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Learning to read in Arabic: the long and winding road

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Abstract We examined the relative contribution of visual abilities, accessibility of letter names, and phonological awareness, to text reading speed and accuracy of Arabic in first, third, and fifth grades. The results revealed that for all levels of skill, phonological awareness contributes significantly to reading accuracy, to the same degree. For reading speed, letter naming speed is crucial in first and fifth grade, whereas phonological awareness is crucial in third grade. These patterns differ from those found of readers of other scripts and are interpreted in the context of diglossia, and the visual aspects of the Arabic orthography.

Keywords Reading acquisition · Arabic · Phonological awareness · Orthography · Phonology

Introduction

The process of reading acquisition in different languages is influenced by the unique characteristics of the orthographic system of each language and other factors. The importance of orthographic and phonological representations and the extent of their uses in the process of decoding and naming written words differ from language to language. Consequently, special cognitive mechanisms are developed in the readers, which enable them to cope as efficiently as possible with the unique orthographic features of the language they are learning to read (Frost, 2012).

Orthographies differ also in the ease with which they are learned. In this paper we are particularly concerned with how reading acquisition occurs in Arabic. Learning to read Arabic is especially challenging for native speakers of the language (Azzam, 1984; The Ministry of Education and Culture, 1992; Ibrahim, Eviatar, & Aharon-

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Perez, 2007; PISA, 2009). Two major reasons for this have been suggested: diglossia, and the visual characteristics of Arabic orthography (Eviatar & Ibrahim, 2012).

Arabic has two forms: the *spoken* form (*Ammia*—the spoken vernacular that has many local dialects) is used by speakers of the language in a specified geographic area for daily verbal communication, and is the native language of virtually all Arabic speakers. The *literary* form (*Fuṣḥa*), is the language in which all speakers of Arabic, from all over the world, read and write. This form of Arabic is universally used in the Arab world for formal communication and is known as "Modern Standard Arabic" (MSA). Previous studies with both children and adults have suggested that the two forms of Arabic are different enough such that the cognitive system of children and adolescents treats them as two languages (Eviatar & Ibrahim, 2000; Ibrahim, 2009). In the context of letter learning, Saiegh-Haddad (2008) and Asaad and Eviatar (2013) have shown that letters representing sounds that do not exist in Ammia (the spoken form) are harder to learn and identify.

A large amount of discussion about reading in different languages has turned on the concept of orthographic depth. The concept of orthographic depth has to do with the relationship between letters and the sounds that they represent (Katz & Frost, 1992). Orthographies in which this relationship is straightforward (such as Spanish and Italian) are considered 'shallow', whereas orthographies in which it is not (such as English), are considered 'deep'. This concept has been generalized also to scripts which are not alphabetic. These are always designated as being deep, because the relationship between the graphemes and the phonology of the words is not one to one, as in Japanese Kana (a syllabary) and systems based on Chinese logography in Japanese Kanji and Korean Hanza. Hebrew and Arabic are an additional type of orthography, being abjads (Daniels, 1990), where alphabetic letters designate consonants and some long vowels, while short vowels are mostly absent. In both of these scripts, a voweled version exists, which is usually used only in children's books and poetry. Thus, these scripts have been defined as having both a deep and shallow version, where all vowels are included as diacritics above, within and below the letters making up the words, thus completely specifying the phonological form of the word.

Cross language research with alphabetic languages that differ in orthographic depth (e.g., Tabossi & Laghi, 1992) or in languages that have both shallow and deep scripts like Korean (Kang & Simpson, 2001), Persian (Baluch & Besner, 1991), and Hebrew (Frost, 1994) have used lexical manipulations such as semantic priming or effects of frequency to examine differing models of reading in these scripts. Thus, a shallow script, which can be read via grapheme-phoneme rules should not show effects of the characteristics of words, such as semantic priming and frequency, because word naming or recognition can be based on nonlexical processes (e.g., orthography-phonology relations). In a deep script these manipulation should affect performance, as word recognition occurs via lexical knowledge (orthography-semantics relations). The findings reveal that performance in all of these languages is sensitive to the context in which the task is done. The presence of nonwords, or the type of stimuli in the previous trial, all affect the strategy that participants use to

recognize and name words. Thus, even in the most shallow orthographies, lexical aspects of words can be seen to affect performance.

The diglossic nature of Arabic is likely to impede the process of converting graphemes to phonemes even in its' vowelled form. One reason for this is that graphemes might represent phonemes which are unknown in the young learners' spoken language. Another reason is the linguistic distance between the two forms of the language. This distance does not allow children to rely on the phonologic representations they have for the words in the spoken language, even though the vowelled Arabic orthography is shallow, or transparent. Hence, the acquisition of reading skills in Arabic requires the study of two systems in parallel: linguistic and orthographic.

