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Reading development in upper elementary language minority readers of Hebrew: the specific challenge of fluency

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Abstract We examined reading proficiency, focusing on fluency, in 56 Russian-speaking language minority (LM) students and 56 native Hebrew-speaking (NH) peers. Fifth-grade students completed measures of Hebrew reading accuracy and fluency from word to text level as well as phonological awareness (PA), RAN and vocabulary. LM students read single words less accurately than NH students, in contrast to previous findings. This result can be understood in the context of Hebrew reading development, the transition to unvowelized reading at this age and the reduced vocabulary knowledge of the LM group. LM students also had lower accuracy and fluency in reading vowelized, and to a greater extent, unvowelized texts. These findings suggest that developing fluent text reading especially in the unvowelized Hebrew script is challenging for LM students, since it requires integrating linguistic and contextual information. Regression analyses demonstrated that although for NH students both PA and RAN were significant predictors of text reading fluency, for LM students PA was a major predictor of fluency, but RAN was not. This finding indicates that LM students relied on basic reading skills, and were less able to recruit automaticity to support fluent reading. Thus, the current results highlight the challenges of developing fluent reading among LM students, and underscore how patterns of achievement and difficulty might be related to the specific linguistic and orthographic characteristics of the societal language.

Keywords Language minority · Reading fluency · Text reading · Single word reading

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Introduction

Language-minority children, who speak a home language that differs from the societal language, are at risk for underachievement in literacy skills compared to their monolingual peers (August & Shanahan, 2006; Chiappe, Siegel, & Wade-Woolley, 2002; Droop & Verhoeven, 2003; Gottardo & Mueller, 2009; Lesaux, Koda, Siegel, & Shanahan, 2006; Lesaux & Kieffer, 2010). However, literacy is a complex construct, spanning from single-word reading, through word and text-reading fluency, to reading comprehension. Whereas language minority children lag behind monolingual peers in reading comprehension, a large body of research has demonstrated that the word reading accuracy of language minority children is similar to that of their native speaking counterparts regardless of their oral L2 proficiency. Such group similarities have consistently been found from the beginning of reading acquisition through adolescence, and across diverse target and background language combinations (Everatt, Adams, & Ocampo, 2000; Gottardo, Yan, Siegel, & Wade-Woolley, 2001; Jean & Geva, 2009; Lesaux et al., 2006; Lesaux, Rupp, & Siegel, 2007; Pasquarella, Gottardo, & Grant, 2012). However, less is known regarding language minority children's ability to fluently read words and texts in the society language—the issue investigated in the current study by comparing the Hebrew reading abilities of Russian-speaking language minority children in Israel with their Hebrew-speaking monolingual peers.

The construct of reading fluency has received different definitions in the literature (for a review, see Wolf & Katzir-Cohen, 2001). In the current study, we choose to define reading fluency as a time-based measure of accurate word reading, both in and out of context, following the definition of Jenkins, Fuchs, Van Den Broek, Espin, and Deno (2003). Although we acknowledge that reading prosody is an important aspect of reading fluency (Kuhn & Stahl, 2003), it is beyond the scope of the present study. Thus, the current study aims to promote our understanding of the reading processes of language minority students from word reading accuracy to text reading fluency. Although children are faced with text reading on a daily basis, only few studies have examined text reading fluency in second language learners (Crosson & Lesaux, 2010; Geva & Yaghoub Zadeh, 2006; Geva & Farnia, 2012; Kieffer, Biancarosa, & Mancilla-Martinez, 2012; Kim, 2012; Lesaux & Kieffer, 2010). In the current study, we examined fifth grade Russian language minority students in comparison to their native Hebrew speaking counterparts at a point where reading is beyond the initial stages of acquisition and fluency has an important role, as at this point, reading is a tool for learning (Chall, 1983).

The current study investigates the Hebrew reading abilities of Russian minority-speaking children in Israel where the societal language is Hebrew. The language minority children, mostly second generation immigrants from the former Soviet Union, are part of the largest sub-cultural Hebrew speaking community in Israel (approximately 20% of the country's total Jewish population). In this community, the Russian culture remains of high prestige and many parents decide to promote the development of both languages, Russian and Hebrew, among their Israeli-born children (Schwartz, 2012).

As stated above, there are robust findings that language minority students are comparable to native speakers in measures of single word reading accuracy. These findings are consistent for different orthographies, such as the deep orthography of English (Chiappe et al., 2002; Farnia & Geva, 2013; Geva & Yaghouh Zadeh, 2006; Geva & Farnia, 2012; Jean & Geva, 2009; Lesaux et al., 2006, 2007; Lipka & Siegel, 2012; Nakamoto, Lindsey, & Manis, 2007) as well as relatively shallow orthographies including Dutch (Droop & Verhoeven, 2003; Verhoeven, 2000), and vowelized Hebrew (Kahn-Horwitz, Schwartz, & Share, 2011; Shany & Geva, 2012). Likewise, the predictors for word reading accuracy in language minority and native speakers are constant, and include phonological awareness and rapid automatized naming (Chiappe & Siegel, 1999; Everatt et al., 2000; Geva, 2006; Geva & Yaghouh Zadeh, 2006; Lesaux et al., 2007).

Although word reading accuracy is a basic reading ability that leads to correct lexical activation (Perfetti, 1985), recently the importance of reading fluency as a parameter of proficient reading has also been stressed (for reviews, Fuchs, Fuchs, Hosp, & Jenkins, 2001; Kuhn & Stahl, 2003; Wolf & Katzir-Cohen, 2001). Fluent reading goes beyond word reading accuracy and is built on oral language knowledge as well (Jenkins et al., 2003; Kim & Wagner, 2015). As Wolf and Katzir-Cohen (2001) pointed out: “one retrieves faster what one knows better, thus continuously emphasizing the connections that link orthographic, semantic, phonological, and morphological systems” (p. 220). Most of the literature on reading fluency, however, has focused on monolingual readers and less is known about the development of fluent reading in language minority children, who are required to read in a language in which they may not be fully proficient.

