Reading and Writing: An Interdisciplinary Journal **10:** 105–119, 1998.

Reading Arabic texts: Effects of text type, reader type and vowelization

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Abstract. While much is known about Latin orthography little is known about Arabic orthography. This study investigates the effect of vowels on reading accuracy in Arabic orthography. Participants were 64 native Arabic speakers. Four kinds of written Arabic texts were administered: narrative, informative, poetic and Koranic. Three texts of each kind were presented in three reading conditions: correctly vowelized, unvowelized and wrongly vowelized. Results indicated that vowels had a significant effect on reading accuracy of poor and skilled readers in reading each of the four kinds of texts. The results are discussed in light of the concept that more cross-cultural considerations should be made in reading theory today.

Key words: Arabic orthography, Vowels, Arabic texts, Triliteral/quadriliteral roots

Introduction

This study investigates the influence of vowels on reading accuracy of poor and skilled native readers in Arabic orthography, a phenomenon which has not been studied. The question of vowels cannot be raised with Latin orthography because they are part of the alphabet and appear as letters in text. English texts are presented in the same reading condition (correctly vowelized) for skilled and poor readers, which differentiates them from Arabic texts. Arabic readers read with vowels to facilitate word recognition, but when reading without vowels, they rely on context to compensate for the lack. Because Arabic writing is highly homographic (i.e., one word carries several different meanings), vowels are necessary for poor and skilled readers to disambiguate Arabic homographic words when they are presented. Four different kinds of Arabic writing were used in the study: narrative, informative, poetic and Koranic, in three textual reading conditions: correctly vowelized, unvowelized and wrongly vowelized.

Arabic orthography versus English orthography

Arabic writing is an almost consistent letter-sound alphabetical system if presented voweled, with 28 letters which are all consonants, with some also serving as long vowels. Short vowels, represented only by added diacritics,

are not part of the alphabet. Short vowel patterns are rule-governed according to word meaning, inflection, and function in a sentence. Each word is pronounced differently in different places in the sentence, and in most cases the change in short vowels leads to different lexical meanings. The words are pronounced differently because they supply a grammatical function in the sentence. Skilled readers usually bring considerable knowledge of literary Arabic to texts and usually read them without vowels, but poor and beginning readers learn and read Arabic with vowels (for a comprehensive review of Arabic script and grammar, see Heywood & Nahmad 1965).

In literary Arabic there is an almost predictable sound-symbol correspondence between letters and their sounds if the text is presented with vowels. There are six vowels in Arabic writing: (a), *a*, *fatha*, فتحه is indicated by a small stroke above the consonant, as بَ *ba*; (b) *i*, *kasra* كسره, is a similar stroke under the letter, as بِ *bi*; (c) *u*, *damma* ضمه, is written like a miniature /*waw*/ above the letter, as بُ *bu*. In order to indicate the absence of a vowel, a *sukon* is written above the letter, as بْ *eb*. Usually these are considered short vowels, and they are lengthened by the addition of the long vowels which are considered part of the alphabet /ا *a*/ /و *waw*/ /ي *ya*/. In most modern written and printed Arabic texts no vowel signs are given, and the reader has to deduce them from context or/and prior knowledge. Reading Arabic script without vowels can be a difficult task for poor or beginning readers owing to word similarities (homograph phenomenon) and letter similarities; certain letters are distinguished from each other only by a single stroke or dot (/ع *ain*/ /غ *ghan*/ and /ج *jim*/ /ح *ha*/ /خ *kha*/), or they may be phonologically indistinct in the colloquial variant of spoken Arabic. For first-grade pupils being introduced to it, literary Arabic is almost a new language in writing, reading and speaking.

The form of a particular letter may differ depending on its position in a word. Some letters have three different forms: one when it begins the word, another when it is in the middle of the word, and a third when it ends the word. Further, different rules are used for the writing of each form. For example, in the words /ولد/ and /لوح/, the letter /waw/ cannot be connected to the left in the first and must be connected from the right in the second. Recognizing the diverse writing rules for these letters in their different positions, and recognizing the different vowels below and above them, is therefore critical for word identification and word decoding, which may demand considerably more than usual cognitive attention by readers in the process of print perception.