It has been previously shown that phonological awareness is an important factor in learning to read English (e.g., Ehri et al. 2001) and in Hebrew (e.g., Bentin & Leshem, 1993; Shatil & Share, 2003). Share (1995) has suggested that phonological knowledge of their language enables beginning readers, who may not be expert at grapheme-phoneme mapping even in shallow scripts, to approximate these relations. Unlike speakers of other languages, children who speak Arabic must cope, right from the beginning, with the necessity of acquiring new language structures that are not familiar to them, while simultaneously learning how these new structures are translated into orthographic representations. Previous research has shown that phonological knowledge is correlated with reading ability at the end of first grade for Arabic readers, but to a lesser extent than for Hebrew readers (Ibrahim et al. 2007). One of the goals of the present research was to explore the contribution of phonological abilities to measures of reading in Arabic at various levels of skill.

An additional possible source of difficulty in reading acquisition in Arabic is the presence of many visual and phonological neighbors among the letters. Visually, many letters share a basic form, and differ only by the placement and number of dots. Table 1 shows examples of these. These factors may have far-reaching effects on skilled reading in Arabic. Previous research with adult skilled readers has suggested that this characteristic of Arabic orthography disallows the involvement of the right hemisphere in letter identification (Eviatar et al., 2004). Analyses of a cross-language lexical decision task have suggested that while the right hemisphere is involved in this task in English and in Hebrew, it is not involved in lexical decision in Arabic (Ibrahim & Eviatar, 2012).

An additional source of visual complexity in Arabic is that 23 of the 29 letters in the alphabet have four shapes each (word initial, medial, final, and when they follow a non-connecting letter, for example, the phoneme /h/ is represented by the graphemes: هـ ـهـ ـه ه, and six letters have two shapes each, final and separate. Thus, the grapheme phoneme relations are quite complex in Arabic, with similar graphemes representing quite different phonemes, and different graphemes representing the same phoneme. We therefore examined the contribution of visual perceptual abilities to reading Arabic at different levels of skill. Previously, Shatil and Share (2003) showed that among children learning to read Hebrew, general visual perceptual abilities such as segmentation and visual short term memory, were not significant predictors of reading ability, whereas memory for symbol strings (letter-like shapes)

Table 1 Some examples of visual and phonological neighbors in Arabic

Visual neighbors	/b/ = ب /θ/ = ث /t/ = ت /y/ = ي /n/ = ن /k/ = ق /f/ = ف /j/ = ج /xh/ = ح /x/ = خ /z/ = ز /r/ = ر
Phonological neighbors	T = ط ت D = ض د S = ص س

was a good predictor. Given that the visual complexity of Arabic is higher than in Hebrew, we expected visual abilities to have a larger role in reading acquisition.

In the Arabic-speaking elementary schools in Israel, in first and second grade, school time is used to develop letter recognition, decoding, and vocabulary in MSA. In the middle of third grade the major focus of study moves on from basic reading skills, and children are required to use reading for learning other topics. In addition, the transition from vowelled to unvowelled text begins in third grade. Reading unvowelled Arabic text is expected to be fluent by the end of 4th grade. In the present study, we examined beginning readers (first graders), fluent readers (fifth grade) and the readers in the process of the transition mentioned above (third grade).

The purpose of this present research is to map reading abilities in the Arabic language in first, third and fifth grade schoolchildren, and to examine the specific influence of visual perceptual abilities, orthographic, and phonologic factors on the process of reading acquisition and on reading fluency. In order to do this, we measured visual abilities, phonological abilities, and speed of letter naming, and tested to see how these abilities are related to both speed and accuracy of text reading. We hypothesized that as a result of the unique features of Arabic (the complex relationship between graphemes and phonemes, and its diglossic nature), the elements of phonological awareness, visual perception and letter retrieval will support reading in a unique and distinct way.

Method

Participants

The research was carried out on 31 first graders (17 girls, with a mean age of 7:02 years), 30 third graders (16 girls mean age of 8:94 years) and 35 fifth graders (17 girls mean age of 10.88 years). All participants were native Arabic speakers who were recruited from the same school in which Arabic is the official language. The school is a private school in Nazareth, with middle to high socioeconomic status. The school is considered one of the best Arabic language elementary schools, such that we believe

we are tapping an optimal educational environment. Thus, our results will reflect the best possible performance of children learning to read Arabic. Based on teachers' review, none of the children suffered from developmental or acquired neurological, learning, emotional, or attentional disorders. In addition, a hearing test was performed for all the children in a quiet room, using a portable audiometer Siemens SD-25 and TDH-50P headphones. Those diagnosed as having hearing within normal range, were chosen to take part in the research. This was done because it has been that small deficiencies in hearing can have long term effects on phonological representations, and on performance on our phonological tasks. The research was approved by the ethics committee of the Ministry of Education in Israel.