Indeed, persistent gaps are well documented between native speakers and language minority children in various aspects of oral language proficiency, especially vocabulary and syntax (Bialystok, Luk, Peets, & Yang, 2010; Chiappe, Siegel, & Gottardo, 2002; Geva & Yaghouh Zadeh, 2006; Lesaux et al., 2006; Lipka & Siegel, 2012). This consistent gap underscores the fact that, even after a number of years of instruction in the societal language, language minority speakers do not catch up with monolingual peers (Farnia & Geva, 2011; Kieffer & Lesaux, 2012; Mancilla-Martinez & Lesaux, 2011), and in some cases the gap in vocabulary knowledge even widens over time (Droop & Verhoeven, 2003; Jean & Geva, 2009; Shany & Geva, 2012).

Thus, it is especially important to compare the reading fluency of language minority children to monolingual peers. In the current study, we identify and examine three facets of fluency and reading efficiency beyond accurate word reading. The first two facets are relatively simple, namely, single word reading fluency and text reading fluency. The third facet relies on work by Biemiller (1981), who compared reading fluency of a text and reading fluency of isolated words taken from the same text. In upper elementary school children, text reading fluency is usually higher than fluency for the single words, indicating the contribution of the context to accurate and faster reading. We include this comparison in the current study to probe whether language minority students are able to benefit from context in a manner similar to that of native speaking children.

Single word reading fluency Several recent studies investigating single word and pseudoword reading fluency did not identify differences between language minority children reading in English as the societal language and their native speaking peers in elementary school (Crosson & Lesaux, 2010; Kim, 2012; Lesaux et al., 2007) or in secondary school (Kieffer et al., 2012; Lipka & Siegel, 2012). We were not able to identify research examining this issue in languages other than English.

Text reading fluency Because text reading fluency relies to a greater extent on language knowledge it might therefore be more challenging for language minority students. However, the few studies examining text reading fluency among language minority populations show inconclusive results. One study found language minority children to have reduced text reading fluency in English compared to the level expected based on national norms (Kim, 2012), but three other studies found comparable text reading fluency of language minority and native speaking readers of English (Crosson & Lesaux, 2010; Geva & Yaghoub Zadeh, 2006; Geva & Farnia, 2012). For example, Crosson and Lesaux (2010) found that language minority children had average word- and text-reading fluency in the fifth grade. However, at the same time, the percentage of underachievers in text reading fluency within the language minority group in this study was higher than expected.

Indeed, text reading fluency is more complex than word level reading because it requires the ability to accurately and efficiently integrate word level reading and language skills. Thus, text reading tasks depend on processes shared with isolated word reading, but also rely on contextual processing and children's language comprehension, which are not necessarily activated in single word reading (Fuchs et al., 2001; Kim & Wagner, 2015). Accordingly, studies have found that, for native English readers in the fourth grade, text reading fluency was more strongly predicted by listening comprehension (Kim & Wagner, 2015) and reading comprehension (Jenkins et al., 2003), and increasingly dissociated from word reading fluency. In contrast, in language minority students, several studies report weak and mostly non-significant contributions of language skills to text reading fluency (Crosson & Lesaux, 2010; Geva, Wade-Woolley, & Shany, 1997; Kim, 2012). Notably, this issue has, to date, been investigated in language minority learners who had low oral language skills in the language tested, which might explain the lack of correlation between oral language skills and text reading fluency.

Advantage of text over single word fluency Research on monolingual school children has demonstrated that they read words in context faster than the same words out of context in English (Biemiller, 1977; Stanovich, 1980) and in Hebrew (Shany, Lachman, Shalem, Bahat, & Zeiger, 2006). Only few studies have examined this phenomenon in language minority children and suggest a reduced benefit of context in this population. Geva and Yaghoub Zadeh (2006) found that, despite similarities in word and text reading, second grade language-minority students benefited less from context, as measured in accuracy and speed, than did their native English-speaking peers. A second study (Geva & Farnia, 2012) found that language minority students in the fifth grade read isolated words faster than their native English-speaking peers. However, this advantage of the language

minority group was not observed in text fluency, indicating less efficient use of context by the language minority readers.

In line with these findings, in the current study, we predict that language minority and native speaking children will perform similarly in word reading fluency. In contrast, in light of the mixed findings in previous research on text reading fluency in language minority students, we hypothesize that it might pose more of a challenge for language minority students. Given the contribution of language proficiency to text reading fluency, language minority children might be expected to show lower performance than monolingual children in text reading fluency. Finally, although for monolingual children in upper elementary school, reading efficiency is higher for texts than for single words (Biemiller, 1977; Shany et al., 2006), language minority students might be less able to benefit from the context, and thus might show a smaller gain in fluency when reading texts as compared to single words (Geva & Yaghoub Zadeh, 2006; Geva & Farnia, 2012).

Of interest, the body of research reviewed above exclusively tested language minority children gaining literacy in English as the societal language. However, in the last decade it has been established that the development of reading skills is uniquely influenced by specific characteristics of language and orthography (Frost, 2012; Geva & Siegel, 2000; Share, 2008). The current study focuses on language minority children speaking Russian, a Slavic language, as a home language and Hebrew, which is a Semitic language, as the societal language. These two languages have minimal typological overlap (Schwartz, Kozminsky, & Leikin, 2009) and use different written forms. Thus, an additional important goal of the current study is to broaden our understanding of literacy development in language minority children by examining children learning Hebrew, which differs from English in its linguistic structure and the features of its written form.