The homograph phenomenon is widespread in Arabic; one word carries several different meanings. Without vowels, reading in Arabic orthography is a difficult mission even for skilled readers because many words are visually and orthographically homographic; they look the same, but they carry differ-

ent meanings and are pronounced differently. Included in this phenomenon are nouns, verbs and conjunctions. The vowels provide the beginning and poor reader with phonological information by showing the right pronunciation of words according to their function in the sentence and also according to their inflection in agreement with a preceding preposition. Thus, they change Arabic from a deep orthography to a shallow orthography.

Regarding English, Venezky (1970) suggested that the letters in a word can be divided into two main types: spelling patterns and markers. Spelling patterns are essentially the letters that are pronounced. A marker is a letter that is not usually pronounced, but whose occurrence either signals some feature of the pronunciation of other letters or preserves some morphological or orthographic patterns. For example, 'e' at the end of the word usually signals a change in the pronunciation of the preceding vowels. In Arabic this 'marker' phenomenon does exist, but it is not as common as in English. For example, the words /كـتـا/ /'covered'/ and /الله/ /'God'/ can be very confusing, even with vowels, for advanced readers. Furthermore, the vowels can be above and/or below the letters for letter-sound pronunciations: /*lo*/ /لُ/, /*la*/ /لَ/, /*loon*/ /لٌ/, and /*li*/ /لِ/. Thus, reading a text with complete vowels is considered a cognitively demanding operation for a beginning reader, with simultaneous perception and processing of many rules in order to decode and derive meaning. This very difficult operation is gradually eased when the poor or beginning readers reach the automaticity level in decoding and acquire more knowledge about Arabic script (e.g., syntax, vocabulary) which enables the reader to use context and vowels perhaps as 'holistic automaticity' in reading instead of 'autonomous automatic word recognition'. A minor mistake through confusion of similar letter shapes, homographic words and vowels above and below the letters leads to wrong decoding. Examples are the different verbs /قَالَ/ /'said'/, /عَانَ/ /'tended'/, /مَالٌ/ /'wealth'/, or the words /فِي/ /'in'/, /فِيَّ/ /'in me'/, /شَرِبَ/ /'drink'/, and /شَرَّبَ/ /'gave to drink'/. Moreover, there are certain irregularities that require the reader to bring to the text considerable knowledge of literary Arabic – syntax, vocabulary and contextual interpretations, especially if the text is written without vowels.

Overview of the literature

Abu-Rabia & Siegel (1995) tested the effect of voweled and unvoweled Arabic sentence context on the reading accuracy of voweled and unvoweled words by skilled and poor Arabic readers. Each subject in each group (poor/skilled) read two types of sentences in Arabic: ten sentences with voweled words and ten sentences with unvoweled words. Each sentence started with a verb, as is usual in Arabic. Each subject read the first word in the sentence while the rest of the sentence was hidden. After subjects had read the first

word of the sentence the tester showed the rest of the sentence to the subject. Subjects were allowed to correct themselves while reading the whole sentence. Words and sentences were written on cards. The results showed that skilled readers did not significantly differ from poor readers in reading Arabic homographs when they were presented unvoweled, namely skilled readers failed to read the unvoweled words because these words had different alternative pronunciations and meanings. Hence the different nature of Arabic orthography should be considered in any discussion of a comprehensive reading theory. Essentially, the situation in Arabic differs from that in English in the well-established fact that in the latter, skilled readers rely on their autonomous decoding of each word and do not need the context to facilitate word recognition. Only poor readers lacking these automatic decoding skills compensate for this deficit with other resources (Stanovich 1980).

Frost, Katz & Bentin (1987) addressed a similar issue in Hebrew, which, like Arabic, is a Semitic language. They tested lexical decision time in the deep unpointed (unvoweled) Hebrew orthography. They found that in Hebrew the lexical status of the word had similar effects on naming and on lexical access, suggesting that pronunciation was achieved by an addressed routine in which the whole word phonology was retrieved from lexical memory and that vowels did not facilitate word naming in Hebrew. The researchers ignored the homograph phenomenon in Hebrew and considered only words carrying one meaning. Further, the use of word naming as the method of the study is not adequate with a Semitic language because then the tester automatically overlooks the homograph phenomenon. This is why Frost et al.'s results (1987) are limited to the Hebrew language and cannot be generalized to Arabic. Studies conducted by Navon & Shimron (1981, 1984) concluded that although the skilled Hebrew reader does not need vowel marks for fast lexical decisions he or she cannot ignore them even when instructed to do so. Further, they showed that the Hebrew reader is not sensitive to interchanges in the printed forms of the two vowel marks representing /a/ or the two vowel marks representing /e/, as long as the correct phonemic structure of the word is maintained.

