

The contribution of morphological awareness to reading comprehension in early stages of reading

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Abstract The contribution of morphological awareness to reading comprehension in Hebrew was studied in 298 second grade students who practiced two types of inflections, plural and possessive. Reading tasks at the beginning and end of the school year indicated that all improved on all tests in that period. Orthographic word recognition and morphological awareness predicted reading comprehension at the end of year. Students with low (LPD) and high (HPD) phonological decoding skills clearly differed qualitatively in reading comprehension. In the HPD students it was predicted by awareness of possessive inflections; in the LPD students it was predicted by orthographic word recognition ability. The results highlight the importance of examining the different components of morphological awareness in readers with different levels of phonological decoding ability.

Keywords Morphological awareness · Inflections · Hebrew · Poor readers · Possessive · Plural

Introduction

Research is ongoing as to whether improved basic reading skills and greater awareness of the morphemes of written words contribute to better reading comprehension. Morphological awareness is believed to contribute to literacy, but this contribution probably varies by developmental time point, type of morphological awareness and the language's orthography. The present study pursues the question by investigating more deeply the relation of morphological awareness to

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reading comprehension in Hebrew, a language with a complex yet transparent morphology. We examined the development of a grasp of plural and possessive inflections and their contribution to reading comprehension in children with high and low reading abilities.

Basic reading skills are known to depend on efficacy of single-word recognition; in the initial stages of reading acquisition, children learn grapheme-to-phoneme relations whereby they can decode the written word, and they gradually develop automaticity in this ability, hence improve the accuracy and speed of word recognition (Perfetti, 1992; Stanovich, 2000; Wolf, 2008). As decoding skills improve, children become increasingly aware of letter units that consistently map into meaning components within words, that is, morphemes (Ehri, 2005; Wolf, 2008). This awareness is made possible because automaticity in grapheme-to-phoneme mapping frees part of the readers' attention resources (Bar-On & Ravid, 2011; Chall, 1983; Reynolds, 2000; Stanovich, 2000).

Morphological awareness is defined as attentiveness to the morphemic structure of words and the ability to inflect words and consciously manipulate their structure to express different meanings (Carlisle, 1995, p. 194; Kuo & Anderson, 2006). Students who have developed morphological awareness observe that language contains simple and complex words. The latter can be broken down into sub-lexical units, namely morphemes (as in *re-play*). Speakers and readers recognize how these word parts combine to form new words with meaning (Taft, 2003; Taft & Ardasinski, 2006; Carlisle, 2010; Nagy, Carlisle, and Goodwin, 2014). Even in kindergarten and first grade children seem able to inflect new words and create simple derivations (Berman, 2002; Carlisle, 1995; Levin, Ravid, & Rapaport, 2001). These new uses of morphemes indicate their independent representation in the mental lexicon, which gradually expands with experience and their use in speech and reading (Berman, 2002). This morpheme manipulation occurs naturally with no conscious effort (Carlisle, 2010). However, the ability to use this knowledge consciously to analyze the morphemic structure of isolated words or words in a specific context appears in the first years of elementary school (Carlisle, 2003). The most accelerated development of morphological awareness was observed in the first 3 years (Berninger, Abbott, Nagy, & Carlisle, 2010; Deacon, Benere, & Pasquarella, 2013), although some morphological awareness—for example, of derivations—continues to develop in the higher grades (Berninger et al., 2010; Singson, Mahoney, & Mann, 2000; Verhoeven & Perfetti, 2011).

Morphological awareness has been found related to the ability to read isolated words (Carlisle, 1995; Deacon et al., 2013), to accurate and fluent decoding of complicated words, and to reading comprehension in early elementary school (Berninger et al., 2010; Carlisle, 2003, 2010; Kuo & Anderson, 2006; Nagy, Berninger, & Abbott, 2006; Nagy et al., 2014; Rispens, McBride-Chang, & Reitsma, 2008). Deacon and Kirby (2004) showed that achievements in morphological tasks, specifically awareness of inflectional forms in second grade, contributed uniquely to decoding in grades three through five and to reading comprehension in grades four and five, after controlling for prior knowledge, verbal and nonverbal abilities and phonological awareness. Similar findings were reported for the contribution of morphological awareness (inflection and derivation) to

reading comprehension in grades four through nine after controlling for vocabulary abilities (Nagy et al., 2006). These findings show that improvement in reading skills is accompanied by increasing use of morphological strategies for decoding and reading comprehension in elementary school children. Reciprocal connections between morphological and phonological awareness and successful reading acquisition have also been reported (Berninger et al., 2010).

