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Metalinguistic Awareness and Reading Performance: A Cross Language Comparison

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Abstract The study examined two questions: (1) do the greater phonological awareness skills of billinguals affect reading performance; (2) to what extent do the orthographic characteristics of a language influence reading performance and how does this interact with the effects of phonological awareness. We estimated phonological metalinguistic abilities and reading measures in three groups of first graders: monolingual Hebrew speakers, bilingual Russian–Hebrew speakers, and Arabic-speaking children. We found that language experience affects phonological awareness, as both Russian–Hebrew bilinguals and the Arabic speakers achieved higher scores on metalinguistic tests than Hebrew speakers. Orthography affected reading measures and their correlation with phonological abilitites. Children reading Hebrew showed better text reading ability and significant correlations between phonological awareness and reading scores. Children reading Arabic showed a slight advantage in single word and nonword reading over the two Hebrew reading groups, and very weak relationships between phonological abilities and reading performance. We conclude that native Arabic speakers have more difficulty in processing Arabic orthography than Hebrew monolinguals and bilinguals have in processing Hebrew orthography, and suggest that this is due to the additional visual complexity of Arabic orthography.

Keywords Metalinguistic abilities · Orthography · Bilingualism · Monolingual Hebrew speakers · Russian–Hebrew speakers · Arabic speakers

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Introduction

The research reported below has two goals. The first is to test the hypothesis that early childhood bilingualism can positively affect reading performance via heightened phonological awareness. The second is the study of reading performance in Arabic.

Phonological awareness and reading

A focus on reading performance and the variables that influence it have revealed strong correlative relations with metalinguistic skills. The majority of previous investigations of the relationship between metalinguistic skills and reading ability focus on single metalinguistic domains (phonological awareness and word awareness). These domains refer to the ability to reflect on and manipulate the subunits of spoken language, the phonemes and the words. In these studies, phonological awareness was more extensively investigated because, although word awareness appears to be related to beginning reading achievement (Bowey & Patel, 1988), there is no need to treat it separately from phonological awareness, because phonological awareness implies word awareness. Namely, the ability to reflect on phonemes pre-supposes the ability to reflect on words, but not vice versa. For example, to segment the word "cat" into its constituent phonemic elements, children must be able to dissociate the phonological realization of the word from its referent.

Many studies have demonstrated that children's performance in various phonological awareness tasks is strongly related to the acquisition of reading skills in English (Bradley & Bryant, 1985; Tunmer & Nesdale, 1986), Italian (Cossu, Shankweiler, Liberman, Katz, & Tola, 1988), French (Bertelson, Morais, Alegria, & Content, 1985), Spanish (de Manrique & Gramigna, 1984) and Hebrew (Bentin & Leshem, 1993). However, these correlative studies tell us very little about the nature of this relationship.

Several longitudinal studies that showed strong correlations between phonological awareness and later reading achievement have suggested a causal role for phonological awareness (Bradley & Bryant, 1985; Muter, Hulme, Snowling, & Taylor, 1997). The causal connection between phonological skills and reading performance has been suggested by studies showing that interventions designed to improve phonemic awareness facilitated the process of reading performance and led to better reading performance in the early school years (Bowey & Patel, 1988; Bentin & Leshem, 1993).

The present study explores the possibility that bilingualism, which has been shown to affect metalinguistic abilities, influences reading performance via these abilities. The consensus in the field is that learning a second language permits children to view their language as one system among others, thereby enhancing their linguistic awareness. It is believed that the systematic separation of form and meaning, that is, experienced in early bilingualism gives children added control of language processing. The general pattern of the effects of bilingualism is as follows: bilinguals achieve higher scores than monolinguals on tests of arbitrariness (Ben Zeev, 1977; Edwards & Christophersen, 1988) and phonological awareness (Dash & Mishra, 1992), and lower scores than monolinguals on tests of vocabulary size (Doyle, Champagne, & Segalowitz, 1978).

The case of Arabic

The study of children learning to speak Arabic is expecially interesting for several reasons. Literary Arabic (LA) (also known as Modern Standard Arabic) is universally used in the Arab world for formal communication and writing, and is the language of prayer and of public occasions. Spoken Arabic (SA) refers to regional dialects and has no written form. The spoken dialect in a particular region is the native language of all native speakers of Arabic in that region, while LA is taught in school in parallel with learning to read and write. Although sharing a limited subgroup of words, the two forms of Arabic are phonologically, morphologically, and syntactically somewhat different. For example, certain vowels (such as "e" and "o") exist in SA, but not in LA; in SA, words may begin with two consecutive consonants or with a consonant and a "schwa," which is illegal in LA; the two forms utilize different inflections (such as plural markings) and different insertion rules for function words, and the two forms have different word order constraints in sentence structure. This situation served as part of the background to the introduction of the term "diglossia" by Ferguson (Ferguson, 1959), and has generated a long debate over the distinction between diglossia and bilingualism (e.g., Eid, 1990).

Three recent psycholinguistic studies addressed this issue directly with adult Arabic speakers. R. Ibrahim (1998, unpublished data) examined visual and auditory lexical decision performance patterns in Hebrew and in LA. The study revealed very similar performance patterns in the two languages, although there was an interaction between modality and language: latencies for printed Hebrew stimuli were slightly faster than for printed LA stimuli, but slightly slower when the same stimuli were presented orally. The percentage of errors was almost identical in the two languages for printed stimuli, and slightly higher for Hebrew than for LA stimuli in speech. Ibrahim and Aharon-Peretz (2005) examined cross-language semantic priming effects, where the primes were in SA, LA or in Hebrew, and the targets were in the participant's SA dialect. Primes in LA and in Hebrew had equivalent effects, which were about half the magnitude of the within language (SA) priming effects. In another recent study (R. Ibrahim, submitted), large repetition effects at relatively long lags were found within SA but were absent when the repetition involved translation equivalents either using Hebrew or LA. These findings suggested that, despite their intensive everyday use and psychological proximity, spoken, and LA are represented in two different lexica in the cognitive system of the native Arabic speaker. Furthermore, for both LA and Hebrew, this pattern is similar to previously reported results for second languages in bilinguals in different languages (J. Altarriba, 1990, unpublished data; Keatly, Spinks, & de Gelder, 1994).