Bentin, Bargai & Katz (1984) examined naming and lexical decisions for unvoweled consonantal strings. Some of these strings could be read as two words whereas some could only be read as one word. The results demonstrated that phonological ambiguity affected naming but not lexical decision performance: naming phonologically ambiguous strings was slower than naming unambiguous ones. In contrast, phonologically ambiguous letter strings were recognized as parts of letter strings with only one meaningful pronunciation. These results suggested that although the reader of Hebrew is sensitive to the phonological structure of the orthographic string when naming is required,

lexical decisions are based on a fast familiarity judgment of the consonantal cluster and do not require a detailed phonological analysis of the printed word.

Frost & Bentin (1992) suggest that vowels in Hebrew are not essential for locating a specific lexical entry. With Hebrew words the consonant structure is sufficient for specifying a single word. This is because in such cases only one phonological pattern can be assigned to the letter string to create a meaningful word. These authors concluded that despite the ambiguity of the unpointed Hebrew structure skilled readers do not need the vowel marks for reading. Further, Koriat (1984) tested lexical decisions of Hebrew readers in unvoweled print. In this study, he used only words that had only one meaningful pronunciation in their voweled form and found almost identical lexical decision latencies for voweled and unvoweled words. Koriat's (1984, 1985) data, despite his initial conclusions, indicate that the presence of vowel marks influences visual word recognition in low frequency words.

Bentin & Frost (1987) tested naming of voweled and unvoweled Hebrew words. Subjects were presented with phonemically and semantically ambiguous consonantal strings. Each string could have been read either as a high-frequency word or as a low frequency word, depending on the vowel configuration assigned to it. Lexical decision time for the unpointed ambiguous consonantal string was compared with lexical decision time for the unequivocal pointed printed forms of the high- or the low-frequency phonological alternatives. The results showed that lexical decisions for the unpointed ambiguous strings were faster than lexical decisions for either of their pointed alternatives: explicit presentation of vowel marks did not necessarily accelerate lexical decision time. The researchers suggest that lexical decisions for Hebrew unpointed words may occur prior to the process of phonological disambiguation at least when the letter string represents two different words (cf. Balota & Chumbley 1984; Chumbley & Balota 1984). The results of Bentin & Frost (1987) are similar to those of Koriat (1984) and Navon & Shimron (1985) in that the lexical decision latencies of voweled and unvoweled words were not significantly different. It is important to note that studies in Hebrew tested single word reaction time and not reading accuracy.

Arabic is quite different from Hebrew and English. The homograph phenomenon is widespread and almost every third word (noun, verb, conjunction) can be a homograph and give two, three, or more meanings; different readings of the missing vowels over the last letter of the word change its structural function in the sentence and give it a different meaning. This phenomenon is not widespread in Hebrew perhaps because Hebrew was neither spoken nor written for centuries (Shimron 1993).

The studies of Bentin & Frost and of Koriat, Katz & Shimron tested in Hebrew single-word reaction time and not reading accuracy. Thus their results may not be directly connected to the rationale of this study because it measures reading accuracy. However, the results and conclusions reached by the above authors are of great relevance to this study since Hebrew, like Arabic, is Semitic and therefore the writing systems are similar. The results may help explain some of the differences between the two languages and some of the results of the present study.

The purpose of vowels in Arabic writing is to convey the unequivocal phonemic structure of the printed word to the beginning and poor reader. Without vowel marks, the beginning and poor reader would have to rely on the holistic identification of consonant clusters and their correspondence to prior semantic knowledge. The beginning reader would find this process very hard since spoken Arabic and literary Arabic are almost two different languages, and beginning readers learn the literary language at school. If an Arabic native speaker has not studied literary Arabic he/she may not understand a literary text read to him/her because the words in literary Arabic and spoken Arabic are two different concepts.

