha and SAV/Ammiya (Saiegh-Haddad, 2003), and the limited use of reading and writing in MSA. Despite the fact that children in this study learned Arabic daily, their reading experience was minimal, resulting in less well-specified linguistic representations, which could have thwarted their word reading. Furthermore, children's Arabic vocabulary use was confined mainly to the classroom (permitting only limited restructuring of their lexicon) whereby the Arabic teachers used MSA/Fusha as a context for teaching the language but also infused SAV/Ammiya throughout the day in their conversations with children. This less-than-optimal vocabulary exposure and use is well documented in bilingual research, highlighting the fact that vocabulary knowledge is split across the languages (and dialects) of bilingual children (August et al., 2005; Dressler et al., 2011; Durgunoglu, 2002), and likely was very limited in the sample in this study.

Collectively, the findings of the present study support the tenets of the extended triangle model of reading put forward by Bishop and Snowling (2004). According to this model, reading development relies on the dynamic orchestration of multiple language

components that work together to differentially impact reading, and depends on reading experience, which was evidently reduced in this sample of children. As the findings suggest, children appeared to have relied on a division of labor (Bishop & Snowling, 2004; Seidenberg & McClelland, 1989) among the language components in the service of reading. Depending on the reading task (word reading accuracy versus word reading fluency) and the context in which reading occurred (vowelized versus unvowelized script), children tend to recruit various language components to help them read words (Nation & Snowling, 2004). This was evident by the contribution of phonology and vocabulary to vowelized word reading, and phonology and morphology to unvowelized word reading.

Conclusion

Pedagogical Implications

The current findings have implications for pedagogy. The language and reading skills of children who learn Arabic are likely minimized by the very nature of the sociolinguistic reality brought about by diglossia and bilingualism, thus impacting the educational outcomes of these children. The sample in this study is at an especially heightened risk for language and reading delays in Arabic due to the cumulative effect of diglossia and the limited use of the Arabic language in the classroom. Given that bilingual children have a better command of certain words or concepts in L1 that they do not possess in L2 and vice versa, practitioners (e.g., speech-language pathologists, teachers) must reinforce children's use of both L1 and L2. Classroom instructional practices must thus (1) build on background knowledge across the language components (phonological, morphological, vocabulary) in both monolingual and bilingual children (Goodwin & Perkins, 2015); (2) encourage early, frequent oral and reading exposure that focuses on word reading accuracy and word reading fluency, with a gradual transition from vowelized to unvowelized words and texts as reading progresses; and (3) make explicit reference to both variants of Arabic (SAV/Ammiya and MSA/Fusha) as it will likely result in highly specified linguistic representations that pave the way to optimal reading outcomes for monolingual and bilingual children who learn Arabic.

Limitations and Future Research

This study has several limitations that should be noted. First, the sample of children included in this study was rather small and limited to a single school context. Second, data are correlational in nature, limiting our ability to draw causal inferences. Although our research is tied to existing theory and research, regression analyses do not imply causal relations among key variables. Finally, our study is limited by the nature of the measures used. Limited validated measures are currently available in Arabic.

Future studies must adopt a developmental perspective on reading in Arabic, including longitudinal examinations of word reading accuracy fluency and their relation to higher-

level processes such as reading comprehension in a larger sample of bilingual English-Arabic children. Future studies should include additional language and reading measures in more than one orthography. In the current study we only assessed predictors of word reading using Arabic measures. Future research could include data from multiple languages that bilingual children speak (e.g., English and Arabic) with attention to various measures relating to children's code and meaning based reading systems in ways that better account for how they learn to read. For example, it might be important to assess important constructs such as morphological awareness (e.g., morphological relatedness and morphological decomposition) and vocabulary (using multiple measures of vocabulary), as well as broadening the examination of fluency beyond the word level to elucidate the contribution of language to reading in children who learn Arabic as their first or second language.

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