Eviatar & Ibrahim (2001) examined this issue in children, by exploiting the effects of the relationship between a bilingual's languages and the emergence of metalinguistic skills in childhood. We used the following logic: given that bilingual children reveal hightened metalinguistic abilities as a result of acquiring two linguistic systems, do pre-literate and newly literate Arab children evince this effect, before they have been exposed to any other language? We tested samples of monolinguals (Hebrew), bilinguals (Hebrew and Russian), and Arabic speaking kindergarten and first grade children. The Arabic speakers' first language was spoken Arabic and they were exposed to Literary Arabic via children's books, television, and formal instruction in kindergarten and first grade. The Russian–Hebrew bilingual children came from Russian-speaking homes and attended school in Hebrew. They showed the classic pattern resulting from

exposure to two languages: higher performance levels in metalinguistic tests and lower performance levels on vocabulary measures as compared to monolinguals. The Arab children's performance levels mimicked those of the bilingual children for the most part, which suggested that exposure to LA in early childhood affected metalinguistic skills in the same manner as that reported for children exposed to two different languages. We concluded that Arabic speaking children exposed to LA behave as bilinguals.

In that study, comparison of kindergartners with first graders revealed that exposure to literacy enhanced phonological awareness across all three groups. The focus of the present study was to explore how the advantages in phonological awareness revealed by Russian–Hebrew bilinguals and Arab children are related to reading performance in first grade. Because we compared reading in languages similar in origin (Semitic) but different in orthography in this study, we also reviewed differences between the two orthographies.

Arabic and Hebrew orthographies

As Semitic languages, Arabic and Hebrew are characterized by a highly productive derivational morphology (Berman, 1978). Most words are derived by embedding a root into a morphophonological word pattern. In both languages, words are based on a trilateral root and various derivatives, formed by the addition of affixes and vowels. The roots and phonological patterns are abstract entities (structures) and only the joint combination forms specific words. As a result of this structure, the root conveys the core meaning and the phonological pattern conveys the word class information. For example, the Arabic word (TAKREEM) consists of the root (KRM) and the phonological pattern TA—I-. In Hebrew, the word (SIFRA) consists of the root (SFR) and the phonological pattern –I—A in which every line represents a consonant. Unlike Latin orthography in which vowels are represented by letters, vowels are not part of the alphabet letters in Arabic and Hebrew. The Arabic writing system consists of 28 letters (versus 22 in Hebrew), all of which are consonants, but some also serve as long vowels (A, O, E). Short vowels are represented only by additional diacritics. Short vowel patterns are rule-governed according to word meaning, inflection, and function in the sentence. Both Arabic and Hebrew texts are usually presented in unpointed script (or unvowelized form). Pointed or voweled texts are reserved for children's books, poetry, and sacred texts. Unpointed Arabic and Hebrew words create identical forms (homographs) which may be read in different ways and have different meanings. Because the homograph phenomenon is very common, several studies have tested the role of vowels and their influence on reading. Abu-Rabia and Siegel (1995) found that, for word recognition, poor readers in Arabic rely on context more than do skilled readers (as in English). Frost (1994) has shown that presentation of voweled words facilitates naming of even nonhomographic word in Hebrew in skilled readers.

There are two sources of additional complexity that occur in both orthographies, but to a much greater extent in Arabic than in Hebrew. The first relates to diacritics and dots. In Hebrew, dots occur only as diacritics to mark vowels and as a stress-marking device (dagesh). In the case of three letters, this stress-marking device (which does not appear in unvowelized scripts) changes the phonemic representation of the letters from fricatives (v, x, f) to stops (b, k, p for the letters ב כ פ respectively). In the unvowelized form of the script, these letters can be disambiguated by their place in

the word, as only word or syllable initial placement indicates the stop consonant. In Arabic the use of dots is more extensive, and many letters have a similar or even identical structure and are distinguished only on the basis of the existence, location, and number of dots (e.g., the Arabic letters representing /t/ and /n/ (ت, ن) become the graphemes representing /th/ and /b/ (ث, ب) by adding or changing the number or location of dots. Another characteristic of the two orthographies is that some letters are represented by different shapes, depending on their placement in the word. Again, this is much less extensive in Hebrew than in Arabic. In Hebrew, five letters change shape when they are word final: (מ-ם, נ-ן, צ-ץ, פ-ף , כ-ך). In Arabic, 22 of 28 letters of the alphabet have four shapes each (word initial, medial, final, and when they follow a nonconnecting letter, for example, the phoneme /h/ is represented by the graphemes (ه ـه ـهـ هـ), and six 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. Previously we showed that this complexity affects the speed in which Arabic and Hebrew letters are identified by adolescent Arabic–Hebrew bilinguals (Ibrahim, Eviatar, & Aharon Peretz, 2002).

The present study

The present study focused on the first grade children from the sample studied by Eviatar & Ibrahim (2001), and presented them with two types of reading tasks: text reading, where we measured reading rate and accuracy, and single word and nonword reading, where we measured errors. We expected all participants to reveal significant relationships between measures of phonological awareness and reading level. However, we also expected effects of language experience on these relationships. It is important to note that only the monolingual group was tested in their native language. The Russian–Hebrew bilinguals did both the phonological awareness tests and the reading tests in their second language, while the Arabic readers did the phonological awareness tests in their native language (the SA dialect of their region) and the reading tests in their second language (LA). This came about because the Russian–Hebrew bilinguals do not learn to read Russian, and there is no written form of the native language of the Arabic speakers.

