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Reading in Arabic Script: A Cross-Linguistic and Cross-National Study

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by

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Abstract

The current study examined within- and cross-language predictors of word reading and reading comprehension among groups of Arabic-English bilingual children in different language learning environments. A total of 80 children were tested, forty Arabic-English bilingual children recruited from Saudi Arabia and forty Arabic-English bilingual children were recruited from Canada. Both groups completed parallel measures of word-level reading, reading comprehension and vocabulary in Arabic and English. Results indicated that the underlying components related to within- and cross-language word reading and reading comprehension varied across groups. Within-language results demonstrate that English morphological awareness was significantly related to English word reading in both the Saudi and the Canadian groups. Vocabulary knowledge and word reading were significantly related to English reading comprehension across groups. Vocabulary knowledge was the only variable explaining unique variance in Arabic reading comprehension literary form for the Canadian group, as well as explaining unique variance in Arabic reading comprehension of the spoken form for both groups. Cross-language results demonstrate that Arabic un-vowelized word reading explained unique variance in English word reading for both groups. English phonological awareness explained a unique variance in Arabic vowelized word reading for both groups.

Keywords: literacy acquisition**,** bilingualism**,** phonological awareness**,** morphological awareness and orthographic processing

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Introduction

According to Saiegh-Haddad and Joshi (2014), Arabic literacy is considered an important area to investigate for the following reasons: *First*, Arabic is the second most widely used segmental script after the Roman script and Arabic is the fourth most universally spoken language. *Second*, the literacy levels in the Arabic-speaking world are alarmingly and uniformly low in both wealthy and poor societies. Also, low levels of literacy have consistently been reported in Arabic-speaking counties, among both for young readers (PIRLS, 2006) and for older adolescent readers (PISA, 2009). *Third*, more research is needed using Arabic orthography as an example to grasp the development and nature of reading because there is limited research on Arabic literacy acquisition and even less research on bilingual Arabic-English speakers,

In this thesis, we focused on Arabic and English literacy acquisition among Arabic-English bilingual children in Canada and Arabic-English bilingual children in Saudi Arabia who were learning the languages in different language learning environments. The current study examined within- and cross-language predictors of word reading and reading comprehension for the groups for whom Arabic was the first language (L1) and English was the second language (L2). Comparable measures in Arabic and English were administered to all children.

The aim of this cross-linguistic, cross-cultural comparison in Canada and Saudi Arabia was to determine the universal and specific processes in learning to read different orthographies. Moreover, understanding the similarities and differences of literacy skills across languages may guide us to determine how skills in the first language (Arabic) are related to the second language (English).

Literature review

Literacy and Reading

Simply, literacy is the ability to read and write the language. There is a strong connection between language and literacy. Literacy is the fundamental pillar for most academic learning. Additional cognitive processes are required to learn to read, beyond understanding and speaking the language (Geva & Wiener, 2014).

One of the essential components of literacy is reading. During reading acquisition, children develop several cognitive skills that enable them to become fluent, skilled readers (Coltheart, 2005). According to Goswami (2008), reading is a complex cognitive process, which is comprised of recognizing letters and words, knowing letter-sound rules, and understanding the meaning of printed words. Children who read a lot, accrue more knowledge, and their academic success and performance on academic tasks continues to grow, whereas children who do not read either stagnate or decline in their relative knowledge or skills (Schwanenflugel, & Knapp, 2015; Stanovich, 1986).

Models and Theories of Reading

This section addresses the most relevant models of reading that have been developed including a traditional perspective, which is represented by a bottom-up model, a cognitive perspective, which is represented by top-down and interactive models, and lastly a metacognitive perspective, which is represented by the simple of view and the dual-route model.

A bottom-up model is an early model of the reading by Gough (1972) that focused on what the readers bring to the process. According to Gough (1972), reading is a sequential mental process: Readers begin to read by translating the parts of written language to sounds, then these sounds create individual words, these words together help readers to understand the written script. According to LaBerge and Samuels (1974), the bottom-up model consists of three memory systems. As the texts are processed, the three systems hold different representations. The visual memory system holds visual representations of the different elements that structure the text such as letters and spelling groups (Beard, 2003). The phonological memory system holds the phonological representation, which "is the mental representation of the sounds and combinations of sounds that comprise words in a particular spoken language" (Goswami & Bryant, 1990, p. 1). The semantic memory system holds semantic representations, which are defined as an autonomous level of representations related to deep structures (Jackendoff, 1983).

By contrast, the top-down model of reading emphasizes that readers extract the meaning from a text based on their knowledge and using the context clues to understand new concepts or words (Smith 1971; Goodman 1967). Context can help children to understand the meanings of new words, yet readers cannot use this model alone to identify words. Based on these two models, children who struggle with phonological processing may have difficulties with the speed of word accessing, which will lead them to various problems in reading comprehension.

These two early models lack a description of how the processes interact with each other but mention that decoding becomes automatic for the fluent reader and comprehending the text arises from reader's attention to the meaning of the text. In fact, the attention of readers is responsible for switching from decoding to comprehension and back again, as only one task can be done at a time (La Berge & Samuels, 1974). Concerns about the validity of these two models motivated researchers to develop the model called an interactive model of reading (Rumelhart & McClelland, 1986).

The interactive model, which is the third model of reading is different than the bottom-up and the top-down models in terms of focusing on the single component of information processing approach and attempts to combine the elements of bottom-up and top-down processing to examine readers using their own knowledge and the information from the text to drive the meaning (Grabe,1991). Likewise, Rumelhart (1994) claimed that the interactions among text, reader, and prior knowledge in interactive models help to demonstrate how the connection of perceptual and the cognitive processes in reading occurred.

Word reading

While many studies mention the importance of word recognition as a starting point of reading comprehension ability (e.g., Gough & Tunmer, 1986; Perfetti, 1985; Stanovich, 1988), many theories of word reading have emerged. Dual-route models are the models that had dominated word recognition theories that involve a metacognitive perspective. According to Bjaalid, Høienb, and Lundberg (1997, p. 73), “the dual route models have been the dominant cognitive framework for modeling reading for the last 20 years.” The dual-route model was described as the model of reading aloud. However, a definitive characteristic of the dual-route model is the theory of two separate mental mechanisms or cognitive routes by which printed words can be recognized: a lexical route and a non-lexical route (Coltheart, 2005). The lexical route is also named the direct route or visual orthographic route. This route refers to the reading of words by activating the direct connection between the orthographic representation and word meaning. Nevertheless, this lexical route fails with reading non-words because these words do not have lexical representations in the reader’s memory (Coltheart, 2005).

The non-lexical route is also named the indirect route or the phonological route. In this route, a word is recognized when the phonological representations of this target word are accessed. In other words, the orthographic information is transformed into a sub-lexical phonological code before contacting phonological output units, whole-word phonological representations, and semantics (Grainger & Ziegler, 2011). The non-lexical (phonological) route is necessary for reading new words or non-words that have consistent grapheme-phoneme relationships (Coltheart, 2005).

Reading comprehension

While several previous studies described the reading models as whole construct, recent studies have begun examining reading as a componential construct which include two or three fundamental components of the reading process. The simple view model is one of the primary models that supports the conceptual transition of reading. The simple view of reading (SVR) by Gough and Tunmer (1986), reports that reading comprehension involves two components or skills, decoding or word recognition and linguistic comprehension, which are represented by the following equation: Reading Comprehension = Decoding × Linguistic Comprehension. In this model, decoding or word recognition skills encompass reading isolated words, decoding unfamiliar of pseudowords, and spelling; whereas, language comprehension skills include vocabulary, grammar, morphology, and listening comprehension (Geva & Wiener, 2014). Moreover, decoding requires the effective use of word recognition skills from print that helps readers to access the mental lexicon and derive word meanings from it. In contrast, linguistic or oral comprehension is the readers' ability to process lexical and syntactic knowledge that will enable them to read the text or script (Hoover & Gough, 1990). Simply, skilled readers should be able to understand the spoken language to be able to read the words in the script and to comprehend how spoken language represented in print (Geva & Wiener, 2014).[1]

Previous researchers examined how decoding (D) and listening comprehension (LC) influence reading comprehension (RC). Gough and Tunmer (1986) claim that decoding is a necessary skill to comprehend context. In other words, decoding is a crucial skill that predicts children's performance on reading comprehension (Nakamoto et al., 2008). In many cases, decoding includes pseudo-word reading (Gottardo & Mueller, 2009). Reading pseudo-words in English does not just focus on processing words one grapheme at once, but also relies on the use of 'flexible units' which include complementing synthetic phonics with attention to rimes, syllables, and whole word patterns (Brown & Deavers, 1999). Based on that, teaching decoding skills at an early age is an effective way to improve children's reading comprehension. Nevertheless, there a strong correlation between word reading and pseudo-word reading, and both skills are highly correlated with reading comprehension (Shankweiler et al., 1999).

Readers with deficiencies in word-level decoding skills struggle in their reading comprehension (Gottardo & Mueller, 2009). Overall, reading ability is the capacity to decode and comprehend.

Variables related to reading acquisition

Ultimately, the National Reading Panel (NRP) provided a model, which gathered the most significant components of literacy that child needs to be literate. The NRP model was completed by a committee under the direction of the National Institute of Child Health and Human Development (NICHD) in teamwork with the United State Department of Education words (National Institute of Child Health and Human Development, 2000). This model includes

[1] In Western contexts, individuals learn to speak and then read a given language. However, this is not the case worldwide.

five elements of language components: phonological awareness, phonics, fluency, vocabulary and text comprehension.

First, phonemic awareness (PA) entails awareness of phonological structure, or sound structure, of spoken words (National Institute of Child Health and Human Development, 2000). Also, it is the ability to manipulate the individual sounds in spoken words by identifying, comparing, separating and combining sounds (Geva & Wiener, 2014). *Second*, phonics is the ability to understand the graphic representation of the writing system by using spelling-sound correspondences and syllable patterns to read words. The *third* component is fluency, which is defined as the ability to read a script accurately and quickly with expression to support comprehension. Fluency also provides the connection between word recognition and comprehension. Fluent readers gain the meaning from what they have read by recognizing the words automatically and quickly. The *fourth* element is vocabulary. Vocabulary consists of the words that exist in any language that should be understood to comprehend text. There are two types of vocabulary: Oral vocabulary includes the words that used to speak and understand oral language and reading vocabulary includes the words, which are used in print. *Lastly*, text comprehension is the ability to read print and understand the meaning of it by coordinating many skills such as vocabulary, background knowledge, and verbal reasoning skills (National Institute of Child Health and Human Development, 2000). The present study examines these components in relation to reading in Arabic-English speakers.

Writing systems, scripts, and orthographic depth

The basic structures of the writing system and the features of the orthography play an important role in reading acquisition (Koda & Zehler, 2008). There are three major writing systems in the world: alphabetic, syllabic, and logographic (Perfetti & Dunlap, 2008). This study focused on two different alphabetic writing systems of two alphabetic languages: Arabic and English. Each writing system has varied scripts, even within a specific orthography. For instance, with English, children learn to read and write in printed Roman script, and later on they learn to write in cursive script, so the script differences within English are purely visual (Koda & Zehler, 2008). However, Arabic is another alphabetic language with two scripts: vowelized and unvowelized, and the script differences in Arabic are based on marked and unmarked linguistic information.

Moreover, the scripts of English and Arabic each represent a single orthography and a single writing system even if they are both alphabetic orthographies. The defining feature of alphabetic writing systems is the mapping of graphs onto phonemes. To illustrate, graphemes are the visual symbols or letters that represent a sound, while phonemes are the smallest unit of speech (sounds) that are used to differentiate words from each other (Koda & Zehler, 2008).

In addition, within alphabetic writing systems, orthographies differ in the transparency of mappings between letters and phonemes (Koda & Zehler, 2008). The level of transparency or orthographic depth of an orthography ranges from shallow to deep (Geva & Wiener, 2014). Shallow orthographies are defined as usually having consistent, one-to-one grapheme-phoneme mapping, while deep orthographies are defined as having graphemes represent more than one phoneme, with one phoneme being written in several ways (Katz & Frost, 1992).

The orthographic depth hypothesis confirms that orthographic transparency in terms of the correspondence between graphemes and speech segments impacts the strategies adopted by readers. For example, the reader can use a print-to-sound decoding strategy with the shallow or transparent orthography to read all words, whereas a reader of the deep or less transparent orthography must sometimes rely on a direct look-up of the word strategy to read words (Katz & Frost, 1992).

Perfetti and Dunlap (2008) developed a table that includes a variety of orthographies in common languages that listed, in numerical order, from the shallowest orthography (e.g., Finnish, Italian, and Spanish) to the deepest orthography (e.g., English, Chinese, Arabic, and Hebrew) (see Figure 1). The degree of transparency is an important concept in cross-language studies to help us understand the differences in literacy acquisition in different orthographies (Geva & Wiener, 2014)

Grapheme-to-phoneme correspondence	Ordering	Language
Transparent/shallow	1	Finnish
1 grapheme-1phoneme	2	Welsh
	3	Italian
	4	Ladin
	5	Serbo-Croatian
	6	Macedonian
	7	Spanish
	8	Catalan
	9	Portuguese
	10	Korean
	11	Hindi
	12	German
	13	Danish
	14	Dutch
	15	Lao
	16	Khmer
	17	French
	18	English
	19	Japanese
Opaque/deep	20	Chinese
1 grapheme-many phonemes	21	Arabic
Many GPC exceptions/irregular words	22	Hebrew

Figure 1. Orthographic depth of various languages.

Shallow and deep orthography in the common alphabetic languages: Spanish, English, Hebrew, and Arabic

Shallow orthographies are easier to decode because readers can use the consistent grapheme-phoneme mappings compared to deep orthographies that often need access to the lexical route or larger units to read the word (Liu & Cao, 2016).