Stimuli and materials

Predictor variables

1. *Test of Visual Perceptual Skill* (Gardner, 1996)—The TVPS-R is a standardized test used to assist in determining a child's capacity to recognize, interpret or give meaning to what is seen. There are seven tasks. We used available norms and computed a composite scaled score for each child. A definition of each of the seven visual-perceptual skills tests is given below (as described in the manual):
   Visual discrimination the task requires matching or determining the exact characteristics of two forms when one of the forms is embedded among similar forms.
   Visual memory measures immediate recall (after 4 or 5 s) of all of the characteristics of a given formand the ability to find this form in an array of similar forms.
   Visual spatial-relationships measures the ability to determine, from among five identical configurations, the one single form or part of single form that is shown in a different direction from the other forms.
   Visual form-constancy measures the ability to see a form, and to find that form, even though the form may be different size (larger or smaller); and, whatever the size, the ability to determine the form if rotated, reversed, or hidden among other forms.
   Visual sequential-memory measures immediate recall (after 4 or 5 s) of a series of forms from among four separate series.
   Visual figure-ground measures perception of a form, and the ability to find this form hidden in a conglomerated ground of matter.
   Visual closure measures the ability to determine, from among four incomplete forms, the one that would be the same as the completed form.
   Cronbachs' alpha was .72 for first graders, .76 for third graders, and .76 for fifth graders.
2. *Letter Naming Task (RAN)*—Six tests were created, each comprised of a card with letters arranged in 5 rows, 10 letters in a row. The tests differed in the identity of the letters, and were aimed to disentangle the effects of visual and

phonological neighbors on letter name retrieval, knowledge of the sounds of MSA, and also of the effects of the variability of letter shapes. Children were required to retrieve names or sounds of the letters as quickly as they could. The time it took them to name all the letters, in each list, was used as an index of childrens' automatized naming speed.

The RAN tests

- *Different letters*—The test consisted of five letters, each repeated ten times randomly, that have no visual or phonological neighbors (و, م, ل, ي, هـ). This test was done to get a baseline for letter name retrieval.
- *Visual neighbors*—The test consisted of five letters, each repeated ten times randomly, that have visual neighbors but without phonological neighbors (غ, ف, حـ, شـ, ب). None of the neighbors of these five letters were included in the test. This test was done to assess the effects of visual neighbors on letter name retrieval.
- *Visual and phonological neighbors*—The test consisted of five letters, each repeated ten times randomly, that have both visual and phonological neighbors (ك, ز, ضـ, ت, س). None of the neighbors of the five letters were included in the test. This test was done to assess the effects of visual and phonological neighbors on access to letter names.
- *Different different shape*—The test consisted of the same letters that are in the 'different letters' test, but they appear in different shapes (م, مـ, ممـ, مـم, ي, يـ, يـي, يـي, ل, لـ, للـ, لـل, و, ـو, هـ, ه, ـه, ـهـ). Recall that shape of the letters is position dependent in the word. Thus the first four letters in list above are different versions of مـ, the next two are different versions of و, etc. In this test, we assessed how the appearance of the same letters in different shapes would affect access to the names of the letters.
- *Visual neighbors different shape*—The test consisted of the same letters that are in the 'visual neighbors' test, but they appear in different shapes (ف, فـ, فـف, ح, حـ, حـح, ش, شـ, شـش, ب, بـ, بـب, بـغ, غـ, غ). In this test we assessed how the appearance of the same letters (that have visual neighbors) in different shapes would affect access to the names of the letters.
- *MSA (Fusha) only*—The test consisted of four letters, each repeated twelve or thirteen times randomly, that have visual and phonological neighbors but represent sounds in MSA that are not used in the spoken language in Nazareth dialect (ق, ظ, ة, ث).

We used the mean score of all six tests for third and fifth grade, and the mean score of the first four tests for first grade. This is because first graders made too many errors on the tests with visual and phonological neighbors and with Fusha sounds. A detailed analysis of performance on these tests is described in Asaad and Eviatar (2013).

Cronbachs' alpha was .92 for first graders, .94 for third graders, and .89 for fifth graders.

