The role of morphological awareness in the development of reading comprehension in Hebrew-speaking second-graders

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Abstract

The aim of the current study was to examine the role of morphological awareness (MA), in reading comprehension in second grade Hebrew-speaking students (n = 595). Three groups of readers (n = 595), formed according to the change in their derivational-awareness (DA) scores throughout the school year, were examined: Low-DA readers, improved-DA readers who exhibited improvement in their awareness throughout the year, and high-DA readers. Findings show that inflectional and derivational awareness were associated with higher reading comprehension in high-DA readers at both time points, and in improved-DA readers at the end of the year. Among low-DA readers, possessive inflections were correlated to higher scores in reading comprehension, in addition to word recognition and phonological decoding. Results suggest that young readers rely on different reading strategies, corresponding to the level of their MA development. Results are further discussed according to theoretical models.

Keywords Derivational awareness · Hebrew · Inflectional awareness · Morphological awareness · Poor readers · Reading comprehension · Second grade

Introduction

Students' ability to comprehend written text is critical to their academic success throughout elementary school years, and for longstanding learning (Deacon & Kieffer, 2018). According to the lexical quality hypothesis, comprehension of a text depends on the quality of representation at the word level, which includes collective linguistic aspects, such as phonological, semantic, syntactic

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and morphological information that associate with each other. The development of high lexical quality representations is thus critical to word recognition for the development of reading comprehension (Perfetti, 2007) because, throughout the school years, written materials become increasingly complex, in particular in terms of morphology (Deacon & Kieffer, 2018). Morphology includes the way in which morphemes, the smallest units of meaning, are attached to each other to compose a word (Goodwin et al., 2017, 2019). Such information is part of the lexical representation of a word that can be used for various literacy processes (such as spoken and written language) (Perfetti, 2007).

In Hebrew, morphemes can create a word linearly, as in inflections (e.g., ball-balls 'kadur-kadur**im**' – the suffix is marked in bold), or non-linearly, which is more typical to derivations. Nonlinear construction, which is considered more complex than a linear one, is produced by intertwining the root-morpheme into a morpheme pattern consisting mainly of vowels. The word computer '*maxshev*' for example, is a combination of the consonantal root X.SH.V. and the morpheme pattern MaCCeC (C stands for consonant). Using the same pattern-morpheme with a different root-morpheme such as Z.L.G, constructs a different word (e.g., 'mazleg', meaning fork). The ability to deliberately analyze a word by its morphemes (e.g., root, pattern, affixes), and to manipulate them, is called morphological awareness (hereafter MA). It enables the readers to decompose familiar and unfamiliar words to their morphemes, and use them as a bridge to meaning in spoken and written language (Carlisle, 2010; Carlisle & Fleming, 2003). Thus, differences in the level of MA are also reflected in reading level, in particular with respect to derivational awareness, which is considered more complex, and develops slower than inflectional awareness (Berman, 1997, 2002; Carlisle, 1998; Ravid, 2006; Verhoeven & Perfetti, 2011). Indeed, derivational awareness was found to distinguish between typical readers and poor readers in elementary school (Carlisle, 1998; Vaknin-Nusbaum et al., 2016a; Vaknin-Nusbaum, 2018). In this study, we seek to explore the role of different types of MA in second-graders' reading comprehension in three groups of readers, classified by the degree of the change in their derivational awareness (DA) score throughout the school year: low, improved and high-DA readers. For clarity we use the term MA when referring to both inflectional and derivational awareness and DA when referring only to derivational awareness.

Most research, to date, has examined general MA ability, and less so specifically with relation to different types of MA (Carlisle, 1995; Kuo & Anderson, 2006; Nagy et al., 2014). This is true particularly in young readers who are still developing their reading skills (Vaknin-Nusbaum et al., 2016a; Vaknin-Nusbaum & Saiegh-Haddad, 2020). Because derivational awareness was found to be a better predictor than inflectional awareness for success in reading comprehension in elementary school years (Vaknin-Nusbaum et al., 2016a; Vaknin-Nusbaum, 2018; Manolitsis et al., 2017), examining reading differences between students based on their DA can strengthen our understanding of the development of reading comprehension, as well as the role of MA. These MA-reading relationships were examined at both time points, the beginning and the end of second grade, enabling us to examine the change in DA score in parallel to reading skills throughout

the year, with a special focus on reading comprehension. A special interest in this regard is the group of readers who, despite their low starting point in DA, improved their scores throughout the school year, allowing us to examine in depth how this positive change can support the development of reading comprehension. To put it another way, instead of distinguishing only between typical and underachieving readers according to their DA, current design allows us to also follow those who develop their awareness. Results from such a group of readers might serve as a foundation for building educational support for struggling readers.

