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To cite this article: Haneen Wattad & Salim Abu Rabia (2020) The Advantage of Morphological Awareness Among Normal and Dyslexic Native Arabic Readers: A Literature Review, Reading Psychology, 41:3, 130-156, DOI: [10.1080/02702711.2020.1768973](https://doi.org/10.1080/02702711.2020.1768973)

To link to this article: <https://doi.org/10.1080/02702711.2020.1768973>



Published online: 21 Jun 2020.



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The Advantage of Morphological Awareness Among Normal and Dyslexic Native Arabic Readers: A Literature Review

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ABSTRACT

This article presents a review of studies that investigated the advantage of morphological awareness and knowledge of basic morphemes that comprise verbs in Arabic among normal and dyslexic native Arabic readers, and discusses the role of Arabic morphology in reading. The review included studies on Arabic as well as some studies on Hebrew, since they are both Semitic languages. Recent studies have demonstrated the importance of morphology in the organization of words, and its effect on the reading process. Studies investigating normal and dyslexic readers usually focused on the role of phonology in different orthographies, rather than on the role of morphology. It is important to study the orthography of the specific language, due to its specific nature, and the different effect that each orthography type may have on the reading process. The present review discusses most of the recent studies on Arabic morphology and focuses on the contribution of morphological awareness for acquisition and fluency in reading and its effect on the reading process of normal and dyslexic readers. The findings of these studies, as well as future research directions are discussed.

ARTICLE HISTORY

Received 16 January 2019
Accepted 21 April 2020

HIGHLIGHTS

1. What is already known about this topic?
*Recent studies demonstrated the importance of morphology in the organization and processing of words and its effect on the reading process. This role is not clear in all orthographies.

2. What this paper adds.

*The present review discusses most of the recent studies conducted on Arabic morphology, shows what these studies concluded as well as future research directions.

Introduction

Recent studies have indicated that morphological awareness makes an important contribution to the quality of reading (Ben-Dror et al., 1995a; Casalis & Louis-Alexandre, 2000; Leikin & Hagit, 2006). Morphological awareness refers to a reader's ability to reflect upon the meaning of morphemes and the ability to parse and manipulate them. It contributes to reading ability above and beyond the contribution of phonological awareness (Schiff & Raveh, 2007).

The morphological structure of a word plays a central role in the organization of the mental lexicon and in word identification (Deutsch & Frost, 2003). The mental lexicon is a store of words that provides fundamental linguistic and conceptual knowledge. It is used for producing and understanding language, as well as for finding a logical explanation for new linguistic inputs (Ravid, 2004). Studies in several different languages found that readers automatically divide words into their morphemic constituents and use these units to activate word meaning in the mental lexicon (Caramazza, 1997; Deutsch & Frost, 2003). Morphology's role in the organization of the mental lexicon is especially important in Semitic languages, for example Arabic and Hebrew, since these are synthetic languages with a rich morphology (Ibrahim, 2006). It is important to understand that morphological awareness is different from morphological processing. The "Wug test" (Berko, 1958) has shown that children as young as 4 years old are able to use knowledge about English morphological rules. Children's overgeneralization of the "ed" suffix to irregular past tenses (for example, *goed or *bued) is an example of their unconscious knowledge of their morphology system, i.e., implicit morphological processing (Nagy, Carlisle, & Goodwin, 2014; Owens, 2001). Morphological awareness at the explicit level refers to conscious activation of the required morphological processes.

Studies show that early morphological awareness may support statistical learning during the acquisition of spoken language and may enable young readers to understand the language's linguistic characteristics (Duncan, Casalis, & Colé, 2009). The role of morphological awareness in word reading has been well established in various languages. It has been linked to several literacy skills, including reading accuracy, reading fluency and reading comprehension (Layes, Lalonde, & Rebaï, 2017; Roman,

Kirby, Parrila, Wade-Woolley, & Deacon, 2009), spelling (Carlisle, 1987; Deacon, Kirby, & Casselman-Bell, 2009; Nunes & Bryant, 2006; Nunes, Bryant, & Olsson, 2003; Taha & Saiegh-Haddad, 2016, 2017), and vocabulary (Bowers & Kirby, 2010; Carlisle & Fleming, 2003; Nagy & Anderson, 1984). Furthermore, morphological instruction was found to lead to significant gains in vocabulary and in reading (Bowers, Kirby, & Deacon, 2010; Goodwin & Ahn, 2013).

The importance of morphological awareness, its connection to reading acquisition and its importance in lexicon organization has been demonstrated. However, there is a scarcity of studies on the Arabic language, and most of these were conducted on small samples, used only a limited number of morphological tasks, or performed priming experiments solely in adults (Tibi & Kirby, 2017).

Studies have demonstrated that normal readers develop sound morphological abilities and awareness of word structures according to their age, understand and develop the morphological links between words, contrary to readers with dyslexia who find it difficult to understand morphological relationships and carry out morphological manipulations in morphological tasks (Abu-Rabia, 2007; Abu-Rabia & Awwad, 2004; Bryant, Nunes, & Bindman, 2000; Carlisle, 1995; Kaminsky, Eviatar, & Norman, 2002; McBride-Chang, Shu, Zhou, Wat, & Wagner, 2003; Shankweiler et al., 1995). The sound of morphological awareness positively affects and helps the reading process, since it supports readers in processing words morphologically and storing them using their morphological structure in their mental lexicon. This leads to efficient identification of new words via morphological analogies with similar words stored in their lexicon (Wattad & Abu-Rabia, 2020; Abu-Rabia & Taha, 2004; Abu-Rabia & Awwad, 2004; Berninger, Abbott, Nagy, & Carlisle, 2010; Deacon & Kirby, 2004; Elbro & Arnbak, 1996; Ravid & Schiff, 2006; Roman et al., 2009; Sénéchal, Basque, & Leclaire, 2006).