3. *Phonological abilities* Since there is no phonological awareness test in Arabic, we used the diagnostic test (Shani, Lachman, Shalem, Bahat & Zeiger, 2006).

The test was translated and adapted to Arabic. The test included four subtests-

- Phoneme segmentation (eight items).
- Blending phonemes (eight items).
- Syllable deletion (14 items).
- Sound deletion (16 items).

The number of errors for each test was counted and the percentage of mistakes per test was calculated separately. The score represents average percentage of errors over all four tests. Cronbachs' alpha was .75 for first graders, .71 for third graders, and .70 for fifth graders.

The dependent variable was reading text—the texts were taken from the reading book of each grade. The text that was chosen for the first grade contained 44 pointed words. The text that was chosen for the third grade contained 141 pointed words. The text that was chosen for the fifth grade contained 220 pointed words. Participants were asked to read aloud the entire text and they were tested for reading accuracy and reading speed. Scores represented the number of word reading errors and time of reading (seconds).

Procedure

Participants were tested individually in quiet room at their school during regular school hours. All of the tests were conducted by the first author. The instructions were given in spoken Arabic. The children were subjected to a battery of diagnostic tests administered over a period of three meetings. During the first meeting, the TVPS-R test was given to all children. During the second meeting, all children were given the automatic letter naming tests. The third meeting consisted of reading tests followed by phonological awareness tests. Verbal responses were recorded on audiotape.

Results

Preliminary analyses with sex as a factor revealed no main effect or interactions ($p > .7$), so that the data were pooled over sex. The mean scores on all of the tests are presented in Table 2.

In order to test the relative importance of visual abilities, phonological awareness, and access to letter names, on measures of reading, we performed regression analyses with the general linear model. We used grade as a between subject factor and the composite scores on the phonological tests, letter naming speed, and visual tests as within subject factors. The analysis was done separately for reading accuracy scores and for reading speed scores. It is important to note that scores on all of our measures are not normally distributed (all are skewed to the right). In order to overcome this, the scores of the children in each grade were classified into percentiles, such that the highest scores in each grade were in the

Table 2 Median and standard deviations (SDs) results of the reading measures and phonological awareness, rapid letter naming, visual perception

Measures	1st grade		3rd grade		5th grade	
	M	SD	M	SD	M	SD
Reading errors (mean number of errors)	4	3.86	7.37	14	8.51	19
Reading speed (mean seconds)	100	99.66	137.28	65.02	175.97	39.91
Phonological awareness (mean % errors)	34.82 %	15.02	26.45 %	10.98	16.29 %	9.33
Rapid letter naming (speed, mean seconds)	46.31	8.91	41.77	7.96	35.03	5.29
Visual perception (mean normed score)	10.43	1.82	11	1.99	11.29	2.11

highest percentile. All subsequent analyses were performed on these percentile scores. In order to compare the effects of the variables in the three grades, the scores of the fifth graders were taken as the standard to which the scores of first and third graders were compared, using hierarchical regression models. The analysis revealed that for text reading accuracy, only phonological awareness was a significant predictor ($F(1,84) = 19.74$, $p < .0001$), and there was no difference in the predictive power of this variable in the comparison of first grade with fifth grade ($p > .24$) or in the comparison of third grade with fifth grade ($p > .8$).

For text reading speed, there was a significant contribution of phonological awareness ($F(1,84) = 9.81$, $p < .01$) and of letter naming ($F(1,84) = 23.25$, $p < .0001$), but not of visual abilities ($F < 1$). In addition, the effects of phonological awareness interacted with grade, $F(2,84) = 5.31$, $p < .01$). The interaction of letter naming with grade was marginally significant ($F(2,84) = 2.81$, $p = .066$). Comparison of the effect of phonology in first and fifth grade revealed a slight trend towards a difference ($p = .09$), whereas comparison of third to fifth grade revealed a significant difference ($t(84) = 3.25$, $p < .005$).

Thus, the weight of phonological awareness is different in the three grades. The Spearman correlation coefficients of the relationships between each one of our predictors and text reading errors and speed are listed in Table 3. In panel A of Table 3 we can see the patterns that underlie the significant interaction between phonological awareness and grade in reading speed scores. It can be seen that in fifth grade the relationship between phonological awareness and text reading speed is small and not significant, in first grade the relationship is stronger but also not significant, and in third grade, the relationship between reading speed and phonological awareness is strong and significant. In Panel B of Table 3 we can see the patterns that underlie the marginal interaction between letter naming speed and reading speed. The correlation between letter naming speed and reading speed is strong and significant in first and fifth grade, but not in third grade. Panel C of Table 3 reveals that the scores on the tests of visual perception were not correlated with either one of the reading measures.