Morphological awareness and reading in developing readers

According to theoretical reading models, shifting to morphological strategy in reading usually appears after children have acquired basic reading skills. For instance, in his developmental model, Seymour (2006) postulates that the use of morphemes in reading usually appears at the third (morphographic) reading stage, after children have mastered decoding skills and syllables; i.e., spelling relations that enable them to build some internal representation of orthographic units. Only then, representations of complex morphological words are created, and readers can identify, combine and decompose bound morphemes. Nevertheless, the development of the morphographic stage, and the cognitive efforts accompanying it, depend on the degree of complexity and transparency in which morphemes are represented in written language. On the other hand, Share (2018) advocates a universal reading model, in which readers gradually build an orthographic lexicon based on learning of one word or morpheme at a time. The representation of morphemes, and the ability to use them in reading, do not appear at a specific reading stage, but rather, start with reading acquisition and continue throughout reading development (Share, 2018). Readers, whether young or adult, use all of their available properties of language knowledge and awareness to support the cognitive process of reading (Frost, 2012). Whether morpheme representations are involved in the process of reading, alongside or after basic reading skills have been acquired, cognitive reading models do acknowledge their importance to reading development. The extent and the level (depth) in which morphological representations are developed and used in reading are dependent not only on the specific language and orthography that is learned, but also on the reader's reading skills and awareness of linguistic resources available to him/her.

Despite the important role MA might play in the development of reading and reading comprehension, research conducted in developing readers in this regard is less common (Apel & Diehm, 2014; Colé, et al., 2018; Dawson et al., 2018) and focuses mainly on European languages (Frost, 2012; Saiegh-Haddad & Henkin-Roitfarb, 2014; Share, 2018; Author, 2020). From the research that has been done on developing readers, we learn that, generally, young readers are aware of word structure and might benefit from awareness of morphemes in their reading. Dawson et al. (2018) for example, found that developing readers between the ages of 7 and 9 showed sensitivity to derivational morphological structure of visual word processing in English. They tended to make more errors in lexical decision tasks when

non-words were combined out of an existing stem and a real suffix, as opposed to non-words with an unfamiliar (non) morphological suffix.

The relation between MA, word reading and reading comprehension in English was examined by Kirby et al. (2012), who investigated first to third graders' performance in word analogy tasks of inflections and derivations in a cross-sectional study. Although the study conducted by Kirby et al. did not have a longitudinal study design, its results revealed the important role of MA in reading in the early grades of elementary school. The study showed that after controlling for the effects of phonological awareness and verbal and nonverbal abilities, reading comprehension and word reading were predicted by MA in second and third graders, but not in first graders. Colé et al. (2018) investigated the relation between derivational awareness, listening comprehension, vocabulary, phonemic awareness and reading acquisition in first graders from low SES families who speak French. Children were assessed on three derivational tasks: a morphological family judgment task, a sentence-completion task, in which children were required to derive a verb, and a non-word sentence-completion task, which examined how well derivational rules can be generalized to novel items. Findings suggested that MA can have a specific influence on reading acquisition (word reading) among low SES groups, and can be a very powerful factor in the development of phoneme awareness and listening comprehension in developing readers.

Recently, Desrochers et al. (2018), found that MA at the beginning of the year uniquely predicted success in reading comprehension and spelling at the end of second grade, regardless of orthographic transparency. This result was found, to a similar extent, in English and French (deep orthographies) and in Greek (shallow orthography), after controlling for the effects of phonological awareness and rapid naming. In another cross-language study, Manolitsis et al. (2019) demonstrated that awareness of inflections and derivations together have a reciprocal relation with literacy skills (reading comprehension, spelling and fluency) in Greek and in English in second graders. MA assessed after the end of second grade predicted reading comprehension in third grade in both languages, whereas literacy skills predicted MA earlier during second grade only in English.