Schiff and Saiegh-Haddad (2018) recently investigated the development and relationships between phonological awareness, morphological awareness and word reading in spoken and standard Arabic. They concluded that morphological awareness plays a crucial role in standard Arabic word-reading fluency. The importance of morphological awareness has been noted in different languages. These studies also provided evidence that development of morphological awareness begins prior to the onset of schooling and improves with age. Morphological awareness affects the reading ability and the quality of reading (e.g., Carlisle, 1995; Mahony, Singson, & Mann, 2000; Shankweiler et al., 1995; Singson, Mahony, & Mann, 2000; Taha & Saiegh-Haddad, 2016).

The mental lexicons of Semitic languages are organized according to morphological principles. All words are stored in memory according to

their roots, and verb forms according to their relevant verb patterns (Frost & Grainger, 2000). Morphological development thus leads to expansion of lexical and formal structural knowledge (for a comprehensive review, see Schiff & Raveh, 2007).

Ben-Dror and Frost (1995a) found that children with developmental dyslexia displayed morphological weakness in spoken language and its comprehension. They failed morphological assignments, which negatively affected their reading. Elbro and Arnbak (1996) provided similar results among dyslexic compared to normal readers in word identification tasks. The authors stressed that morphological awareness is significantly linked to a reader's ability to identify words. These results have been reinforced in many studies on the morphological effect of letter identification and production on successful reading acquisition (e.g., Abu-Rabia & Saliba, 2008; Abu-Rabia & Abu-Rahmoun, 2012; Levin, Ravid, & Rapaport, 1999; McBride-Chang et al., 2003; Sénéchal, 2000; Taha & Saiegh-Haddad, 2016).

The main goal of this review was to highlight the importance of morphological awareness for reading and organization of the mental lexicon in Arabic among normal readers and readers with dyslexia, based on the few studies conducted to date on the Arabic language, and to understand the differences in its contribution to these two populations.

Complex Arabic Morphology

Arabic is a root and pattern language, which is characteristic of Semitic languages. Most lexemes in Arabic, including verbs and nouns, are structured from root and pattern morphemes. Roots are generally made up of three or four consonants. Root morphemes represent the general meaning of a word. Pattern morphemes provide accurate lexical meaning and syntactic information and determine person, number, gender and tense (Qaddur, 1996). All verbs and most nouns are made up of non-linear structures of root and pattern, which together constitute the lexical status of a word. The root and pattern are in fact an abstract of the morphological essence of a word, and only combining them together produces a word (Berent & Shimron, 2003; Ravid, 2003; 2006; Shimron, 2003). Boudelaa and his colleagues (Boudelaa, 2014; Boudelaa & Marslen-Wilson, 2005) well-described Arabic morphology and its complexity in a series of important studies. Indeed, Boudelaa and Marslen-Wilson (2015) description, quoted below, perfectly describes and explains Arabic morphology:

Word pattern morphemes are also highly productive. For instance, the syntactic reading agentive of the verbal word pattern {faa ilun فاعل} will be realised transparently in any combination of this pattern with a transitive root – for example with {ktb ك ت ب} to obtain [kaatibun كاتِب] one who

writes, or with {ktm ت ك م} to yield [kaatimun كاتم] one who conceals and so forth. Word pattern morphemes can have distinct phonological structures but common syntactic properties. The word patterns {faa ilun فاعل} and {mufta ilun مفتعل} for example, both carry the syntactic reading agentive, leading to forms like [kaatimun كاتم] one who conceals and [mumtahinun مُمتحن] one who examines. Conversely, the same word pattern can have different readings depending on the type of root it combines with. The pattern {fi aalatun فعالة}, for example, typically denotes a singular profession noun in forms like [hilaqatun حلاقة] hair dressing, [ti aaratun تجارة] trade, and [kitaabatun كتابة] writing, however, the same word pattern has only a feminine derived noun reading in a number of forms such as [ibaaratun عبارة] expression, [hikaayatun حكاية] story, and [binaayatun بناية] building, where there is no trace of the “profession noun” meaning (p. 956).

Arabic morphology is constructed from two key systems: derivation and declension. The morphology of derivation is the addition of morphemes to the basic verb, مجرد (mujarrad), which includes three or four root consonants. A new verb is produced by using the root together with additions and changes added to the same basic root, مزيد (mazeed). When morphemes are added to a basic root, they produce new meanings for existing words or change their grammatical category. For example, تمارض (tamarada) (makes himself ill) is derived from the root م ر ض (M R D) (ill) with the addition of (t & aa) (Chalil, 1995).

The morphology of declension is linked to syntax, and depends on the grammatical role of the word. Verb declension is systematic and linked to person, number, gender and tense. Nouns have a masculine or feminine form, where the feminine form is created by adding particular endings to the male form (Abd El-Minem, 1987; Al-Dahdah, 1989; Wright, 1967).