The contribution of morphological awareness to reading fluency and comprehension grows significantly in grades four through six and in middle school, apparently due to the increasing complexity of words in texts (Rispen et al., 2008; Verhoeven & Carlisle, 2006; Verhoeven & Perfetti, 2003) and students' greater experience in reading. The expanding number of complex words requires increased attention to the relation of morphemes to meaning, especially in the derivational system. With reading experience, readers become aware of the morphological components that construct the word (Gonter-Gaustad & Kelly, 2004; Nagy et al., 2014), and morphological analysis becomes an integral element in reading comprehension, at least with words that are morphologically transparent (Carlisle, 2003). Because unfamiliar words in texts can be decoded and understood through morphological analysis (Carlisle, 2007; Nagy et al., 2006, 2014), students with high morphological awareness should have an advantage in decoding and learning unknown words over students with low morphological awareness (Carlisle, 2003, 2010; Nagy et al., 2014). This assumption is supported by the finding that poor readers are less aware of morphological units, that is, have difficulty identifying and manipulating morphemes (Fowler & Liberman, 1995; Tong, Deacon, & Cain, 2013; Share, 2005), especially with complex forms such as derivations (Tong, Deacon, Kirby, Cain, & Parrila, 2011). This difficulty will likely hinder comprehension of texts with morphologically complex words (Tong et al., 2011). In contrast to these findings, Marcolini, Traficante, Zoccolotti, & Burani (2011) reported that dyslexic Italian readers read pseudowords composed of a stem and a derivational suffix more quickly and precisely than morphologically simple words, indicating that poor readers benefited from the advantage of reading morphologically transparent complex words, and tended to use units larger than graphemes in their reading. The researchers claim that familiarity with morphemic units is essential for developing fluency in reading shallow orthography, especially for children with reading difficulties who have not yet mastered word identification.

Languages differ in morphological complexity, transparency level, and consistency of representation of the spoken language's morpho-phonemic structure in the written system, so they are also likely to differ in the contribution of morphological awareness to reading (Share, 2008; Verhoeven & Perfetti, 2011). Most research on this contribution to reading and spelling in children has been done in English, which has a relatively simple morphology and irregular orthography due to the lack of consistency between the spoken and written languages in the representation of sounds (Verhoeven & Perfetti, 2011). In light of the importance of morphological awareness in reading skills, the present study examined its contribution to children's reading skills in pointed Hebrew, a morphologically complex language with a transparent orthography.

Morphological awareness in Hebrew

Morphological awareness seems particularly useful in Hebrew, which is characterized by high morphological density in both its inflectional and derivational word formation. A noun can indicate plural, gender and possessive through suffixation, and a verb can indicate tense, person and number by prefixes and suffixes; and several prefixes and suffixes can be attached to verbs, nouns, adjectives and adverbs to construct prepositions such as *in* and *to* (Ravid, 2006; Shimron, 2006; Vaknin & Shimron, 2011).

Hebrew allows inflection and conjugation through both linear and nonlinear concatenation. Verbs are derived via non-linear formation alone, while nouns are derived by both non-linear and linear formation. Linear word formation is created by concatenation of morphemes to create a word. For example, to create the noun plural inflection, one has to add a masculine or feminine plural suffix to the word according to the gender of the noun's stem (e.g., the masculine noun *kadur* 'ball' + the masculine plural suffix—*im* forms *kadurim* 'balls'); In irregular plural inflections, the plural suffix—*im* for masculine nouns or—*ot* for feminine nouns do not agree with the gender of their noun's stem. (e.g., the feminine noun *beytza* 'an egg' + the masculine suffix—*im* forms *beytzim* 'eggs'). The possessive inflection system is another example of linear composition, adding to the noun a possessive suffix appropriate to its gender, person and number (e.g., *shulxan* 'table' + possessive suffix *i* forms *shulxani* 'my table'). Hebrew non-linear formation is created by the combination of consonantal roots with pattern morphemes known as *binyan* or *mishkal*, composed of vowels and sometimes also consonants. For example, the word *maxshev* 'computer' is created by a derivation in which the root X.SH.V. is intertwined into the pattern MaCCeC (where the Cs stand for the root letters). The roots generally refer to semantic domains, and patterns generally refer to syntactic characteristics (as in verbs) and word phonology. Still, the definite meaning and phonology of roots and the patterns become fully specified only when they are combined. This is a non-linear composition because the root morpheme is inserted into a pattern instead of being linearly attached, as is common in Indo-European languages like English. Hence, understanding complex words in Hebrew requires sensitivity to both linear and non-linear morphological structures.