Spanish is an alphabetic orthography, and it is a clear example of a shallow orthographic system represented in the Roman script. The grapheme–phoneme correspondence rules are consistent in Spanish; indeed, each grapheme has a clear and precise phonemic translation. Therefore, the grapheme–phoneme correspondence rules in Spanish allow readers to determine the phoneme corresponding to each specific grapheme without ambiguity (DeFior, Martos, & Cary, 2002).

English is written using a deep alphabetic orthography. While there is some regularity among grapheme-and-phoneme correspondences, there are many irregular letter-to-sound mappings that are often associated with multiple phonemes (e.g., "ch" in chef, choir, and cheese). Also, according to Frost (2012), grapheme-and-phoneme correspondences in English can be changed depending on the addition of affixes, and very often the result shows the changes in the pronunciation (e.g., heal/health, and courage/courageous). These changes preserve relations between the spellings of morphologically related words at the cost of phonology (Seymour, Aro & Erskine, 2003). Thus, these relationships might lead to many challenges for learning to read in English (Perfetti & Dunlap, 2008). In comparison, Spanish readers may rely on applying a reliable grapheme-phoneme conversion to read their orthography, whereas English students may rely more on whole-word representations to read their orthography (Frith et al., 1998).

Hebrew and Arabic are both Semitic languages with an alphabetic orthography, and both languages have a shallow and deep orthographic form. According to the orthographic depth hypothesis, deep orthographies enhance readers' abilities to process printed words by referring to their morphology (Katz & Frost, 1992). Words in Semitic languages are all derived from roots, and these roots generally consist of three consonants; indeed, these consonants and roots convey the core meaning of words (Frost, 2012, p. 11). Moreover, "Semitic words are always composed by intertwining root morphemes with word-pattern morphemes – abstract phonological structures consisting of vowels, or of vowels and consonants, in which there are 'open slots' for the root's consonants to fit into" (Frost, 2012, p. 11). Many studies have shown that skilled readers of both Arabic and Hebrew are more conscious of both root morphemes and affix patterns in morphologically complex words, and they can use root and word pattern knowledge to recognize the words easily (Abu Rabia, 2002; Bentin & Feldman, 1990). In contrast, beginning readers have much more difficulty learning to decode words in the languages that have deep orthographies.

By focusing on the Arabic language, there are some features of Arabic orthography that affect Arabic readers to read words. First, Arabic is highly transparent/consistent in the sense of letter-sound relations when the script is vowelized. According to Abu-Rabia and Siegel (2003), Arabic script is known as "shallow" orthography if it is vowelized and "deep" if it is unvowelized (Abu-Rabia & Siegel, 2003). Second, Arabic in its less transparent form has some unique dimensions of complexity (e.g., ligatures, diglossia, dual letters) that are often cited as a source of difficulty in learning to read in Arabic (Share & Daniels, 2015). In conclusion, orthographic depth has an impact on the ways in which words are read.

Linguistic knowledge for learning to read

Orthographic knowledge and processing

In general, orthography is the combination of the word orthos, which means “correct”, and graphein, which means “to write”. Orthography truly means correct writing (Apel, 2011). Orthographic knowledge is an essential component of orthographic skills, which "refers to the information that is stored in memory that tells us how to represent spoken language in written form” (Apel, 2011, p.1). In other words, children’s ability to recognize the typical visual patterns (e.g., possible letter sequences of the language) refers to orthographic knowledge (Abu-Rabia & Siegel, 2002). Therefore, orthographic knowledge plays an important role in literacy acquisition, and it is an essential component not only for spelling but also for reading (Cassar & Treiman, 1997; Castles & Coltheart, 2004). Moreover, orthographic knowledge was related to reading comprehension through accurate, rapid, and effortless word reading (Stanovich, 2000). However,

Orthographic processing refers to the ability that identifies the real-words or pseudo-words through the analysis of spelling patterns of printed words (Koda & Zehler, 2008).

Metalinguistic Awareness

Metalinguistic awareness plays an essential role in reading development. Simply, metalinguistic awareness is the ability to identify, analyze, and manipulate language systems independent of the actual meaning of each word (Koda & Zehler, 2008). Metalinguistic awareness also defined as the ability to “reflect on and manipulate the structural features of languages” (Nagy & Anderson, 1995, p.1). In the other words, metalinguistic awareness is the capacity to think abstractly about language and deal with it by using the knowledge to think about appropriate language structure and linguistic processes to access and manipulate various linguistic units (Gombert, 1992; 2003). Phonological awareness and morphological awareness are essential components of metalinguistic awareness that related to learning to read.

Phonological awareness (PA)

Phonological awareness "refers to children’s understanding of the sound structure of spoken words in the absence of print and their ability to use that knowledge" (Schwanenflugel, & Knapp, 2015, p. 46). Understanding the relationships between spoken and written words includes grasping the concept of the sound units (e.g., syllables, rhymes, stressed and unstressed syllables, and individual sounds that can be combined to create words) (Schwanenflugel, & Knapp, 2015). One of the most important levels of phonological awareness is phoneme awareness, which has been recognized as an important skill in children’s literacy development (Stanovich & Siegel, 1994; Treiman & Zukowski, 1991). Phonemic awareness is the awareness of the smallest units of speech in any language (Kuo & Anderson, 2008). Phonological awareness skills are often measured by using a phoneme elision (deletion) task.

Phonological awareness is a key indicator of children's reading performance (Stanovich, Cunningham, & Cramer, 1984). Moreover, it is the best predictor of word reading during the early stages of learning to read words for first language (L1) and second language (L2) learners (Lindsey, Manis & Bailey, 2003). Additionally, awareness of the phonological structure of a language is the key to literacy development in the second language learners because it provides an analytical framework to segment speech in the new language (Kuo & Anderson, 2008).

Morphological awareness (MA)

Morphological awareness is another important element of metalinguistic ability. Simply, morphological awareness is the recognition and awareness that word parts carry semantic information. The definition of morphological awareness refers to "children's awareness of the morphemic structure of words and their ability to reflect on and manipulate that structure" (Carlisle, 1995, p.194). Morphology, in this case, is a “description of how words are formed and patterns of words formation in a language” (Geva & Wiener, 2014, p.6). Morphemes are defined as the smallest meaningful units in words that carry semantic information that can be added or removed from a word to change its meaning (Kuo & Anderson, 2008). For instance, morphemes are represented as prefixes, suffixes, root words, and grammatical inflections (e.g., the use of “s” to mark plural). Likewise, the derived word “sadness” consists of two morphemes: the stem “sad” and the suffix “ness”. Morphological awareness was significantly correlated to both word level reading and reading comprehension (Deacon & Kirby, 2004). These characterizations of morphology have been based in languages with Indo-European roots and might not apply in the same way to Arabic and other Semitic languages, which have different morphological systems (see below).

Furthermore, morphological awareness plays a significant role in reading development while vocabulary is a key predictor of reading performance (Anderson & Freebody, 1981). Many researchers agreed that morphological awareness and vocabulary growth are associated (Nagy & Anderson, 1984; Singson, Mahony, & Mann, 2000). Additionally, one of the main reading difficulties that face many second language learners is a lack of vocabulary knowledge (Droop & Verhoeven, 2003; Verhoeven, 2000). This relationship might in part be related through morphological awareness especially in second language learners who have lower vocabulary knowledge and weaker morphological awareness skills. Moreover, Deacon and Kirby (2004) report that derivational morphological awareness significantly correlated to both pseudoword reading and reading comprehension.

Bilingualism and Second language acquisition

Because of rapid globalization, bilingualism is becoming a widespread phenomenon (Grosjean, 1982). Therefore, bilingualism has been studied over the past several decades. Bilingualism means that a person “knows” two languages. According to Bialystok (2009), bilingualism is an experience that has a significant impact on linguistic and cognitive performance across the lifespan. Bilinguals who are skilled in both languages have a more complex and possibly multi-structured mental lexicon, which affects their literacy development (Cummins, 1978).

There are two types of bilinguals based on when the second language (L2) is learned. First, simultaneous bilingualism refers to first language (L1) learners who have exposure to two languages since birth. In contrast, sequential bilingualism refers to L1 learners who acquire the L2, which differs from their mother tongue after they have some proficiency in their L1 (Paradis, Crago, & Genesee, 2003). Within these types of bilinguals, individuals might show dominance in their L1 or their L2, or be balanced bilinguals with approximately equal levels of skill in each language.

Research has shown that there is a positive relation between bilingual children’s skills in their L1 and reading acquisition in their L2 (e.g., Genesee, Geva, Dressler, & Kamil, 2006; Gottardo, 2002). Literacy acquisition is considered a lengthy, deliberate, and effortful process, especially in the second language. Skilled readers in the second language can use the most important linguistic and metalinguistic skills that they had in their L1, which can include the orthographic processing and phonological and morphological awareness (Chen, Dronjic & Helms-Park, 2015). A study has found that children who acquire a second language can take advantage of the skills that they have had the opportunity to develop their L1 (Abu-Rabia, &

Siegel, 2002). Indeed, the failure to achieve adequate reading proficiency in L1 or L2 hinders students' academic success. For instance, when children struggle to learn to read, they might think about dropping out of the school, which is considered a serious problem for some minority groups. Consequently, this issue might be more serious for second language learners whose L2 differs substantially from their mother tongue or their L1 (Koda & Zehler, 2008). Therefore, investigating the literacy skills of bilingual children that were developed in the L1 will help researchers understand factors that affect reading development in the second language.

Second language learners include a broad range of learners with different ages and with various first-language backgrounds. This study focused on second language learners who spoke Arabic as a first language L1 and English as second language with age range of eight and ten years.

Cross-language transfer

The definition of cross-language transfer by Odlin (1989) is often used because it is broad enough to include many different perspectives: "transfer is the influence resulting from similarities and differences between the target language and any other language that has been previously (and perhaps imperfectly) acquired" (p. 27). According to the previous definition, investigating the distance between the L1 and L2 in terms of similarities and differences is considered an important step to determine how literacy experiences or skills can be transferred across languages.

There are many hypotheses about the relationships among skills in the L1 and L2. The linguistic interdependence hypothesis is one of the influential theories in cross-language transfer. This hypothesis was developed by Cummins (1979), who claimed that the transfer of linguistic skills from L1 happens automatically, regardless of the type of orthography involved. Also, this hypothesis suggests that academic skills acquired successfully in the L1 will be transferred to the L2. Furthermore, children who have learning difficulties in the L1 will show similar difficulties in the L2 (Abu-Rabia, & Siegel, 2002).

Additionally, there are two types of transfer: positive transfer that happens when L2 learners can use their knowledge of spoken and written structure of their L1 to develop their proficiency in the L2. Conversely, negative transfer happens when the structures in the L2 are distant from the L1, so particular types of errors may be more likely to transpire while developing the L2 or when similar surface structures have different functions or meanings (Geva & Wiener, 2014). Moreover, it is important to note that performance in the L1 and L2 may have a positive relationship in terms of cognitive processes such as phonological awareness and rapid naming (RAN), which emphasize the ability to read with accuracy and fluency in the both L1 and L2 (Geva & Wiener, 2014; Koda & Zehler, 2008). Positive and negative transfer is partially related to whether or not the two languages share oral and written linguistic typologies (Caravolas, 2006). For instance, languages like English and Spanish that are typologically similar, in that they share a lot of structures of spoken or written language, are likely to show greater transfer. For example, if L1 and L2 share the same root words, it would make acquiring cognate words in L2 much easier (e.g., bicycle, bicicleta). In other words if the L1 and L2 are similar, the learner of the L2 may make fewer errors in terms of orthographic knowledge or phonological awareness. In contrast, languages like English and Arabic are typologically different, which means that they do not share the same structures of spoken or written language. For instance, Arabic L2 learners would not be able to rely on their word specific knowledge to derive the meaning of unknown new words in their L2 (Geva & Wiener, 2014). In addition, orthographic differences in terms of the script used and even the directionality of script reading will have an impact on reading across English and Arabic.

In short, investigating the distance between first and second languages is important to determine how literacy skills can be transferred across languages. Through this study, we examined reading acquisition in Arabic and English, which have two distinct orthographies and linguistic roots.

The nature of the Arabic language

Arabic is the fourth most common language with more than 300 million native speakers worldwide, and Arabic is an official language in 27 countries (Abu-Rabia, & Taha, 2006). Indeed, Arabic script is the second most common segmental script after the Roman alphabet, which is the most widely used alphabet (Saiegh-Haddad & Joshi, 2014). In addition, Arabic is a language of Quran-the holy book of Islam- that all Muslims around the world use for religious purposes such as daily prayers. Additionally, the Quran impacts the content, structure and literary style of the Arabic language (Omran, 1988). Arabic is used by several hundred million people who do not speak Arabic but speak languages, such as Urdu, Pashto, and Persian (Mirdehghan, 2010).

The structure of the Arabic language

Arabic Orthography

Arabic, like Hebrew, is a Semitic language, and it is written from right to left in a cursive form. Additionally, Arabic is written with an alphabetic system based on 28 letters. All these letters represent consonant sounds, with the exception of (aleph أ /aa/, yeh ي /ii/, and wow و /uu/), which represent both consonant sounds and long vowel sounds (/a:/, /u:/, /i:/). Also, most of these letters have different letter shapes based on the positions of the letters: initial, middle, or terminal of the word (Abu-Rabia, & Taha, 2006). For example, letter ه/ Haa'/ has three shapes (initial: هـ, middle ـهـ, final ـه). Furthermore, the Arabic system uses dots within the letters; and the appearance or the absence of dots differentiates specific letters whereas the number of dots is represented on, in, or under the letters. Thus, many letters in Arabic are only distinguishable by the number and placement of the dots. In other words, dots eventually considered part of the letter in Arabic, which can denote a different word and different phoneme (Saiegh-Haddad & Henkin-Roitfarb, 2014). As an illustration, dots appear with 15 letters with ten letters having one dot; three letters having two dots, and two letter having three dots, while there are 13 letters on which no dots appear (Abu-Rabia, & Taha, 2006, see Table1).