All this is additional to the notion that written Arabic is orthographically homographic if presented unvowelized. The addition of the vowel marks changes Arabic orthography from deep to almost as shallow as Hebrew, but with at least two exceptions: first, in Arabic orthography there are more diacritics on, below and/or in the letters that the reader has to process; second, ends of words are vowelized differently according to their position and function in the sentence. Namely, the same word in four different sentences can be vowelized and/or written and pronounced differently because it functions differently in the sentence. Thus, the mastery of fluent reading in Arabic demands holistic simultaneous automatic processing of many variables. The most important variables are vowels in a vowelized or unvowelized text and sentence context. Deriving these diacritics is dependent on sentence context and knowledge of syntax. Therefore, by using the vowelized print, teachers help trigger the phonemic awareness that is essential for efficient reading acquisition.

Since the present study assumes that Arabic orthography is highly homographic, natural texts from four different writing styles were sampled to ensure that the material used in the experiment was the kind of language actually read by poor and skilled high-school readers. To examine the influence of vowels on the native readers' reading accuracy, different texts were introduced in three different reading conditions: correctly vowelized, unvowelized and wrongly vowelized. This question is of special interest because it is often assumed that skilled readers rely on extensive visual-orthographic cues rather

than on phonological recoding and sentence context in word recognition (for a review, see McCusker, Hillinger & Bias 1981).

Method

Participants. A group of 64 native Arabic speakers, all 17 years old, participated in this study. They were 11th grade high-school students from two Arab schools in central Israel. The 64 participants were screened out of 88 native Arabic speakers. They were divided into poor and skilled readers according to their reading scores on a list of 100 vowelized Arabic words especially compiled for this study. The list was graduated according to difficulty, and all words were selected from the 11th grade high-school Arabic literature book. The list of words was judged by the eight Arabic teachers of these students for length, difficulty and vowelization. The teachers' evaluation of the skilled and poor readers matched the screening results. Another 32 subjects who scored $\geqslant$50 were labeled skilled readers. Subjects who scored $\leqslant$40 were labeled poor readers. Twenty-four subjects scored between 41 and 49 and were not included in the study.

Materials. Four kinds of written Arabic texts were used: narrative, informative, poetic, and Koranic. All texts were randomly sampled from the Arabic literature curriculum of Arab high schools in Israel. In each of these four kinds, three texts, each of 200 words, were given with different reading conditions: one correctly vowelized, one unvowelized, and one wrongly vowelized. 'Wrongly vowelized' words meant that short vowels were posted on the wrong letters, which could change these words into different words or into pseudowords if the reader considered these vowels. None of the texts was read more than once in any of the reading conditions.

Procedure. Participants individually read aloud each of the four kinds of text in the three reading conditions. To counterbalance materials and reading conditions for each four participants, order of texts and reading conditions were changed. For example, the first four participants started by reading aloud correctly vowelized narrative texts and the next four participants started by reading aloud unvowelized informative texts, etc. Participants were tested for reading accuracy. The maximum scoring for each reading condition was 200. Subjects read aloud each text with full vowelization. If vowels were not posted subjects had to figure them out. They were allowed to correct themselves.

Statistical analysis. For each text type (types of texts – narrative, informative, poetic, Koranic) a 3×2 MANOVA was designed for the data of this study: 3

(reading conditions – correctly vowelized, unvowelized, wrongly vowelized) × 2 (types of readers – poor, skilled). A summary of results is presented in the end of the results section showing the overall interactions of group × types of texts × vowelization.

Results

Narrative texts. Table 1 presents descriptive statistics of reading accuracy scores on all kinds of tests in the three reading conditions. Poor as well as skilled readers achieved higher scores when they read the correctly vowelized text. A 3×2 MANOVA of the above values showed a main significant effect for reader, $F(1,62) = 497.69$, $p < 0.001$ (see Figure 1) and significant interaction of reader × vowels, $F(8,26) = 129.67$, $p < 0.001$. The post hoc comparison of mean scores of correctly vowelized condition vs. wrongly vowelized condition of both types of reader revealed a significant vowels effect, $F(1,62) = 1244.84$, $p < 0.001$, and a significant interaction of reader × vowels, $F(2,124) = 460.6$, $p < 0.001$. Further, when mean scores of correctly vowelized condition vs. unvowelized condition of two types of readers were compared, post hoc comparison revealed a significant vowels effect, $F(1,62) = 897.43$, $p < 0.001$ and a significant interaction of reader × vowels, $F(1,62) = 422.86$, $p < 0.001$. Both significant interactions mean that vowels were a good reading facilitator for poor and skilled readers but to different degrees. It seems that the skilled readers benefited more than the poor readers from the contribution of vowels.