Hebrew is also known for its morphological density—the tendency to use long clusters of bound morphemes. Compare the Hebrew single word *k'sh'erehu* with the English equivalent of four separate words *when I see him*. Information contained in just one Hebrew word requires an entire phrase in English. This Hebrew feature can at times slow the recognition and reading comprehension process; indeed, Hebrew speakers read slower than English speakers (Shimron, 2006). Therefore, knowledge of morphological structures in morphologically rich languages like Hebrew seems essential for the reader in decoding and reading comprehension (Vaknin-Nusbaum, Sarid, & Shimron, 2016).

For all its complexity and rich morphological structures, the Hebrew writing system is morphologically more transparent than other languages (Ravid & Malenky, 2001; Berman, 2002). This feature is attributed to the Hebrew (Semitic) writing system, which represents morphemes of the spoken language in a

distinguishable manner. The root morphemes are represented clearly and concretely (Ravid & Schiff, 2006; Shimron, 2006): usually the root is represented in writing as a complete and continuous letter cluster, while the representation of vowels are either missing in the written form (as in the unpointed Hebrew orthography) or located as diacritics above and below the root letters (as in the pointed Hebrew orthography), as opposed to being interspersed among the root's consonants (Ravid, 2001, 2002; Ravid & Bar-On, 2001; Ravid & Malenky, 2001; Ravid & Schiff, 2006, Shimron, 2006).¹ This is in contrast to English, where the vowels are always represented in the written word. So in general, given Hebrew's rich morphology and clarity and transparency of its morphological patterns as represented in the orthography, sensitivity to morphemes may influence the reading process early in elementary school (Ravid & Epel-Mashraki, 2007).²

Hebrew-speaking children's ability to identify and manipulate morphemic units in words seems to indicate that morphological awareness begins to develop in preschool (Berman, 2002; Ravid, 2002) and progresses in elementary school (Levin et al., 2001; Ravid & Schiff, 2006; Schiff & Lotem, 2011). Inflectional systems, although usually acquired early on in childhood, differ in their level of difficulty. They also differ in their developmental course. For example, plural forms of nouns in Hebrew are highly frequent and obligatory. They emerge already in toddlerhood. The ability to form plural nouns develops rapidly and can be seen in preschoolers spontaneous speech, with the exception of irregular noun plurals that are harder to acquire (Ravid, 1995; Ravid et al., 2008). On the other hand, possessive inflection is considered non-obligatory and less frequent. Its use is relatively rare in every day's speech and tends to appear mostly in the written language. Indeed, the possessive inflection system develops slowly and is acquired during the elementary school years. Hebrew speakers need to be sensitive to the gender, number, and person aspects of the possessive inflection in order to inflect it correctly. Thus, it requires the ability to attend to more information, compared with the simple plural inflection (Schiff, Ravid, & Levy-Shimon, 2011). Schiff et al. (2011) examined how two different inflectional constructions develop in first grade Hebrew speakers. The students demonstrated differential performance with respect to plural and possessive inflections. Performance on plural inflection was higher already at the beginning of first grade but performance on possessive inflection significantly improved throughout the school year.

Further research on morphological awareness in elementary school conducted by Vaknin-Nusbaum et al. (2016) examined Hebrew-speaking second and fifth graders. According to their study, readers with high morphological awareness exhibited high performance in both plural and possessive inflections as well as derivations. Additionally, their reading abilities (word recognition and comprehension) were significantly better than those of readers with low morphological awareness, who

¹ There are some cases in which the root sequence is interrupted by vowels that are represented by letters but these forms.

² Hebrew orthography is considered shallow and transparent at the beginning of elementary school when it is presented pointed, and considered deep and opaque when it is presented unpointed.

demonstrated poor performance particularly in complex forms such as derivations. The relation of poor reading abilities to low morphological awareness was also found in higher elementary school grades (Ben-Dror, Bentin, & Frost, 1995; Cohen, Schiff, & Gillis-Carlebach, 1996) and in reading-impaired adolescents (Schiff & Ravid, 2004) and adults (Schiff & Ravid, 2007). Due to the relatively sparse research on the contribution of morphological awareness to reading comprehension in Hebrew in young children, here we focused on second grade, a critical stage for reading acquisition.