Table 1. *Arabic letters classification in terms of dots*

	One dot	**Two dots**	**Three dots**
Letters with dots	ب – ج – خ – ذ – ز – ض – ظ – غ – ف – ن	ت – ق – ي	ث – ش
Letters without dots	أ – ح – د – ر – ع – س – ص - ط – ك – ل – م – ه – و		

Moreover, Arabic script is known as a "shallow" orthography if it is vowelized and a "deep" if it is unvowelized (Abu-Rabia & Siegel, 2003). Arabic readers are exposed to two different types of script. Beginning readers are introduced to fully vowelized Arabic, but advanced or skilled readers are introduced to unvowelized Arabic (Abu-Rabia, 2001).

In terms of Arabic vowelization, there are three basic short vowels marks that are known as تشكيل tashki:l 'forming' and called حركات haraka:t 'motions', and they written as diacritics placed above or below the consonant letters. *First*: Fatħa is the short vowel of /a/, which is represented by a mark placed above a letter. *Second*, Damma is the short vowel of /u/, which is represented by a mark placed above a letter. *Third*, Kasra is the short vowel of /i/, which is represented by a mark placed below a letter (Saiegh-Haddad & Joshi, 2014, see Table 2).

According to Abu- Rabia (2001), the purpose of short vowels in Arabic writing is to transfer the unambiguous phonemic structure of the printed word to assist the poor and beginning reader. Therefore, reading Arabic script without short vowels can be a difficult task for poor and beginning readers because they would have to rely on identification of consonant clusters and their correspondence to previous semantic knowledge.

Moreover, since Arabic is highly homographic, reading Arabic script without short vowels can be a challenging task for poor and beginning readers (Abu-Rabia, 2001). An example of how homographic words can be read differently depending on the choice of vowels follows. The same three consonantal letters [k.t.b] can be read differently when different short vowels are added yielding the following possible readings (e.g., كَتَبَ /kataba/ [he wrote], كُتِبَ /kotiba/ [was written] and, كُتُبْ /kotob/ [books]). If the word is not vowelized, then the reader must determine the correct meaning, from these three homographic possibilities, based on syntactic and semantic cues.

Understanding the latter information about Arabic orthography is necessary for orthographic segmentation (Saiegh-Haddad & Joshi, 2014). Arabic has unique orthographic features that impact the reading processes of Arab readers particularly bilinguals (Abu-Rabia, & Taha, 2006). Nevertheless, more research is needed in the field of Arabic reading to understand the development and nature of reading compared with other orthographies such as English.

Diglossia

A description of Arabic without a mention of diglossia would be incomplete. Diglossia is a unique feature of Arabic language; Ferguson (1959, p. 336) has defined diglossia as follows:

> Diglossia is a relatively stable language situation in which, in addition to the primary dialects of the language (which may include a standard or regional standards), there is a very divergent, highly codified (often grammatically more complex) superimposed variety, the vehicle of a large and respected body of written literature, either of an earlier period or in another speech community, which is learned largely by formal education and is used for most written and formal spoken purposes but is not used by any sector of the community for ordinary conversation.

In other words, diglossia is defined as two forms of the same language that are used by the same person under different conditions (Fedda, & Oweini, 2012). The case in point, Arabic has two forms: first, the Standard Arabic (StA), which is the literary form used for reading and writing among all Arabic speakers. The second form is the spoken form (SpA), which Arabic speakers use for daily verbal communication. This spoken form is also called the colloquial dialect (Abu Rabia, 2000). Moreover, there are many spoken dialects of Arabic based on geographic area. For example, there are several dialects such as the Gulf Arabic dialect for the Gulf States, the Iraqi Arabic dialect for Iraq, the Levantine Arabic dialect for Levant countries such as Lebanon, Syria, and Jordan, the Egyptian Arabic dialect for Egypt, and the Maghrebi Arabic dialect for the Western Arab countries such as Morocco, Algeria, Tunisia and Libya (Biadsy, Hirschberg, & Habash, 2009).

Therefore, both the Standard Arabic (StA) and the spoken Arabic (SpA) forms differ in vocabulary, phonology, syntax and grammar (Ibrahim, Eviatar, & Aharon Peretz, 2007).

According to Ayari (1996), the diglossic situation of the Arab world has a negative impact on the reading acquisition of Arabic children. Diglossia is considered a key factor in making learning to read Arabic a challenging task for native speakers (Eviatar & Ibrahim, 2012). As an illustration, Arabic children learn to speak the local dialect at home, later they learn Modern Standard Arabic at school for reading, writing and communicating.

A study conducted by Abu-Rabia (2000) investigated the impact of early exposure to Arabic literary on the reading acquisition of Arabic children. Two hundred and eighty-two children participated in this study (135 from Grade one and 147 from Grade two). One hundred and forty-four children were in the experimental group who exposed to literary Arabic throughout their preschool period, while 138 children in the control group who were exposed only to spoken Arabic at the same period. These two groups of participants were examined at the end of Grade 1 and Grade 2 on reading comprehension. The results of this study showed that children who were exposed to only spoken Arabic had inferior reading comprehension skills than children who were exposed to literary Arabic.

A recent study by Saiegh-Haddad and Schiff (2016) examined the impact of linguistic distance on reading accuracy and fluency by comparing two categories of Arabic word reading; Standard Arabic (StA) and Spoken Arabic (SpA) words. One hundred native Arabic speakers participated in this study in Grades 2, 4, 6, and 10. The results indicated that the linguistic distance between SpA and StA had a significant effect on word reading development across all grades.

Arabic phonology

The Arabic language is marked by limited vocalic letters and rich consonantal letters. There are three basic vowels a,u,and i that are represented in both short and long forms (see Table 2).

Table 2. *Arabic short and long vowels*

Arabic Vowels							
Short vowels				**Long vowels**			
Short vowels marks	◌َ	◌ُ	◌ِ	Long vowels letters	ا	و	ي
Name of the marks in Arabic	فتحة	ضمة	كسرة	Name of the long vowels in Arabic	ألف	واو	ياء
Translate name of the marks In English	fatḥah	ḍammah	kasrah	Translate name of long vowels In English	Alif	Wāw	Ya'
Sound in English	a	u	I	Sound in English	aa	uu	ii

When compared to English phonemes, Arabic phonemes are divided into three groups. The *first* group of sounds in Arabic is similar in English sound such as b/, /d/, /dh (ð)/, /f/, /h/, /j/, / k/, / l/, /m/, /n/, /s/, /sh (ʃ)/, /t/, /th (θ) /, /w/, /y/ and /z/. The *second* group of sounds in Arabic does not exist in English but be may found in other European languages such as the /r/ sound which is like trilled r of Scottish, the /gh/ sound that is close to the /r/of Parisian French and the /kh/ sounds that is like to the German sound /ch/. The *third* group of sound the Arabic language is referred to the emphatic sounds (e.g., ṭ, ṱ, ṣ, ṩ and ḳ) and to the pharyngeal sound (e.g., h) (Amayreh & Dyson, 1998).

Arabic Morphology

Arabic morphology is different from Indo-European morphology in terms of linguistic structure and functions (Boudelaa, 2014; Frost, 2012; Saiegh-Haddad & Henkin-Roitfarb, 2014). Arabic is a non-concatenative language with an opaque morphology (Holes, 2004). Arabic morphology includes two main systems: inflectional and derivational morphology.

Inflectional morphology includes prefixes and suffixes that mark the grammatical distinctions of person, number, gender and tense (Abu-Rabia, & Taha, 2006). Using the vowel diacritics (e.g., long or short vowels) and affixes (e.g., prefixes and suffixes) helps to distinguish the meaning of the same word shapes and convey the word class such as noun or verb. For example, the root درس -d r s is used below to illustrate how vowels and affixes change the meaning and word shape of these three-letter roots: درس , means study, (see Table 3). In this inflectional system affixes (e.g., prefixes and suffixes) are added to real words in a linear fashion /Dars/ “one lesson” /darssaan/ “two lessons.”

For Arabic derivational morphology, words are derived by means of combining the root with the word pattern in a nonlinear fashion. Both roots and word patterns differ in their form and function (Boudelaa et al., 2010). In terms of form, roots exclusively consist of consonants and carry the general meaning of the lexeme, whereas word patterns are primarily comprised of vowels and can even feature some consonants as well (Boudelaa et al., 2010).

In terms of function, roots carry core semantic meaning that is modified by its derivatives (Boudelaa et al., 2010). The meaning of studying inherent in the root {drs}, for example, surfaces in many derived forms containing this root (e.g., [Darasa] studying; [dars] lesson; [duresa] studied). In contrast, word patterns function as composite morphemes by conveying grammatical information on one hand and providing phonological structure on the other hand. Another function of word patterns is that the word pattern can carry a place noun meaning (Boudelaa et al., 2010). For example, [Malaab] refers to a place where one plays and [maktab] refers to a place where one writes (Holes, 2004).

In summary, Arabic encompasses both linear (prefixes and suffixes) and nonlinear morphology (combining the root with word patterns). In other words, the Arabic language works more on a root system that means with the exception of some words such as body parts and foreign borrowed words, all Arabic words are derived from the basic root pattern of consonants that comprise the foundational meaning of the word. According to Boudelaa and Marslen-Wilson (2010), there are 5,336 roots and 2,324 word patterns in Standard Arabic. It also includes derivational affixes more similar to Indo-European languages.

Table 3. *Example of vowels and affix change the meaning of root*

Arabic words with the same root	**Transcription**	**Meaning in English**	**Add vowel diacritics change the meaning**	**Add affix change the meaning**	**Part of speech**
دَرَسَ	Darasa	He studied	Short vowel	-	verb: past tense
دَرْسْ	Dars	Lesson	Short vowel	-	Noun
دُرِسَ	Do resa	It was studied	Short vowel	-	verb: passive tense
يدْرُس	Ya dros	He is studying	-	Add prefixes	verb: present tense
تدْرس	Ta dros	She is studying	-	Add prefixes	verb: present tense
مدَرِّس	Ya dros	Teacher	-	Add prefixes	Noun
أدْرس	Ao dros	I study	-	Add prefixes	verb: present tense
مَدرَسة	Madrasah	School	-	Add both prefixes and suffixes	Noun

Studies of reading acquisition in Arabic

In the matter of reading acquisition in Arabic, the impact of Arabic vowels on reading accuracy in four different reading texts (narrative, informative, poetic, and Quranic) was examined by Abu-Rabia (1998). Each text was styled to be in three different conditions: correctly vowelized, unvowelized, and wrongly vowelized. The results showed that for each condition the type of vowels presented had a significant impact on reading accuracy with both poor or skilled readers.

Another study by Abu-Rabia (2002) assessed the reading, language, and memory skills of bilingual Arab-Canadian children. English was their language of schooling while Arabic was their spoken language at home. All children also attended the Arabic Heritage Language programs in Toronto to receive sessions in writing, reading, and speaking in Arabic for three hours a week. Fifty-six children, with age range between 9 to 14 years old, participated in this study. The children were tested on word and pseudo-word reading, language and working memory tasks in Arabic and English. The results showed a significant correlation between reading skills in both English and Arabic. In other words, there was a significant relationship between word and pseudo-word reading tests, working memory tests, and syntactic awareness tests in the two languages. However, bilingual English-Arabic children with reading problems in English were likely to demonstrate problems in their Arabic language. Despite the different nature of Arabic and English orthographies, no negative consequences were found for the development of language or reading skills in Arabic and English.

Linguistic diversity

This project focused on Arabic-English bilingual children who live in Canada and Saudi Arabia. The Arabic children who live in Canada used their first language Arabic for daily interpersonal communication with their family and neighbours and used their second language for academic and social purposes. Their exposure to the Arabic language at school was approximately three hours per week, where they received instructions in speaking, reading and writing Arabic. In addition, most Arabic children in Canada were identified as an English Language Learners (ELL) in which English is an addition to their native or home language, and it is commonly used in the school environment.

In Saudi Arabia, most public schools start to teach English in grade six. Furthermore, teaching English in private schools starts in grade one, and international schools begin teaching English from kindergarten. Therefore, English becomes an essential language to learn in Saudi Arabia for educational purposes, and it is considered an important tool for communicating with non-Arab people. In addition, most children in Saudi Arabia were identified as L1 Arabic speakers who were learning English as a Foreign Language (EFL), which implies that they learn English from non-native speakers and in non-English speaking country and context.

The Current Study

In this project, we examined Arabic and English literacy acquisition among Arabic-speaking children in Canada and Arabic-speaking children in Saudi Arabia by administering comparable measures in both languages (Arabic & English). The current study aimed to identify how phonological awareness, morphological awareness and orthographic processing contribute to word reading within and across languages, and how vocabulary and word reading contribute to reading comprehension within and across languages in Arabic, the L1, and English. This study focused on two groups (Canadian and Saudi children) for the following reasons: first, to determine how children in the Canadian group who are receiving most of their instruction in English and some in their L1 will perform on the reading and spoken language skills compared to children in the Saudi group who are receiving all their instruction in Arabic. Second, Arabic Canadian children may not be expose to the Standard Arabic (StA) as much as Saudi children, so we would like to see if that affects their first language literacy acquisition.

Research questions and hypotheses

Research Question1 a: Which variables will be correlated with word reading and reading comprehension in English and Arabic within-language?