Informative texts. On informative texts, poor as well as skilled readers achieved higher scores in the correctly vowelized text (Table 1). A 362 MANOVA of these values revealed a significant main effect for reader, $F(1,62) = 497.64$, $p < 0.001$ (see Figure 1) and a significant interaction of reader × vowels, $F(8,26) = 120.67$, $p < 0.001$. Further, when mean scores of correctly vowelized condition vs. wrongly vowelized condition of both types of reader were compared post hoc, results revealed also significant vowels effect, $F(1,62) = 1941.21$, $p < 0.001$, and a significant interaction of reader × vowels, $F(8,59) = 82.08$, $p < 0.001$. Post hoc comparison of mean scores of correctly vowelized condition vs. unvowelized condition of readers revealed a significant vowels effect, $F(1,62) = 560.91$, $p < 0.001$ and a significant interaction of reader × vowels, $F(1,62) = 293.34$, $p < 0.001$. All the above significant interactions indicate that vowels were a good reading facilitator more for skilled readers than for poor readers.

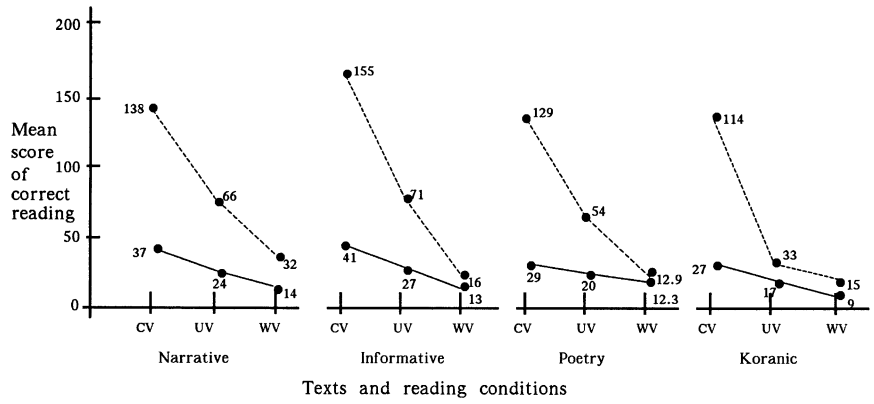

Figure 1. The performance of poor and skilled readers on all texts in all reading conditions. cv = correctly vowelized text; uv = unvowelized text; wv = wrongly vowelized text (●- - - -● skilled readers; ●——● poor readers).

Poetic texts. In the three reading conditions, poor as well as skilled readers improved their reading achievement when they read vowelized texts (Table 1). A 362 MANOVA revealed a main significant effect for reader, $F(1,62) = 497.69$, $p < 0.001$ (see Figure 1) and a significant interaction of reader $\times$ vowels, $F(8,26) = 120.67$, $p < 0.001$. When mean scores of correctly vowelized condition vs. wrongly vowelized condition of poor and skilled readers were also compared post hoc, the results revealed a significant vowels effect, $F(1,62) = 1244.84$, $p < 0.001$, and a significant interaction of reader $\times$ vowels, $F(2,124) = 460.6$, $p < 0.001$. When mean scores of correctly vowelized condition vs. unvowelized condition of poor and skilled readers were also compared post hoc, results revealed a significant vowels effect, $F(1,62) = 426.55$, $p < 0.001$ and a significant interaction of reader $\times$ vowels, $F(2,124) = 402.95$, $p < 0.001$. All these significant interactions indicate that vowels were a good facilitator of both types of readers.

Koranic texts. Poor as well as skilled readers improved their reading of Koranic texts with vowels (Table 1). A 362 MANOVA revealed a main significant effect for reader, $F(1,62) = 497.69$, $p < 0.001$ (see Figure 1) and a significant interaction of reader $\times$ vowels, $F(8,26) = 120.67$, $p < 0.001$. Further, when mean scores for correctly vowelized conditions vs. wrongly vowelized condition for poor and skilled readers were compared post hoc, they revealed a significant vowels effect, $F(1,62) = 347.56$, $p < 0.001$, and a significant interaction for reader $\times$ vowels, $F(2,124) = 157.83$, $p < 0.001$. The post hoc comparison for correctly vowelized condition vs. unvowelized condition for poor and skilled readers revealed a significant vowels effect,