The present study

Most research on Hebrew has examined the contribution of morphological awareness to single-word recognition, rather than the relation of morphological awareness to reading comprehension. This relation is especially interesting in languages with complex morphology such as Hebrew, so we set out to investigate its effect from beginning to end of second grade. The finding that in this grade Hebrew readers begin to use morphemic cues in their reading (Bar-On, 2010) indicates that this may be a critical stage in the development of this contribution. Inasmuch as young readers have more developed awareness of words' structure and can parse words in the text, they should be better able to identify and rely on morphological cues to process the text's meaning (Perfetti, 2007). Accordingly, high morphological awareness is expected to contribute to better reading comprehension. In view of the richness of Hebrew morphology, we expected awareness of plural and possessive inflections to contribute to reading comprehension as early as second grade. A second goal was to compare readers with high and low phonological decoding skills (HPD and LPD respectively) for the contribution of morphological awareness to their reading comprehension. In line with previous research (Vaknin-Nusbaum et al., 2016), we assumed that HPD readers' comprehension would depend more on morphological awareness than would LPD readers' comprehension.

Methods

Participants

A total of 298 s-grade students (161 males, 137 females) aged 7–8 years participated in the study. They were from ten second-grade classes in two schools in a town of medium socioeconomic standing in northern Israel. All were native Hebrew speakers. According to the homeroom teachers, none of the participants experienced any specific language, attention or developmental deficit. Students with possible deficits were excluded according to their teacher's report. All subjects received their parents' written consent prior to inclusion in the study.

Research tools

Morphological awareness test

Morphological awareness was examined by a two-part test (plural and possessive inflections) designed for second graders (Vaknin-Nusbaum et al., 2016). It consisted of common and familiar words in everyday use in the spoken language (e.g. table, window, ball). The teachers confirmed that the words were common in the children's vocabulary. The test was also judged by two morphology experts who validated each of its parts according to regularity of the forms, both morphologically and phonologically.

After receiving a printed example, examinees were instructed to circle the correct answer in each part, with no time limit. There were 16 word pairs: eight plural inflections (four regular, four irregular) and eight possessive inflections. The students were required to identify the correct regular plural inflection (e.g., *kadur exad* 'one ball' *harbe* 'many' *kadurim*/**kadurot*) and the correct irregular plural inflection (e.g., *beytza axat* 'one egg', *harbe* 'many' *beyzim*/**beyzot*) out of two given options separated by a slash: a plural form with a feminine suffix and another with a masculine suffix. Four out of the nine plural inflections had phonological changes in their base form. Children were also required to identify the correct possessive inflection (e.g., *Hatik shelahem hu ... tikam/tiko* 'Their backpack is... their backpack/his backpack'). Note that unlike in English, in Hebrew the possessive form is expressed as a bound suffix specific to each possessive inflection. Cronbach's α was .81. The morphological awareness score of each subtest was the percent of correct answers out of the total number of items in that subtest.

Standardized word recognition and reading comprehension tests

The Hebrew assessment battery of group reading measures—Elul (Shatil, Nevo, & Breznitz, 2007)—consists of tests for orthographic word recognition, phonological decoding and reading comprehension. This battery was developmentally designed, with age-appropriate versions from first to ninth grade. It was developed and validated with 495 s-grade students (Shatil et al., 2007) and has been used in numerous studies on reading skills at elementary schools (e.g., Bar-Kochva, 2013; Horowitz-Kraus, Cicchino, Amiel, Holland, & Breznitz, 2014; Nevo, Brande, & Shaul, 2015; Vaknin-Nusbaum et al., 2016). All tests were presented in pointed Hebrew orthography.

Orthographic word recognition test Students were instructed to identify and circle words that named animals. The test consisted of 80 words, familiar in the second-graders' spoken language; 25 of them represented animals (maximal score). After a time limit of 2 min and 35 s the students were asked to stop the assignment. The score was the percentage of identified animal words out of the total words. Cronbach's α was 0.94.

Table 1 Means, SDs and repeated measures results comparing morphological awareness and reading measures at beginning and end of second grade in low phonological decoding (LPD) and high phonological decoding (HPD) readers

	All	LPD n = 141	HPD n = 156	F Group df = 1,295 (η^2)	F (time) df = 1,295 (η^2)	F Interaction group \times time df = 1,295 (η^2)
Reading comprehension	Mean	51.03	41.71	50.58*** (0.15)	***264.58 (0.47)	63.76*** (0.02)
	SD	24.80	25.25			
	Mean	73.55	68.04			
	SD	18.98	21.60			
Orthographic word recognition	Mean	16.04***	11.89***	10.96***		
	SD	70.69	55.32	84.59	91.61*** (0.24)	23.18** (0.07)
	Mean	27.61	27.42	19.17		
	SD	86.90	79.89	93.23		
Phonological decoding	Mean	25.13	24.52	24.05		
	SD	9.37***	10.20***	3.71***		
	Mean	50.81	27.27	72.09	210.28*** (0.42)	17.32* (0.06)
	SD	26.50	12.86	15.26		
End of 2nd grade	Mean	56.55	51.64	60.98		
	SD	26.68	24.84	27.57		
Paired sample t	2.99**	11.52***	4.77***			