Table 4 lists the correlations between the three reading predictors among themselves. In the three grades, the only significant correlation is between phonological awareness and visual abilities, which is significant in the first and fifth grade. Phonological awareness performance was better when visual perception was stronger.

Table 3 Spearman correlation between reading measures and phonological awareness, letter naming and visual abilities [values with the same letter are not significantly different (by transformation of Fisher Z)]

	Text reading accuracy	Text reading speed
(A) Phonological awareness		
1st grade	0.53*[a]	0.35[ab]
3rd grade	0.49*[a]	0.68***[b]
5th grade	0.39*[a]	−0.03[a]
(B) Rapid letter naming		
1st grade	−0.04[a]	0.70***[a]
3rd grade	0.25[a]	0.28[b]
5th grade	0.12[a]	0.45*[ab]
(C) Visual perception		
1st grade	−0.09[a]	−0.04[a]
3rd grade	−0.35[a]	−0.30[a]
5th grade	−0.28[a]	−0.16[a]

*** $p < .0001$, ** $p < .001$, * $p < .05$

Table 4 Spearman correlation between the reading predictors themselves

	Rapid letter naming (speed)	Visual perception (accuracy)
Phonological awareness (errors)		
1st grade	0.12[a]	−0.46*[a]
3rd grade	0.18[a]	−0.34[a]
5th grade	0.04[a]	−0.34*[a]
Rapid letter naming		
1st grade		0.04[a]
3rd grade		−0.21[a]
5th grade		−0.25[a]

Values with the same letter are not significantly different (by transformation of Fisher Z)

*** $p < .0001$, ** $p < .001$, * $p < .05$

Discussion

The goal of this study was to assess the relative role of phonological awareness, letter knowledge, and visual abilities, on reading accuracy and speed in Arabic, at different skill levels. Overall, we found that phonological awareness affects reading accuracy at all levels, and that access to letter knowledge affects reading speed in first and fifth grade, while phonological awareness has an interesting pattern of relations with reading speed. Contrary to our hypothesis, visual abilities were not related to our reading measures. However, interestingly, as shown in Table 4, visual abilities are positively related to phonological abilities in all grades. This finding supports the hypothesis that the visual complexity of Arabic script does affect its' processing, but this is not a direct effect. We cannot speculate about the process by which this happens, but given that previous research has found effects of visual complexity on letter detection in adult readers (Eviatar et al., 2004) and another sample of children (Abdelhadi et al. 2011), it is clear that the route by which the

visual characteristics of letters affects phonological processes should be examined closely in future research.

There are two aspects of our results that we would like to emphasize. One has to do with the difference in patterns of reading acquisition in Arabic than in Hebrew and the other focuses on the developmental path of reading that we have mapped here between beginning readers in first grade, via more skilled readers in third grade to fluent readers in fifth grade.

The comparison of acquisition processes between Arabic and Hebrew is useful because of the patterns of similarity and differences between the two languages. Both are Semitic languages with a root based morphology, where most words are derived by embedding a root into a morphophonological word pattern (Berman, 1978). As mentioned in the introduction, the orthographies of both languages are abjads (Daniels, 1990), where letters represent consonants and some long vowels, with short vowels represented by optional diacritics. Both orthographies have two versions: without diacritics, there are many homographs, and the phonological form of words is underrepresented, and thus they have been defined as deep orthographies; with diacritics, the phonological forms of words are fully represented, and the orthographies have been defined as shallow. The differences between the languages are important as well. The most striking is the diglossic situation of Arabic, which is absent in Hebrew. Another striking difference is the visual complexity of the orthographies: Eviatar and Ibrahim (2004) showed that letter identification requires much longer exposure durations in Arabic than in Hebrew or in English. There is a relatively rich literature about reading acquisition in Hebrew, allowing comparisons. Most importantly, in Hebrew, it has been shown that there is a stronger correlation between phonological awareness and reading accuracy in the beginning of first grade than at the end of first grade (Bentin & Leshem, 1993; Geva et al. 1993; Shatil & Share, 2003). This pattern has also been reported for children acquiring Latvian, another highly regular orthography (Sprugevica, Paunina, and Hoien, 2006). These authors found that a composite measure of phoneme segmentation and phoneme deletion accounted for 27 % of variance in reading accuracy in December of first grade, 9 % at the end of it, and none by the middle of second grade. Thus, these studies suggest that as students become more skilled, reliance on phonological awareness is lessened. We found that for Arabic readers, phonological awareness was a strong predictor of text reading accuracy, to the same degree, at all levels of skill, from first through fifth grade.