Similar conclusions emerge from interventional studies. The influence of an 8-week morphological intervention program, delivered to kindergarten children through second grade, was evaluated (Apel & Diehm, 2014). The participants—developing readers from low socioeconomic-status homes—were asked to inflect or derive a word from a given base-word in the context of a sentence, or to derive new words by composing two morphemes (production tasks). In another task, the children were asked to circle inflectional and derivational affixes appearing in a list of pseudowords (identification task). Results indicated that first- and second-graders who participated in the morphological intervention program significantly improved their MA and reading skills. Some MA tasks predicted real- and pseudo-words reading as well as reading comprehension (Apel & Diehm, 2014). Other interesting results were obtained from Wolter and Dilworth's (2014) intervention study conducted on second-graders with poor spelling and literacy skills. Differences in the effectiveness of two metalinguistic intervention programs aimed to improve reading were examined. One intervention program focused on phonological and

orthographic awareness, and the second with the additional focus of MA lessons, which included construction of inflections and derivations. Children who participated in the morphological intervention group exhibited better performance in reading comprehension and in spelling tests, as opposed to the other intervention group.

Overall, the presented studies above underscore the importance of MA in the development of reading comprehension, and suggest that it should be included more frequently in the assessment and instruction of developing readers (Colé et al., 2018; Kirby et al., 2012), to prevent future difficulties in reading and writing (Desrochers et al., 2018). Moreover, morphological training should be embedded in the curriculum as early as first grade (Apel & Diehm, 2014; Colé et al., 2018), or even earlier (Desrochers et al., 2018), particularly among children from low SES backgrounds (Aple & Diehm, 2014; Colé et al., 2018). Nevertheless, all of the presented studies above examined MA-reading relationship in languages with linear morphology such as English, French or Greek, and less so in other languages with different morphological and orthographic features (Share, 2018; Verhoven & Perffeti, 2011). Investigating various languages can help us differentiate between universal reading-development processes and more specific language- and orthography-related processes. Hebrew, the language examined in the present study, uses both linear and nonlinear formation, and is considered a language with complex and dense morphology represented differently in its orthography.

Hebrew morphology and MA

Hebrew is characterized by both linear and non-linear formation. Like in other languages, **linear formation** in Hebrew is constructed by a composition of morphemes, one after the other, to produce an inflection: *gamad* 'dwarf' + the plural suffix *-im* forms *gamadim* 'dwarves'; *tik* 'backpack' + possessive suffix *-i* forms *tiki* 'my backpack'. Although both plural and possessive inflections are linearly formed, they differ in level of difficulty and in age of acquisition. Plural forms of nouns in Hebrew are highly frequent and obligatory and emerge already in toddlerhood. The ability to form plural nouns develops rapidly and can be seen in pre-schoolers' spontaneous speech, with the exception of irregular noun plurals, which are harder to acquire (Ravid, 1995; Ravid et al., 2008). However, possessive inflection is considered non-obligatory and less frequent. Its use is relatively rare in everyday 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. To form the possessive inflection correctly, Hebrew speakers need to be sensitive to the gender, number, and person aspects of the inflection. Thus, forming this inflection requires the ability to attend to more information than is needed to form the simple plural inflection (Schiff et al., 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 inflections was better at the beginning of first grade, but performance on possessive inflections improved significantly throughout the school year.

Hebrew also has a tendency to attach bound morphemes to a word and compose morphologically complex words. The dense Hebrew word *a'sh'marehu* is equivalent to the five-word sentence in English, *I will keep him safe.* The ability to understand dense words depends on the reader's competency in decomposing them into their morphemes – a process that might delay the process of reading comprehension (Shimron, 2006).

Non-linear formation in Hebrew is mainly used to produce derivations. Instead of being linearly attached, the consonantal root morpheme is inserted into the pattern of morphemes which is composed of vowels and sometimes also consonants: *mashpex* 'funnel' is created by the insertion of the root SH.P.X. into the pattern **MaCCeC** (C stands for the root letters). Therefore, the ability to understand morphologically complex Hebrew words depends on one's sensitivity to both linear and nonlinear structures. MA of the root, which appears in kindergarten, allows children to derive simple words (denominal adjectives) orally, whereas the ability to place a root in a new word develops only in elementary school (Levin et al., 2001). Although children in elementary school years, starting in second grade, are aware of root and pattern morphemes, the ability to form a derivation by interweaving a root into a morphemic pattern, a production task, gradually develops during the period from second to fifth grade (Ravid & Schiff, 2006).

Note that each morphological formation type—plural, possessive and derivation—develops at a different pace depending on its complexity, with derivation considered as the most complex of the three (Berman, 1997; Ravid & Schiff, 2006). Awareness of different types of morphemes, such as affixes, roots and patterns, which appear frequently in written Hebrew, can be of crucial importance in reading comprehension, in particular when examining the development of reading acquisition. Besides exploring the general role of MA in reading, in this study we mainly focused on how the improvement in derivational awareness might entail improvement in reading. Because such awareness enables readers to recognize unfamiliar words, its development might serve as a sensitive variable that can distinguish between students with different reading levels (Vaknin-Nusbaum et al., 2016a).