Table 1 continued

	All	LPD n = 141	HPD n = 156	F Group df = 1,295 (η^2)	F (time) df = 1,295 (η^2)	F Interaction group \times time df = 1,295 (η^2)
Plural inflections	Mean	71.32	82.05	18.44*** (0.06)	57.75*** (0.16)	1.98 (0.01)
	SD	27.86	22.91			
End of 2nd grade	Mean	89.34	92.24			
	SD	18.28	14.25			
Paired sample t	Mean	7.53***	5.25***			
	SD	74.22	66.82	29.74*** (0.09)	53.10*** (0.15)	.46 (0.00)
Beginning of 2nd grade	Mean	29.94	32.45			
	SD	87.20	81.09			
End of 2nd grade	Mean	21.96	25.33			
	SD	7.27***	4.75***			
Paired sample t	Mean	7.27***	4.75***			
	SD					

* $p < .05$; ** $p < .01$; *** $p < .001$

Phonological decoding test Out of the 78 homophonic pseudowords presented to them, students were instructed to identify and circle those that sounded like food items (an example in English would be *bred*). The pseudowords sounded like familiar words from different semantic categories, 22 of them like food items (maximal score); after a time limit of 3 min and 5 s the students were asked to stop the assignment. The score was the percentage of identified food items out of the total number. Cronbach's α was 0.89.

Reading comprehension test Students were instructed to read two texts in the allotted time and answer true/false questions about their content. The first text ("Udi and Ro'i") contained 44 words and the time limit was 3 min and 2 s; the second ("Sweet and Sour Popsicle") contained 67 words and the time limit was 3 min and 32 s. Students were asked to answer eight questions following each text. Comprehension scores were the percentage of correct answers. Cronbach's α was 0.88.

Procedure

The researchers administered the morphological awareness and reading tests to groups of students in their homerooms at the beginning of the school year (October) and again at the end of the year (June). Each student was given a notebook and was asked to listen carefully to the instructions. These appeared as part of each test sheet and were read out by the researcher. Written examples were presented first and the test began when the training items had been answered correctly. When the time limit of each test was reached, participants were asked to stop their work. The tests were given in the following order: orthographic word recognition, phonological decoding, reading comprehension, morphological awareness. The same tests were used in the beginning and the end of the year. The percentage of correct answers was calculated for each test separately. The morphological awareness test had no time limit; administration time was approximately 30 min.

Table 2 Pearson correlation coefficients between reading comprehension at the end of second grade, and morphological awareness, orthographic word recognition and phonological decoding at its beginning

	Reading comprehension		
	All readers	HPD readers (n = 157)	LPD readers (n = 141)
Plural inflections	.33***	.26***	.32***
Possessive inflections	.35***	.32***	.30***
Orthographic word recognition	.42***	.22**	.40***
Phonological decoding	.32***	.19**	.21**

* $p < .05$; ** $p < .01$; *** $p < .001$

Results

Analysis of the whole sample

Table 1 summarizes the means and standard deviations of the morphological awareness and reading measures at the beginning and end of second grade.

To test whether the change in reading and morphological awareness measures varied over time, a repeated measures MANOVA with morphological awareness and reading measures was performed at the beginning and at the end of the year. A significant multivariate main effect of time [$F(5,291) = 66.62$, $p < .001$, $\eta^2 = 0.53$] pointed to a developmental effect for all the examined variables. As seen in Table 1, all students attained relatively high scores on inflectional morphology, and their awareness of plural and possessive inflections improved over the year. Results of the repeated measures MANOVA for reading comprehension, phonological decoding and orthographic word identification also showed significant improvement in all of these measures from the beginning to the end of the year.

Correlations between reading comprehension and awareness of plural and of possessive inflections indicated positive correlations in the whole sample, showing that higher morphological awareness was related with better reading comprehension (see Table 2). Prior to running the regression analysis we also examined the correlation between the plural and possessive inflections, in order to eliminate possible multicollinearity if it existed. The correlation between the variables was $r = .44$, $p < .001$, showing that awareness of plural and awareness of possessive

Table 3 Results of regression analysis for predicting reading comprehension at the end of second grade by morphological awareness, orthographic word recognition and phonological decoding