We believe that this pattern results from the diglossic features of the language and from the complex grapheme-phoneme relations in Arabic. It may be that these factors weaken the linkage between orthographic and phonological representations in memory and delay the acquisition of integrated orthographic representations. In addition, in the unvowelled version of Arabic, read by the fifth graders, there are a lot of homographs. Disambiguation of these depends on the syntactic rules and vocabulary knowledge of MSA. Hence, although readers in third and fifth grades exhibit mastery over the alphabetic code, and are considered skilled readers by their teachers; they still rely on phonological awareness to ensure reading accuracy.

The winding road to Arabic literacy

Our results showed that factors influencing text reading fluency (speed) among young children in the beginning stages of reading acquisition are not necessarily identical to factors affecting text reading fluency in more skilled readers. Thus, in first and fifth graders, the time needed to read a text was influenced by the speed of letter retrieval, whereas amongst third graders phonological awareness played a greater role in determining reading speed, and letter retrieval had a smaller role.

We believe that the similar patterns amongst first and fifth graders result from different factors. In first grade, children are still at the stage of letter learning, and their reading is based mainly on decoding a series of graphemes and their interconnections, in order to arrive at the meaning of the words and to create phonological representations for these words. It must be remembered that due to the diglossic features of Arabic, first graders cannot rely on phonological representations to accelerate their reading pace, thereby lowering the effects of phonology on reading speed. Thus, rapid identification of letters and retrieval of their names affects the time necessary to read texts. In contrast, fifth grade readers read in a more global manner, and therefore, their letter retrieval ability reflects the ability to retrieve orthographic patterns or parts thereof, in order to arrive at the phonology and meaning of the word. Therefore, accessibility of letter identity plays a larger role than phonological awareness in predicting text reading speed.

Third grade students, on the other hand, are in the middle of the reading acquisition process, transitioning from analytic to global reading. It is likely that due to the visual complexity of written Arabic, the students still have difficulty reading in a global manner, and therefore, they are "pseudo-global" readers. They thus depend on the phonological representations that have been learned in the previous 3 years of schooling in order to read in a global-like manner, by providing well-specified phonemic templates that make it possible to bridge the gap between imperfect global reading and target pronunciation in order to accelerate reading. This results in a stronger relationship between phonological awareness and text reading speed, which plays a larger role than letter accessibility.

Thus, we see changing effects of phonological awareness and letter accessibility in the three levels of reading skill, which are also related to the proficiency of the children in MSA. Phonological awareness can influence reading speed if the child has a phonological representation of the language (MSA), whereas letter accessibility can influence reading speed when letters are being acquired (decoding, in first grade), and when reading is becoming more global (as in fifth grade).

Conclusions

These results serve to emphasize the difference in reading acquisition between Arabic on the one hand, and English and Hebrew on the other. Beginning readers of Arabic, as opposed to those of English or Hebrew, cannot depend on their auditory vocabulary to help them decode written words. Again, it is important to remember that the Arabic language is considered a diglossic language, so that generally, for

the beginning reader, there is no phonological representation of the words he or she reads. Our findings are consistent with those presented by Saiegh-Haddad (2003, 2004, 2005, 2007a, b), which emphasize the importance of establishing phonological representations of standard words and phonemes. Furthermore, these results have shown the importance of using various measurements of reading (reading accuracy and speed) when there is a need to analyze the specific effects of visual, orthographic and phonological factors on the process of reading acquisition.

Our results have implications to teaching methods applied to literary Arabic and to Arabic orthography in early childhood. For example, although there is a lot of work on phonological awareness in Arabic-speaking kindergartens, exposure to MSA is not structured. It is important to enrich vocabulary in MSA, and specifically, to emphasize parallel lexical entries in spoken Arabic (SA) and in MSA. There is a continuum of similarity and difference in the phonological representation of SA and MSA (Saigh-Haddad, 2005). Being explicitly taught the elements of this continuum would allow children to use vocabulary knowledge to enhance phonological decoding in first grade. Another type of important work is strengthening auditory comprehension of MSA. For example, simple instructions can be given in MSA instead of in SA. In addition, exposure to the letters should begin early, with emphasis on letters that represent sounds that do not occur in SA. Higher familiarity with letter names in the beginning of first grade would allow children to decode words more easily and to have more resources to enlarge vocabulary. From a theoretical standpoint, the results of this research emphasize how studies on different languages and various orthographic systems can deepen our knowledge of the effects of different skills on reading.