In the Hebrew orthography, letters represent mostly consonants, while vowels are represented mostly by diacritical marks. A unique characteristic of the Hebrew writing system is that it has two versions of script. The shallow script, where vowel information is represented mostly by diacritic marks, is used mostly in the early stages of reading acquisition. The deep Hebrew script omits the diacritic marks, such that most vowel information is not represented (Frost, 2009; Ravid, 2005), and is used universally beyond the early elementary school years. This deep orthography creates a challenge for the reader because between 25 and 40% of Hebrew words in a regular text are homographic (Share & Bar-On, in press; Shimron & Sivan, 1994). Resolution of this homographic ambiguity, and reconstructing the missing vowel information, requires the Hebrew reader to rely on morpho-syntactic information as well as lexical and pragmatic clues from the context (Share & Bar-On, in press). This within language distinction between the two scripts allows us to probe the interplay of phonological decoding abilities and contextual reading.

Share and Bar-On (in press) recently proposed a Triplex model for Hebrew reading development. In the first, sub-lexical phase (first grade), students are fully dependent on the diacritic marks in order to decode, and their attentional resources are focused on phonological sub-lexical units. Because vowelized Hebrew is a shallow script, this phonological sequential decoding is mastered already by the end of the first grade (Share & Levin, 1999; Share & Bar-On, in press). In the second,

lexical phase (second through third grade), children transition to reading unvowelized texts by developing higher order lexical and morpho-orthographic knowledge, and their attention is focused at the word level. Thus, for normally developing readers at the end of third grade, the diacritics become gradually redundant. Interestingly, during this phase, reading accuracy of the diacritic marks declines, as the focus during reading moves to morpho-lexical units. The third, supra-lexical phase begins in the upper elementary grades and from this stage onward, readers of Hebrew use their knowledge of morphological and orthographic patterns to decode words, and their attention is directed from the word level to the sentence level. At this point, readers rely on morpho-syntactic, contextual-semantic and pragmatic information in text processing. These additional sources of information allow readers to efficiently resolve lexical ambiguity and to fully abandon the vowel system.

According to the Triplex model (Share & Bar-On, in press), the fifth grade students examined in the current study are progressing from the second to the third phase, and thus are expected to increasingly rely on contextual information in reading. Further, they have at least 2 years of experience in reading unvowelized Hebrew. Thus, we directly investigate children's reading strategies by comparing their fluency in reading vowelized and unvowelized texts. If language minority students lag behind monolingual peers in advancing through the reading phases proposed by the Triplex model, because of lower linguistic knowledge, they might be expected to use more low-level, sub-lexical strategies and rely to a lesser degree on lexical and morpho-syntactic contextual strategies. Therefore, we expect that language minority children will show greater discrepancies than native-speaking children between reading vowelized and unvowelized texts.

The current study goes beyond previous research in two important ways. First, most previous research on reading abilities of language minority students has focused on single word reading accuracy. We extend this body of knowledge by focusing on word and text reading fluency. This is important because fluent reading is an essential component for efficient reading comprehension (Crosson & Lesaux, 2010; Fuchs et al., 2001; Geva & Farnia, 2012; Kim & Wagner, 2015). Second, the development of reading efficiency in language minority students has, to date, been studied almost exclusively in the context of English. Because of the documented cross-linguistic differences in reading development, it is critical to understand this process in children acquiring other languages as well. The current study is an important step in this direction by focusing on language minority students acquiring literacy in Hebrew.

Methods

Participants

Participants were 114 fifth grade students from five different public elementary schools in an urban area in the north of Israel. Fifty-six students (52% girls) reported speaking Hebrew exclusively at home and were classified as native Hebrew

speakers. Fifty-eight students (65% girls) reported Russian as their native language and were classified as Russian-speaking minority learners. These groups are a result of convenience sampling, yet all participants were drawn from the same classrooms, from schools in similar neighborhoods with equivalent middle-low socio-economic status (see full sample characteristics in Table 1).

In order to identify suitable participants, letters describing the study and seeking parental approval were distributed to all fifth grade students from participating schools. The letter included basic questions about home language environment, self-rating of Hebrew and Russian oral proficiency as well as reading and writing skills in both languages, in addition to background data and language usage at home. At this stage, children who spoke languages other than Hebrew and Russian at home were excluded from the study. Children whose parents approved participation were divided into two groups. The sample was drawn from regular classes, such that students are typically developing with no sensory-motor difficulties. However, based on parental reports, nine participants from the native Hebrew speaking group and 10 from the language minority group had a learning disability or ADHD. Those participants were included in their language group and no independent assessment was carried out as part of the study.

A majority of the of the language minority students are second generation immigrants, as 78.5% were born in Israel, with at least one parent who emigrated from the former USSR. Further, 95% of the language minority learners reported attending Hebrew speaking kindergartens, and the entire sample had attended Hebrew speaking public schools since first grade. All the language minority students reported speaking Russian at home on a regular basis—half reported speaking Russian exclusively with their parents, and the rest spoke both Russian and Hebrew at home. Russian language proficiency was also assessed objectively using a Russian receptive vocabulary test administered by a native Russian speaker (a

Table 1 Participant characteristics

	Native Hebrew	Language minority
Age (years; months)	11.02 (.33)	11.05 (.46)
Toni III (non-verbal ability test)	25.09 (7.15)	23.39 (7.61)
Parental education		
Mother	14.18 (2.50)	13.40 (2.30)
Father	13.80 (2.19)	13.04 (2.65)
Parent self-rated language proficiency (0–5)		
Mother's Hebrew prof.**	4.87 (.33)	2.96 (1.43)
Mother's Russian prof.**	–	4.90 (.23)
Father's Hebrew prof.**	4.79 (.43)	2.58 (1.36)
Father's Russian prof.**	–	4.48 (.91)