H1: We expect that there would be a correlation between orthographic processing, phonological and morphological awareness and word reading (vowelized, unvowelized, and pseudoword reading) in Arabic among groups, children in Saudi Arabia and children in Canada.

H2: We expect that there would be a correlation between orthographic processing, phonological and morphological awareness and word reading (real words and pseudoword) in English among groups, children in Saudi Arabia and children in Canada.

H3: Within-language orthographic processing, phonological and morphological awareness will be correlated with reading comprehension in Arabic and English among groups.

Research Question1 b*:* Which variables will be correlated cross-language?

H1: We expect that phonological awareness in Arabic will be correlated with word reading in English.

H2: We expect that phonological awareness in Arabic will be correlated with phonological awareness in English.

Research question 2a: What are the within-language predictors of word reading in English and Arabic?

H1: Orthographic processing, phonological and morphological awareness will predict word reading among Saudi and Canadian groups within languages.

Phonological awareness, morphological awareness, and orthographic processing were selected as predictor variables based on significant results of previous research (Stanovich, Cunningham, & Cramer, 1984; Deacon & Kirby, 2004; Koda & Zehler, 2008).

Research question 2b: What are the within-language predictors of reading comprehension in English and Arabic?

H1: We expect that word reading will predict reading comprehension within-language among groups.

H2: We expect that vocabulary will predict reading comprehension within-language.

Variables for these hypothesise were selected based on the simple view of reading, specifically, word reading and listening comprehension. Given that listening comprehension is difficult to measure, vocabulary scores were used as a proxy (August, Carlo, Dressler, & Snow, 2005).

Research question 3: What are the cross-language predictors of word reading for English and Arabic?

H1: We expect that Arabic orthographic knowledge, phonological awareness, and morphological awareness, and Arabic un-vowelized word reading would predict English word reading.

H2: We expect that English orthographic knowledge, phonological awareness, and morphological awareness and English word reading would predict Arabic vowelized word reading.

Method

Participants

Children who spoke Arabic as a first language L1 and English as second language L2 were recruited from Canada and Saudi Arabia. In total 80 participants were included with a mean age of 8.6 years, SD = 0.66 years. This age is a critical period for language and literacy development.

Forty Arabic children (25 males and 15 females) who live in Saudi Arabia participated in this study with an average age of 8.4 years with age range from 8.00 to 9.11 years; SD = 0.5. Participants were recruited from international schools in which the education is mostly in English, but they were exposed to the Arabic language for approximately five hours per week, where they received instructions of speaking, reading and writing in Arabic.

Forty Arabic children (18 males and 22 females) who live in Canada participated in this study with a mean age of 8.8 years with age range from 8.00 to 10.4 years; SD = 0.7. Participants were recruited from different Islamic Schools and Weekend Schools. The average amount of exposure to the Arabic Language in these schools was approximately between three to four hours per week where they received instruction in reading and writing in Arabic. These children also attended English-speaking schools and were in the range of grade 2 to 4 in their public schools.

Furthermore, all children who participated in this study were tested by using a battery of measures in both English and Arabic. Most measures in English and Arabic were standardized with a high level of reliability and validity.

Family Questionnaire

The parents of the two groups of children in Canada and Saudi Arabia were asked to complete a questionnaire for the purpose of collecting some background information about their children's age, gender, the usage of the L1 (Arabic) and the L2 (English) with parents, siblings and friends. Also, in this questionnaire parents were asked to report the number of books in Arabic and English in their home and how much time they spend reading books and watching programs in both languages. In addition, parents were asked to provide information about their own levels of education.

Based on the family questionnaire, it was determined that the usage of L1 and L2 at home with parents, siblings, and friends varied across the two groups. For the Saudi group, children used spoken Arabic to communicate with their parents, siblings and friends more than standard Arabic and English. For the Canadian group, children used spoken Arabic to communicate with their parents more than standard Arabic and English; whereas they used English -the language at home and the community- more than Arabic to communicate with their siblings and friends.

Additionally, most of the children who live in Saudi Arabia allocated more time to reading Arabic books and watching Arabic programs than English, in comparison to children who live in Canada who spent more time reading English books and watching English programs than doing the same activities in Arabic. In this case, English is considered as the L1 for the Canadian group and Arabic is their second language.

In terms of parental educational level, approximately 45% of the Saudi group had parents who had completed an undergraduate degree, 41% of parents had completed a professional or post-graduate degree, another 9% had completed a college diploma, and the remaining 5% completed high school education. Forty-eight percent of the Canadian group had parents who had completed an undergraduate degree, 33% of parents had completed post-graduate degree, 12% who had completed a college diploma, and the remaining 7% of parents had completed high school.

Measures

The language and literacy measures for this research were selected to be age-appropriate for children who were between the ages of eight and ten years. All children in both groups were tested on two metalinguistic awareness skills (phonological awareness and morphological awareness), orthographic processing, word level reading (real word reading, pseudo-word reading, and word identification), reading comprehension, and cognitive-linguistic processing skills (vocabulary and digit span) in both English and Arabic.

In addition, we measured the impact of diglossia in Arabic through two tasks. First, the printed form of a reading comprehension task was presented to participants in spoken Arabic to assess Arabic diglossia. Second, we examined diglossia by asking participants to listen to a comprehension task in Arabic spoken form.

The details of each measure were outlined in the following section.

Reading measures

Reading Comprehension

In English. The passage comprehension subtest of the Woodcock Language Proficiency Battery-Revised (Woodcock, 1991) was used to assess English reading comprehension. The first four items of this measure provided picture cues designed to help the child supply the missing words. The remaining items of this measure examined the child's ability to read short passages and identifying a missing key word. The task was stopped after six consecutive errors in a set. The test manual reported internal consistency reliability coefficients of (r_{11}= .95) for age eight, (r_{11}= .78) for age nine, and (r_{11}= .77) for age ten (Woodcock, 1991).

In Arabic. The Individual Diagnostic Tests in the Assessment of Learning Disabilities in Arabic: Tests and Manual-Logat Elkaraa (Asadi, Shany, Ben-Semon, & Ibrahim, 2014) was presented in standard Arabic (literary form) and was used to assess reading comprehension. In this task, children were asked to read two vowelized passages. Each passage was approximately eighty words in length followed by multiple choice comprehension questions. In total, there were 21 multiple-choice questions for grade 3 passages and 25 multiple-choice questions for grade 4 passages. Children showed their level of understanding of the passages through answering these multiple-choice questions. The Cronbach's alpha for children in grade three was $\alpha = 0.89$, and in grade four was $\alpha = 0.81$.

A printed form of certain dialects of spoken Arabic, such as Saudi, Egyptian, Syrian, and Palestinian, was created based on the Standard Arabic reading comprehension passages for grades three and four. Theses adapted version of the Arabic spoken form was used to assess reading comprehension in spoken Arabic. In this task, children were asked to read two passages that were in the same length as the literary form. Following this activity, children were asked multiple choice comprehension questions. The raw score was the total number of correct responses of multiple questions. The Cronbach's alpha reliability for this task was 0.57.

Word-level reading (decoding)

In English. The Word Identification and Word Attack subtests of Woodcock Reading Mastery Test-Revised (WRMT-R; Woodcock, 1987) were used to assess children's word and non-word reading accuracy. As well, the two subtests of the Test of Word Reading Efficiency (TOWRE; Wagner, Torgesen, & Rashotte, 1999) were used to assess children's word and non-word reading fluency.

The Word Identification subtest was used to examine children's word reading accuracy. This subtest included 106 words, beginning at an easy level (e.g., is, you, boy) and becoming gradually more difficult (e.g., yardage, cologne, alkali). The children read as many words as possible before reaching six consecutive failed responses. Responses were scored as correct if the child read the presented word correctly; thus, the raw scores on this test were consisted of the number of words that were read correctly. According to the Word Identification subtest manual (Woodcock, 1991), the internal consistency reliability of this subtest was α=.92

Pseudoword reading accuracy in English was measured using Word Attack subtest. The subtest included 45 words, beginning with high-frequency monosyllabic words (e.g., ap, poe) and progressing to low frequency multisyllabic words (e.g., vunhip, knoink). Children were asked to read these pseudowords until the examiner assessed that a child had made six consecutive errors. The raw scores for this task were consisted of the number of words read correctly. The reliability of this subtest was α = .91 (Woodcock,1991). Next, both Word Identification and Word Attack subtest raw scores were transferred into standardized scores for final analyses.

The Test of Word Reading Efficiency (TOWRE; Wagner, Torgesen, & Rashotte, 1999) was used to examine children's reading fluency of words and pseudowords. Children were asked to read as rapidly as possible a list of 104 real words within forty-five seconds, and a list of sixty-three pseudowords within forty-five seconds. The row scores were calculated based on the number of correct words from the lists of words and pseudowords in forty-five seconds. If the child finished any of the lists before forty-five seconds have passed, then this was reported by the examiner. If the child did not finish the lists in 45 seconds, child was asked to read any familiar words remaining in the lists. The reliability of the (TOWRE) test was α =. 95 (Wagner et al., 1999).

In Arabic. The Individual Diagnostic Tests in the Assessment of Learning Disabilities in Arabic: Tests and Manual-Logat Elkaraa by Asadi, Shany, Ben-Semon, and Ibrahim (2014) was used to measure children's ability to decode the vowelized and unvowelized real words and pseudowords.

The Vowelized and Unvowelized Real Word Reading subtests examined both the accuracy and fluency of reading words in Arabic. Children were asked to read aloud a list of twenty-two vowelized words and a list of twenty-two unvowelized words. The words in each list were increasingly difficult in terms of the number of syllables, phonological structure, and morphological complexity. The range of difficulty was appropriate for children in grades three and four. Responses were scored as correct if the chid read the word correctly. Raw scores were calculated based on the number of correct responses in each word list. Task internal reliabilities of the vowelized and unvowelized word reading accuracy subtest were calculated using Cronbach's alpha. Vowelized word reading Cronbach's alpha in grade three was $\alpha = 0.93$ and in grade four was $\alpha = 0.81$, whereas unvowelized word reading Cronbach's alpha in grade three was $\alpha = 0.88$ and in grade four was $\alpha = 0.81$ (Asadi, Shany, Ben-Semon, & Ibrahim, 2014).

The Pseudoword Reading subtest was administrated to measure the children's ability to decode pseudowords of the Arabic alphabet system both accurately and fluently. This timed subtest included eighteen words that have been created based on linguistic constraints of Arabic. Children were asked to read aloud two columns of pseudowords and the examiner computed the time in seconds as well as noting errors. Participants were scored (1) for correct reading of pseudowords and (0) for incorrect reading of pseudowords. The Cronbach's alpha for children in grade three was $\alpha = 0.91$, and in grade four was $\alpha = 0.81$ (Asadi, Shany, Ben-Semon, & Ibrahim, 2014).

Metalinguistic awareness

Phonological awareness

In English. Children's phonemic awareness of the phonological structure of spoken words in English was measured using the Elision task subtest of the Comprehensive Test of Phonological Processing (CTOPP; Wagner, Torgesen, & Rashotte, 1999). This subtest was consisted of six practice items that was designed to help children understand the task and twenty test items. For example, the task began with easy practice items of syllable awareness where children were asked to delete part of a word (e.g., say 'toothbrush'; now say toothbrush without saying 'tooth'). Then, the practice and test items became harder by asking children to delete a smaller part at the beginning, the middle, or the end of the word (e.g., say 'cup', now say 'cup' without saying '/k/'; say 'split', now say 'split' without saying '/p/'; say 'meet', now say 'meet' without saying '/t/'). Moreover, the examiner stopped the child when child made three consecutive errors. The examiner recorded correct answers as 1 and incorrect answers as 0. The test manual reported reliability coefficient alpha of .89 for age eight, .89 for age nine, and .91 for age ten.

In Arabic. To determine children's phonological awareness skills, Phoneme Deletion subtest of the Tests and Manual-Logat Elkaraa by Asadi, Shany, Ben-Semon, and Ibrahim (2014) was selected. This phonemic deletion subtest examined children's ability to perform deletion of phonemes at the beginning and the end of words. This task was consisted of a list of twelve items that were randomly organized based on their linguistic attributes. For example, Children had to repeat a word (e.g. حليب) without saying a part of the word (e.g. /ح/). Also, this list included one-syllable words and two-syllable words. The reported Cronbach's alpha was α = 0.88 for grade three and α = 0.81 for grade four.

The Rapid Digit Naming

In English. The speed of naming the numbers was measured using the Rapid Digit Naming subtest of the Comprehensive Test of Phonological Processing (CTOPP; Wagner, Torgesen, & Rashotte, 1999). The numbers were presented in four rows and nine columns of six randomly selected numbers. Children were asked to read rows of numbers as quickly and accurately as possible. The raw score was calculated based on the total time that was taken in seconds to name all the numbers on forms A and B combined. Additionally, if the child took longer than two seconds to read a certain number, the examiner marked this item as incorrect and point to the next number. The test manual reported reliability coefficient alpha of .83 for age eight, .83 for age nine, and .90 for age ten (Wagner et al., 1999).

In Arabic. Rapid Digit Naming subtest of Tests and Manual-Logat Elkaraa developed by Asadi, Shany, Ben-Semon, and Ibrahim (2014) was administrated to the children. This subtest was used to measure the speed of naming numbers on a form that presents five rows and ten columns of five randomly selected (e.g., ٥-١-٧-٣-٩). Children were asked to read the numbers as quickly as possible. The examiner recorded the length of time in seconds and the number of errors.