According to Qaddur (1996), there exist three types of pattern morphemes: free; linked and zero morphemes. Free morphemes, which are infrequent in Arabic, are single words such as الـ (Eila). Linked morphemes (affixes) are common and are added as prefixes, for example the letters that symbolize the present tense حروف أنيت (Anit); infixes, such as duplicating the second letter in the root of a verb فَعَل (FaAaLa); and suffixes, such as the suffix X which symbolizes plurals حدادون (welder; حدادون welders). Zero morphemes do not change the form of a word, but nonetheless indicate particular features arising from context. For example, the verb كتب (write) shows a singular, masculine person in simple construction. In this verb, the morpheme is not marked.

The Root (الجزر)

The root is the formative and semantic nucleus of words in Arabic and Hebrew. There are over 6000 different roots in standard Arabic (Boudelaa

& Marslen-Wilson, 2011). These roots can be divided into two different types (Holes, 1995; Wright, 1995). One type is strong roots, such as *قرب* (q-r-b; closeness), *كتم* (k-t-m; hidden) and *ختم* (x-t-m; end). They are called strong roots because of their ethnographic and phonological transparency, since their three consonants are expressed methodically in any derivation or declension in any surface structure. The other type is weak roots, in which one phoneme glides: *و/w* or *ي/y* as one of their consonant components. For example, *نوم* (n-w-m; sleep), *وحد* (w-h-d, unity) (Awwad, 2013), which undergo allomorphy and in some derivations appear with only two of their three consonants. Weak roots constitute approximately 10% of the total roots in Arabic (Mrayati, 1987).

Roots have three elements: semantic, phonological and orthographic. In the semantic sense, the root is the main content topic of a word and connects words belonging to the same word family. In the phonological sense, the same three or four root consonants appear in words from the same root, and are linked phonologically. The phonological unity of a root is breached in cases where roots are likely to have, or when there is, assimilation of root consonants to one of the pattern consonants that appear afterwards. In the orthographic sense, writing root letters does not change despite phonological changes that occur in root consonants. Roots are perceived as being linked to the root type – whether it is strong or weak; to phonological changes in root consonants; and to transparency levels in the semantic connection between words. In fact, orthography plays a crucial role in representing a root because of the consistency and uniformity of letters (Ravid & Bar-On, 2005).

Pattern (الوزن الصرفي)

The pattern (الوزن الصرفي) is a non-sequential chain, containing vowels and sometimes even affixes and the accentuation form. The role of patterns is to complete roots in structure and meaning. The pattern provides the basic vowel framework needed to pronounce words. Some patterns include only vowels. Others also contain consonants, which appear mainly as affixes, which are integral to patterns, and without them there is no existing pattern (Awwad, 2013).

Patterns determine the basic accent of derived Arabic words of more than one syllable. At the level of meaning, words derived from the same root are sorted into lexical syntactic categories according to pattern (Boudelaa & Marslen-Wilson, 2011; Holes, 2004; Idrissi, Prunet, & Béland, 2008; Versteegh, 1997; Wright, 1995). Morphological patterns in Arabic are divided into two types: patterns that serve as verbs, called verbal stems, *الصرفية البنّية*, and patterns that serve as nouns or adjectives, called patterns, *الأوزان الصرفية*. In a verbal stem system, all verbs in

Table 1. The most frequent conjugations in modern Standard Arabic.

		Conjunction		Examples
1	فَعَلَ فَعِلَ فَعُلَ	<i>faʿal</i> <i>faʿil</i> <i>aʿul</i>	<i>CaCaC</i> <i>CaCiC</i> <i>CaCuC</i>	كَتَبَ qataba (write) لَبَسَ labis (wear) حَسَّنَ ḥasun (improve)
2	فَعَّلَ	<i>faʿʿal</i>	<i>CaCCaC</i>	جَرَّبَ jarrab (try)
3	فَاعَلَ	<i>faaʿal</i>	<i>Ca:CaC</i>	قَاتَلَ qa:tal (fight)
4	أَفْعَلَ	<i>ʔafʿal</i>	<i>ʔaCCaC</i>	أَخْلَصَ ʔ akhlasa (loyal)
5	تَفَعَّلَ	<i>tafaʿʿal</i>	<i>taCaCCaC</i>	تَعَلَّمَ taaallam (learn)
6	تَفَاعَلَ	<i>tafaʿaʿal</i>	<i>taCa:CaC</i>	تَشَارَكَ tasha:raq (share)
7	انْفَعَلَ	<i>ʔinfaʿal</i>	<i>ʔinCaCaC</i>	اِنْصَدَمَ ʔ insadama (surprised)
8	اِفْتَعَلَ	<i>ʔiftaʿal</i>	<i>ʔiCtaCaC</i>	اِقْتَرَبَ ʔ iqtarab (come near)
9	اَفْعَلَ	<i>ʔifʿal</i>	<i>ʔiCCaCC</i>	اِضْطَرَّ ʔ ittarra (force)
10	اِسْتَفْعَلَ	<i>ʔistaʿʿal</i>	<i>ʔistaCCaC</i>	اِسْتَحْدَمَ ʔ istakhdam (use)

standard Arabic are derived integratively by placing the consonant root in one of the conjugations. These derivation links create new lexical values. The verb system has about ten frequent conjugations and can theoretically be applied to all roots (Awwad, 2013). Table 1 presents the ten frequent conjugations in modern standard Arabic.

The superficial structure of Arabic is derived from roots and word patterns. Boudelaa (2014) proposed a comprehensive model, demanding obligatory morphological decomposition (OMD). This is the predominant model according to which the mental, and mainly the semantic, lexicons are comprised of word patterns and explanation-based roots. This model presents a high level of matching to knowledge in memory

Many studies on the Arabic language raised the importance of word roots for identifying new words and acquiring reading, in addition to their role in organizing a reader's word lexicon (Abu-Rabia, 2002; Wattad & Abu-Rabia, 2020; Boudelaa & Marslen-Wilson, 2001a; Saiegh-Haddad, 2018). These studies emphasized that word roots play an important role in the reading and writing process. The priming paradigm was used in these studies to explore the contribution of a word's root to identifying new words derived from the same root. The root is produced from the written word during word identification.