The parent questionnaire included a self-rated language proficiency scale between 0 (not proficient at all) to 5 (very proficient) in oral, reading and writing skills in Hebrew and Russian. An average score was calculated for all skills together in each language

** Groups differed significantly ($p < .001$)

Russian translation of the Hebrew version of the Peabody Picture Vocabulary Test; Dunn, 1965; Solberg & Nevo, 1979). The average score of the language minority group was 76 correct items, out of 110 ($SD = 13.54$). Although the Russian version of the test is not standardized, the average score of the language minority group is roughly equivalent to the receptive vocabulary expected from 10-year-old children in the Hebrew version. We thus feel confident that although the language minority students are mostly second generation immigrants and Hebrew is the only instructional language at school, the participants have adequate oral language abilities in Russian. Finally, two students initially identified as belonging to the language minority group, but who scored more than two standard deviations below the mean of the group on the vocabulary measure were excluded from the sample, leading to a final group of 56 language minority students.

Regarding Russian literacy of the language minority students, 37% reported no ability to read and write in Russian, 32% reported basic literacy skills, and only 31% rated their Russian literacy skills as very good. Consistent with the educational policy in Israel, the public schools deliver literacy instruction only in Hebrew, so that any existing Russian literacy skills were taught either by family members or in afternoon classes.

Measures

Reading measures

Measures of reading skills were taken from the standardized Reading and Writing Achievement Test: Alef Ad Taph (Shany et al., 2006) with national norms available in Hebrew. This battery uses measures of speed (words per minute) and accuracy (percentage of errors). In the current study, we report accuracy as the percent of correct responses, and speed was converted into a measure of fluency (correct words per minute).

Vowelized single words This subtest includes 38 single words, representing various morphological structures. Words are ordered by increasing length and decreasing frequency. Participants read the words aloud. Internal consistency reported for the original test (α Cronbach) is .85 in fourth grade (Shany et al., 2006).

Vowelized text This subtest includes a 100 word vowelized narrative text taken from a textbook for Grades 4–5. The text includes morphemically complex and high register words. Participants were instructed to read the text aloud as quickly and accurately as possible. External consistency reported for the original test is .82 (Shany et al., 2006).

Unvowelized text This 102 words text was taken from the same textbook as the vowelized text. This text also includes high register words. The same instructions and scoring were used. External consistency reported for the original test is .89 (Shany et al., 2006).

Vowelized isolated words taken from a text This subtest includes 50 isolated words from the vowelized text (above), randomly ordered. The participants read the word list aloud as quickly and accurately as possible.

Based on the two texts, a comparison of accuracy and fluency rates between vowelized and unvowelized text reading was calculated in order to investigate how the readers benefited from the full phonological information to enhance their reading. Additionally, according to Biemiller's (1981) model, the comparison between the vowelized text and the isolated words taken from the same text is an indicator for the contribution of the context to enhance fluent reading (Shany et al., 2006). The contribution of the vowel information, as well as the contribution of context, was calculated for each participant, allowing us to ask whether the two groups use this information to the same degree while reading.

Additional measures

Phonemic awareness and Rapid automatized naming (RAN) measures are based on the Reading and Writing Achievement Test: Alef Ad Taph (Shany et al., 2006).

Phonemic awareness Participants were instructed to say a word produced by the experimenter and then repeat the word after deleting a requested phoneme. This task includes 16 items. Percentage of correct answers was calculated. Internal consistency reported for the original test (α Cronbach) is .87 (Shany et al., 2006).

Digit naming speed This subtest consists of five digits, each repeated randomly 10 times. All 50 digits were presented on a sheet to the participant, who had to name them aloud as quickly as possible. Results are reported in terms of number of items per minute.

Letter naming speed This subtest consists of five Hebrew letters, each repeated randomly 10 times. The participant had to name them aloud as quickly as possible. Results are reported in terms of number of items per minute. For both RAN measurements, external consistency reported for the original test is .69 (Shany et al., 2006).

Productive vocabulary Hebrew vocabulary was assessed using a picture naming test (Kavé, 2006) consisting of 48 black-and-white line drawings, each referring to a Hebrew noun, presented according to descending word frequency. Participants were instructed to name each picture using one word, and the number of correct answers was calculated. Standardized scores are available for Hebrew native speaking children (Kavé, 2006). Split half reliability reported for the original test is .6 (Kave, 2005).

Non-verbal intelligence Non-verbal intelligence was measured by the Test of Nonverbal Intelligence-3 (Brown, Sherbenou, & Johnsen, 1982). The test includes five training items and 45 abstract/figural problem-solving items arranged in

increasing order of difficulty. Items are in multiple-choice format, with either four or six options. Participants selected and marked the best option. This measure was included in order to match groups on this background variable. Internal consistency for the original test is reported as between .8 and .9 (Brown et al., 1982).

Procedure

The current study was part of a larger project, which also investigated reading comprehension and morphological abilities of language minority learners. Participants were administered a battery of tests in February through May of fifth grade, in two testing sessions each lasting approximately 1 h. One session was administered individually and included the productive vocabulary task, phonemic awareness, RAN and reading measures. The other session was administered in a group setting of 5–8 children and included the nonverbal intelligence task (and other tasks not reported in this paper). The order of the two sessions was random, and the order of tasks within each session was fixed. All tasks were administered during school hours in a quiet room by the first author and trained graduate students from the Department of Learning Disabilities at the University of Haifa.

Results

Group comparisons in reading and language

Reading efficiency and linguistic skills were compared between the language-minority and the native Hebrew-speaking children. Table 2 presents means and standard deviations of accuracy and fluency of reading and language measures.