Morphological awareness

In English. Derivational awareness task was selected to determine children's morphological awareness of the base forms of words. This expressive derivational awareness task was adapted from Carlisle (2000) to be suitable for younger children and language learners by deleting some items that may be too advanced for the age range in our sample. In this test, children were required to produce a derived word to complete a sentence. For example, "swim. She was a strong ______. [swimmer]". This test contained fifteen items for Saudi participants and twenty items for Canadian participants. Five more items were added to test Canadian participants based on the assumption that fifteen items would be too easy for them. Raw scores were obtained from the number of correct sentences. The reliability for this task was high (Cronbach's alpha = 0.87)

In Arabic. A Morphological Odd Word Out subtest of the Tests and Manual-Logat Elkaraa by Asadi, Shany, Ben-Semon, and Ibrahim (2014) was administrated to examine children's morphological awareness. More precisely, this task tested children's awareness of roots in Arabic which contained twenty items, and each item presented four word sets. One word of each word set was phonologically similar to the other three words but not morphologically related to the other words (e.g., مدرسة، مدرس، درس، **سرد**). The examiner told children that there are three words in each set that refer to the same root, whereas one word does not belong to the same root. The children read the words, and then they were asked to identify the unrelated root word within each set by across or circle this specific word (e.g., **سرد**). Raw scores were the total number of words correctly selected by the child, which did not belong to the root of the main words. Reliability (Cronbach's alpha) of this test was α = 0.86 for grade three and α = 0.81 for grade four.

Orthographic processing

In English. The orthographic legality task created by Siegel, Share, and Geva (1995) was used to determine children's orthographic processing skills. This task contained seventeen pairs of pronounceable letter strings that were created to encourage the use of orthographic patterns in choosing word likeness. One word of each pair has some orthographic neighbours (e.g., moke), whereas the other item had no orthographic neighbours (e.g., moje). During this task children were asked to determine which one of the two pseudowords looks more like it could be a word or which pair could be the spelling of a word (e.g., filv vs. filk). Raw scores were used in the analysis, with a correct if the child selects the correct pseudoword that fits with the English orthographic pattern. The reliability for this task was low (Cronbach's alpha = 0.29) even after deleting items 1, 6, and 7.

In Arabic. The Cross Out the Wrong Word subtest of Tests and Manual-Logat Elkaraa (Asadi, Shany, Ben-Semon, & Ibrahim, 2014) was used to test children's orthographic knowledge. The task included five practice words and fifty test words which involved judging the correct spelling and incorrect spelling. Through this task, children were asked to read the items and cross out the incorrectly spelled words. The task was timed in seconds, and the raw score was calculated based on the number of correct words that the examinee left without crossing out. Reliability (Cronbach's alpha) of this subtest was α = 0.89 for grade three and α = 0.81 for grade four.

Vocabulary

In English. The Expressive One Word Picture Vocabulary Test (EOWPVT) developed by Brownell (2000) was used to measure children's vocabulary knowledge which can be accessed retrieved from memory and used to produce meaningful speech. The EOWPVT test consisted of 170 pictures, beginning with easy items (e.g., boat, tree, ear) and then gradually becoming increasingly difficult during the task (e.g., penguin, status, tweezers, clarinet, stirrup). Through this task, children were asked to name the picture on the page. The basal of this test begins with a series of eight consecutive correct responses whereas the ceiling of this test refers to a series of six consecutive incorrect responses. The raw score was the total number of correct responses. The Cronbach's alpha of this measure for age eight and nine was .95, and for age ten was .96 (EOWPVT-SBE, Brownell, 2000).

In Arabic. The Picture Vocabulary subtest of the Tests and Manual-Logat Elkaraa (Asadi, Shany, Ben-Semon, & Ibrahim, 2014) was administered to measure children's vocabulary knowledge. The task contained forty Arabic standard words. Children saw four pictures, and were asked to point to the picture that matched a word said by the tester. The raw score was the total number of correct responses. Reliability (Cronbach's alpha) of this subtest was $\alpha = 0.86$ for grade three and $\alpha = 0.81$ for grade four.

Listening Comprehension

Since Arabic children are not often exposed to standard Arabic or formal dialect until they begin formal schooling, assessment using a listening comprehension test in this study was particularly important for a diglossic language such as Arabic.

The Listening Comprehension subtest of Early Grade Reading Assessment (EGRA) National Baseline Assessment (2014) was administered to measure children's proficiency in the formal dialect of Arabic. Knowing the level of children's proficiency in the formal versus informal versions of the dialect might provide us more information about children's ability in their Arabic spoken language.

Before starting the task, the examiner asked children to listen carefully to two stories in preparation for the several questions that were asked after each story. The examiner read the first short story of seventy-one words written in Modern Standard Arabic form, and then the children were asked seven questions about that story. Next, the examiner read the second short story of seventy-one words written in Spoken Arabic form or dialect, followed by asking the children seven questions about that story. The listening comprehension raw score for both passages was the total number of correct answers, with a maximum possible score of seven. This subtest was untimed, but children who did not reply to a specific question within ten seconds were scored as "No Reply" on that question. Each question in both passages was asked only once.

The Cronbach's alpha reliability for Arabic literary listening comprehension was = .62 and after deleting item 2 reliability became = .67. Thus, the Cronbach's alpha reliability was lower for Arabic spoken listening comprehension. Reliability was = .49 and after deleting item 2 the reliability became = .56.

Procedure

Most of the English and Arabic measures were standardized tests with reported reliabilities and validity. The Arabic testing session took approximately one hour, whereas the English session took approximately fifty-four minutes. The sessions were conducted on two separate days with each day designated to one language. The two testing sessions were administered individually to all participants by the researchers. Children who live in Saudi Arabia received the Arabic tasks first and the English tasks second, whereas children who live in Canada received the English tasks first and the Arabic tasks second. This order was selected because it was expected that the children will be much more comfortable in their dominant than non-dominant language. All participants were received the tasks in the same order within each language. Finally, ten dollars were given to each child as compensation for participation.

Results

Results are described in three subsections. These sections include descriptive statistics, correlations, and regression analyses among variables. All tests of significance were two-tailed, and the significance level of .05 was used.

Descriptive Statistics

Table 4 displays means, standard deviations, F-values, p-values and effect sizes for the raw scores of developed measures and standardized tests for each task in both languages: Arabic and English in both groups (Saudi and Canada). The result of descriptive statistical analyses showed that there were group similarities and differences in terms of scores for the variables related to English and Arabic word reading, reading comprehension, and metalinguistic awareness tasks among Arabic-English bilingual children in Saudi Arabia and Canada.

Skewness values were examined for all measures. English phonological awareness was negatively skewed for the Canadian group; the Arabic morphological task was negatively skewed for the Saudi group; Arabic phonological awareness was negatively skewed for the Canadian group. All other variables were normally distributed. Therefore, to deal with this negative skew, raw scores from these negatively skewed variables were reverse-scored then transformed into (Log10) transformation to normalize the distribution, and analyses were conducted with these transformed scores. However, corrections to normality did not change the pattern of results for the correlational and regression analyses. Therefore, all reported analyses were conducted on raw scores.

Correlational Analyses

The relationships between variables were examined based on the Pearson correlation coefficients. Correlational analyses were conducted separately by subgroup. This section was divided into two research questions in which the significant correlations were highlighted.

***Research Question1 a**:* Which variables are correlated with word reading and reading comprehension in English and Arabic within-language?

Word reading

Saudi group. English Word Identification was positively correlated with the morphological awareness task, the English orthographic legality task, and the English vocabulary test. English RAN digits was negatively correlated with English Word Identification. Moreover, English Word Attack was positively correlated with morphological derivational task, phonological awareness elision task, English orthographic legality task, and English vocabulary test. English RAN digits was negatively correlated with English Word Attack (see Table 5).

Arabic pseudoword reading accuracy was positively related to vowelized and un-vowelized word reading accuracy, Arabic morphological awareness, Arabic orthographic processing and Arabic phonological awareness. However, Arabic vowelized and un-vowelized word reading accuracy were positively related to Arabic morphological awareness, the Arabic orthographic processing task, Arabic phonological awareness, and the Arabic vocabulary task (see Table 6).

Canadian group. English Word Identification was positively correlated with the English morphological derivational task, the English phonological awareness elision task, and the English vocabulary test, whereas English Word Identification negatively correlated with English RAN digits. Furthermore, English Word Attack was positively correlated with the morphological awareness task, and the English vocabulary test, whereas English Word Attack was negatively related to English RAN Digits (see Table 5).

Arabic pseudoword and vowelized word reading accuracy were positively related to Arabic morphological awareness, Arabic orthographic processing, and Arabic phonological awareness. Arabic un-vowelized words reading accuracy was positively related to Arabic morphological awareness, Arabic orthographic processing, Arabic phonological awareness, and the Arabic vocabulary task (see Table 6).

Reading comprehension (RC)

Saudi group. English RC was positively correlated with English Word Identification, English Word Attack, the English morphological derivational task, the English orthographic processing task, and the English vocabulary test, whereas English RAN digits was negatively correlated with English RC (see Table 5).

Arabic reading comprehension literary form and spoken form were positively correlated with Arabic pseudoword reading accuracy, vowelized and un-vowelized word reading accuracy, Arabic listening comprehension literary form and spoken form, Arabic morphological awareness, Arabic orthographic processing, Arabic phonological awareness and the Arabic vocabulary task (see Table 6).

Canadian group. English RC was positively correlated with English Word Identification, English Word Attack, the English morphological derivational task, the phonological awareness elision task, and the English vocabulary test, whereas English RAN digits was negatively correlated with English RC (see Table 5).

Arabic reading comprehension literary form was positively correlated with Arabic listening comprehension literary form and spoken form, Arabic morphological awareness, Arabic orthographic processing, and the Arabic vocabulary task. Arabic reading comprehension spoken form was positively related to Arabic listening comprehension literary form and spoken form, Arabic un-vowelized words reading accuracy, Arabic morphological awareness, Arabic orthographic processing task, Arabic phonological awareness, and Arabic vocabulary task (see Table 6).

***Research Question1 b**:* Which variables are correlated with word reading cross-languages?

Saudi group. English Word Identification and Word Attack were positively correlated with Arabic un-vowelized word reading accuracy. In addition, English morphological derivational task showed a positive correlation with Arabic pseudoword reading accuracy and un-vowelized word reading accuracy. Finally, English phonological awareness was positively related to Arabic vowelized and un-vowelized word reading accuracy, Arabic morphological awareness, Arabic orthographic processing and Arabic phonological awareness (see Table 7).

Canadian group. English Word Identification and Word Attack were positively correlated with Arabic pseudoword reading, vowelized and un-vowelized word reading accuracy, and Arabic phonological awareness. Moreover, the English morphological awareness task was positively related to Arabic pseudoword reading, vowelized and un-vowelized word reading accuracy, Arabic morphological awareness, and Arabic phonological awareness. Finally, English phonological awareness was significantly correlated with Arabic pseudoword, vowelized and un-vowelized word reading accuracy, Arabic orthographic processing and Arabic phonological awareness (see Table 7).

Regression Analyses

Research question 2a: What are the within-language predictors of word reading for English and Arabic?

Phonological awareness, morphological awareness, and orthographic processing were selected as predictor variables based on significant correlations and the results of previous research (see Introduction).

Variable related to English word reading. Multiple regression analyses were conducted to see if English morphological awareness, English orthographic processing, and English phonological awareness were related to English Word Identification in each group.

Saudi group. English morphological awareness, English orthographic processing, and English phonological awareness explained a significant amount of variance in English Word Identification when entered together (R^2 = .598, F (3,36) = 17.846, p <.001). The analysis showed that English Word Identification was related to English morphological derivational, β = .616, t (36) = 5.232, p < .001 and English orthographic processing, β =. 247, t (36) =2.142, p = .039, (See Table 8).

Canadian group. English morphological awareness, English orthographic processing, and English phonological awareness explained a significant amount of variance in English Word Identification when entered together (R^2 = .444, F (3,36) = 9.570, p<.001). However, the analysis showed that English Word Identification was only related to English morphological awareness, $\beta = .562$, *t (36)* = 3.947, $p < .001$, in this group (See Table 8).

Variables related to English pseudoword reading

Multiple regression analyses were conducted to see if English morphological awareness, English orthographic processing, and English phonological awareness were related to English Word Attack in each group.

Saudi group. English morphological awareness, English orthographic processing, and English phonological awareness explained a significant amount of variance in performance on English Word Attack ($R^2 = .463$, F (3,36) = 10.350, $p < .001$). The analysis showed that English pseudoword reading was related to English morphological awareness, β = .287, *t (36)* = 2.113, $p = .042$, English orthographic processing, β = . 271, *t (36)* = 2.037, $p = .049$, and English phonological awareness, β = .451, *t (36)* = 3.574, $p = .001$ (see Table 9).

Canadian group. English morphological awareness, the English orthographic processing, and English phonological awareness explained a significant amount of variance in performance on English pseudoword reading ($R^2 = .419$, F (3,36) = 8.668, $p<.001$). The analysis showed that English pseudoword reading was only related to English morphological awareness, β =.667, *t (36)* = 4.583, $p < .001$ (see Table 9).

Variables related to Arabic pseudoword reading

Multiple linear regression analyses were conducted to determine variables related to Arabic pseudoword reading based on the Arabic morphological awareness task, the Arabic orthographic processing task and the Arabic phonological awareness task for each group.

Saudi group. Morphological awareness, orthographic processing and phonological awareness in Arabic were entered as one step and explained a significant amount of variance in Arabic pseudoword reading (R^2 =.366, F (3,36) = 6.938, p < .001). The analysis showed that Arabic pseudoword reading was only related to the Arabic phonological awareness task, β =.346, *t (36)* =2.076, p = .045 (see Table 10)

Canadian group. Morphological awareness, the orthographic processing task, and the phonological awareness task in Arabic were entered in the equation and explained a significant amount of variance in Arabic pseudoword reading (R^2 =.541, F (3,36) = 14.118, p <.001). The analysis showed that Arabic pseudoword reading was related to the Arabic orthographic task, β =. 519, *t (36)* =3.481, p < .001 and the Arabic phonological awareness task, β =.480, *t (36)* =3.657, p < .001 (see Table 10).