Although Hebrew morphology is considered complex and dense, morphemes are represented in the writing system in a morphologically transparent manner. The root morpheme is usually salient, because it appears as a complete and continuous letter cluster. Vowels are either absent (as in deep unvoweled Hebrew orthography) or represented, in most cases, as diacritics above and below the letters (as in shallow voweled Hebrew orthography), thus preserving the continuity of the root's consonants (Ravid, 2001, 2002; Ravid & Bar-On, 2001; Ravid & Malenky, 2001; Ravid & Schiff, 2006, Shimron, 2006 [1]). Both morphological transparency in the written form and the frequent exposure to morphologically complex words in the orthography can urge young readers to identify morphemes and develop their MA further alongside the development of their reading skills. Indeed, reading comprehension is predicted by MA in developing Hebrew readers (Vaknin-Nusbaum, 2016b; Vaknin-Nusbaum, 2018).

Results from previous studies conducted in Hebrew suggest that the contribution of MA to reading comprehension depends on the student's reading skills, and that different aspects of MA can contribute differently to reading comprehension, with derivational awareness being the best predictor. In a study conducted by Vaknin-Nusbaum

and colleagues (2016a) in second and fifth graders, awareness of inflections, derivations and construct formations predicted reading comprehension only among typical readers with a high MA, whereas among low-MA readers who had poor reading achievements, reading comprehension was predicted solely on the basis of word recognition. In a more recent study (Vaknin-Nusbaum, 2018), after controlling for vocabulary, reading comprehension was predicted by awareness of derivations and construct formation in second- and third-graders. Students with low MA also demonstrated poor reading comprehension achievements. Both of the above presented studies did not include developmental aspects of MA- reading relationships in a longitudinal design, in each grade level along the school year. In another study that did examined changes in these relations throughout the school year among second graders, only inflectional morphology was examined (Vaknin-Nusbaum et al., 2016b). Awareness of possessive inflections at the beginning of the year predicted reading comprehension at the end of the year, only among high phonological decoding readers. Reading comprehension of low phonological decoders was predicted by word recognition (Vaknin-Nusbaum et al., 2016b). Despite that the above presented studies examined the role of MA in reading comprehension, none of these studies examined the contribution of MA types to reading comprehension in a longitudinal perspective (e.g., longitudinal, various aspects of MA). In the current study, we aim to expand the understanding of the role of various MA in reading comprehension, at a critical age of reading development, in a short longitudinal perspective throughout the school year, in different types of readers classified according to their level of DA development. We chose the focus on second graders who, along with reading acquisition, are building an orthographic mental storage of words and morphemes that, in turn, support their reading and reading comprehension skills (Share, 2018). Yet, this support is expected to differ between readers, due to differences in their reading skills and their awareness of morphemes (Carlisle, 1995; Vaknin-Nusbaum et al., 2016a, 2016b), in particular with regards to derivation (Vaknin-Nusbaum et al., 2016a; Vaknin-Nusbaum, 2018; Vaknin-Nusbaum & Saiegh-Haddad, 2020). Thus, positive changes in awareness of morphemes, mainly of complex forms, such as derivations, might also be reflected in a better reading comprehension result. Examining the link between different types of MA, that are different in complexity, to reading comprehension, in a short longitudinal perspective, can provide a wider picture as to the effect of varying DA level of development on reading skills.

The present study

The present study adds to the current knowledge with respect to the developmental relationships of MA and reading comprehension. Moreover, it is also enabling us to expand our understanding regarding differences between readers with different levels of derivational awareness (DA). Change in DA score throughout the year was chosen as indicator for MA level in Hebrew because of its complexity (Berman, 1997; Ravid & Schiff, 2006), and vitality for understanding new words. Another reason for the essentiality of DA in the development of reading in Hebrew, concealed in findings, suggest that DA is a good predictor of reading comprehension in elementary school, and sensitive to differences between typical and underachieving readers

in Hebrew (Vaknin-Nusbaum et al., 2016a; Vaknin-Nusbaum, 2018) and Arabic (Vaknin-Nusbaum & Saiegh-Haddad, 2020).