A multivariate analysis of variance (MANOVA) found significant differences between the native Hebrew and the language minority students in most reading measures and vocabulary, but groups performed similarly on phonological awareness and RAN. Native Hebrew students were more accurate in word reading, $F(1,110) = 4.142, p < .05$, vowelized text reading, $F(1,110) = 4.422, p < .05$, and unvowelized text reading, $F(1,110) = 7.824, p < .01$. Further, native Hebrew students had significantly higher fluency scores in vowelized text reading, $F(1,110) = 5.241, p < .05$, and unvowelized text reading, $F(1,110) = 6.093, p < .05$, and marginally higher fluency scores in word reading, $F(1,110) = 3.516, p = .063$. Along the same lines, native Hebrew students had significantly higher productive vocabulary scores than language minority students, $F(1,110) = 37.882, p < .001$.¹ In contrast, the groups did not differ in their phonological awareness, $F(1,110) = 1.805, p = .182$, or RAN performance (for both RAN letters and RAN numbers, $F < 1$).

¹ Native Hebrew speaking students fell within the normal range of expected productive vocabulary knowledge (mean standard score $-.22, SD = .84$). In contrast, the language minority group achieved an average standard score of $-1.66 (SD = 1.51)$ which is below the normal range.

Table 2 Mean performance on experimental tasks (*SD*), by language group

	Native Hebrew	Language minority
Word reading		
Accuracy (% correct)*	88% (7.1)	85.1% (7.8)
Fluency (WPM)	44.3 (14.6)	39.3 (14.0)
Vowelized text reading		
Accuracy (% correct)*	94.4% (4.7)	92.3% (6.0)
Fluency (WPM)*	93.5 (27.7)	81.7 (26.8)
Unvowelized text reading		
Accuracy (% correct)**	91.6% (7.0)	87.8% (7.4)
Fluency (WPM)*	78.3 (25.5)	67.5 (23.0)
Phonological awareness (% correct)	72.1% (21.4)	66.4 (23.9)
RAN Letters (items per minute)	97.4 (16.4)	100 (18.4)
Numbers (items per minute)	124 (27.9)	123.9 (26.7)
Vocabulary (number of correct answers)***	40.4 (3.5)	34.5 (6.2)

Group differences significant at * $p < .05$; ** $p < .01$; *** $p < .001$

Underachieving readers

Because the current study used standardized and nationally normed reading tasks, we compared the performance of the two participant groups to normative age-based performance. Such comparisons have important pedagogical consequences both for identification of reading disabilities in immigrant populations and for targeted literacy interventions in this population (August & Shanahan, 2006; Geva & Wiener, 2015). As expected, the reading achievements of the Hebrew native speaking group in the current study are similar to the national standard.

The national reading battery classifies performance under the 26th percentile as below normative performance (Shany et al., 2006). In order to examine whether the prevalence of underachieving readers in the current sample is similar to their prevalence in the national sample, a Chi square goodness of fit test was used for each group separately. Participants' performance in each task was classified into one of two categories: under-achieving or average and above, according to a cutoff point set at the 25th percentile of the national norms. We tested whether the percentage of underachievers in each group was significantly higher than expected based on the national norms. Table 3 presents the prevalence of under-achieving readers in the two groups, and marks rates of underachievement that are statistically higher than expected based on the national norms.

As seen in Table 3, the proportion of children falling under the 25th percentile in the Hebrew native speaking group is not significantly different from that expected in the national norms. In contrast, the proportion of children falling under the 25th percentile in the language minority group was significantly higher than expected from the national norms in two out of three measures. Thus, there was an over-representation of underachieving children in the language minority but not in the native Hebrew speaking group.

Table 3 Prevalence of performance below 25th percentile by language group²

	Native Hebrew (%)	Language minority (%)
Word reading: accuracy	35	48**
Vowelized text reading: accuracy	18	30
Unvowelized text reading: accuracy	33	55**

** $p < .001$ —prevalence of underachieving readers significantly different from national norm

Table 4 Correlations among reading and language tasks for the entire sample ($N = 112$)

Measure	2	3	4	5	6
Phonological awareness	.13	.30***	.54***	.52***	.50***
RAN letters		.03	.18	.36***	.29***
Vocabulary			.27***	.38***	.42***
Word reading accuracy				.63***	.57***
Vowelized text fluency					.90***
Unvowelized fluency					

*** $p < .005$

Predicting reading fluency

We next investigated which variables contributed to text reading fluency in the two groups. The relevant predictors were phonological awareness, RAN letters, vocabulary and word reading accuracy. Prediction of text reading fluency was examined separately for vowelized and unvowelized texts. The first order correlations between these variables for the entire sample are presented in Table 4 (the magnitudes of correlations were similar for the two language groups).

As can be seen in Table 4, all variables can be considered as potential predictors of both vowelized and unvowelized text reading fluency. Not surprisingly, the strongest high-moderate correlation was found between accuracy in basic word reading and text reading fluency. Similar in magnitude were the correlations between phonological awareness and fluency measures. Letter naming (RAN) and vocabulary correlated with text reading fluency to a lesser degree. Therefore, and based on theoretical considerations, we computed four regression models (for each group, for each type of text). Predictor variables were entered in the following order: Phonological awareness, RAN, vocabulary knowledge and word reading accuracy (see Table 5).