Given the visual complexity of Arabic orthography, we hypothesized that the relative weights for visual and phonological processes might be different for Arabic readers. Although we have no direct measure of visual processing in this study, we hypothesized that the additional importance of visual processing in Arabic would weaken the relationship between phonological ability and reading ability in this sample.

The Tests

In the phonological awareness test, the children were given a word and asked to say it, deleting one syllable in the initial, middle, or final position: for example, “Say the word MARKET without ARK” (the answer is MET). All these tests were originally constructed and validated in Hebrew (Bentin & Leshem, 1993). Because Hebrew and Arabic are both Semitic languages and are similar in their morphophonemic structure, it was possible to construct the stimulus lists in Arabic on the basis of the existing

tests in Hebrew. The lists were equated on syllable structure and number of sounds. Performance on all these tests in Hebrew has been found to correlate highly with reading ability and age (Shany & Ben Dror, 2002).

All the participants completed a test of vocabulary size. Given that bilinguals tend to have smaller vocabularies than monolinguals (in both their languages: Abudarham, 1997; Doyle et al., 1978), we tested whether the relationship between vocabulary and reading skills would be affected by language experience.

Method

Participants

The participants were 59 children from three populations in northern Israel. These populations differ in native language and language experience. There were 20 Druze native Arabic speakers (ten males), 20 monolingual native Hebrew speakers (ten males), and 19 children of Russian immigrants (nine males), where the home language is Russian and the children are bilingual in Russian and Hebrew. All the children were in first grade. Only children between 6 years 10 months and 7 years 3 months were included in the study. In Israel, all children are evaluated in kindergarten for emotional, learning, and attentional difficulties as part of a general screening for school readiness. None of the children in our samples suffered from known neurological, emotional, or attention disorders. Only children without a known reading disability were tested. The tests measuring verbal cognitive abilities (Vocabulary Test from the translated and standarized versions of the WISC-R to Hebrew and Arabic and phonological awareness tests) were subjected to standardized norms to reject those falling under normal scores. All participants fell within normal limit in these tests. All the participants lived in villages. The Hebrew-speakers and Russian–Hebrew bilinguals live in the same large village (population = 10,000) and attend the village public schools. The Arabic speakers were all members of the Druze minority.

The lifestyle, language, and social norms of Israeli Druze are similar to those of their Arab neighbors, but historical events at the turn of the 20th century lead to their alliance with Jews rather than with Arabs, and to the application of conscription into the Israeli army by Druze men. The largest occupational category in Druze society is the security forces, followed by public and community services. Druze society has close contact with Israeli Jewish society which, together with a strong allegiance to religion and religious leaders, has resulted in close ties and identification with both Jewish and Arab cultures (Abu-Rabia, 1996; Seginer & Halabi-Kheir, 1998). All the Druze and participants live within a 10 km radius of the Jewish village in four separate villages (average population of each village = 3,000), and attend the village public schools. Although we did not collect socio-economic data on our participants specifically, the overall socio-economic status of the Jewish and Arab villages from which our samples come is similar.

None of the children attended mixed schools (with both Arabic and Hebrew speakers). This was done to minimize the exposure of the Arab children to Hebrew, the majority language of the country. The Arab schools in the north of Israel begin teaching Hebrew in second grade; none of the Arabic speaking children had any formal instruction in Hebrew, nor could they speak Hebrew. Both the monolingual and

bilingual Hebrew speakers were being taught in Hebrew and were tested in Hebrew. The Arab children were being taught in Arabic and were tested in Arabic.

We did not assess bilingualism directly. The Russian–Hebrew bilinguals had all been born in Israel, but came from homes in which all of the adults were native Russian speakers, and Russian was the sole or major language used in the home. All of the children had attended Hebrew speaking day-care and kindergarten. The parents of the Arabic-speaking children were given a 6-item questionnaire to assess the degree to which their children were exposed to LA at home. The responses were measured on a Likert scale, with one being minimal exposure to LA and five being maximum exposure (a translation of the test is presented in Appendix C).

Materials

Phonological awareness tests

All the words in each language were familiar to the speakers of that language. All the stimuli and instructions in Arabic were in SA. Transliterations of the lists of words in Hebrew and Arabic are included in Appendix A.

1. Initial Phoneme Detection: Here the children were asked to identify the first sound in a word spoken by the experimenter ("What is the first sound in the word _____?") The test included 20 words. Scoring: syllables were not accepted as correct, such that the answer SEE to SEEKA was counted as incorrect, the answer "SUH" or "S" was scored as correct.
2. Final Phoneme Detection: Here the children were asked to identify the last sound in a word spoken by the experimenter ("What is the last sound in the word _____?") The test included 20 words. Scoring: syllables were not accepted as correct, such that the answer TA to MEETA was counted as incorrect, the answer "AH" was scored as correct.
3. Phoneme/Syllable Deletion: In this test the children were presented with a word and then asked to generate the word deleting a phoneme or syllable from either the beginning, the middle, or the end of the word. There were 20 items in this test and the answer was always a real word. Examples: Hebrew: "say the word MATANA (present) without TA" (the answer MANA means portion). Arabic: "say the word SEKEENE (knife) without KEE" (the answer SENE means year).

Vocabulary test

We used the word definition test from the translated and standarized versions of the WISC-R to Hebrew and to Arabic. The child is presented with a word and asked to explain what it means in his/her own words. We used the raw scores, where easy items receive scores of either 0 or 1, and more difficult items receive scores between 0 and 2. The maximum score is 36, and there are 22 items in the test.