Table 1. Means and standard deviations of students' reading accuracy scores on texts in three reading conditions: Correctly vowelized, unvowelized and wrongly vowelized

Reader	Reading condition	Mean	sd
Narrative texts			
Poor*	Correctly vowelized	37.56	6.11
Skilled*		138.37	22.38
Poor*	Unvowelized	24.44	5.18
Skilled*		66.46	11.73
Poor*	Wrongly vowelized	14.50	4.28
Skilled*		32.37	9.22
Informative texts			
Poor*	Correctly vowelized	41.44	7.55
Skilled*		155.78	21.02
Poor*	Unvowelized	27.94	4.13
Skilled*		71.75	13.35
Poor*	Wrongly vowelized	13.90	3.43
Skilled*		16.78	9.90
Poetic texts			
Poor*	Correctly vowelized	29.03	6.24
Skilled*		129.37	23.32
Poor*	Unvowelized	20.12	5.75
Skilled*		54.81	8.62
Poor*	Wrongly vowelized	12.34	3.03
Skilled*		12.91	7.14
Koranic texts			
Poor*	Correctly vowelized	27.91	6.26
Skilled*		114.65	35.73
Poor*	Unvowelized	17.40	4.46
Skilled*		33.09	9.87
Poor*	Wrongly vowelized	9.28	2.57
Skilled*		15.75	3.78

* n = 32 in each reading condition.

$F(1,62) = 285.32$, $p < 0.001$ and a significant interaction of reader $\times$ vowels, $F(1,62) = 169.99$, $p < 0.001$; namely, vowels were always a good facilitator of skilled readers more than of poor readers.

Summary of results. A MANOVA was carried out to test the overall interactions of group, types of texts and vowelization. The results indicated a significant interaction of group $\times$ text type, multivariate Wilks $f(3,60) = 26.43$, $p < 0.001$; a significant interaction of group $\times$ vowelization, multivariate Wilks $f(2,61) = 352.19$, $p < 0.001$; a significant triple interaction of group $\times$ text type $\times$ vowelization, multivariate Wilks $f(6,57) = 23.64$, $p < 0.001$.

Discussion

The most important finding of this study is that vowels significantly influenced reading of poor and skilled readers in the four Arabic writing styles in the three reading conditions. These results diverge from findings obtained from parallel Hebrew orthography studies testing similar issues, namely that readers in Hebrew orthography do not need the vowels and they are not essential for locating a specific lexical entry (Frost & Bentin 1992; Frost, Katz & Bentin 1987; Koriat 1984, 1985; Navon & Shimron 1984; Shimron 1993). However these results are similar to reading comprehension results obtained by Shimron & Sivan (1994), in which they compared highly skilled adult native Hebrew speakers on vowelized and unvowelized Hebrew texts. Their results indicated that the vowelized texts have a significant effect on reading comprehension.

The Arabic readers read texts in four different writing styles of varying difficulty. Narrative and informative texts are considered easier than poetic and Koranic texts since the latter contain a high percentage of low frequency words. Yet skilled and poor readers improved their reading accuracy in all writing styles when they read with vowels. This finding also supports recent findings obtained by Abu-Rabia (1996, 1997c, d) where the vowels and the sentence context were significant facilitators for word recognition for skilled and poor readers. This finding adds another variable to reading theory: vowels are an important variable to be considered when explaining reading processes of poor and skilled readers in Arabic orthography (cf. Perfetti 1985; Stanovich 1980, 1986; Stanovich & Feeman 1981; West & Stanovich 1978).

In addition, when wrongly vowelized texts of all writing styles were compared with correctly vowelized and unvowelized texts, vowels had a significant effect. Poor as well as skilled readers did not ignore vowels when they were wrongly posted on letters, which led to wrong pronunciation. This

finding also confirms the important role of vowels for poor and skilled readers in reading Arabic orthography.