Variables related to Arabic vowelized word reading

Multiple regression analyses were conducted to see if the Arabic morphological awareness task, the Arabic orthographic task and the Arabic phonological awareness task were related to Arabic vowelized word reading in each group.

Saudi group. Morphological awareness, orthographic processing and phonological awareness in Arabic were entered and explained a significant amount of variance in Arabic vowelized word reading (R^2 =.646, F (3,36) = 21.885, p<.001). The analysis showed that Arabic vowelized word reading was related to the Arabic orthographic task β =. 463, *t (36)* =3.317, p = .002 and the Arabic phonological awareness task β =. 460, *t (36)* =3.687, p < .001(see Table 11).

Canadian group. Morphological awareness, orthographic processing and phonological awareness in Arabic were entered in the equation and explained a significant amount of variance in Arabic vowelized word reading (R^2 =.584, F (3,36) = 16.834, p<.001). The analysis showed that Arabic orthographic processing, β =. 438, t (36) =3.087, p = .004 and Arabic phonological awareness, β =. 501, t (36) = 4.008, p < .001, were related to vowelized reading in Arabic (see Table 11).

Variables related to Arabic un-vowelized word reading

Multiple regression analyses were conducted to see if Arabic morphological awareness task, Arabic orthographic task, Arabic phonological awareness task related to Arabic un-vowelized word reading in each group.

For Saudi group. Morphological awareness, orthographic processing and phonological awareness in Arabic explained a significant amount of variance in Arabic un-vowelized word reading (R^2 =.458, F (3,36) = 10.155, p < .001). The analysis showed that Arabic un-vowelized word reading was related to the Arabic orthographic processing task, β =. 506, t (36) =2.933, p = .006. Arabic phonological awareness was also related to Arabic un-vowelized word reading, but did not reach traditional levels of significance, β =. 308, t (36) =1.996, p = .054 (see Table 12).

Canadian group. Morphological awareness, orthographic processing and phonological awareness in Arabic were entered as one step and explained a significant amount of variance in Arabic un-vowelized word reading (R^2 =.347, F (3,36) = 6.373, p<.001). However, the analysis showed that un-vowelized word reading was only related to the Arabic orthographic processing task, β =. 481, t (36) =2.705, p = .010 (see Table 12).

Research question 2b: What are the within-language predictors of reading comprehension for English and Arabic?

Variables for these analyses were selected based on the simple view of reading, specifically, word reading and listening comprehension. Given that listening comprehension is difficult to measure, vocabulary scores were used as a proxy (August, Carlo, Dressler, & Snow, 2005).

English reading comprehension predictors

Multiple regression analyses were conducted to see if English word reading and English vocabulary were related to English reading comprehension in each group.

Saudi group. English word reading and English vocabulary explained a significant amount of variance in English reading comprehension (R^2 =.707, F (3,36) = 44.68, p <.001). The analysis showed that English reading comprehension was related to both English word reading, β =. 562, t *(36)* =4.207, p < .001 and English vocabulary (β =. 334, t *(36)* =2.501, p = .017 (see Table 13).

Canadian group. English word reading and English vocabulary explained a significant amount of variance in English reading comprehension (R^2 =.577, F (3,36) = 25.282, p <.001). The analysis showed that English reading comprehension was related to both English word reading (β =. 331, t *(36)* =2.623, p = .013 and English vocabulary (β =. 530, t *(36)* = 4.201, p < .001 (see Table 13).

Arabic reading comprehension predictors. Arabic vocabulary and vowelized word reading were selected based on the significant correlation and the results of previous findings.

A. Literary form or Standard Arabic (StA)

Hierarchical regression analyses were conducted separately for the Saudi group and Canadian group, to determine which variables were uniquely related to Arabic reading comprehension literary form (ARCLF). Arabic vocabulary was used as a control variable and entered in the first step, and vowelized word reading was entered as the second step. Group differences were found in terms of the variables related to Arabic reading comprehension literary form (see Table 14).

Saudi group. Arabic vocabulary was significantly related to ARCLF when it was entered as the first step β =. 391, *t (38)* =2.62, *p* = .013, but it was not a unique statistical predictor of ARCLF. As the first step, vocabulary accounted for 15.3 % of the variation in ARCLF. Furthermore, when vowelized word reading was included in the analyses as a second step, only vowelized word reading was a unique statistical predictor, β = .511, *t (38)* =3.66, *p* = .00, (see Table 14). Adding vowelized word reading to the regression model explained an additional 22.5% of the variation in ARCLF and this change in R^2 was significant F (1,37) = 13.422, p <.001.

Canadian group. Arabic vocabulary also was significantly related to ARCLF when it was entered as the first step β =.704, *t (38)* =6.106, *p* < .001. In addition, vocabulary was uniquely related to ARCLF when vowelized word reading was included in the analyses as a second step β =.687, *t (38)* =5.804, *p* < .00, (see Table 14). Moreover, vocabulary accounted for 49.5 % of the variation in ARCLF. The addition of vowelized word reading to the regression model explained 0.6% of the variation in ARCLF and this change in R^2 was not significant F (1,37) = .492, p = .492.

B. Spoken form or spoken Arabic (SpA)

Hierarchical regression analyses were conducted separately for the Saudi group and Canadian group, to determine which variables were related to Arabic reading comprehension of the spoken form (ARCSF). Arabic vocabulary was used as a control variable and entered in the first step, and vowelized word reading was entered as the second step. Group differences were found in terms of the variables related to Arabic reading comprehension spoken form (see Table 15).

Saudi group. Arabic vocabulary was significantly related to ARCSF when it was entered as the first step β =. 545, *t (38)* =4.00, $p < .001$. Additionally, vocabulary was a unique statistical predictor of ARCSF, β =. 344, *t (38)* =2.89, $p < .001$, after vowelized word reading was included in the analyses as a second step (see Table 15). Vocabulary accounted for 29.7 % of the variation in ARCSF as the first step. Adding vowelized word reading to the regression model explained 25.3% of the variation in ARCSF and this change in R^2 was significant F (1,37) =20.818, p <.001.

Canadian group. Arabic vocabulary was significantly related to ARCSF when it was entered as the first step, β =.522, *t (38)* =3.77, $p < .001$. Additionally, vocabulary was the only measure uniquely related to ARCSF, β =.480, *t (38)* =3.45, $p < .001$, after vowelized word reading was included in the analyses as a second step. Furthermore, vocabulary accounted for 27.2 % of the variation in ARCSF as the first step. Adding vowelized word reading to the regression model explained an additional 4.2% of the variation in ARCSF and this change in R^2 was not significant F (1,37) = 2.24, $p = .143$ (see Table 15).

Research question 3: What are the cross-language predictors of word reading for English and Arabic?

Cross-language variables related to English word reading

Hierarchical regression analyses were conducted to identify cross-language relations among variables and English word reading separately for the Saudi group and the Canadian group. Arabic orthographic processing, phonological awareness, and morphological awareness were entered in the first step. Arabic un-vowelized word reading was entered as a second step. Group differences were found in terms of which variables were related to English word reading as measured by the Woodcock Word Identification subtest (see Table 16).

Saudi group. Arabic orthographic processing, phonological awareness, and morphological awareness were not related to English word reading when they were entered as a first step. When Arabic un-vowelized word reading was included in the analyses, Arabic un-vowelized word reading was a unique statistical predictor of English word reading, β =.525, t (36) =2.501, p =. 017. Adding un-vowelized word reading to the regression model explained an additional 14.9 % of the variation in English word reading and this change in R^2 was significant F (1,35) =6.256, p =.017 (see Table 16).

Canadian group. In contrast, Arabic phonological awareness was significantly related to English word reading, β =.427, t (36) =2.505, p = .017 when it was entered as a first step. Arabic orthographic processing, phonological awareness, and morphological awareness accounted for 1.6% of the variation in English word reading as the first step. When Arabic un-vowelized word reading was included in the analyses, both Arabic phonological awareness and the un-vowelized word reading were unique statistical predictors of English word reading, β =.377, t (35) =2.443, p = .020; β =.498, t (35) =3.042, p = .004. Adding un-vowelized word reading to the regression model explained an additional 16.2 % of the variation in English word reading and this change in R^2 was significant F (1,35) =9.252, p =.004 (see Table 16).

Cross language variables related to Arabic vowelized word reading

Hierarchical regression analyses were conducted separately for the Saudi group and Canadian group, to determine which variables were related to Arabic vowelized word reading.

English orthographic processing, phonological awareness and morphological awareness were entered as the first step. English word reading was entered as a second step. Hierarchical regression analyses were conducted to determine the unique variance contributed by English word identification as well as the variability explained by the other variables when cross-language word reading was not controlled. Group differences were found in terms of the variables related to Arabic vowelized word reading (see Table 17).

Saudi group. When English orthographic processing, phonological awareness and morphological awareness were entered as a first step, English phonological awareness was significantly related to Arabic vowelized word reading, β =.583, t (36) =4.487, $p < .001$. When English word reading was included in the analyses, English phonological awareness remained unique statistical predictor of Arabic vowelized word reading, β =.594, t (35) =4.447, $p < .001$. English phonological awareness accounted for 43% of the variation in Arabic vowelized word reading. The addition of English word reading to the regression model explained an additional 0.3 % of the variation in Arabic vowelized word reading and this change in R^2 was not significant F (1,35) =.211, p =.649 (see Table 17).

Canadian group. When English orthographic processing, phonological awareness and morphological awareness were entered as a first step, only English phonological awareness was significantly related to Arabic vowelized word reading, β =.403, t (36) =2.620, p =013. English phonological awareness and English orthographic processing accounted for 35% of the variation in Arabic vowelized word reading as the first step. When English word reading was included in the analyses, English phonological awareness was the only unique statistical predictors of Arabic vowelized word reading, β =.350, t (35) = 2.326, p =026. Adding the English word identification to the regression model explained an additional 6.6 % of the variation in Arabic vowelized word reading and this change in R^2 was significant F (1,35) =3.939, p =.055 (see Table 17).

Discussion

The current study examined predictors of word reading and reading comprehension within- and across-languages in Arabic, the L1, and English, the L2, for two groups of Arabic-speaking children, one group in Saudi Arabia and one in Canada. Comparable measures in Arabic and English were administered to both groups of Arabic-English bilingual children with distinctly different experiences in terms of exposure and use of L1 and L2. The Saudi group was exposed to English (L2) only within the confines of school instruction. They used their first language for academics and for social communication, with family, peers, and in the community. In contrast, Canadian group received most of their education in English, and they used their L2, English, for academic and social purposes while their L1 was used for interpersonal communication with their family and neighbours. Also, they were exposed to the Arabic language for approximately 3 hours per week at their school.

The result of statistical analyses showed that there were group differences in terms of variables related to English and Arabic word reading, reading comprehension, and metalinguistic awareness tasks among Arabic-English bilingual children in Saudi Arabia and in Canada who had different levels of experience in the English and the Arabic language learning environment. For instance, Arabic-speaking children in Saudi Arabia were more advanced in their Arabic language skills and less advanced in their English skills whereas Arabic-speaking children in Canada were more proficient in their English skills than their Arabic skills. These differences can be explained by the sequential exposure to both languages, and the type of educational system in which they were enrolled.

Within-language predictors among groups

English word reading

Multiple regression analyses produced similarities and differences among predictors of English word reading across groups. First, English morphological awareness was significantly related to English word reading for both the Saudi and the Canadian groups. This finding corresponded with previous research showing that the morphological awareness is a strong predictor of English word reading (Carlisle, 2000; Deacon, & Kirby, 2004; Nagy et al., 2003).

This finding also supported the importance of morphological awareness (roots and suffixes) in learning to read English words for different groups of Arabic-English bilingual children. In short, both the Saudi and the Canadian groups showed a high level of proficiency in acquiring morphological awareness of the spoken language and representing the morphological information within their lexicon (Duncan et al., 2009).

Second, our finding showed that English phonological awareness was not related to English word reading in both groups of Arabic-English bilinguals. The explanation for these results likely differs for the two groups. Obtaining this result can be associated with the way that Arabic-English bilinguals in Saudi Arabia are taught to read English in the early stages of literacy development. For example, when Arabic bilingual children in Saudi Arabia read English words, they may use the "look-and-say" method, which is the method that children use to read by recognizing and memorizing whole words or sentences rather than associating letters with individual sounds (Weaver, 1988). On the other hand, the lack of a significant relationship between phonological awareness in English word reading for the Arabic-English bilinguals in Canada could be due to the ceiling effect obtained on the phonological awareness measure.

Multiple regression analyses produced similarities and differences among predictors of English pseudoword reading across Arabic-English bilingual groups. Our findings showed that morphological awareness was significantly related to English word reading in both groups of Arabic-English bilinguals. A previous study demonstrated that morphological awareness contributed significantly to pseudoword reading (Deacon & Kirby, 2004). Further, this finding of a role of morphological awareness in pseudoword reading may seem surprising because pseudoword items are not typically viewed as having a morphemic structure. However, Arabic-English bilinguals in both groups might be "processing pseudowords, such as gaked and mancingful (both items in Word Attack), with an eye to morphemic units" (Deacon & Kirby, 2004, p. 235). Moreover, the combination of a root with a suffix can interfere with accurate processing for pseudowords (Duncan et al., 2009).