Semitic languages with a rich and complex morphology, such as Arabic, constitute a huge challenge for their learners and speakers in reading and writing. Today, there are three main common types of Arabic:

Classical Literary Arabic (CLA) الفُصْحَى (al fuscha): This is the language of the Quran and of classical poetry. Arabic-speaking children are exposed to classical literary Arabic in prayer texts when they start school.

Modern Standard Arabic (MSA) المعيارية: This language is a derivative of Classical Literary Arabic and is essentially syntactically similar to it. However, it has greater flexibility in its vocabulary and expressions, and adopts foreign terms which penetrate into the standard conversation style.

This language is used mainly for literary, professional and scientific writing; formal social functions; textbooks and newspapers; media news, sermons in mosques and churches. This is a uniform Arabic which Arab children study at school (Holes, 2004).

Spoken Arabic Vernacular العامية *ala'amia*: This is the spoken Arabic language. It is less morpho-syntactically and syntactically complex, and is generally more up-to-date than the written literary variety (Ferguson, 1959; Versteegh, 1997). Spoken Arabic is divided into regional dialects, where every region has its own local dialect. Arabic-speaking children acquire their local dialect at home, and learn the literary variety mainly at school (Omar, 2017).

This situation, of a difference between spoken language and dialect among Arabic speakers and the written language acquired at school, is a classic example of diglossia (اللغوية الازدواجية) (Ayari, 1996; Ferguson, 1959), which describes a situation where there is more than one language focus, dialect or register in a given society (for more information, see Saiegh-Haddad & Joshi, 2014). This diglossia, and the distance between the spoken and Standard Arabic, constitute a functional factor in the quality of Arabic reading acquisition, and pose difficulties for children trying to make judgements about correct pronunciation. This difficulty affects their phonological and morphological awareness (Saiegh-Haddad, 2005; Abu-Rabia, 2002; Saiegh-Haddad, Levin, Hende, & Ziv, 2011). For instance, the word (have been heard) in STA is (سُمِعَ *sumiʔa*), and in spoken Arabic it is (اِنْسَمِعَ *?insamaʔ*), and the word like (أَعْرِفُ *?aʔrifu*) in STA is (بَعْرِفُ *ba ʔrif*) in the spoken language.

The Role of Morphology in Reading among Normal and Dyslexic Readers

Morphological awareness refers to children's "conscious awareness of the morphemic structure of words and their ability to reflect on and manipulate that structure" (Carlisle, 1995, p. 194). Various models have suggested that the morphological dimension is a powerful component and mechanism for organizing a reader's mental lexicon, and it is therefore reasonable to assume that the morphological structure fitting for a discussed Semitic language will play an important role in reading and writing components. Morphological awareness may facilitate a variety of reading tasks. A child at the single-word reading stage who attempts to pronounce a word can refer to its morphemic boundaries. Morphology can also assist in discovering the meaning of single words. For example, the base and affix morphemes provide an indication of their meaning. Morphological "problem solving" might also play an important role in constructing the meaning of a text

Studies that examined reading among normal readers demonstrated a positive correlation between morphological awareness and individual word decoding, reading comprehension, and pseudoword reading (Brittain, 1970; Leong, 1989; Mahony, 1994; Singson et al., 2000; Fowler, Liberman & Feldman, 1995; Carlisle, 2000). Various studies highlighted the importance of morphological awareness and its relation to reading acquisition (Abu-Rabia, 2007; Abu-Rabia, Share, & Mansour, 2003; Abu-Rabia & Saliba, 2008; Ben-Dror et al., 1995b; Joanisse, Manis, Keating, & Seidenberg, 2000; Levin et al., 1999; McBride-Chang et al., 2003; Sénéchal, 2000; Schiff & Raveh, 2007; Raveh & Schiff, 2008; Leikin & Hagit, 2006). These studies emphasized the fact that normal readers can recognize a word as a whole by using orthographic and/or phonological codes. These processes are faster than morphological decomposition. Dyslexic readers, on the other hand, use morphological decomposition for lexical access. Processing the word as a whole is slow and inefficient. Dyslexic readers apparently develop a compensatory sensitivity to a word's morphological constituents and therefore seem to be more sensitive to morphemes than normal readers.

Developmental dyslexia is diagnosed among children with normal development but inferior reading skills, compared to peers with the same measured intelligence and similar educational opportunities. It is characterized by difficulties with accurate and/or fluent word recognition and poor spelling and decoding abilities (Lyon, Shaywitz, & Shaywitz, 2003; Vellutino, 1979; Vellutino, Fletcher, Snowling, & Scanlon, 2004).

Dyslexic learners were found to have both a phonological deficit and greater language processing difficulties, particularly on the morphological processing level. Several studies suggested that dyslexic readers are distinctly delayed in grammatical skills compared to normal readers (Carlisle, 1987; Siegel & Ryan, 1984; Tyler & Nagy, 1990). Scholars studied the development of morphological awareness and its connection to reading acquisition and found a positive correlation between morphological awareness and reading achievements among dyslexic readers. Dyslexic readers show weakness in the morphological analysis strategies that play a role in word recognition (Ben-Dror et al., 1995a; Joanisse et al., 2000; Kaminsky et al., 2002; Shankweiler et al., 1995; Taha & Saiegh-Haddad, 2016). Sensitivity to a language's morphological structures can thus be regarded as influencing reading among both normal and disabled populations (Leikin & Hagit, 2006).