Reading tests

Text reading The texts (both Arabic and Hebrew versions) were constructed in collaboration with the teachers of the first grade classes in the respective schools and

were designed to reflect the expected level of reading at each testing time. The text was unknown but taken from the reading book. The text, both in Arabic and Hebrew, consisted of 47 pointed words. The text did not contain any unlearned letter or vowel mark. The child was told, "You are going to see a new text that you have not seen before, but it is not more difficult than what you are used to reading. You should read it as quickly as possible but try not to make errors." The reading session for each subject was recorded for later coding of the reading time and errors (see Appendix B).

Single Word and Nonword Reading We compiled separate word and nonword reading tests.The material was selected to meet the most basic level of this grade and a pool of words was chosen from the formal books of the the grade with the direct teachers. To reach independent tests of stimuli, ten language teachers overall (five from the Hebrew schools and five from the Arab schools from which the particpants were sampled) were presented with the lists of words and evaluated them in terms of the extent to which variables such as frequency, number of letters, number of syllables, and morpho-phonemic structure were present in both languages. Words that did not match the level of the grade and were not equivalent to the stimuli in the other language were excluded. These same judges also rated the legality of the nonwords on the lists. For both words and nonwords, we created two subtests, one including 12 single syllable stimuli and one with 12 two-syllable stimuli. These are included in Appendix B.

The children were presented with each list and asked to read the words. The words were presented in unpointed form, and we accepted all forms of the homographs as correct readings. The children were told that some of the stimuli would not be real words. All the sessions were recorded for later coding and the decision for scoring was made by the direct teachers. Reading mistakes contained all reading rule violations, including wrong vowelization.

Procedure All the children were tested individually in a relatively quiet room at school. Each session was 40 min long. In each session, the tests were given in a fixed order: final phoneme identification, initial phoneme identification, phoneme/syllable deletion, vocabulary test, and reading tests.

Each test was preceded by practice trials to verify that the child understood the task. During the practice trials, the children were given feedback and, when necessary, the task was explained again and further examples were given. No feedback was given during the experimental trials. All the sessions were tape recorded for later transcription and coding. The Arabic-speakers and the monolingual Hebrew speakers performed the metalinguistic tests in their native languages. The Russian–Hebrew bilinguals performed all the tests in their second language, Hebrew. The Arabic speakers and the Russian–Hebrew bilinguals performed the reading tests in their second language (LA and Hebrew, respectively), while the monolinguals read in their first language.

Results

Phonological and vocabulary tests

These data were included in the analyses reported by Eviatar & Ibrahim (2001). The three measures of phonological awareness (Initial Phoneme Detection, Final

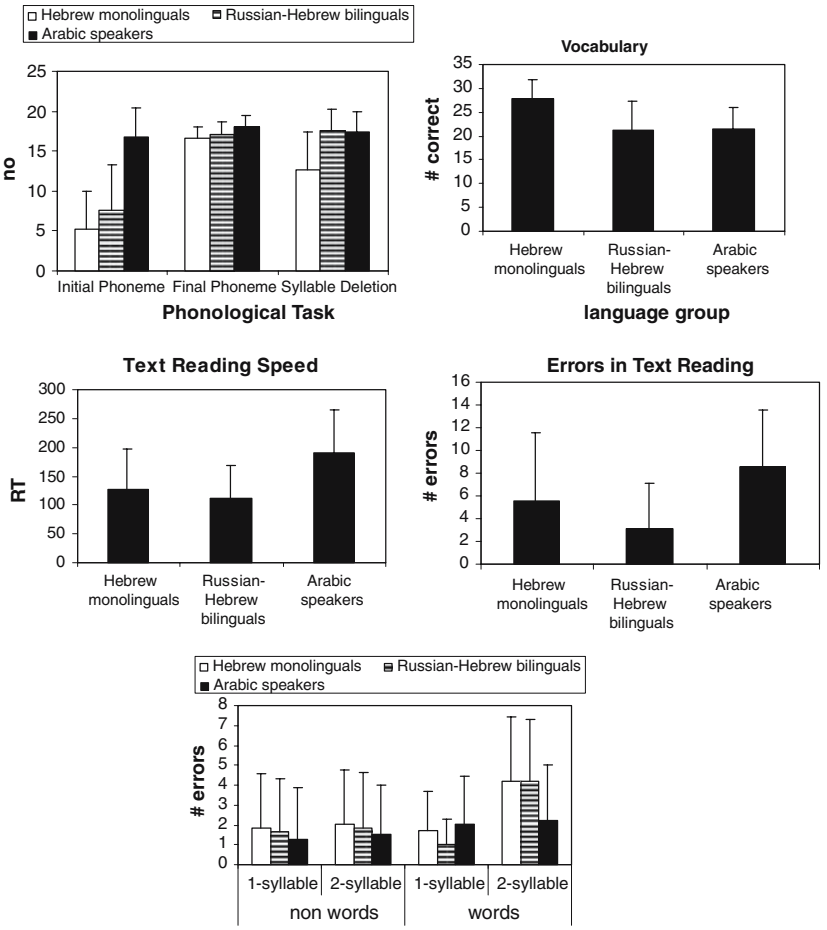

Fig. 1 *Top panels*: Scores of the three groups in the tests of metalinguistic awareness (initial phoneme, final phoneme and deletion task and vocabulary. *Error bars* are standard deviations. *Middle panels*: Reading text measures. *Error bars* are standard deviations. *Bottom Panel*: Number of errors in single item reading. *Error bars* are standard deviations

Phoneme Detection, Syllable Deletion Task) and Vocabulary measure for the sample in this study are illustrated in the top panels of Fig. 1.