Therefore, an in-depth investigation of reading development of groups that vary in the pace of the development of their DA (change score) throughout the school year may be of great value in understanding MA–reading comprehension relations. Readers that improve their DA dramatically along second grade are particularly of interest, as compared with other groups that show little change in their DA skills. A dramatic change in DA can result in a positive significant change in reading skills. To our knowledge, studies comparing the contribution of MA to reading comprehension in different types of readers on the basis of their achievements in DA are rare.

While inflectional awareness contributed to reading comprehension in Semitic languages in both poor and typical readers, derivational awareness contributed uniquely only to reading comprehension in typical readers (Vaknin-Nusbaum et al., 2016a, Vaknin-Nusbaum & Saiegh-Haddad, 2020). In this research, we examined whether inflectional and derivational awareness can predict second-graders' reading comprehension in three groups of readers, classified by the degree of the change in their DA score throughout the year. The first, **low-DA readers**, are readers with low scores at both examined time points. The second, **improved-DA readers**, who had low scores at the beginning of second grade and high scores at the end of second grade. The third group, **high-DA readers**, exhibited high scores at both time points.

Research questions and hypotheses

For the purpose of this study, we posed the following three research questions and their accompanying hypotheses. The first research question refers to the general developmental status of second graders' reading skills and inflectional and derivational awareness throughout the year. The second and third research questions particularly address the current research goal and refers to three groups of readers (e.g., low-DA, improved- DA and high-DA).

1. How will reading scores (i.e., orthographic word recognition, phonological decoding and reading comprehension) and MA scores (e.g., inflectional and derivational) at the beginning of second grade vary throughout the school year? As reading and MA develop over time, we expected that all readers would attain higher reading scores and MA in all examined measures at the end of second grade in comparison to the beginning of the year.
2. Because MA changes at different rates in different readers, we sought to ascertain the pattern of improvement in reading skills (i.e., orthographic word recognition, phonological decoding, reading comprehension) along the year in students with low DA, high DA, and those who improve their DA along the year. It was hypothesized that improved-DA readers are expected to show more rapid improvement in reading achievement than low- and high- DA readers along the year, particularly in reading comprehension, due to their improvement in MA in general. This assumption is supported by previous intervention studies conducted in younger

(Apel & Diehm, 2014; Wolter & Dilworth, 2014) and older elementary school students (Vaknin-Nusbaum, 2018; Vaknin-Nusbaum et al., 2016a; Vaknin-Nusbaum & Saiegh-Haddad, 2020), which show that improving MA is associated with an improvement in reading skills among struggling readers.

3. What is the unique contribution of plural, possessive inflections, and derivations to reading comprehension above other reading measures (word recognition and phonological decoding) at each time point (T1, T2) and in each group of readers classified according to their varying growth of profile? Derivational awareness is expected to predict reading comprehension when such basic reading skills as phonological decoding and word recognition are acquired. Thus, derivational awareness is expected to contribute to reading comprehension at both time points among high DA readers, and at the end of the year among improved DA readers. This assumption relies on previous research supporting strong positive correlations between (a) derivational awareness and the capability to extract and use morphemes as a bridge to word meaning (Carlisle, 2010; Frost, 2012; Manolitsis et al., 2017; Share, 2018), and between (b) low-MA readers' low derivational-awareness and low reading-comprehension scores (Vaknin-Nusbaum et al., 2016a; Vaknin-Nusbaum, 2018).

Method

Participants

The participants were 595 s-grade native Hebrew-speaking students, including 327 boys and 268 girls, aged 7–8 years. They came from 15 s-grade classes in five schools, in a town of low socioeconomic standing in northern Israel. The data were collected during 2015–2019. According to information obtained from the homeroom teachers, there was no specific language, attention, or developmental deficits among the children who participated in the study. Students with possible deficits were excluded according to their teacher's report. Gender distribution did not differ by school ($\chi^2 = 6.3$, $p = 0.18$).

We focused on second-graders based on previous studies, which found that MA-reading relations appear as early as second grade in Hebrew readers, probably due to the complexity of Hebrew morphology and the transparency of its representation in written form, which encourages readers to rely on morphemes in the reading comprehension process (Vaknin-Nusbaum et al., 2016a, 2016b; Vaknin-Nusbaum, 2018). Moreover, second-graders are at a crucial stage of reading acquisition, and are still honing their reading comprehension skills; hence, collecting data from this age group can shed light on the role of MA in this process.