In Arabic, morphology constitutes an important and dominant component for identifying the written word. A review of the few existing studies suggested that relying on morphological processes (morphological breaking down and manipulations) has a highly significant and strong effect on reading acquisition and on identifying new words. These

morphological processes are unique to Semitic languages (especially Arabic and Hebrew) (Boudelaa & Marslen-Wilson, 2015).

Recent studies showed that root mediation among young dyslexic Arab readers leads to improved reading (Boudelaa, 2014; Ravid, 2001; Ravid & Farah, 1999; Ravid & Schiff, 2006; Schiff & Ravid, 2004; Saiegh-Haddad, 2013; Taha & Saiegh-Haddad, 2016, 2017). Studies on the effect of language morphology on written word identification employed a priming paradigm, which is an experimental approach for obtaining rich information about how the mental lexicon is formulated and organized (Bentin & Feldman, 1990; Boudelaa & Marslen-Wilson, 2001b, 2005; Deutsch, Frost, & Forster, 1998; Frost, Forster, & Deutsch, 1997; Frost, Deutsch, & Forster, 2000; Frost, Kugler, Deutsch, & Forster, 2005; Velan, Frost, Deutsch, & Plaut, 2005; Velan & Frost, 2007, 2009, 2011). According to this paradigm, presenting a preliminary stimulus (priming word) before a particular stimulus (target word) is likely to facilitate target word processing. There are two types of priming in the priming paradigm: direct priming in which a target stimulus is presented after an identical stimulus, and indirect priming where a target stimulus is presented after a stimulus connected to it (Tulving, Schacter, & Stark, 1982). The link between a target stimulus and a priming stimulus in indirect priming can be varied, or a combination of types. The priming paradigm can include:

1. *Masked priming*, where every experiment is comprised of three visual events presented in the center of a screen (a preliminary masked pattern, a priming stimulus immediately after masking, followed immediately by the target word). The participants are not aware of the priming word and cannot identify it (Forster & Davis, 1984). The task is to decide whether the presented word exists in the language, or to name it as quickly as possible. Facilitation in the masked priming paradigm is due to a transfer effect. All processing of the priming serves to identify or reject the priming word (Forster, 1998, 1999).
2. *Cross-model immediate repetition task*, where subjects are exposed to a spoken priming word, and immediately afterwards the target word appears visually. The subjects must make a lexical decision about it (Marslen-Wilson, Tyler, Waksler, & Older, 1994). The priming effect between target words with a morphological link can reflect semantic and phonological overlap between a word pair (Frost et al., 2000).

Taha and Saiegh-Haddad (2017) examined awareness of derivational roots and patterns among young Arab-speaking elementary school pupils

and morphological processing in Arabic spelling. They showed that awareness of word roots led to remarkable reactions among participants, and that root awareness emerges earlier than word-pattern awareness. It begins at a young age and reaches its climax among second graders. Awareness of word patterns also develops from a young age.

In another study, Taha & Saiegh-Haddad, (2016) examined the contribution of two intervention programs, one phonological and the other morphological, on the development of word pronunciation in Arabic, among skilled and poor readers in second, fourth and sixth grades divided into three groups: a morphological intervention group, a phonological intervention group and a control group. The intervention programs' effects were measured by a comparison between the two groups that participated in the program and each group with the control. The study tested phonological awareness, morphological awareness and pronunciation skills, before and after the intervention. Participants from both intervention groups at all ages showed progress in pronunciation after the intervention program. This study showed that both intervention programs improved pronunciation skills, and that weak older readers were supported by the morphological intervention to a greater extent than more skilled readers. The findings also showed that phonological and morphological processing made a developmental contribution to reading vowelized words as opposed to non-vowelized words.

Abu-Rabia (2007) examined the role of morphology and short vowelization in reading Arabic among normal and dyslexic readers in third, sixth, ninth and twelfth grades using the Raven matrices, word reading, nonword reading, working memory test, spelling test and reading comprehension test. The results showed that morphological identification among normal readers contributes to word reading more than among dyslexic readers, and that this skill increases over time (between ninth and twelfth grade). Abu-Rabia and Abu-Rahmoun (2012) tested the role of phonology and morphology in the development of basic reading skills of dyslexic and normal native Arabic readers in sixth and eighth grade using reading and cognitive measures. All tests had vowelized and non-vowelized versions: phonological, orthographic, reading, spelling, syntax, and working memory skills. Significant differences were found between the dyslexic and the normal readers on most measures. Moreover, the participants performed much better in the vowelized than in the non-vowelized tests and used morphology to assist their reading accuracy. Syntax, reading measures (isolated words, real roots and false roots), morphology and spelling achievements were the most powerful predictors of reading accuracy among dyslexic and normal readers.

Boudelaa and Marslen-Wilson (2015) investigated whether organization of the mental lexicon reflects the combination of abstract underlying

morphemic units or the concatenation of word-level phonological units. They tried to provide clear evidence for the active role of abstract morphemic units in the representation and processing of complex spoken and written forms in Arabic as a Semitic language by using five cross-modal priming experiments to examine the processing of morphologically complex forms in the three major subdivisions of the Arabic lexicon – deverbal nouns, verbs, and primitive nouns. It was shown that root and word pattern morphemes function as abstract cognitive entities, operating independently of semantic factors and dissociable from possible phonological confounds.