All three phonological tests revealed a significant main effect of language experience: Initial Phoneme Deletion: $F(2,56) = 33.08, p < 0.0001$; Final Phoneme Deletion: $F(2,56) = 3,21, p < 0.05$; Syllable Deletion: $F(2,56) = 12.94, p < 0.001$. Planned comparisons revealed that the Arabic speakers achieved higher scores than the monolingual Hebrew speakers in all the measures (Initial Phoneme: $F(1,56)$=59.64, p<0.0001; Final Phoneme: $F(1,56)$=6.23, $p < 0.05$; Syllable Deletion: $F(1,56)$=18.43, $p < 0.0001$). The Russian–Hebrew bilingual children achieved higher scores than the monolongual children in the Syllable Deletion task, $F(1,56) = 20.19, p < 0.0001$; and scores not significantly different from the Arabic speakers on the Final Phoneme task ($p >$ 0.11). The Vocabulary Test also revealed a significant main effect of language experience, $F(2,56) = 10.97, p < 0.0001$. Here the Hebrew monolingual group achieved

significantly higher scores than both the Russian–Hebrew bilinguals ($F(1,56) = 16.78$, $p < 0.0001$) and the Arabic speakers ($F(1,56) = 15.98, p < 0.0001$), while these groups did not differ from each other ($p > 0.8$).

The Arab children's performance levels were similar those of the bilingual children and suggest that exposure to LA may require the same intensive language analyses as those demanded of children who are exposed to two languages as different from each other as Hebrew and Russian. This interpretation is supported by the correlation between two of the phonological awareness tests and the estimate of degree of exposure to LA. The mean score over the six questions in the exposure questionnaire were entered into a correlation analysis with each of the measures of metalinguistic awareness for the Arab children. The analyses revealed that the relationship between mean exposure score and test approaches significance ($r(18) = 0.40$, $p = 0.08$) in the final phoneme detection task. In the deletion task, the relationship between mean exposure to LA and test scores was significant ($r(18) = 0.46$, $p < 0.05$).

In summary, the Arab children's performance levels showed that exposure to LA may require the same intensive language analyses as those demanded of children who are exposed to two languages as different from one another as Hebrew and Russian. This interpretation is supported by the correlation between two of the phonological awareness tests and the estimate of degree of exposure to LA: children whose parents reported higher levels of exposure tended to achieve higher scores on these tests. The results also support the suggestion of Yelland, Pollard, and Mercuri (1993) that even low levels of ability in the second language are related to metalinguistic advantages.

Text reading

Text reading times and number of errors are illustrated in the middle panels of Fig. 1. The analysis for reading time (RT) of the text revealed a significant effect of language experience, $F(2, 56) = 7.65, p < 0.005$, with Arab children having the slowest RT ($M = 191$ s), Russian–Hebrew bilinguals showing the fastest RT (M=112 sec.) and monolingual Hebrew children in between ($M = 127$ s). Planned comparisons revealed that the RTs of the Hebrew monolinguals and Russian-Hebrew bilinguals did not differ from one another ($p > 0.48$) and that the RTs of both differed significantly from those of Arabic readers (Arabic readers versus Hebrew monolinguals: $F(1, 56) = 9.0, p < 0.005$; Arabic readers versus Russian–Hebrew bilinguals, $F(1, 56) = 13.41, p < 0.001$). Thus, the children reading Hebrew read faster than the children reading Arabic.

The same statistical analysis for the number of errors in text reading revealed a similar pattern. The language experience effect was found to be significant, $F(2, 56) = 5.29$, $p < 0.01$, with the Arabic readers making the highest mean number of errors ($M = 8.6$), Russian–Hebrew bilinguals making the smallest mean number of errors ($M = 3$) and monolingual Hebrew speakers in between ($M = 5.6$). Planned comparisons revealed that the Hebrew monolinguals and Russian–Hebrew bilinguals did not differ from one another ($p > 0.14$) and that both differed from Arabic readers (Russian–Hebrew bilinguals versus Arabic readers: $F(1, 56) = 10.52, p < 0.005$; Hebrew monolinguals versus Arabic readers: $F(1, 56) = 3.22, p = 0.08$).

Table 1 Correlations between measures of phonological ability and vocabulary and mean text reading time (*RT*) and errors (*ER*)

Text reading	Hebrew monolinguals $N = 20$		Russian–Hebrew bilinguals $N = 19$		Arabic readers $N = 20$	
	RT	ERR	RT	ERR	RT	ERR
Phonological tests						
Initial phoneme	**−0.46**	ns	**−0.51**	**−0.47**	ns	ns
Final phoneme	**−0.59**	**−0.48**	**−0.48**	ns	ns	ns
Deletion	**−0.80**	**−0.82**	**−0.56**	**−0.61**	**−0.46**	**−0.55**
Vocabulary	**−0.55**	**−0.52**	ns	ns	**−0.54**	ns
Mean	127 s	5.6	112 s	3.1	190 s	8.6
SD	69.2	6.4	55.7	4.1	74.1	5.0

Only significant correlations are shown ($p < 0.05$)

Phonological awareness and text reading

We computed correlations between the measures of reading speed and errors of the text and our measures of phonological ability. These are presented in Table 1. As can be seen, the pattern evinced by the Arabic speakers differs from the patterns of the other groups. For the monolinguals and the Russian–Hebrew bilinguals, all the phonological measures are related to the rate of text reading, and all but one (initial phoneme detection for monolinguals and final phoneme detection for bilinguals) are related to errors in the text. The Arabic readers reveal a relationship only between the syllable deletion task and text reading rate and errors. None of the other phonological measures are related to their text reading ability. Thus, of the six correlation analyses between the phonological tests and the measures of text reading, five were significant for the monolingual and bilingual children who were learning to read Hebrew, but only two of six were significant for the children learning to read Arabic. In addition, comparison of the correlation coefficients for the syllable deletion task and text reading revealed that the relationship between them was significantly smaller in the Arabic reading group than in the monolingual group ($z = 1.79, p < 0.05$, one tailed) for text reading speed, with this difference approaching significance for syllable deletion and text error rates ($z = 1.52, p = 0.064$). The correlation coefficients of the bilingual group did not differ significantly from those the monolinguals or the Arabic readers ($p > 0.08$).