Appendix A: Transliterations and translations of the phonological tests lists

Segmenting words into phonemes

Spoken Arabic	Gloss
Dam	Blood
Rama:	Throw
Nese	Forget
‘enab	Grapes
Bare:d	Mail
Jandab	Grasshopper
Farfu:r	Young
Mandale:na	Clementine

Blending phonemes into words

Spoken Arabic	Gloss
Dura	Corn
Seta	Rain
Same:r	(name)
‘asfu:r	Bird
Barme:l	Barrel
Mafate:ḥ	Keys
Za’tar	Thyme
‘ankabu:t	Spider

Deletion syllable task
Instructions: I will say a word, then I will take away part of it, and you will tell me what is left

Gloss	Say	Delete
Spread	našar	Na
(name)	Mas’u:d	Mas
Wounded	Majru:ḥ	Maj
Train	qeṭa:r	qi
Replete	Šaba:n	Aan
Squirrel	Senja:b	Jab
Tree	šajara	Ja
Judge	ḥakam	Ka
Window	šubak	Ba
Ship	Safe:ne	Fee
Squeezers	Ma’a:ser	Aa
Walled	Masu:ra	Soo
Fatty	Dasam	Sa
Magic	seḥer	He

Deletion phoneme task
Instructions: I will say a word, then I will take away part of it, and you will tell me what is left

Gloss	Say	Delete
Sleeve	Kum	K
Camel	Jamal	J
Dog	Kaleb	K
Body	Jesem	J
Throw	Kab	K
(Name)	Same:r	S
(Name)	Sa:jed	J
Ceremony	ḥafel	H
Exhalation	Zafe:r	F
Elephant	Fe:l	L
Hot	ḥam	M
Day	Nha:r	H
Holiday	ʻe:d	A
Empty	Fa:de	F
Cucumber	Xya:ra	X
Bells	Jra:s	J

Appendix B: Reading tests

Text for first grade

سامِرٌ وأُختُهُ سميرَة

خَرَجَ سامِرٌ وأُختُهُ سميرَة الى حَديقَةِ المَنْزِلْ. جَمَعَتْ سَميرَة الحِجارَة الصَّغيرَةَ وأعْطَتْها الى أخيها. وضَعَ سامِر الحجارَة فوقَ المَمَرِّ التُّرابيِّ في الحَديقَةِ .
بعدَ أن أنهَيا العَمَلَ، قالَ سامِر لأُختِهِ: الآنَ يُمكِنُ أنْ نَسْقيَ نباتاتِ الحَديقَةِ وأزهارَها ونَقْطِفَ ثِمارَ أشْجارِها دونَ أن يلتَصِقَ الوَحْلُ بأحذِيَتِنا.

Text for third grade

الثَّعلَبُ والدِّيكُ
عَرَبَتِ الشَّمْسُ فيما كانَ ثَعْلَبٌ يَمُرُّ بِإحْدَى القُرَى يَعْوي أُغنِيَةً قديمَةً مِنْ أغاني أجدادِهِ، فلَمَحَ ديكاً يَنْبِشُ التُّرابَ بَحْثاً عَنْ حُبُوبٍ يتَغَذَّى بها .
تَوَجَّهَ الثَّعلَبُ الى الدِّيكِ وحَيّاهُ قائلاً: "لَقَدْ كانَ أبُوكَ عَذْبَ الصَّوْتِ بارعاً في الصِّياح، وكُنْتُ أمُرُّ في القَريَةِ فيَأسُرُني جَمالُ صَوتِهِ."
أجابَ الدّيك: "إنّ صَوْتي لعَذْبٌ هُوَ كذلِك". ثُمّ أغْمَضَ عَيْنَيْهِ وصَفَّقَ بجَناحَيْهِ وصَاحَ مُتَباهِياً، فوَثَبَ الثَّعلَبُ وقَبَضَ عَلَيْهِ بمَخالِبِهِ ثُمَّ فَرَّ هارباً.
سَمِعَتْ كِلابُ القَرْيَةِ صِياحَ الدِّيكِ وانتَبَهَتْ الى خُطورَةِ الأمْرِ فأخَذَتْ تَجري في اتّجاهِ الصِّياح .
قالَ الدّيكُ للثَّعلَبِ وهوَ يئِنُّ مِنَ الوَجَع: "إذا أردْتَ التَّخَلُّصَ مِنَ الكِلابِ فقُلْ لَهُم أنَّني لَسْتُ دِيكَ قَرْيَتِهِم، بل إنّني من قَريَةٍ أخرى." ففَتَحَ الثَّعلَبُ المَدْعُورُ فَمَهُ لِيَنْطِقَ بهذِهِ الكَلِماتِ، فسَقَطَ الدِّيكُ ناجياً مِنَ الموْتِ المُؤَكَّدِ عائِداً الى القَريَةِ بأقصَى سُرْعَةٍ وهوَ يَصيحُ: "اللعنَةُ على عَيْنٍ تُغْمَضُ في غَيْرِ وَقْتِها". أمّا الثَّعلَبُ فأخَذَ يَلْهَثُ ويلعَنُ فَمَهُ الذي انفَتَحَ في غيرِ وَقتِهِ.