² From the Chi-square goodman test a similar pattern was found for reading rate. As described above, the national battery norms exist for reading rate in words-per-minute, but not for fluency, which was our measure of interest in the current study. In the Hebrew native speaking group, in one out of three rate measures there was a significantly higher prevalence of slow readers than in the national sample, whereas for the language minority group in two out of three rate measures there was a significantly higher prevalence of slow readers than in the national norms

Table 5 Regression analyses predicting reading fluency of vowelized and unvowelized texts by language group

Variable	Native Hebrew			Language minority								
	Vowelized text fluency			Unvowelized text fluency			Vowelized text fluency			Unvowelized text fluency		
	R^2	ΔR^2	β	R^2	ΔR^2	β	R^2	ΔR^2	β	R^2	ΔR^2	β
Phonological awareness	.139	.139**	.373**	.162	.162***	.403***	.417	.417***	.645***	.341	.341***	.584***
RAN	.32	.182***	.453***	.286	.123***	.374***	.442	.026	.163	.361	.019	.142
Vocabulary	.383	.063*	.273*	.314	.028	.183	.475	.033	.189	.460	.099***	.327***
Word reading accuracy	.509	.125***	.437***	.423	.110***	.409***	.616	.141***	.437***	.531	.072**	.311**

* $p < .05$; ** $p < .01$; *** $p < .005$

In general, the percentage of variance explained by each of the predictor variable was similar for both vowelized and unvowelized text reading fluency. As can be seen in Table 5, for the native Hebrew speaking group basic linguistic skills played significant roles in explaining the variance in text reading fluency. Phonological awareness had similar contributions to both models (14% and 16% for vowelized and unvowelized fluency, respectively), but RAN seemed to capture more of the variance in vowelized text reading (an additional 18% to the model, vs. 12% in unvowelized text reading). Word reading accuracy was also a significant predictor, and added an additional 13% to vowelized text reading fluency and 11% to unvowelized text reading fluency. Unlike other predictors, vocabulary was significant only in vowelized text reading fluency and explained six percent of the variance (in unvowelized text reading fluency it did not reach significance, $p = .183$). Overall, the regression models explained 51% of the individual differences in vowelized text reading fluency and 42% in unvowelized text reading fluency for native Hebrew speaking children.

Table 5 shows that the predictors of vowelized and unvowelized texts reading fluency for the language minority group were different. Specifically, the predictor variables explained similar degrees of variance across vowelized and unvowelized text reading fluency, but their relative weights were markedly different than those observed for the native Hebrew-speaking students. Thus, phonological awareness seems to be a stronger predictor for the language minority group, explaining 42% of the variance in vowelized text reading and 34% in unvowelized text reading fluency, which is more than twice what was observed for the native Hebrew readers. In contrast, RAN did not add significant variance to either vowelized or unvowelized text reading (vowelized text $p = .125$ and unvowelized $p = .210$) in this group. The next significant predictor was word reading accuracy, which contributed 14% and 7% to the variance in vowelized and unvowelized text reading fluency measures respectively, similar to the results seen in the native Hebrew models. Finally, vocabulary was not a significant predictor of vowelized text reading, $p = .086$, but contributed 10% to the variance in unvowelized text reading fluency for language minority students.

A comparison across all four models shows, first, that the models predicted a higher percent of variance for the language minority group than for the native Hebrew speaking group. The average percentage of explained variance of vowelized and unvowelized models for the language minority group was 57%, whereas for the native Hebrew group the average percentage of explained variance was 47%. Second, the models explained a higher percent of variance for vowelized text reading fluency (average of 57%) than for unvowelized text reading fluency (average of 47%).

The effect of vowelization

Beyond the investigation of the differences in fluent text reading, an additional issue, which is especially important for reading in Hebrew, is a direct comparison of the impact of vowelization on text reading for the two participant groups. To this end, we conducted a two-way repeated measures ANOVA with group as a between

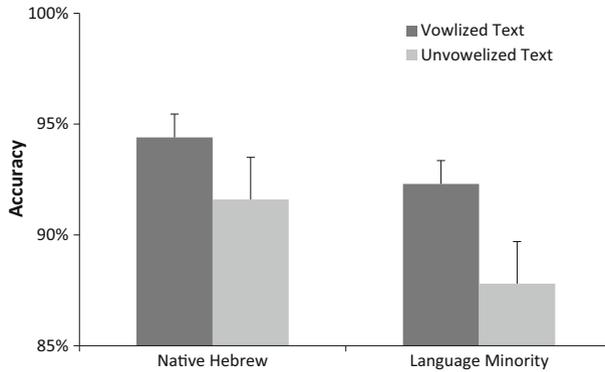


Fig. 1 Accuracy in reading vowelized and unvowelized text by language group

participants factor (Native Hebrew, Language Minority) and vowelization as a within participants factor (Vowelized text, Unvowelized text). One analysis examined accuracy and the other analyzed fluency. There was a significant main effect of participant group in accuracy, $F(1,110) = 6.96$, $p < .05$, and in fluency, $F(1,110) = 5.97$, $p < .05$, because native Hebrew speakers were more accurate and more fluent in both texts in comparison to the language minority readers (see also Table 2). The main effect of vowelization was also significant in both accuracy, $F(1,110) = 77.64$, $p < .001$ and fluency, $F(1,110) = 153.26$, $p < .001$. Thus, the vowelized text was read more accurately and fluently than the unvowelized text by all children, as previously demonstrated in national norms (Shany et al., 2006). Most interestingly, there was a significant two-way interaction in the accuracy analysis, $F(1,110) = 4.01$, $p < .05$, because language minority students showed a larger gain in accuracy with vowelization than did the native Hebrew students (see Fig. 1). In contrast, the two-way interaction was not significant in the fluency analysis ($F < 1$).

Benefit from context

Another important aspect of increasing reading efficiency is readers' growing ability to rely on contextual information to enhance their reading. This issue was investigated by comparing reading fluency of a text and reading fluency of single words taken from the same text. We asked whether the two language groups used the context in a similar manner to improve their reading fluency. To do so, we computed the discrepancy between text fluency and single word fluency for each group. As expected from upper elementary school children, both language groups showed an advantage in text reading fluency as opposed to single word fluency (the mean fluency discrepancy for language minority was 14.98, $SD = 33.7$, and for

native speakers 19.08, $SD = 31.9$).³ Further, both groups benefitted from context to the same extent, $t(110) = .662$, $p = .509$.