	B	SE	β	t	P
1st step					
Reading comprehension (T1)	.31	.04	.40	7.57	.000
	adj. $R^2 = .16$				
2nd step					
Reading comprehension (T1)	.18	.05	.23	3.78	.000
Orthographic word recognition	.17	.05	.24	3.52	.000
Phonological decoding	.07	.05	.10	1.53	.13
	adj.cum. $R^2 = .22$				
3rd step					
Reading comprehension	.15	.05	.20	3.21	.001
Orthographic word recognition	.12	.05	.17	2.43	.02
Phonological decoding	.06	.05	.08	1.23	.22
Plural inflections	.09	.04	.13	2.18	.03
Possessive inflections	.09	.04	.14	2.44	.02
Summary	$F(5,292) = 21.46$, adj. $R^2 = .26$, $p < .001$				

inflections were correlated, but still distinct—justifying their inclusion as separate variables.

To predict achievements in reading comprehension, a linear hierarchical regression analysis was performed, with reading comprehension at the end of second grade as the dependent variable; reading comprehension at the beginning of second grade was entered in the first step to control for the preliminary effect of reading comprehension. Phonological decoding and orthographic word recognition were entered in the second step, and the morphological awareness subtests (plural inflections and possessive inflections) were added in the third step. The regression results (see Table 3) point to a significant effect of orthographic word recognition

Table 4 Regression results for predicting reading comprehension at the end of second grade, by morphological awareness, orthographic word recognition, and phonological decoding in HPD and LPD readers

	B	SE	β	T	p	R ²
<i>LPD readers</i>						
1st step						
Reading comprehension	.32	.07	.38	4.82	.000	.14
2nd step						
Reading comprehension	.20	.07	.24	2.71	.008	.19
Phonological decoding	.15	.13	.09	1.12	.26	
Orthographic word recognition	.20	.07	.26	2.83	.005	
3rd step						
Reading comprehension	.18	.07	.21	2.46	.02	.22
Phonological decoding	.10	.13	.06	.75	.45	
Orthographic word recognition	.15	.07	.19	1.99	.06	
Plural inflections	.10	.07	.14	1.55	.12	
Possessive inflections	.07	.06	.11	1.31	.19	
Summary	F(5,135) = 8.75, R ² = .22, p < .001					
<i>HPD readers</i>						
1st step						
Reading comprehension	.19	.05	.28	3.64	.000	.07
2nd step						
Reading comprehension	.15	.06	.21	2.51	.01	.09
Phonological decoding	.09	.08	.09	1.12	.26	
Orthographic word recognition	.09	.06	.12	1.39	.17	
3rd step						
Reading comprehension	.11	.06	.16	1.93	.05	.14
Phonological decoding	.07	.08	.07	.86	.39	
Orthographic word recognition	.04	.06	.05	.59	.56	
Plural inflections	.07	.05	.11	1.27	.21	
Possessive inflections	.12	.05	.21	2.44	.02	
Summary	F(5,151) = 5.88, R ² = .14, p < .001					

on reading comprehension at the end of second grade. Performance on orthographic word recognition at the beginning of second grade predicted reading comprehension at the end of the year ($\Delta R^2 = .06$). In addition, performance on plural and possessive inflections at the beginning of second grade predicted reading comprehension at the end of the year ($\Delta R^2 = .04$ for both plural and possessive inflections).

High and low phonological decoding readers

To examine the effect of morphological awareness at the beginning of second grade on reading comprehension in low and high readers, we divided the students into low and high according to the median of phonological decoding at the beginning of second grade ($ME = 50$).

A repeated-measure analysis examined the change over time in all reading and morphological measures for the two groups of readers (see Table 1). With regard to the reading measures, differences appeared between LPD and HPD readers in all reading measures [multivariate $F(5,291) = 66.62, p < .001$]. The means indicated improvement from the beginning to the end of second grade. Differential improvement over the year was found for reading comprehension, orthographic word recognition and phonological decoding, as reflected in significant interaction effects of time X group. LPD readers improved more than HPD readers in these skills. LPD and HPD readers showed significant improvement over the year in both plural and possessive inflections.

In order to examine the change in awareness to plural versus possessive inflections throughout the year, we conducted a 3-way repeated measure analysis of type of inflection (plural vs. possessive) X time (beginning vs. end of second grade) X group (high vs. low phonological decoders). The analysis revealed a significant main effect of inflection type [$F(1,295) = 5.94, p < .02$] and time [$F(1,295) = 84.9, p < .001$] as well as an interaction of type of inflections X group ($F(1,295) = 4.54, p < .05$). No interaction of type of inflection X time X group was found [$F(1,295) = .29, p = ns$]. Based on the interaction and the mean scores (see Table 1) of the inflection measures we can see that HPD readers achieved high scores for plural and possessive inflections while LPD readers gain lower scores on possessive inflections as opposed to plural inflections at both time points.