Text for fifth grade

القِرْدُ وبائِعُ الألبان

عاشَ تاجِرُ ألبانٍ في مَدينَةٍ ساحِليَّةٍ قديمَةٍ، وكانَ مُعْرَماً بكَسْبِ الأمْوال، فكانَ يَخْلِطُ الحَليبَ بالماءِ ويَبيعُهُ لأهْلِ المَدينَة.

وحينَ اقْتُضِحَ غِشُّ التّاجِرِ عَزَمَ الأهالي أمْرَهُم على طَرْدِهِ منَ المَدينَة. وفيما هُم يتشاوَرونَ في الأمْرِ كانَ التّاجِرُ يتسَوّقُ فاشْتَرَى قِرْداً كانَ قد لَفَتَ إنْتِباهَهُ.

لمْ يَخْفَ على بائِعِ القُرُودِ غِشَّ تاجِرِ الألبان، فباعَهُ القِرْدَ، وهُوَ أذْكَى القُرُودِ عِنْدَهُ، بسِعْرٍ باهِظٍ، آملاً أن يُلَقِّنَ التّاجِرَ عِبْرَةً.

طُرِدَ التّاجِرُ، فتَوَجّهَ مَعَ قِرْدِهِ الى مِيناءِ المَدينَةِ مُغادِراً على مَتْنِ سَفينَةٍ تَتَأهَّبُ للإبْحار، ومَعَهُ عَدَدٌ مِنَ المُسافِرين.

كانَ التّاجِرُ حَريصاً قَلِقاً على أمْوالِهِ التي كَسِبَها من بَيْعِ اللَّبَنِ المَغْشُوش، فوَضَعَها في صُرَّةٍ أخْفاها تحتَ رِدائِهِ وأخَذَ يَتَفَحَّصُها مَرَّةً بَعْدَ المَرَّة.

وفي مَرَّةٍ مِنَ المَرّاتِ غافَلَهُ القِرْدُ الذَّكِيُّ واخْتَطَفَ صُرَّتَهُ الثَّقيلة مُبتَعِداً بقَفَزاتٍ رَشيقَةٍ الى قِمَّةِ الصّارِيَة. عَجِزَ التّاجِرُ عَنِ اللّحاقِ بالقِرْدِ وَمَكَثَ على مَتْنِ السَّفينَةِ مُرْتَبِكاً يَصْرُخُ بلا تَوَقُّفٍ كَمَنْ فَقَدَ عَقْلَهُ.

هَزِءَ القِرْدُ من صُراخِ مالِكِهِ وأخَذَ يُلقي بأوراقِ المالِ وَرَقَةً وَرَقَةً الى مِياهِ البَحْرِ الواسِعِ مُفْهِمَها بشَمائِلِهِ.

أخَذَ التّاجِرُ يَهُزُّ عامُودَ الصّارِيَةِ بقُوَّةٍ عَلَّهُ يُسْقِطُ القِرْدَ، فكانَ القِرْدُ يَتَمادى في التَسلِيَةِ واللَّعِبِ ببعثَرَةِ المالِ مَعَ ازدِيادِ إهْتِزازِ الصّارِيَةِ وحُنْقِ التّاجِرِ وغَضَبِه.

ضَحِكَ المُسافِرونَ من هذا المَشْهَدِ، وكانوا يعرِفُونَ عنْ غِشِّ التّاجِرِ وطَمَعِهِ، وما كانَ منَ القِرْدِ أن ألقى بِبَعْضِ ما تَبَقّى من النُّقودِ الى التّاجِرِ كَرَماً مِنْهُ وَشَفَقَة، فصَفّقَ الجَميعُ لِذكاءِ القِرْدِ وظَرافَتِهِ. أمّا التّاجِرُ فَعضَّ على شَفَتَيْهِ وقد تَعَلَّمَ دَرْساً لا يُنْس

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