Groups of readers according to DA level

As mentioned earlier, derivational awareness not only develops later than inflectional awareness, and is considered more complex, but it also distinguishes between poor and typical readers, probably due to an understanding of the phonological and semantic relations between words, and the way syntactic roles can apply on them (Carlisle, 1995; Kirby et al., 2012). As such, DA task, might be a sensitive measure in understanding the reading comprehension process in young readers. While inflectional awareness contributed to reading comprehension in Semitic languages in both poor and typical readers, derivational awareness contributed uniquely only to reading comprehension in typical readers (Vaknin-Nusbaum et al., 2016a; Vaknin-Nusbaum & Saiegh-Haddad, 2020). Therefore, we chose to classify groups of readers according to the change in their derivational awareness throughout the school year, and to examine which MA and word reading measures predict their reading comprehension at the beginning and the end of second grade.

The participants were classified according to their median scores on the derivational awareness subtest at the beginning (T1) and at the end (T2) of the school year, according to the T1 median of 4 (out of 11 maximum). The median of T1 was chosen as a baseline measure of DA level that the students achieved at the beginning of second grade because it enabled us to follow its change throughout the year with one constant value. According to the results, each participant was classified into one of three groups:

1. Low-DA readers, who achieved a lower score than the median cut-off point at T1 and T2 (n = 138, 24%).
2. Improved-DA readers, who scored lower than the median cut-off point at T1 and achieved a higher than median score at T2 (n = 191, 33%).
3. High-DA readers, who had higher than the median scores at both T1 and T2 (n = 256, 44%).

Research tools

We used a two-part morphological awareness (MA) test and reading tests as presented in the following sections. The MA and the reading scores were collected from five different cycles of second-grade pupils throughout five years (2015–2019).

Morphological awareness test Morphological awareness was examined by a two-part test (inflections and derivations) designed for second graders and previously used in numerous studies (Vaknin-Nusbaum et al., 2016a, 2016b; Vaknin-Nusbaum, 2018). The test consists of familiar everyday words that frequently appear in children's spoken language (e.g., table, window, ball) and textbooks. The test was judged by two morphology experts, who validated each of its parts according to the regularity of the forms, both morphologically and phonologically. After students were shown a printed example, each question was presented visually on the screen and read aloud to the students, who were instructed to circle the correct answer in each part, with no time limit. This was done to narrow

the effect of reading skills on MA. In the original test on inflections and derivations, the examinees were presented with two optional answers for each item, which increased the probability of choosing the correct answer. Therefore, in the current version, a third option was added to each item, and the student was required to choose one out of three answers.

Inflections The inflections part contains 18 words: nine plural inflections (four regular; five irregular) and nine possessive inflections. In both plural and possessive inflections tasks children require to linearly decompose the presented word into its morphemes in order to locate the suitable suffix. In the plural inflection part, the students were required to identify the correct regular or irregular plural inflection out of three given options separated by a diagonal line. The distractors are inflections that contain an incorrect suffix. For instance, after practicing two examples, the students were presented with the regular masculine noun *kadur exad* 'one ball' and were asked to choose the correct plural inflection*: harbe* 'many' ***kadurim*** / *kadurot** / *kedurut** (the correct answer is marked in bold). The distractors were inflections that bear a feminine suffix. In the same way, students were presented with an irregular feminine form such as *beytza axat* 'one egg', and were asked to choose the correct inflection: *harbe* 'many' ***beytzim*** / *beytzot**/ *biztot** (an inflection that carries the masculine suffix -im). In a random sample of 30 participants from the study sample, Cronbach's α reliability for the plural inflections score at the beginning of the year was α = 0.78 and α = 0.79 at the end of the year.

In a similar manner, the students were required to identify the correct possessive inflection out of three given options. For example, they were presented with a singular target noun and a possessive word (my, his, her etc.) (e.g., *hatik shelahem hu …'* their backpack is… '*),* next to the noun and the possessive word, appeared three complex bound possessive forms separated by a diagonal line (***tikam*** / *tiko* / *tiki* 'their backpack / his backpack / my backpack'). Note that unlike in English, the Hebrew possessive form is expressed as a bound suffix specific to each possessive inflection. Cronbach's α reliability for the possessive inflections score at the beginning of the year was α = 0.80 and α = 0.83 at the end of the year. The morphological awareness score of each subtest was the sum of correct answers out of the total number of items in that subtest, calculated as a percentage score.