Group differences were found in terms of how phonological awareness and orthographic processing were related to English pseudoword reading. For the Saudi group, morphological awareness, phonological awareness and orthographic processing skills together were clearly important to decode the English pseudoword reading. In contrast, for the Canadian group, the English orthographic processing measure had lower reliability, which may have influenced the strength of the correlation with the English pseudoword reading variable. Also, the lack of a relationship between the English phonological awareness and English word reading in the Canadian children likely reflects ceiling effects for the phonological awareness task. In sum, developing an advanced morphological awareness skills will influence Arabic-English bilinguals to read both visual words and Pseudoword in English.

Links to models of English word reading

The “Dual Route Model” is one of the important word reading models that has dominated word recognition theories involving the metacognitive perspective (Coltheart, 2005). According to the “Dual Route Model”, successful reading relies on two routes: the sub-lexical and the lexical route. For the sub-lexical route of an alphabetic orthography, letters are decoded by phoneme-grapheme rules. In contrast, the lexical route is related to written words (visual representations) as a complete pattern without the necessity of phoneme-grapheme decoding (Zabell & Everatt, 2002). Though several previous studies showed that phonological awareness was related to English word reading in an alphabetic orthography (Arab-Moghaddam & Senechal, 2001; Durgunoglu, Nagy, & Hancin-Bhatt, 1993; Gholamain & Geva, 1999; Wade-Woolley & Siegel, 1997), in this study, we found that English phonological awareness did not relate to English word reading in both Arabic-English speakers in Saudi Arabia and Canada. This finding corresponds with reading using the lexical route when Arabic bilinguals read English words where children recognized the word pattern without the necessity of phoneme-grapheme decoding. Thus, models of word reading for bilingual children should not only be focusing on the language being read, but also should consider the children’s first language.

Arabic word reading

Multiple regression analyses produced similar results among variables related to Arabic word reading across groups. Arabic phonological awareness was related to both Arabic vowelized word reading and Arabic pseudoword reading for both the Saudi and the Canadian groups. This finding is consistent with those of many previous studies (Abu- Rabia et al., 2003, Al-Mannai & Everatt, 2005; Saiegh- & Geva, 2008). Since Arabic is a homographic language, vowels are essential facilitators in the process of word recognition. Therefore, in our case, Arabic vowelized word reading and Arabic vowelized pseudoword reading, which are examples of a shallow orthography, showed important facilitative effects on reading among Arabic groups. This finding corresponds to research on Spanish, which is an alphabetic orthography with shallow orthographic system represented in the Roman script. The grapheme–phoneme correspondence rules are consistent in Spanish (DeFior, Martos, & Cary, 2002); indeed, each grapheme has a clear and precise phonemic translation. Therefore, the grapheme–phoneme correspondence rules in Spanish allow readers to determine the phoneme corresponding to each specific grapheme without ambiguity (DeFior et al., 2002). Shallow orthographies, such as Spanish and vowelized Arabic, are easier to decode because readers can use the consistent grapheme-phoneme mappings compared to deep orthographies that often need access to the lexical route or larger units to read the word (Liu & Cao, 2016).

Additionally, Arabic orthographic processing was related to Arabic un-vowelized word reading for both the Saudi and the Canadian groups. This suggests that, orthographic processing in Arabic is associated with the development of word reading skills. Our findings showed that acquiring knowledge of permissible orthographic patterns of the Arabic orthography may help children who read Arabic to facilitate the reading of both vowelized and un-vowelized words (Fender, 2008).

English reading comprehension

Multiple regression analyses produced similar results in terms of predictors of English reading comprehension across groups. The results showed that vocabulary knowledge and word reading were significantly related to English reading comprehension across the Saudi and the Canadian groups. This finding corresponded with previous studies that have shown that vocabulary knowledge and word reading are stable predictors of reading comprehension (Cain, Oakhill, & Lemmon, 2004; Catts, 2005; Tunmer & Hoover, 1993). This finding is consistent with *the simple view of reading* that shows that word reading and listening comprehension, which is related to vocabulary, are necessary for reading comprehension (Gough & Tunmer, 1986). In this case, it seems that both groups are dependent on their vocabulary knowledge when comprehending text, and their decoding ability becomes more automatic in terms of word recognition (Pasquarella, Gottardo & Grant, 2012).

Arabic reading comprehension

Hierarchical regression analyses produced similarities and differences among a unique predictors of Arabic reading comprehension across groups. Arabic vowelized word reading was the only factor explaining unique variance in Arabic reading comprehension of the literary form for the Saudi group. In contrast, for the Canadian group, vocabulary was the only variable explaining unique variance in Arabic reading comprehension of the literary form. For the Saudi group, the lack of variability on the multiple-choice reading comprehension measure, which was used for this study, may explain why vowelized word reading accuracy was a unique predictor of Arabic reading comprehension of the literary form rather than vocabulary. To deal with this issue in the future, we can re-examine the reading comprehension task by using different reading comprehension strategies. According to previous studies, cloze-format tests have shown a stronger relationship between vocabulary and comprehension than multiple-choice, true–false format (Francis, Fletcher, Catts, & Tomblin, 2005; Francis et al., 2006; Keenan, Betjemann, & Olson, 2008). Thus, in our case for the Saudi group, using cloze-format tests that involve filling in a missing word instead of multiple-choice questions might provide a strong relationship between vocabulary and reading comprehension. In addition, vowelized word reading accuracy is considered an important factor for the Saudi group to comprehend the Arabic literary form.

Notably, Saudi children are taught to read using vowelized Arabic and continue to use this form into the late elementary grades, so they heavily rely on the vowelized phonological information in order to effectively decode words in the texts (Schiff, & Saiegh, 2016).

Furthermore, both vocabulary knowledge and vowelized word reading explained unique variance in Arabic reading comprehension of the spoken form for the Saudi group. In contrast, vocabulary knowledge was the only factor explaining unique variance in Arabic reading comprehension of the spoken form for the Canadian group. These findings suggest that vocabulary is an important predictor of Arabic reading comprehension of the spoken form. In other words, acquiring vocabulary in Standard Arabic may assist Arabic-speaking children in both groups to comprehend the spoken texts. In sum, our results considered with the previous research that have shown that vocabulary is a fundamental factor of successful reading comprehension in the Arabic language (Farran, 2016).

Cross-language predictors among groups

Results of hierarchical regression analyses produced similarities and differences in cross-language predictors English word reading and Arabic un-vowelized word reading.

English word reading cross-language predictors. For the Saudi group, Arabic un-vowelized word reading explained unique variance in English word reading. In contrast, for the Canadian group, both Arabic phonological awareness and the un-vowelized word reading explained unique variance in English word reading.

Un-vowelized word reading was selected as a unique predictor of English word reading because when Arabic word reading is unvowelized, it considered as a deep orthography. Therefore, it is likely more similar to English than the shallow, vowelized version of Arabic. Hence, knowing the relation between English word reading and Arabic un-vowelized word reading makes more sense to compare these two measures rather than using Arabic vowelized word reading.

Our findings showed that Arabic un-vowelized word reading is related to English word reading for both Arabic-English speakers in Saudi Arabia and Canada. This finding corresponds with *orthography depth* in both English and Arabic. English is written using a deep alphabetic orthography. While there is some regularity among grapheme-and-phoneme correspondences, there are many irregular letter-to-sound mappings that are often associated with multiple phonemes (e.g., “ch” in chef, choir, and cheese). Also, according to Frost (2012), grapheme-and-phoneme correspondences in English can be changed depending on the addition of affixes, and very often these changes result in changes in the pronunciation (e.g., heal/health, and courage/courageous). In contrast, Arabic is a Semitic language, that has an alphabetic orthography. Arabic script is known as “shallow” orthography if it is vowelized and “deep” if it is unvowelized (Abu-Rabia & Siegel, 2003). Words in the Arabic language are all derived from roots, and these roots generally consist of three consonants; indeed, these consonants and roots convey the core meaning of words (Frost, 2012, p. 11). Therefore, orthographic depth has an impact on the ways in which words are read with greater similarities between English and unvowelized Arabic than between English and vowelized Arabic.

This finding is consistent with *the interdependence hypothesis* that shows “language proficiency transfers across languages, such that students who have developed literacy in their [first language] will tend to make stronger progress in acquiring literacy in [second language]” Cummins (2000, p.173). In this case, it seems that both the Saudi and the Canadian groups show greater relations between the deep orthography of their L1 and reading English words in their L2.

Arabic vowelized word reading cross-language predictors. English phonological awareness explained unique variance in Arabic vowelized word reading. No group differences were found in terms of how English phonological awareness was related to Arabic word reading. This finding is supported by *the common underlying cognitive processes* (Geva & Ryan,1993) in which phonological awareness predicted word reading in Arabic which is typologically distant from English. Therefore, Arabic bilingual children may rely heavily on metacognitive skills from their L1 to read words in their L2.

Limitations and future directions.

This current study has some limitations that should be highlighted. *First*, the sample of children included in this study was rather small and limited to a single school context. Also, there were a potential importance of including demographic variables, but the sample size of this study limited us with the only four variables per analysis. *Second*, some of the non- standardized tests that were used in this study such as orthographic processing in English, and listening comprehension of Arabic spoken form with limited items have low reliabilities. Also, using only one measure of morphological awareness in Arabic was not enough to assess the children's ability on morphological awareness, so using more than one test would help to determine whether morphological awareness skills load on a single reading factor or show separate constructs. Moreover, since the English phonological awareness task has a ceiling effects that did not capture enough variance for the Canadian group, using a different measure of phonological awareness may help prevent ceiling effects due to the high performance in this group. *Third*, this study was designed as a correlational study, which limits our ability to establish a causal link between key variables of interests and word reading or reading comprehension. Thus, even if there are strong significant correlations among two variables, we cannot presume that one causes the other.

For the future directions, a longitudinal study with experimental design for this research would help us to understand how changes in the level of high performance would have an influence on reading processes. Moreover, since the current study examined language and literacy acquisition among Arabic-speaking children in Saudi Arabia and in Canada, it would be interesting to examine language and literacy acquisition among the Arabic-English speaking adolescents in Saudi Arabia and in Canada.

Conclusion

The results of this current study showed that bilingualism is clearly not a barrier to the development of reading (Cummins, 1981). Moreover, two groups of Arabic-English speakers that were involved in this study showed somewhat different patterns of relations among variables. First, Arabic bilingual children in Saudi Arabia who were being educated in Arabic but received extensive instruction in English performed well in reading tasks in both Arabic and English. Second, Arabic bilingual children in Canada who were being educated in English but received extensive instruction in Arabic also performed well in most of the reading tasks in both Arabic and English. However, some of the children in Saudi group who showed reading difficulties in Arabic showed similar patterns in English, whereas some of the children in Canadian group who showed reading difficulties in English showed similar difficulties in Arabic.

To summarize the major findings briefly, similarities and difference were found in patterns of relations across variables and across groups. Morphological awareness was related to English word reading, while phonological awareness was most highly related to Arabic word reading. For reading comprehension, vocabulary was consistently related across groups, tasks and languages, with word reading showing different patterns of results. Finally, the deep version of Arabic word reading was more consistently related to English word reading, which is written using a deep alphabetic orthography.

The findings of this study highlighted the importance of developing materials in the Arabic language that support teaching communicative and functional language skill development rather than focusing on knowledge about language. Furthermore, the findings of this study could help both teachers and parents to recognize the fundamental elements of language and literacy that could assist them to improve their teaching skills.

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Table 4. *Descriptive Statistics, effect size F-ratio and p-value of all tasks in both languages: Arabic-English in Saudi Arabia and in Canada*

English Measures	**Saudi Arabia**		**Canada**				
Variables	***M***	***SD***	***M***	***SD***	***F ratio***	***sig***	η^2
E-Reading Comprehension	12.03	3.166	21.98	4.003	152.019	.000	.661
E-Word ID	48.73	12.245	71.38	12.217	68.583	.000	.468
E-Word Attack	20.08	6.937	29.63	6.225	41.992	.000	.350
E-TOWRE Real Words	46.53	12.132	66.50	12.239	53.742	.000	.408
E-TOWRE non-Real Words	25.80	10.075	35.73	11.357	17.096	.000	.180
E-Morphological Derivational Task	6.30	1.897	14.20	2.946	203.341	.000	.723
E-Orthographic processing (legality)	10.25	1.794	11.10	1.722	4.675	.034	.057
E-Phonological CTOPP Elision	14.83	4.712	17.75	1.391	14.179	.000	.154
E-CTOPP RAN Digits	43.93	12.332	33.88	8.293	18.293	.000	.190
E-Vocabulary EOWPVT	32.70	9.036	78.30	15.482	258.825	.000	.768
Arabic Measures	**Saudi Arabia**		**Canada**				
Variables	***M***	***SD***	***M***	***SD***	***F ratio***	***sig***	η^2
A-Literary Form Reading Comprehension	19.38	2.705	16.73	5.257	8.035	.006	.093
A-Spoken Form Reading Comprehension	6.90	1.959	5.45	1.867	11.488	.001	.128
A- Literary Form Listening Comprehension	4.43	1.299	3.15	1.642	14.841	.000	.160
A- Spoken Form Listening Comprehension	4.70	1.137	4.08	1.457	4.576	.036	.055
A-Pseudo Words Reading (In Seconds)	52.80	27.47	69.25	30.417	6.442	.013	.076
A-Pseudo Words Reading (Raw Score)	13.20	2.554	12.93	3.640	.153	.697	.002
A-Pseudo Words Reading (Per Minute)	19.52	11.38	13.79	7.930	6.820	.011	.080
A-Vowelized Words Reading (In Seconds)	73.37	44.93	112.07	49.46	13.415	.000	.147
A-Vowelized Words Reading (Raw Score)	16.65	3.239	16.00	4.249	.592	.444	.008
A-Vowelized Words Reading (Per Minute)	19.15	11.36	10.97	6.86	15.175	.000	.163
A-Un-vowelized Words Reading (In Seconds)	54.45	34.75	98.30	36.236	30.509	.000	.281
A-Un-vowelized Words Reading (Raw Score)	17.70	3.131	13.90	3.388	27.140	.000	.258
A-Un-vowelized Words Reading (Per Minute)	29.68	21.26	10.02	5.413	32.133	.000	.292
A-Morphological Task	17.50	2.755	13.95	3.281	27.462	.000	.260
A-Orthographic Task	40.23	6.678	33.23	7.540	19.323	.000	.199
A- Phonological Awareness Task	9.25	1.878	10.53	1.797	9.625	.003	.110
A_RAN Digits (In Seconds)	32.77	9.74	56.52	25.491	30.293	.000	.280
A-Vocabulary Task	32.60	3.828	22.63	4.996	100.468	.000	.563