Studies among normal and impaired Arabic readers examined whether they employ and rely on morphological entities (word roots and patterns) for identifying and producing written words. It was found that word roots and patterns do indeed constitute lexical entities with an important role in identifying, producing and storing written words (Abu-Rabia & Awwad, 2004; Abu-Rabia et al., 2003; Marslen-Wilson, 2001; Ravid, 2001; Ravid & Farah, 1999; Saiegh-Haddad, 2004, 2005, Saiegh-Haddad, Hadieh, & Ravid, 2012). For example, Taha and Saiegh-Haddad's (2016) research indicated that pupils with dyslexia demonstrate weakness in morphological awareness, and that morphologic intervention programs positively affect the reading process among both dyslexic and normal readers. Similar results emerged from studies on the Hebrew language, which is essentially similar to Arabic, wherein the awareness of a word root constitutes an important and central component in reading and identifying written words, which was found impaired among dyslexic readers (Ben-Dror et al., 1995a; Ravid & Schiff, 2006; Schiff & Ravid, 2004).

New evidence in the Arabic language reinforces previous research results. A recent study by Wattad and Abu Rabia (2020) investigated the developmental model of organizing and building a mental lexicon among normal and dyslexic native Arabic speakers in sixth, eighth, and tenth grades divided into three groups: dyslexic readers; normal readers of the same age, and normal readers one or two years younger than the dyslexic readers. The lexical status of the root and pattern morphemes were examined using two priming paradigms. Masked priming and the cross-modal immediate repetition task were used to examine the effect of auditory priming on word identification. According to the priming paradigms, one explanation for failures may be a morphological flaw in the lexical processing stage – a process of modal morphological representation. This flaw causes the mental lexicon to be mixed up by the process, but since it does not include morphological representations – or morphemes – its organization differs from that of normal readers, and is not structured morphologically. They assume that dyslexic readers will not produce

words from auditory-morphological priming, and this goes beyond the flaw in the effect of morpho-visual priming. It is possible, however, that mistakes by dyslexics result from a flaw in the first processing stage, which constitutes the specific component – visual orthography. In such circumstances, it is expected that the effect of morpho-auditory priming will be identical to that of normal readers.

The findings indicated that roots are lexical units with a role in organizing the lexicon, and such units can facilitate lexical access to a wide range of verbs among normal and dyslexic readers of different ages. No patterns were found, and they made no significant contribution to the identification and organization of words in the mental lexicon among normal and dyslexic readers in the three groups. Dyslexic readers represent and access morphologically complex words differently from normal readers, and it seems that the roots are lexical entities and contribute to the reading process. However, the contribution is different among dyslexic readers. It appears that the Arabic verb system's lexical structure is similar to that of Hebrew, and the Arabic verb lexicon also consists of two representation levels: (1) whole lexical units – high-frequency words, meaning less frequent morphological decomposition (Boudelaa, 2014), and no need for decomposition due to their familiarity because readers' written units are more developed and every word becomes one written unit; (2) at a deeper level, sublexical units (root morphemes) enabling morphological decomposition of low-frequency words. Dyslexic readers appear to rely on other channels, such as phonological and orthographic channels, and this affects the structure of their mental lexicon.

Tibi, Tock, and Kirby (2019) developed a measure of root awareness as a dimension of morphological awareness in Arabic, and validated this measure by predicting reading outcomes in an Arabic population. The results confirm evidence on the role of the root in young Arabic speakers' visual word recognition (Shalhoub-Awwad & Leikin, 2016) and ability to decide whether words are related to the root (Taha & Saiegh-Haddad, 2017). The robust role of the root underscores the predominance of the morphological structure as a core part of the Arabic reading model, as proposed by Saiegh-Haddad (2018). The significant role of root awareness for reading Arabic confirmed that the root is a salient feature of Arabic orthography and has a unique role beyond vocabulary,

A literature review by Al Ghanem and Kearns (2014) on children's morphological skills and word reading in Arabic (three studies) provided significant evidence on the role of morphological skill in word reading, specially for normal readers, and that the most important contribution is in the higher grades, when students develop their phonological knowledge and sublexical orthographic knowledge. This is especially true for Arabic readers. Dyslexic readers who demonstrate difficulties in recognizing the

Arabic root system and exhibit poor performance in the morphological tasks rely on alternative reading strategies to identify and read words (such as phonological decoding strategies). Saiegh-Haddad (2018) summarized the role of morphology in reading in that phonological processing skills, such as phonological awareness, will be more strongly related to reading outcomes in Arabic in first-second grades, while morphological processing skills such as morphological awareness will take over in higher grades. Furthermore, word processing in Arabic will be more strongly affected by the manipulation of diacritics (e.g., wrong vowelization) in younger than in older readers.

In order to highlight and clarify the role of morphological awareness in reading among normal and dyslexic Arab speakers, we examined the outcomes of studies in Arabic that discussed and investigated this issue and the differences between these two populations.

Method

Search Procedures

In the current literature review, we examined studies that emphasize the effect of morphological awareness and its lexical status in organizing the mental lexicon and its importance in reading among normal and dyslexic children. We searched English databases (ERIC, PsycINFO, Psyc-Articles, Education full Text, Academic Search Premier) using the following keywords: Arabic, reading, dyslex, word recog, morph, reading processing, mental lexicon), between the years 2000-2020. In the summarizing table we included articles from 2010 to 2020. We found 11 new studies that met our review criteria, and disregarded articles that discussed reading comprehension in particular, and articles about bilingual children. The main important findings of the studies that investigated Arabic morphology and reading among normal and dyslexic readers are presented in [Table 2](#), which includes the recent studies.