As can also be seen in Table 1, vocabulary extent is not related to text reading speed accuracy for Russian–Hebrew bilinguals, but is significantly related to both speed and accuracy for monolinguals and to text reading speed for Arabic-readers.

Single word and nonword reading

We computed separate one-way analyses of variance for each of the single one and two syllable word and nonword lists, with number of errors as the dependent variable and language experience as the independent variable. These means are illustrated in the bottom panel of Fig. 1. Language experience approached significance only for the list of two syllable words, $F(2, 56) = 2.91, p = 0.06$, where the Arabic readers made the smallest mean number of errors while Russian–Hebrew bilinguals and monolingual

Table 2 Correlations between measures of phonological ability and vocabulary and number of errors in single word and nonword reading

Single items	Hebrew monolinguals $N = 20$		Russian–Hebrew bilinguals $N = 19$		Arabic readers $N = 20$	
	Words	Nonwords	Words	Nonwords	Words	Nonwords
Phonological tests						
Initial phoneme						
1-syllable items	−0.69	ns	ns	ns	−0.63	ns
2-syllable items	−0.53	−0.59	ns	ns	−0.49	ns
Final phoneme						
1-syllable items	−0.60	ns	−0.71	ns	−0.62	ns
2-syllable items	−0.55	−0.46	−0.71	−0.55	−0.53	−0.62
Deletion						
1-syllable items	−0.83	ns	ns	ns	−0.87	−0.55
2-syllable items	−0.83	−0.77	ns	−0.45	−0.76	−0.75
Vocabulary						
1-syllable items	ns	−0.44	ns	ns	ns	ns
2-syllable items	−0.45	ns	ns	nd	nd	nd

Only significant correlations are shown ($p < 0.05$)

Hebrew speakers made more mean errors. In general, the trend was that children reading Arabic made less errors than children reading Hebrew.

Correlations between phonological abilities and single word and nonword reading are listed in Table 2. For both monolinguals and Arabic speakers, all the phonological measures were significantly related to word reading, while only the final phoneme deletion test was related to word reading in the bilingual group. Interestingly, among all the groups, there were fewer significant correlations between measures of phonological ability and nonword reading than in word reading. It can also be seen that vocabulary extent is related to single word and nonword reading only for monolingual Hebrew readers.

Regression analyses

In order to examine more closely the contribution of phonological abilities to reading, we computed regression analyses for each of the reading measures using performance on the phonological tests as predictor variable. The left section of Table 3 presents the percentage of the variance in text reading speed and errors, that is, explained by each of the phonological tests individually, as well as by the three tests together.

The most salient aspect of these data is that while phonological ability predicts over 60% of the variance in text reading speed and accuracy for monolingual Hebrew readers, and close to that percentage for the bilingual Hebrew readers, it predicts only 30% of this variance for Arabic readers. It can also be seen that for all of the language groups, the syllable deletion task is the most predictive of text reading ability. Another interesting aspect of these data is that addition of the vocabulary measure to the regression model raised the percentage of variance explained to a greater degree for the monolinguals, to a quite smaller degree for the Arabic speakers, and not at all for the Russian–Hebrew bilinguals.

Table 3 Percentage of the variance in text reading speed and errors explained by performance on the phonological measures and vocabulary

		Text reading				Single item reading					
		Mono-lingual Hebrew readers	Bilingual Hebrew readers	Arabic readers		Mono-lingual Hebrew readers		Bilingual Hebrew readers		Arabic readers	
Phonological tests					Stimulus type	1-syllable	2-syllable	1-syllable	2-syllable	1-syllable	2-syllable
Initial phoneme	RT	20.75	26.00	16.58	Words	47.00	28.00	7.68	0.82	39.33	24.33
	errors	16.11	22.48	12.29	Nonwords	1.10	26.32	5.66	8.30	10.02	16.23
Final phoneme	RT	34.37	23.41	2.71	Words	36.41	30.79	50.45	49.91	38.08	28.50
	errors	22.71	15.35	18.15	Nonwords	0.17	21.62	7.46	30.47	7.15	38.69
Deletion	RT	64.18	30.82	21.13	Words	69.50	68.90	4.92	15.54	76.56	57.59
	errors	66.43	36.76	29.82	Nonwords	7.03	59.78	4.55	20.27	30.01	56.92
All phonological measures	RT	**66.05**	**58.34**	**28.11**	Words	**76.64**	**69.75**	**53.03**	**57.89**	**77.93**	**57.80**
	errors	**66.85**	**55.28**	**30.11**	Nonwords	**9.25**	**60.94**	**12.92**	**44.72**	**36.37**	**57.90**
Vocabulary	RT	29.82	0.36	28.73	Words	8.09	20.11	0.79	3.64	4.03	1.26
	errors	16.11	0.15	0.75	Nonwords	19.11	10.16	3.03	1.87	3.52	0.21

Table 4 Correlation co-efficients between measures of text reading (RT and errors) and number of errors in single word and nonword reading

Single items		Text RT			Text errors		
		Monolingual Hebrew readers	Bilingual Hebrew readers	Arabic readers	Monolingual Hebrew readers	Bilingual Hebrew readers	Arabic readers
Words	1-syllable	**0.72**	**0.53**	ns	**0.86**	**0.58**	**0.49**
	2-syllable	**0.82**	**0.68**	ns	**0.89**	**0.67**	ns
Nonwords	1-syllable	ns	**0.53**	ns	**0.44**	**0.56**	ns
	2-syllable	**0.76**	**0.62**	ns	**0.77**	**0.77**	ns

Only singificant correlaitons are shown ($p < 0.05$)

The results of the same type of regression analyses for single word and nonword reading are shown in the right section of Table 3. Here it can be seen that phonological skills predict the majority of the variance in word reading for all of the groups, and in nonwords to a lesser extent.