Correlations of reading measures and morphological measures at the beginning of second grade with reading comprehension at the end of second grade were positive and significant in low and high phonological decoding readers (see Table 2).

Next we conducted linear regression analyses separately for the LPD and HPD groups (see Table 4). The regression was performed on reading comprehension scores achieved at the end of second grade, and the predictors were their scores in morphological awareness (plural and possessive), orthographic word recognition, and phonological decoding at the beginning of the year. Reading comprehension at the beginning of the year was entered first in the regression to control for its correlation with comprehension at the end of the year; orthographic word

recognition and phonological decoding were entered in the second step to control for their effects. The last step included the morphological awareness measures: plural and possessive inflections.

Possessive inflections predicted reading comprehension in HPD readers at the end of second grade: better awareness of possessive inflections was associated with better reading comprehension ($\Delta R^2 = .05$ for both plural and possessive inflections). Only orthographic word recognition at the beginning of the year predicted reading comprehension in LPD readers ($\Delta R^2 = .05$ before the addition of morphological awareness to the model).

Discussion

The present study sought the contribution of morphological awareness to reading comprehension in second-grade Hebrew-speaking students, and the difference between HPD and LPD readers in reading profiles and morphological awareness. Our findings, from a relatively large group of students, show that they improved their level of morphological awareness in parallel with an improvement in reading measures (reading comprehension, orthographic word recognition and phonological decoding) over the course of the school year. The improvement occurred in both the plural and possessive types of morphological awareness, approximately at the same rate. These findings are in line with results of developmental research in Hebrew (Bar-On and Ravid, 2011; Berman, 1997; Ravid, 2006; Shany, Bar-On, & Katzir 2012) and other languages (Carlisle, 2010; Nagy et al., 2014; Verhoeven & Perfetti 2011), suggesting that awareness of inflections already appears in early stages of elementary school.

Awareness of plural and possessive inflections and orthographic word recognition ability at the beginning of second grade were all significant predictors of reading comprehension at its end. Orthographic word recognition explained 6 % of the variance in reading comprehension, and inflectional morphological awareness (plural and possessive) added a unique contribution of 4 % to reading comprehension at the end of the year.

A possible explanation for this unique contribution is that improvement in grapheme-to-phoneme decoding freed up the reader's attention resources to concentrate on higher-order consistencies, specifically the word's morphological structure, in order to locate its meaning in the text (Bar-On & Ravid, 2011; Gontergaustad & Kelly, 2004; Reynolds, 2000). Previous research suggests that the morphemes serve as a bridge to the meaning of words and facilitate word recognition (Carlisle, 2010; Frost 2011). When words are presented in context, they tend to appear in inflected forms more frequently than in isolation, so reading comprehension can benefit from awareness of the inflectional units. This may be especially true for Hebrew readers due to this language's rich and complex morphological structure. Several grammatical and syntactic morphemes join together as a single word in Hebrew. So when a word appears in context it contains grammatical and syntactic information; for example, instead of using the four-word phrase 'and when I said', Hebrew represents this meaning in one multi-

morphemic word *v'k'sh'amarti*. To extract all the meaning components from this one dense word, the reader has to be able to use linear decomposition. Here we tested this ability on inflectional awareness tasks; previous research has shown it to be related to reading comprehension in second and fifth graders (Vaknin-Nusbaum et al., 2016). Additionally, awareness of possessive inflections proved an important variable that distinguished low and high achievers in reading comprehension, as discussed below.

Readers with high versus low phonological decoding ability

To elucidate the contribution of morphological awareness to reading comprehension we examined the reading profiles of two reader groups separately: HPD readers, with high phonological decoding abilities, and LPD readers, with low phonological decoding ability. Both groups showed significant improvement from the year's beginning to its end in awareness of both plural and possessive inflections. The LPD readers' improvement in their morphological awareness exceeded that of the HPD readers, which may be attributed to the relatively lower starting point of the former. Thus the difference between the two reader groups narrowed by the end of the year, though it remained significant. Although the developmental advantage of plural over possessive inflection was exhibited only in LPD readers, this finding corroborates with the slower development of possessive inflection relative to plural inflection found in previous studies conducted in Hebrew (Ravid, 1995; Ravid et al., 2008; Schiff et al., 2011). This difference in developmental course may be attributed to the difference in complexity between the two inflectional systems (Schiff et al., 2011).