Derivation The derivations part includes 11 items (maximal score) and requires performing two tasks: analogy (six items) and root family words (five items). All items were regular and fully tri-consonantal, with no missing elements (Ravid, 1995; Schwarzwald, 2011). In the analogy task, after being shown examples, the students were required to choose the correct infinitive transformation out of the three given options, separated by a diagonal line. The distractors included a word with the same root as the root source, but not with the same pattern, and a word with the same pattern as the word source with a root unrelated to both source and target (e.g., *lishmor – shmira* 'to guard – guarding' is like *likshor* – ***kshira*** / *kesher / shtifa* 'to tie – **tying** / a tie / washing'). The correct choice appears here in bold type. Also note that in Hebrew these word pairs are examples of derivations. To identify the correct derivation (e.g., *kshira*), the child was required to analyze the morphological root-and-pattern structure of the example, locate the new root (e.g., the root K.SH.R of the

word *likshor*) and weave it into the morphemic pattern introduced in the example (e.g., the pattern of the word *shmira* – CCiCa).

The root-family task was added to the original derivational-analogy task used in previous research conducted in Hebrew (Vaknin-Nusbaum et al., 2016a, 2016b; Vaknin-Nusbaum, 2018) for two reasons. The first, because the root morpheme is the core of a family of words, and often used to access meaning of both familiar and new written words (Frost, 2012; Velan et al., 2005), it is considered to play an important part in DA. Second, due to the limited number of items in the analogy task, and its level of complexity for young children, adding such a part can increase the variability of the derivations score and provide a more representative sample of items that assess derivational awareness. In the root-family-words task, after providing two examples, students were required to identify two words out of five, separated by a diagonal line, that share the same root as the target word presented to them. For example, the infinitive *gdila* 'growth' was presented as a target word, and the students were asked to choose the two words that share the same root with the target word (G.D.L): **gid**u**l**im, dgalim, me**gud**al, tzmixa, shmira (the root of the relevant words is marked in bold). The distractors included semantic relation (synonym word: *tzmixa*), orthographic similarity (e.g., different root with the same letters presented in a different sequence creating a different word: *dgalim* 'flags') and pattern similarity (same pattern – CciCa – with a different root: *shmira* 'guarding'). To identify words that share the same root, the child had to extract the root from the target word (e.g., ***gdila***) and identify it in other words (e.g., the root G.D.L appears in the words ***gidul***im and ***megud***al but not in ***dg***alim or ***tzmix***a, which have different roots. Note that in Hebrew, the vowels usually appear as diacritics below the consonants (מִגְדָּל). Cronbach's α reliability for the derivations test at the beginning of the year was α = 0.90 and α = 0.85 at the end of the year.

Reading tests (Age-Normed) The Hebrew assessment battery of group reading measures—Elul (Shatil et al., 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 et al., 2014; Nevo et al. 2016; Vaknin-Nusbaum et al., 2016a, 2016b, Vaknin-Nusbaum, 2018). All tests were presented in pointed Hebrew orthography.

Orthographic word recognition test Students were instructed to identify and circle words that named animals familiar to them from their spoken language within a limited time frame. The test consisted of 80 words; 25 of them represented animals (maximal score). The scores were calculated as the percentage of the total number of correct words. The test yielded Cronbach's α = 0.94.

Phonological decoding test The stimuli were homophonic pseudowords. Students were instructed to circle pseudowords that sounded like food (bread/bred) within an allotted time. The test enabled children to associate novel letter sequences with familiar words by accessing their phonological lexicon. The test for second graders contained 78 pseudowords, 22 of which sounded like food items (maximal score).

The scores were calculated as the percentage of the total number of correct words. The test yielded Cronbach's $\alpha = 0.89$ for second graders.

Orthographic word recognition and phonological decoding tests were chosen because they examine essential skills involved in reading comprehension and reading acquisition and because they can distinguish between struggling and typical readers (Ziegler & Goswami, 2005). Note that both tests contain morpheme patterns and that recognizing some of these patterns might assist the children in reading words and pseudowords.

Reading comprehension Students were asked to read two texts in the allotted time and answer true/false questions about their content. The first text ("Udi and Roy") contained 44 words and the second ("Sweet and Sour Popsicle") contained 67 words. Students were asked to answer eight true/false questions for each text. Considering that most Hebrew words consist of at least two morphemes (a root and a pattern) and that Hebrew is characterized by a dense morphology, the reading comprehension texts in this study also contained morphologically complex words. The composite reading-comprehension scores in ranged from 0 to 16, which was calculated as a percentage score of accurate responses. The test yielded Cronbach's $\alpha = 0.88$. As the correlation between the two comprehension tests was significant ($r = 0.56$, $p < 0.001$), the two parts were combined into one score.