The results presented in Table 3 suggest that there may be a dissociation between the type of reading task, text or single stimuli, and language experience. We therefore computed correlations between the performance of the children on the text reading tasks and on the single stimuli reading tasks. These are presented in Table 4. Here it can clearly be seen that there are large positive correlations between the two types of reading tasks for the monolingual and bilingual Hebrew readers, and only one, much smaller correlation between the two types of tasks for the Arabic readers.

Discussion

The present study explored the relationship between phonological awareness and reading skills in first grade. We found, as expected, that there are significant relationships between phonological abilities as measured by our tests and reading performance, within all of the language groups. This finding joins the list of studies mentioned in the Introduction that have found such relationships.

We looked for specific effects of language characteristics and the linguistic history of our participants on the reading measures themselves, and on the relations between these measures and the phonological and vocabulary measures. We found that for text reading, the groups that were reading Hebrew performed significantly better than the group that was reading Arabic, while a trend in the opposite direction was found for reading single words and nonwords. Most importantly, these two types of tasks also resulted in an interesting dissociation in their relationship to phonological ability. For both monolingual and bilingual Hebrew readers, a large proportion of the variance in measures of both text and single word reading was explained by performance on the phonological tasks. For the Arabic readers, this was true only for single word reading, while a much smaller proportion of the variance in text reading was explained by performance on the phonological tasks (see Table 3). The findings presented in Table 4 clearly support the notion that for Arabic readers, the two types of tasks may rely on different abilities or combination of abilities, where this is not true for the two groups of Hebrew readers.

The objective of this study was twofold. First, we asked whether the advantage in phonological awareness shown by bilinguals over monolinguals carries over to reading performance. Second, we explored the extent to which the orthographic characteristics of a language influences reading performance, and how this interacts with the effects of phonological awareness. Previously we have shown that exposure to LA in early childhood affects metalinguistic skills in the same manner as that reported for children exposed to two different languages (Eviatar & Ibrahim, 2001). Based on the data showing Arab children to be similar in their metalinguistic ability to Russian–Hebrew bilinguals, we asked in this study if the Arab children's performance levels in reading Arabic would be similar to that of the Russian–Hebrew bilingual children reading Hebrew.

The answer to the first question seems to be negative in general, but with an interesting twist. Although as a group, the Russian–Hebrew bilinguals achieved higher scores on the syllable deletion test than the monolinguals, their reading scores were equivalent to those of the monolinguals. In addition, within each of these groups there was a significant correlation between the measures of phonological awareness and reading scores. However, the data in Table 3 reveal that vocabulary size accounts for almost 30% of the variance in text reading for monolinguals, but not at all for the bilinguals. Thus, it may be that their higher levels of phonological abilitites allow the bilingual children to compensate for their smaller vocabularies.

The answer to the second question is also negative, because even though the Arab children had higher scores than monolinguals on the tests of phonological awareness, their performance on the text reading measures is significantly poorer. In addition, in the two language groups who were acquiring reading in Hebrew, all three of the phonological measures are correlated with reading speed, and two of three phonological measures are correlated with reading accuracy. However, for the group that was learning to read Arabic, only the phoneme deletion task was correlated with test reading speed and accuracy (see Table 1), and even this relationship is weaker than in the Hebrew reading groups. Thus, for the measures we used, the charactersitics of the language that the children learned to read are more important than the status of the language in the children's linguistic history.

There are two findings in the data that are especially interesting, and that we believe are related to the difference in visual complexity between the Arabic and Hebrew orthography. The first is that although text reading differentiated between the groups of children learning to read Hebrew from the group learning to read Arabic, reading single items did not. The second is that there were strong correlations between single item reading measures and text reading measures for the children reading in Hebrew, but not for the children reading in Arabic. Although we did not measure this directly, we interpret both findings as reflecting differential attentional requirements in the two languages. Previous research has suggested that Arabic requires more visual attention than Hebrew (Ibrahim et al., 2002; Roman & Pavard, 1987). Thus, when the task is to read single items, the two groups are not significantly different from each other. The only effect that approached significance, in 2-syllable single words, supports the hypothesis that the children reading Arabic were paying more attention to the task, as they made less errors than the children reading Hebrew. However, when the children were reading text, the large attentional demand made by the Arabic orthography in the letter and word identification stage resulted in less attentional resources available to higher processing of syntax and comprehension. This hypothesis is further supported by examination of the types of errors made by the children reading the text in Arabic, which were mostly inaccuracies related to using false affixes (diacritics

or letters) that generally represent the syntactic roles in the sentence and not false identification of the word itself.

In summary, we have shown that the higher visual complexity of the Arabic orthography results in a smaller effect of phonological awareness among Arabic children in the first grade on reading levels, than for children who are reading Hebrew. This is true even though the children reading Arabic evince higher levels of phonological awareness than the monolinguals reading Hebrew. This finding converges with our own and other's reports that Arabic orthography requires more resources than Hebrew orthography (Ibrahim et al., 2002) or French orthography (Roman & Pavard, 1987).