In reading profiles, the HPD readers showed higher achievement than the LPD readers on both measures—orthographic word recognition and reading comprehension—at the beginning and end of the year. Together with the lower morphological awareness of the LPD readers, these findings corroborate earlier reports showing that readers with difficulty identifying and manipulating morphemes were also poor readers in Hebrew (Ben-Dror et al., 1995; Schiff & Ravid, 2007; Share, 2005; Vaknin-Nusbaum et al., 2016) and other languages (Carlisle, 2010; Fowler & Liberman, 1995; Kirk & Gillon, 2009; Nagy et al., 2014; Tong et al., 2011). Still, the LPD readers improved their scores on all reading measures all through the school year.

The main purpose of comparing the two groups of readers was to learn whether their reading comprehension at the end of the year reflected qualitatively different reading processes. At the end of the year the regression analyses of reading comprehension revealed a different pattern for either reader group. Reading comprehension of the HPD readers was predicted only by their awareness of possessive inflections at the beginning of the year (5 %), but not by their awareness to plural inflections and word reading measures. By contrast, LPD readers' reading comprehension of was predicted only by their orthographic word recognition ability at the beginning of the year (5 %).

These results show a clear qualitative difference between HPD and LPD readers in their reading comprehension. Only in HPD readers was morphological awareness

(possessive) associated with reading comprehension, and the sole predictor of reading comprehension in the LPD readers was orthographic word recognition ability. This suggests that reliance on morphological awareness in reading comprehension may occur only after proficiency in basic reading skills is acquired (Carlisle, 2010). The LPD readers may still be investing considerable resources at the level of decoding single words, that is, grapheme-to-phoneme mapping. As noted earlier, the decoding and word recognition skills of the LPD readers were still relatively weaker than those of the HPD readers at the end of the year. As phonological decoding and orthographic word recognition abilities become more efficient, the way opens to enjoying the benefits of morphological awareness for reading comprehension.

Furthermore, in HPD readers only awareness of possessive inflections, but not of plurals, predicted reading comprehension, although their performance in the two tasks was practically equivalent (81 and 82 % respectively). This may be because possessive inflections tend to appear more often in the written than in the spoken language, suggesting that good comprehension of written texts requires identification of the possessive forms and their meaning. Also, the possessive forms carry important information about semantic and syntactic relations in the sentence. Hence awareness of different types of morphological forms has different weight in the relation with reading comprehension.

Our finding that LPD readers' reading comprehension was not predicted by morphological awareness runs counter to previous studies suggesting that morphemic decomposition may serve as a compensatory strategy for students with reading difficulties. According to the literature, morphological awareness made a greater contribution to reading comprehension in readers with lower than with higher word-reading ability (Gilbert, Goodwin, Compton, & Kearns, 2014), as well as for reading morphologically transparent pseudowords in readers with dyslexia (Marcolini et al., 2011). These contradictory findings may stem from the participants' different ages, as these studies were mainly with adult readers or higher elementary grade students. The use of morphemic awareness to compensate for reading difficulties may appear later with more experience in reading or a more developed meta-linguistic ability.

To summarize, like findings from studies in other languages, our results indicate that morphological awareness plays an important part in reading comprehension (Carlisle, 2003; Carlisle & Fleming, 2003; Gonter-Gaustad & Kelly, 2004; Kirk & Gillon, 2009; Kuo & Anderson, 2006; Rispens et al., 2008). The study further indicates that in a morphologically rich language like Hebrew, morphological awareness contributes to reading comprehension relatively early in reading acquisition. Although morphological awareness and reading comprehension were separated in time by almost a year, caution should be exercised in respect of the directionality of the relation between the two measures. Note that the relation of morphological awareness to reading comprehension may be reciprocal, that is, cumulative experience in reading and exposure to a greater variety of written morphemes may strengthen one's morphological awareness. In addition, we set the morphological awareness tasks in written form: future research should include oral morphological tasks as well. Several additional measures, such as spoken

vocabulary and/or listening comprehension ability, may also clarify whether morphological awareness was associated with reading comprehension directly or through its association with a receptive language ability.

Our results also highlight two specific factors involved in the relationship between morphological awareness and reading comprehension. The first concerns the distinction between two components of inflectional morphological awareness: plural and possessive. The second factor concerns the qualitative difference between students with high and with low phonological decoding abilities in their reading comprehension profile. Awareness of possessive inflections contributed considerably to reading comprehension only in HPD readers. Thus, morphological awareness can serve as a good discriminator between skilled readers and students with reading difficulties (cf. Kieffer, 2014; Wolter & Gibson, 2015) as early as second grade. An examination of different components of morphological awareness and different types of readers may help in designing early morphologically oriented intervention programs, particularly for struggling and young readers.

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