Summary and Discussion

It can be concluded that all studies examined in the present review emphasized the importance and contribution of morphological awareness for reading acquisition, written word identification and arranging words in the mental lexicon. It has been demonstrated that normal Arab readers (without dyslexia) develop this awareness over the school years, perform morphological manipulations and connections while reading, and have an awareness of this ability. This awareness becomes more prominent in higher grades (after second grade), contrary to their dyslexic peers who

Table 2. Recent studies on morphological awareness discussed in the present review.

Author/s (year)	Research questions	Number of participants & ages or grades	Main results
Schiff and Saiegh-Haddad (2018)	What is the contribution of PA and MP in SP, SA word reading?	100 students, (grades 2, 4, 6, 10) normal Arabic readers.	Major role for spoken MA in reading and spelling.
Taha and Saiegh-Haddad (2016) Taha and Saiegh-Haddad (2017)	What is the role of LI PA and MA in spelling? 1. What is the type development of MA among native Arabic-speaking children, specifically the development of derivational root and word-pattern morphological units in normally developing children? 2. What is the contribution of the morphological transparency of the written words to spelling accuracy among children with typical reading development?	289 native Arabic-speaking children, skilled and poor, in grades 2, 4 and 6. 143 Arabic native speaking children with normal reading skills in grades 2, 4 and 6.	Significant role in both programs. Early emergence of derivational morphological awareness in children, with root awareness emerging earlier than word-pattern awareness. Morphological processing in spelling words and pseudowords across all grades play a major role.
Abu-Rabia (2012)	What is the role of root in reading MC with and without vowelization?	59 adults (age range 25-32 years), highly skilled native Arabic readers.	Play a major role in reading in all conditions.
Abu-Rabia and Abu-Rahmoun (2012) Saiegh-Haddad (2018)	What is the role of phonology and morphology in the development of basic reading skills of dyslexic and normal native Arabic readers? What is the role of morphology, vowelization and diglossia?	87 skilled and poor readers in grades 6 and 8. Review model.	Participants were much better at the vowelized than the non-vowelized tests and used morphology to assist their reading accuracy. Morphology and spelling were the most powerful predictors of reading accuracy among dyslexic and normal readers. The three variables play major roles.
Saiegh-Haddad (2013)	Is morphological processing different for different morphemes and in different grades?	150 native Arabic-speaking children, in grades 1, 2, 3, 4 and 5.	Morphological processing appears to depend on the specific morpheme targeted, and some morphemes lend

(continued)

Table 2. Continued.

Author/s (year)	Research questions	Number of participants & ages or grades	Main results
Saiegh-Haddad and Taha (2017)	What is the role of MA and PA in reading and spelling?	160 reading-accuracy disabled children and age-matched typically developing controls in grades 1–4.	themselves more strongly to morphological processing than others. Both play major roles.
Tibi and Kirby (2017) Layes et al. (2017) Tibi et al. (2019)	What dimensions underlie MA in Arabic? What is the role and extent of involvement of MA contrary to rapid automatized naming (RAN) in word reading and comprehension of Arabic as a morphologically-based orthography among normal and dyslexic students? How does root awareness play a crucial role in Arabic reading acquisition?	102 normal Arabic-speaking children in grade 3. 40 students from grade 6, normal and dyslexic readers. 201 normal childrens, grade 3, native Arabic speakers.	Highly important role. RAN was a significant predictor of word reading and reading comprehension, whereas MA explained only the variance in reading comprehension. MA has important roles in predicting reading skills. Major role in reading acquisition.

PA = Phonological Awareness SA = Standard Arabic
 MA = Morphological Awareness LI = Linguistic Intervention
 SP = Spoken Arabic MC = Morphological Complex words
 IMCW = Isolated Morphological Complex words

demonstrate great weakness in morphological awareness and slowness in acquiring it, which leads to impairment in reading acquisition and development. It could also be concluded that morphological awareness explains both different reading levels among pupils and their reading skills. In other words, sensitivity to word roots and patterns is a critical factor in written word identification and in every fluent reading process, among both normal and dyslexic readers (Abu-Rabia et al., 2003; Abu-Rabia & Awwad, 2004; Abu-Rabia & Siegel, 2003; Wattad & Abu-Rabia, 2020; Saiegh-Haddad, 2018; Taha & Saiegh-Haddad, 2016, Tibi et al., 2019).

Recent studies in Arabic that investigated the development and organization of the mental lexicon among children with and without dyslexia revealed that roots are lexical entities with a role in organizing the mental lexicon of all types of readers at all ages. However, patterns do not

constitute lexical entities in this arrangement. Employing root morphemes begins in fourth grade and strengthens with age (Wattad & Abu-Rabia, 2020; Taha & Saiegh-Haddad, 2017; Abu-Rabia, 2012). The study's findings are explained through Boudelaa's (2014) model, that claims that the lexicon of the verbs of Arabic orthography is composed of two levels of representation: One level in which whole lexical units are represented and morphological decomposition is less common (Boudelaa, 2014) and there is no need to dismantle them, since the reader's writing unit is more developed and each word becomes a single orthographic unit; a deeper level where sublexical units are represented and are decomposed by morphological decomposition into the less frequent word. The two levels seem to be interconnected, and a word can be identified by direct access on an orthographic or phonological basis, or by the morphological decomposition through which the root is extracted.