Appendix

Appendix A Transliterations and translations of the phonological tests lists

1. Initial phoneme detection

Hebrew	gloss	Arabic	gloss
seeka	pin	samake	fish
orez	rice	akal	eat
patu-akh	open	fatah	opened
tseva	color	kareem	generous
kakhol	blue	madrase	school
madrega	stair	osbaa	finger
amar	said	lahem	meat
leket	gather	basal	onion
batsal	onion	arth	ground
oolay	maybe	esem	name
eretz	land	jalas	sit
gashoom	rainy	daera	circle
dakhleel	scarecrow	fareek	team
veelon	curtain	zahra	flower
zimra	singing	tamreen	exercise
targeel	trick	imraa	woman
eesha	woman	reeh	wind
notza	feather	nokta	point
reeshon	first	shamal	north
shalom	hello	kamar	moon

2. Final phoneme detection

Hebrew	gloss	Arabic	gloss
ra-ash	noise	ramash	blink
gav	back	raf	shelf
khaveet	barrel	baseet	simple
sof	end	shoof	look
argaz	box	gaz	gaz
melon	melon	aamood	pole
khamood	cute	sefer	zero
tsofar	siren	haram	pity
marom	sky	taj	crown

khag	holiday	bas	kiss
kos	cup	jabal	mountain
gamal	camel	chamees	thursday
khamootz	sour	bareed	post
baree	healthy	sateh	roof
sha-teeach	rug	malek	king
devek	glue	helou	nice
meeta	bed	kakao	kakao
taleh	lamb	bakara	cow
ka-ka-o	cocoa	sook	market
parah	cow	batal	hero

3. Deletion tasks

Instructions: I will say a word, and then I will take away part of it, and you will tell me what is left, for example, if I say GADOL, and take away GADO, what is left?

Hebrew		Arabic	
say	take away	say	take away
geshem	ge	nashar	na
matana	ta	ketar	ke
bayit	yi	bakar	kar
kaftor	kaf	shamea’	ea’
khateema	tee	jamaa	ja
yakar	ya	samak	k
khaveela	vee	hakam	ka
gezer	ge	jamal	ja
ganav	na	rakas	ra
kabala	ba	darab	da
khadron	ron	dahraj	dah
shemen	me	makaad	mak
madkhom	mad	yabes	ya
badran	ran	dokan	do
mispar	mis	safara	sa
safsal	saf	baseeta	see
kalmar	mar	sekeene	kee
shakhor	sha	majrooh	maj
shablool	shab	matara	ta
gamal	ma	masnaa	naa

Appendix B

Reading Text Test in Hebrew:

כלם עזרו להכין את המסיבה. אמא סידרה את החדר הגדול. אחי יובל תקן את הספסל השבור. רותי אחותי

קיפלה מפיות נייר. אני ניפחתי בלונים צבעוניים. כולנו יחד ערכנו את השולחן. אבא קשט את כל הבית.

כרמל ואני הקלטנו מוסיקה והכנו את התכנית למסיבה.

Word and Nonword Reading Test in Hebrew:

הברה אחת One Syllable	שתי הברות Two Syllables
דג	מחט
סיר	דירה
צב	פינה
הר	סדין
פיל	ריבה
קש	עין
אח	מפית
איש	זית
בר	שפה
שיר	איכר
תיק	זמיר
חם	תירס
טג	סעל
מיר	עינה
ציב	כיזה
הק	מריז
פל	ציה
קז	וסד
יח	נליק
ניש	שלק
בג	פחה
שים	ציבל
תק	רגית
לם	גישן

Reading Text Test in Arabic:

فياض صياد ماهر. فياض رجل قوي. سافر فياض يوما الى بحيرة طبريا ورمى صنارته فصاد سمكة بوري. ثم رمى شبكته, وبعد قليل سحبها فوجدها ثقيلة. شد وشد, فخرجت شبكته وفي داخلها سمك كثير. عد وعد, فوجد فيها عشرين سمكة بوري وثلاثين سمكة مشط.

Word and Nonword Reading Test in Arabic:

مقطع واحد One Syllable	مقطعان Two Syllables
سن	جمل
جيل	قطع
دم	وردة
حب	حجر
فيل	شمعة
اخ	مطر
باب	قلم
قط	كتاب
فم	شارع
يد	ضباب
حر	دفتر
حق	كرسي
لد	دبل
مير	دفج
صاف	مراخ
هك	هلن
زح	اشم
رين	صبيل
لس	فحط
سيم	ربون
كال	كتر
طون	جمط
بش	غبل

Appendix C Questionnaire—exposure to literary Arabic

1. What language do you use in speaking to your child?

1	2	3	4	5
Spoken Arabi only	Spoken Arabic mostly	Spoken and Literary equally	Mostly Literary Arabic	Literary only

2. To what degree do you read stories to your child versus telling them the story in Spoken Arabic?

1	2	3	4	5
Spoken Arabi only	Spoken Arabic mostly	Spoken and Literary equally	Mostly Literary Arabic	Literary only

3. To what degree do you use translation to Spoken Arabic when reading a story?

1	2	3	4	5
Translate immediately	Read and then translate	When I feel s/he doesn't understand	When the child requests	Never translate

4. How often does your child watch cartoons in which the characters speak in Literary Arabic?

1	2	3	4	5
Once a week	Twice a week	On alternate days	Once a day	Several times a day

5. How often does your child watch children's TV programs in Literary Arabic?

1	2	3	4	5
Once a week	Twice a week	On alternate days	Once a day	Several times a day

6. How often does your child insert words in Literary Arabic in everyday speech?

1	2	3	4	5
Never	A little	To a moderate degree	Often	Very often

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