Table 5. *Correlation matrix among English variables for children in Saudi Arabia above the diagonal and children in Canada below the diagonal*

		English Measures							
	Variables	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1	ERC	---	.811**	.608**	.763**	.195	.536**	-.458**	.753**
2	EWID	.613**	---	.739**	.734**	.241	.474**	-.511**	.746**
3	EWAttack,	.556**	.692**	---	.485**	.501**	.361*	-.386*	.637**
4	EMD	.675**	.641**	.639**	---	.213	.377*	-.288	.651**
5	EPA	.551**	.430**	.273	.488**	---	-.040	.044	.127
6	EOL	.056	.136	-.078	.026	.000	---	-.268	.576**
7	ERAND	-.584**	-.620**	-.464**	-.583**	-.594**	.064	---	-.404**
8	EOWPVT	.706**	.532**	.512**	.621**	.331*	-.078	-.356*	---

* ***P*** $< .05$**;** *****P*** $< .001$

Note, ERC= English reading comprehension; EWID=Word Identification (Woodcock); EWAttack= Word Attack (Woodcock); EMD, English Morphological Derivational; EPA, English Phonological Awareness (CTOPP Elision); EOL=English Orthographic Legality; ERAND= English RAN Digits (CTOPP); EOWPVT= Expressive One Word Picture Vocabulary Test.

Table 6. *Correlation matrix among Arabic variables for children in Saudi Arabia above the diagonal and children in Canada below the diagonal*

		Arabic Measures													
	Variables	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
1	ARCLF	---	.690**	.523**	.463**	.434**	.356*	.586**	.379*	.543**	.421**	.624**	.547**	.476**	.391*
2	ARCSF	.473**	---	.430**	.412**	.394*	.385*	.669**	.433**	.610**	.539**	.618**	.604**	.593**	.545**
3	ALCLF	.650**	.396*	---	.558**	-.026	.007	.317*	.061	.373*	.124	.297	.202	.281	.618**
4	ALCSF	.649**	.317*	.596**	---	-.111	.034	.180	.095	.341*	.193	.213	.158	.180	.378*
5	APWRa	.268	.265	.006	.011	---	.578**	.520**	.439**	.553**	.367*	.437**	.522**	.545**	.181
6	APWRf	.306	.347*	.199	.196	.729**	---	.537**	.861**	.538**	.782**	.324*	.482**	.571**	.181
7	AVWRa	.219	.304	.000	.033	.889**	.661**	---	.612**	.632**	.599**	.506**	.713**	.715**	.371*
8	AVWRf	.393*	.433**	.232	.214	.644**	.867**	.731**	---	.581**	.819**	.394*	.579**	.567**	.362*
9	AUVWRa	.308	.453**	.109	.308	.704**	.737**	.641**	.666**	---	.749**	.398*	.631**	.558**	.458**
10	AUVWRf	.391*	.498**	.304	.353*	.554**	.854**	.509**	.800**	.821**	---	.440**	.594**	.595**	.336*
11	AMA	.567**	.506**	.325*	.382*	.405**	.408**	.493**	.523**	.442**	.446**	---	.640**	.511**	.348*
12	AOP	.720**	.494**	.480**	.456**	.608**	.591**	.619**	.682**	.575**	.596**	.644**	---	.578**	.296
13	APA	.146	.394*	.060	.034	.610**	.429**	.662**	.452**	.337*	.310	.496**	.409**	---	.382*
14	AVT	.704**	.522**	.464**	.497**	.193	.402*	.199	.530**	.410**	.548**	.545**	.632**	.117	---

$^{*}P < .05$; $^{**}P < .001$

Note, **ARCLF =** Arabic reading comprehension Literary Form; **ARCSF** = Arabic reading comprehension spoken Form; **ALCLF** = Arabic Listening Comprehension Literary Form**; ALCSF** = Arabic Listening Comprehension Spoken Form; **APWRa** = Arabic Pseudo Words Reading accuracy; **APWRf** = Arabic Pseudo Words Reading fluency; **AVWRa** = Arabic Vowelized Words Reading accuracy; **AVWRf** = Arabic Vowelized Words Reading fluency; **AUVWRa**= Arabic Unvowelized Words Reading accuracy; **AUVWRf** = Arabic Unvowelized Words Reading fluency; **AMA** = Arabic Morphological Awareness; **AOP** = Arabic Orthographic processing task; **APA** = Arabic Phonological Awareness; **AVT** = Arabic Vocabulary Task

Table 7. *Correlation matrix cross English and Arabic variables for children in Saudi Arabia above the diagonal and children in Canada below the diagonal*

Variables		1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	EWID	---	.739**	.734**	.474**	.241	.074	.115	.098	.152	.335*	.173	.096	.105	.020
2	EWAttack	.692**	---	.485**	.361*	.501**	.319*	.162	.142	.163	.373*	.137	.127	.232	.099
3	EMD	.641**	.639**	---	.485**	.361*	.501**	.319*	.176	.131	.365*	.108	.157	.118	.079
4	EOL	.136	-.078	.026	---	-.040	.084	-.010	-.196	-.105	.078	-.116	.125	.029	-.141
5	EPA	.430**	.273	.488**	.000	---	-.040	.084	.621**	.519**	.681**	.477**	.345*	.613**	.446**
6	APWRa	.480**	.347*	.420**	.153	.487**	---	.578**	.520**	.439**	.553**	.367*	.437**	.522**	.545**
7	APWRf	.603**	.385*	.397*	.042	.415**	.729**	---	.537**	.861**	.538**	.782**	.324*	.482**	.571**
8	AVWRa	.546**	.375*	.451**	.168	.525**	.889**	.661**	---	.612**	.632**	.599**	.506**	.713**	.715**
9	AVWRf	.601**	.362*	.448**	.101	.433**	.644**	.867**	.731**.	---	.581**	.819**	.394*	.579**	.567**
10	AUVWRa	.531**	.379*	.395*	.208	.413**	.704**	.737**	.641**	.666**	---	.749**	.398*	.631**	.558**
11	AUVWRf	.553**	.311	.371*	.029	.435**	.554**	.854**	.509**	.800**	.821**	---	.440**	.594**	.595**
12	AMA	.258	.148	.404**	.046	.233	.405**	.408**	.493**	.523**	.442**	.446**	---	.640**	.511**
13	AOP	.287	.043	.285	.227	.387*	.608**	.591**	.619**	.682**	.575**	.596**	.644**	---	.578**
14	APA	.463**	.415**	.571**	-.017	.515**	.610**	.429**	.662**	.452**	.337*	.310	.496**	.409**	---

$^{*}P < .05$; $^{**}P < .001$

EWID, Word Identification (Woodcock); **EWAttack**, Word Attack (Woodcock); **EMD**, English Morphological Derivational; **EPA**, English Phonological Awareness (CTOPP Elision); **EOL**, English Orthographic Legality.

APWRa, Arabic Pseudo Words Reading accuracy; **APWRf**, Arabic Pseudo Words Reading fluency; **AVWRa**, Arabic Vowelized Words Reading accuracy; **AVWRf**, Arabic Vowelized Words Reading fluency; **AUVWRa**, Arabic Unvowelized Words Reading accuracy; **AUVWRf**, Arabic Unvowelized Words Reading fluency; **AMA**, Arabic Morphological Awareness; **AOP**, Arabic Orthographic processing task; **APA**, Arabic Phonological Awareness.

Table 8. *Multiple regression model predicting English word reading (word identification)*

Variables	Saudi group				Canadian group			
	β	*Std. Error*	*t*	*sig*	*β*	*Std. Error*	*t*	*sig*
English Morphological derivational	.616	.760	5.232	.000	.562	.591	3.947	.000
English orthographic processing (legality)	.247	.786	2.142	.039	.121	.883	.974	.337
English phonological awareness	.120	.284	1.103	.277	.155	1.251	1.089	.283

Table 9. *Multiple regression model predicting English word reading (word Attack)*

Variables	Saudi group				Canadian group			
	β	*Std. Error*	*t*	*sig*	*β*	*Std. Error*	*t*	*sig*
English Morphological derivational	.287	.497	2.113	.042	.667	.308	4.583	.000
English orthographic processing (legality)	.271	.514	2.037	.049	-.095	.459	-.750	.458
English phonological awareness	.451	.186	3.574	.001	-.052	.651	-.360	.721

Table 10. *Multiple regression model predicting Arabic pseudo word reading*

Variables	Saudi group				Canadian group			
	β	*Std. Error*	*t*	*sig*	*β*	*Std. Error*	*t*	*sig*
Arabic morphological awareness	.092	.164	.520	.606	-.167	.174	-1.066	.294
Arabic orthographic	.263	.071	1.406	.168	.519	.072	3.481	.001
Arabic phonological awareness	.346	.227	2.076	.045	.480	.266	3.657	.001

Table 11. *Multiple regression model predicting Arabic vowelized word reading*

Variables	Saudi group				Canadian group			
	β	*Std. Error*	*t*	*sig*	*β*	*Std. Error*	*t*	*sig*
Arabic morphological awareness	-.026	.156	-.194	.847	-.038	.193	-.252	.803
Arabic orthographic processing	.463	.068	3.317	.002	.438	.080	3.087	.004
Arabic phonological awareness	.460	.215	3.687	.001	.501	.295	4.008	.000

Table 12. *Multiple regression model predicting Arabic un-vowelized word reading*

Variables	Saudi group				Canadian group			
	β	*Std. Error*	*t*	*sig*	*β*	*Std. Error*	*t*	*sig*
Arabic morphological awareness	-.083	.186	-.508	.614	.084	.193	.448	.657
Arabic orthographic processing	.506	.081	2.933	.006	.481	.080	2.705	.010
Arabic phonological awareness	.308	.257	1.996	.054	.099	.295	.633	.531

Table 13. *Multiple regression model predicting English reading comprehension*

Variables	Saudi group				Canadian group			
	β	*Std. Error*	*t*	*sig*	*β*	*Std. Error*	*t*	*sig*
English word identification	.562	.035	4.207	.000	.331	.041	2.623	.013
English Vocabulary	.334	.047	2.501	.017	.530	.033	4.201	.000

Table 14. *Hierarchical regression analyses for variables predicting Arabic reading comprehension literary form, separate for Saudi group and Canadian group*

Variable	Saudi group (N = 40)				Canadian group (N = 40)			
	β	***t*-value**	R^2	ΔR^2	**β**	***t*-value**	R^2	ΔR^2
Model 1			.153	.153			.495	.495
Arabic vocabulary task	.391	2.62**			.704	6.10***		
Model 2			.378	.225			.502	.006
Arabic vocabulary task	.202	1.44			.687	5.80***		
Vowelized word reading	.511	3.66***			.082	.695		

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

Table 15. *Hierarchical regression analyses for variables predicting Arabic reading comprehension spoken form, separate for Saudi group and Canadian group*

Variable	Saudi group (N = 40)				Canadian group (N = 40)			
	β	***t*-value**	R^2	ΔR^2	**β**	***t*-value**	R^2	ΔR^2
Model 1			.297	.297			.272	.272
Arabic vocabulary task	.545	4.00***			.522	3.77***		
Model 2			.550	.253			.314	.042
Arabic vocabulary task	.344	2.89***			.480	3.45***		
Vowelized word reading	.542	4.56***			.208	1.49		

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

Table 16. *Hierarchical regression analyses for variables predicting English word reading cross language, separate for Saudi group and Canadian group*

Variable	Saudi group ($N = 40$)				Canadian group ($N = 40$)			
	β	***t*-value**	R^2	ΔR^2	**β**	***t*-value**	R^2	ΔR^2
Model 1			.016	.016			.227	. 227
Arabic orthographic processing	.106	.454			.141	.731		
Arabic phonological awareness	-.076	-.363			.427	2.51***		
Arabic morphological awareness	.067	.304			-.044	-.219		
Model 2			.165	.149			.388	.162
Arabic orthographic processing	-.160	-.662			-.098	-.511		
Arabic phonological awareness	-.237	-1.158			.377	2.443**		
Arabic morphological awareness	.111	.535			-.086	-.469		
Arabic un-vowelized word reading	.525	2.50***			.498	3.04***		

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

Table 17. *Hierarchical regression analyses for variables predicting Arabic vowelized word reading cross language, separate for Saudi group and Canadian group*

Variable	Saudi group (N = 40)				Canadian group (N = 40)			
	β	***t*-value**	R^2	ΔR^2	**β**	***t*-value**	R^2	ΔR^2
Model 1			.430	.430			.351	.351
English orthographic processing	-.224	-1.638			.162	1.204		
English phonological awareness	.583	4.487***			.403	2.620**		
English morphological awareness	.137	.976			.250	1.624		
Model 2			.434	.003			.417	.066
English orthographic processing	-.202	-1.371			.120	.918		
English phonological awareness	.594	4.45***			.350	2.326**		
English morphological awareness	.193	1.029			.057	.320		
English word reading	-.092	-.459			.343	1.985		

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