Many studies discussed factors affecting reading and its acquisition and the link between language skills and reading skills. This link was found to depend on phonological and morphological factors. For example, Taha and Haddad (2016) examined the development of word spelling and promoting reading skills among skilled and poor native Arabic readers by two intervention programs, one phonological and the other morphological (for other languages, see Liberman, 1995; Leikin & Hagit, 2006; Shankweiler et al., 1995). Most studies emphasize that phonological and morphological awareness are mutually interconnected, and that pupils with dyslexia demonstrate weakness and impairment in their morphological awareness and ability as a result of developmental delays in language skills or because of an impairment in morphological structures in the word stage itself (Abu-Rabia et al., 2003; Ben-Dror et al., 1995a; Carlisle & Nomanbhoy, 1993; Casalis & Louis-Alexandre, 2000; Joannis et al., 2000; Mahony et al., 2000).

In Arabic, a dyslexic mental lexicon is built through the reader's development, and relies on roots more than on word patterns. Its construction is slower and different from that of readers without a deficiency. It appears that word patterns and roots have less effect on lexicon construction among dyslexic than among normal readers, and because their mental lexicon contains more word roots than patterns, dyslexic readers apparently rely on other channels, such as phonological and orthographic channels. This affects the structure of their mental lexicon (Wattad & Abu-Rabia, 2020) and their knowledge of grapheme-phoneme correspondence even in higher grades (Abu-Rabia, 2007). When the morphological complexity of Arabic and its uniqueness are added, this appears to be a very problematic factor in the case of reading disabilities and explains the differences between Arabic language studies and other languages. The diglossic context seems to be a big factor in this unique

situation (Saiegh-Haddad & Spolsky, 2014; Taha & Saiegh-Haddad, 2017). This factor affects the developmental processes of phonological and morphological awareness in the literary language, but not in the spoken language, and in turn affects reading acquisition in the same language. There are also morphological differences between spoken and written language. Arabic orthography has unique characteristics in phoneme-graphic representation, in the form of letters and in writing, alongside the existence of a unique scoring system that represents the short vowels. These unique orthographic characteristics affect morphological awareness and reading acquisition in this language. For example, the word “nolzemkomoha نلزمكموها” (we will charge you), which is derived from the required root (l-z-m, must م ز م), is in fact a complete sentence, and in the absence of the diacritic and phonological channels, it is more complicated to read and understand. It can be concluded that the strong and sufficient establishment of morpho-orthographic representations could be expressed by greater accuracy in reading and spelling words.

The results of the studies show that the contribution of phonological and morphological processing to the reading of vowelized and non-vowelized words is developmental. Morphological knowledge is likely to be a source of individual differences in reading ability because roots are phonologically opaque, and are manifested on the surface level in a variety of syllable forms. We thus support the conclusions of Abu-Rabia’s (2012) study that morphological knowledge and short vowelization are the key variables in reading accuracy.

Suggestions for Future Studies

Studies in Arabic did not examine the morphological qualification of dyslexic readers whose impairments are categorized into different sub-groups of dyslexia, such as the study of Joannis et al. (2000). Most of the dyslexic readers in Arabic studies were diagnosed according to measures of reading texts and isolated words, but were not sorted into types of reading impairments and characteristics. It is therefore important in future research to consider characteristics and various types of impairments, and to sort dyslexic readers into sub-groups and perhaps levels of dyslexia or sub-types of dyslexia in order to achieve a clear picture of how the reading process of these sub-types takes place.

Classifying presented words according to frequency is also very important, because some researchers (Bybee, 1995; Katz, Rexer, & Lukatela, 1991) argued that a word’s frequency, rather than morphological complexity, dictates lexical storage. Morphological decomposition is necessary only when encountering a new derived or conjugated word, or a low-frequency word. Readers must then employ morphological

knowledge to understand the meaning. Words that are frequent have a greater chance of being stored in their whole form, and this is supported by Boudelaa's OMD model (2014). It is therefore desirable that future studies classify word lists by frequency and control this factor during their experiments.

There was limited discussion in the research literature on morphological research methods. According to Boudelaa (2014), techniques used in morphological awareness research remain controversial. Two techniques (masked and cross-modal priming) appear to be ideal when researching word storage in the mental lexicon and access to this morphological information, and provide information and a description of the initial lexical stages performed when reading. However, according to his argument, these techniques raise many questions, some of which have been studied. For example: Do all words in the Arabic language provide morphological information? In other words, is there priming between words that share the same root and other words that share the same structure? Another area of questions raised in the discussion, which are less researched, asks whether priming emerges between words with high morphological transparency as opposed to words that are morphologically impervious? Does the priming effect change according to where it is used in language? These questions will provide important information on storage, reading acquisition and fluency. According to Boudelaa and the approaches presented in his research (2015), each approach provides an essentially different response to others, and it will therefore be important and interesting to explore this information with regard to each theory and approach separately. Studies that consider these suggestions will certainly enrich the literature about the nature of the status and organization of the opaque morphemes, since such morphemes have not been studied to date. This may contribute to morphological reading theory and revisions of the suggested morphological models.

Finally, we support Al-Ghanem and Kearns's (2014) conclusion and suggestion that it may be helpful to focus on morphological skills in elementary school curricula, because of the evidence that morphological awareness benefits from representations of the roots and identifying them in print. This would prevent reading problems for some students and promote reading for others, and possibly compensate for the phonological deficits among these students.

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