Discussion

The current study explored the Hebrew reading abilities of fifth grade language minority students, who speak Russian as a home language and Hebrew as a societal language. In contrast to many previous studies (Everatt et al., 2000; Lesaux et al., 2007; Pasquarella et al., 2012), language minority readers in the current sample were less accurate in reading single words and texts, and were also less fluent when reading texts. Moreover, we found that the groups differed in the composition of underlying skills supporting fluent reading, as well as the extent to which each skill was used. Further, the transition to unvowelized reading, which is a crucial step in developing proficient reading in Hebrew, was less successful for the language minority group. We discuss this pattern of group differences in relation to the developmental trajectory of Hebrew literacy acquisition and in light of the reduced linguistic knowledge of language minority students in Hebrew. Importantly, the current study demonstrates specific challenges in reading fluency for language minority students, a topic that has received only limited attention in the extant literature. Hence, the current results broaden our understanding of language minority literacy by investigating students beyond the initial stages of reading acquisition, and by examining both reading accuracy and reading fluency at the word and text levels.

As mentioned above, the main finding of the current study was that the language minority group showed lower performance in most reading measures in comparison to their native speaking peers. Significant differences were found in single word reading accuracy and differences in single-word reading fluency were marginally significant. More profound gaps between groups were manifested in accuracy and in fluency of vowelized and unvowelized texts. The language minority readers found the reading of unvowelized text especially challenging, because it requires highly developed reading and linguistic abilities. Importantly, this type of text is the most common script in Hebrew, and children in the fifth grade are required to read such texts on a daily basis, emphasizing the possible consequences of the language minority students' difficulties for academic achievement.

This disadvantage in reading measures is also apparent in comparison to national norms. In contrast to the native speaking group, the prevalence of underachievement in language minority students in most reading measures was higher than expected. Specifically, in accuracy of reading an unvowelized text, 55% of the language minority students were below the average range.

These patterns are quite different from much of the research on literacy acquisition in language minority students acquiring English (e.g., Farina & Geva,

³ Note that the SDs for this measure are very high. This is because across participants, although most show an advantage for text reading over single word reading there are children exhibiting the opposite pattern. Similar high SDs for this measure have also been reported in previous studies (e.g. Shany et al., 2006).

2013; Lesaux et al., 2007; Lipka & Siegel, 2012). For example, a study comparing language minority students learning English to monolinguals in second and fifth grades found no group differences in word reading accuracy and fluency, or in text reading fluency in both grade levels (Crosson & Lesaux, 2010; Geva & Farnia, 2012). These findings raise the question why the current results diverge from previous studies.

Cross-study differences are often a result of differences in participant characteristics, especially with the highly heterogeneous population of language minority students. However, the population in the current sample is highly comparable to participants investigated in the previous literature: First and second generation immigrant students who have been fully immersed in the societal language at schools since the first grade and in most cases even before. Further, the language minority participants in the current sample were from low-middle class backgrounds, similar to participants in many previous studies. Thus, we do not ascribe the current results to a difference in participant characteristics. Further, in line with previous research, both groups performed equally well in measures of phonemic awareness, and RAN (Chiappe & Siegel, 1999; Geva, 2006; Geva & Yaghoub Zadeh, 2006; Lesaux et al., 2007). Thus, we suggest that the current lower performance of language minority students cannot be ascribed to deficits in these underlying skills.

We first examine the unexpected differences in single word reading accuracy. We posit that the lower performance of the language minority students in this measure can best be understood in the unique context of Hebrew reading development. As described above, decoding in Hebrew, a shallow orthography, is acquired already by the end of first grade (Shany, Bar-On, & Katzir, 2012; Share & Levin, 1999). However, during the third and fourth grades children make a transition from reading the vowelized script (a shallow orthography) to reading the unwowelized script (a deep orthography). This transition is accompanied by a unique phenomenon showing a decline in accurate decoding of the diacritic marks. This decline is explained by the fact that in this stage of development, diacritic marks gradually lose their importance, and with advancing reading skills, the reader relies to a greater extent on word level and morphological information (Share & Bar-On, in press).

For example, in a nationally representative study of elementary school children (Shany et al., 2012), combinations of letter-diacritic marks and pseudowords with illegal morphological patterns, which rely exclusively on decoding and cannot rely on morpho-lexical patterns, were read less accurately in fourth grade than in second grade. However, by the sixth grade, readers have rebounded from this temporary reduction in accuracy, and were more accurate in all tasks than both second and fourth grade readers. The authors suggest that second graders rely more on diacritic marks, whereas fourth graders use their more developed morpho-orthographic skills while ignoring, to some extent, the diacritic marks. In contrast, in the sixth grade, the readers are able to efficiently use both phonological and morph-orthographic information.

These findings suggest that the current study captures children's performance in an unstable, transitional phase in which they temporarily reduce their use of vowel

information carried by the diacritic marks and rely to a greater degree on morpho-lexical patterns. Indeed, according to the Triplex model proposed by Share & Bar-On (in press), by the fifth grade Hebrew reading children have incorporated reliance on morpho-orthographic and lexical patterns to their single word reading.

This stage of increased reliance on morpho-lexical patterns might lead to disproportionate difficulties for the language minority students, who have less exposure to spoken Hebrew, smaller vocabularies, and lower quality lexical representation, as evident in the current findings (see also Schwartz & Katzir, 2011; Schwartz et al., 2009; Shahar-Yames, Eviatar, & Prior, 2016). As shown in Table 4, there are indeed significant correlations between vocabulary knowledge and single word reading accuracy. Thus, because the dominant source of knowledge in this stage of reading development in Hebrew is morphological and lexical, and because the language minority children's vocabulary knowledge is less developed, they are less accurate in reading single words in Hebrew. Going back to the discrepancy between the current results and those previously reported in the literature (e.g., Lesaux et al., 2007), these can now be understood by focusing on the unique orthographic characteristics of Hebrew and the requirements it poses on reading development.