From these results it is obvious that vowels facilitate word recognition in context for both poor and skilled readers. Arabic orthography is different from Latin and Hebrew orthographies, and vowels are important facilitators in word recognition because of the 'homograph phenomenon'. That is, if vowels and context are not available, then reading every second or third word correctly is impossible. This may make Arabic the only language in which skilled readers must first understand the sentence in order to recognize the word. This activity is very hard for the poor reader, but is more manageable by the skilled reader, and it clearly contradicts word recognition models and raises the question of 'generalization' of reading theory today. This theory requires more cross-cultural orthographic testing to ensure applicability or inapplicability to orthographies that have not been studied. The results of this study suggest that although skilled Arabic readers have been exposed to vowelized Arabic print, they have not developed reading strategies that allow them to generate the missing vowel information in the unvowelized print usually presented to skilled readers. Namely, skilled Arabic readers need vowels for phonological information to facilitate reading even though they are reading in context; this finding differs from those in Hebrew orthography (Bentin & Frost 1987; Frost, Katz & Bentin 1987; Shimron 1993 for a thorough review). However, these findings are consistent with the recent findings of Abu-Rabia (1996, 1997c, d) derived from Arabic orthography.

Further, skilled readers did not find reading Arabic in any of the reading conditions to be an easy task. These results suggest that reading vowelized Arabic is not just a letter-sound correspondence, but it is distinguished by additional Arabic characteristics and factors that skilled readers have to master in order to read Arabic correctly. The Arabic reader has to process short vowels posted above and under the letters and other diacritics such as *shadda* and *hamza*. This is cognitively highly demanding even for skilled readers. Processing all the diacritics may demand more attention for eye fixation; in principle, this might result in extra demands on the reader and substantial fatigue. The reader has to bring to the text prior knowledge of literary Arabic in order to be able to process automatically all diacritics, especially those on ends of words. Vowelization of ends of words changes owing to the grammatical function of these words in the sentence. As mentioned above, the same word may be vowelized and pronounced differently in four sentences owing to its grammatical function in the sentence. Thus, reading this word in its four syntactic positions is linguistically highly demanding even for skilled readers. Further, since literary Arabic is totally different from spoken Arabic, the diglossia of the Arab world (Ayari 1996; Feitelson, Goldstein, Iraqi &

Share 1993) readers cannot decode in the same way as native English or even Hebrew readers do. This difference emerges because in English the reader relies on identification of letter strings and their correspondence to the spoken language. Likewise in Hebrew, native readers rely on holistic identification of consonant clusters and their correspondence to spoken words, unlike the Arabic reader who cannot relate his/her letter strings to spoken Arabic because it is almost a second language (Ayari 1996; Feitelson, Goldstein, Iraqi & Share 1993). The elements and characteristics of Arabic raised here may explain the low performance of the skilled readers of the present study.

It seems that mastering phonology in reading accuracy in Arabic is essential and hard to acquire perfectly even by skilled readers. For compensation and aid readers rely on triliteral/quadriliteral roots of words for initial lexical access, which later directs to correct and precise pronunciation. In support of this argument an important study was carried out by Badry (1983) on Arab primary schoolchildren's creative production of novel verbs to express new concepts. Badry's study indicated that the key issue is children's knowledge of triliteral roots in Arabic; such triliteral roots are the most important variable for creative production of verbs and reading. Thus, perhaps as a result, reading an unvowelized Arabic text might be a difficult task even for skilled readers because some cognitive effort is wasted on morphological resources of the voweled word such as suffixes, prefixes, and context, and on disambiguating homographs: this cognitive effort leaves the reader with limited attentional capacity for correct textual reading. This is why in the present study vowelized texts or shallow orthography were comprehensible, but unvowelized texts, with deep orthography, were less comprehensible. Moreover, in support of the importance of phonology in Arabic reading, two recent studies by Abu-Rabia (1997a, b) tested the effect of vowels on reading comprehension. The first study was carried out among second- and sixth-grade Arab students, and the second was conducted among highly skilled adult native Arabic speakers. In both studies the vowelized texts were more significantly comprehensible than the unvowelized texts; such findings support the results of the present study.

Reading in Arabic orthography by poor and skilled readers should apparently be viewed more as their simultaneously following the whole direct visual-orthographic route for word root identification and processing vowels for phonological recoding. Thus, a careful distinction should be made between correctly vowelized and unvowelized texts when explaining reading in Arabic orthography regardless of the writing style – narrative, informative, poetic or Koranic. These parallel sources of information contribute to word recognition in Arabic text reading (Seidenberg & McClelland 1989; Van Orden, Pennington & Stone 1990) where these bits of information are accumulated, e.g., vowels, triliteral and quadriliteral roots, context and suffixes.

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