We now turn to discuss the language minority students' text reading fluency. Reading fluency is far less studied among language minority populations despite the central role of efficient reading for comprehension, especially at the upper elementary level. Fluent reading requires a combination of rapid recognition of orthographic units and automatic access to their lexical representations. At the text level, fluency is also enhanced by top-down processes of meaning integration within and across sentences, and thus involves children's oral language comprehension (Fuchs et al., 2001; Geva & Farnia, 2012; Kim & Wagner, 2015; Wolf & Katzir-Cohen, 2001). This linguistic information processing during text reading may be more challenging for language minority readers and may lead to reduced reading fluency.

In line with these arguments, the results of the current study indeed show significant gaps in text reading fluency, as well as text reading accuracy. The native Hebrew speaking students read both the vowelized and the unvowelized texts more fluently and accurately than their language minority peers. These findings add to the few studies available about text reading fluency among language minority students and, like the findings of Kim (2012), show that language minority readers lag behind native-speaking peers in text reading fluency.

The lower performance of the language minority students' fluency and accuracy of reading the vowelized text again suggests that their linguistic knowledge is less well-developed, as was evident from the single word reading. The transition to unvowelized text reading revealed an additional source of difficulty for the language minority students. The gap in fluency between the groups, which was already apparent in the vowelized text, increased significantly for the unvowelized text. In the unvowelized text, the reader has no choice but to rely on morpho-lexical patterns and lexical knowledge because the lack of diacritic marks results in missing phonological information. Indeed, previous studies have shown that semantic and syntactic abilities contribute selectively to unvowelized but not vowelized reading

(Shatil & Share, 2003), whereas morphological knowledge is important for both scripts (Cohen-Mimran, 2009). Thus, language minority students, who have weaker lexical representations, encounter greater difficulties with the unvowelized script. In addition, unvowelized Hebrew texts have a high percentage of homography (Share & Bar-On, in press), which readers resolve by relying on surrounding lexical and morpho-syntactic contextual information (Bar-On, 2015; Benuck & Peverly, 2004). Here again, language minority students' reduced exposure to Hebrew and less developed linguistic knowledge is a contributing factor to their difficulty in fluently reading unvowelized texts. This last conclusion is also supported by the finding that vocabulary knowledge significantly contributed to language minority students' fluency in reading unvowelized, but not vowelized, texts.

An examination of the skills that contribute to reading fluency in each population again reveals important group differences. Although the two groups were well matched in their phonological awareness and RAN performance, they relied on these skills to a different degree both in vowelized and in unvowelized fluent reading. Specifically, phonological awareness contributed to fluent reading in both groups, but twice as much for the language minority students. In contrast, RAN made a significant contribution to fluency for the native Hebrew but not for the language minority students. The RAN task measures a serial ability to automatically connect between phonological and perceptual components and can be viewed as a predictor of reading fluency (Norton & Wolf, 2012).

The finding that phonological awareness made a major contribution to language minority text reading fluency, but RAN did not, suggests that the language minority students rely to a greater degree on basic reading processes, and are yet unable to reliably recruit automatic retrieval processes to support fluency. Fluency can be conceptualized as a developmental process, with children being able to recruit more and more variable sources of knowledge to support fluent reading as they become more skilled readers (Kuhn & Stahl, 2003). Thus, in the current study, the language minority students were not yet able to recruit such automatic processes, although they had developed this basic ability to the same degree as the native Hebrew children. This group difference in recruiting automaticity is most likely a contributing factor to the overall pronounced gaps in reading fluency.

The final aspect of reading efficiency examined in the current study was readers' ability to benefit from context. As expected from typically developing readers in upper elementary school, the language minority students were faster and more accurate when reading a text than when reading isolated words taken from the text. Thus, they were able to use contextual information in a top-down manner to enhance their reading fluency. Furthermore, the contribution of context was equivalent in both language groups. Importantly, the performance of the language minority group remained significantly lower than that of their native Hebrew speaking peers, demonstrating a lag in developing fluent text reading.

Taken together, the results of the current study suggest several important implications and avenues for future research. Text reading fluency is not normally assessed and identified as a locus of difficulty for language minority students, as most literature focuses on reading comprehension and oral language knowledge. However, fluency makes an important contribution to reading comprehension and to

academic achievement more generally (Jenkins et al., 2003). Definitely, in the context of Hebrew as a societal language, we have identified a significant difficulty for the language minority students in developing text fluency. At this point, there is not enough data to ascertain whether the current pattern of results is specific to language minority students learning a Semitic language (such as Hebrew) or whether these findings might generalize to language minority students immersed in other societal languages. The few studies examining text reading fluency among language minority students (mostly immersed in English) have yielded conflicting results, underscoring a need for further research. Such future research should take into consideration the specific linguistic and orthographic features of the societal language in question. Additional research along these lines will allow us to reach a full understanding of the reading and academic challenges faced by language minority students.

The current study also has important implications for intervention, which are possibly also relevant to societal language contexts beyond Hebrew. The language minority sample in the current study had higher than expected levels of performance below the average range, especially in fluency measures, along with a less well-developed Hebrew lexicon. Thus, intervention should simultaneously focus on vocabulary and language enrichment on the one hand, and on targeted reading fluency practice on the other hand. In addition, diagnosis and identification of learning disabilities in such language minority populations needs to take special care to avoid errors in over or under identification (Geva & Wiener, 2015).

To conclude, because language minority students are increasingly becoming a significant percent of students across educational systems internationally, it is important to carefully characterize their unique challenges in literacy acquisition, which is a cornerstone of academic achievement. The current study, by investigating upper elementary language minority students immersed in Hebrew as a societal language, expands our understanding of reading efficiency in this population, and points towards important considerations for assessment and intervention.

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