Procedure

Data were collected from five different cycles of second-grade students along five school years between September, 2015, and June, 2019 using the same tests at the beginning and the end of the year. All reading tests and MA tests were delivered to all 595 participants in groups of 15 students by a research assistant. The home classroom teacher was present during the test delivery to ensure the children's cooperation.

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 research assistant. Written examples were presented first, and each subtest 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 percentage of correct answers was calculated for each test separately. The morphological awareness test had no time limit; administration time was approximately 30 min.

Difference score was calculated for all test scores as a subtraction between T2 minus T1.

Statistical analysis

The first and third hypotheses were examined using 2-way Repeated Measure MANOVA. The reading level according to DA level was used as a between-subjects

independent variable (second hypothesis), while time (beginning vs. end of year) was used as a within-subjects independent variable (first hypothesis). The interaction of DA level X time provided results for the second hypothesis. The dependent variables were the pupils' reading scores at the beginning and at the end of the year.

The third hypothesis regarding the prediction of reading comprehension in each of the three groups DA level was examined by hierarchical linear regression. The predictors at the first step were word recognition and phonological decoding. At the second step inflectional awareness measures (plural and possessive) were entered, and at third step DA was entered. The hierarchical regression was conducted three times, for each DA group separately.

Results

Changes in reading and MA scores throughout the school year (first hypothesis)

As expected, the results point to developmental effect among second graders, showing that, in general, all of the readers improved their reading skills (i.e., word recognition, phonological decoding and reading comprehension) and their inflectional and derivational awareness from the beginning to the end of the year (see Table 1 for means and SD's of the whole sample, see Table 2 for time effect). As presented in Tables 1and 2, overall, readers improved their all-examined reading skills (word-recognition, phonological decoding and reading comprehension). Similarly, students improved their both inflectional and derivational awareness.

Table 1 Pearson Correlation Coefficients, Means and SD's Between Reading Measures and MA at the Beginning (T1) and at the End (T2) of Second Grade for the Entire Sample

		2	3	4	5	6	Mean	SD
T1	1 Word recognition	.63	.61	.47	.46	.40	71.1	(27.6)
	2 Phonological decoding		.53	.38	.35	.35	51.8	(27.4)
	3 Reading comprehension			.36	.41	.38	50.6	(27.7)
	4 Plural inflections				.53	.40	74.2	(27.7)
	5 Possessive inflections					.55	63.5	(34.2)
	6 Derivations						36.5	(30.7)
T2	1 Word recognition	.46	.53	.45	.43	.30	87.1	(20.5)
	2 Phonological decoding		.32	.28	.30	.21	63.0	(27.4)
	3 Reading comprehension			.40	.49	.44	72.8	(20.8)
	4 Plural inflections				.59	.42	83.7	(22.6)
	5 Possessive inflections					.52	79.9	(27.8)
	6 Derivations						60.4	(30.5)

All correlations are significant at the level of $p < .001$

N = 595. The minimum and maximum values to all variables are from 0 to 100

Table 2 Means, SDs' and Repeated Measures MANOVA Results of Reading Measures and MA, Comparing Low, Improved, and High DA's Readers at the Beginning and the End of Second Grade

DA level:		Low			Improved			High			F values		
		T1	T2	Difference	T1	T2	Difference	T1	T2	Difference	time X group	between groups	Time
Word recognition	M	58.3	77.9	19.6^a	66.2	86.6	20.5^a	82.2	92.8	10.6^b	11.03***	49.61***	269.34***
	SD	(28.8)	(25.4)	(26.4)	(28.6)	(21.2)	(27.3)	(21.4)	(13.9)	(20.9)			
Phon. decoding	M	39.3	52.2	12.9^a	48.1	65.9	17.8^a	61.7	67.2	5.5^b	9.32***	35.88***	90.04***
	SD	(26.9)	(28.7)	(29.1)	(26.6)	(25.8)	(33.5)	(24.6)	(26.1)	(28.2)			
Reading comp	M	40.5	60.1	19.6^a	44.6	72.5	27.9^b	61.0	80.4	19.4^a	6.70***	58.51***	415.37***
	SD	(27.0)	(25.7)	(27.5)	(27.4)	(18.8)	(27.1)	(24.9)	(14.4)	(24.3)			
Plural inflections	M	55.4	68.8	13.4^a	64.9	84.4	19.5^b	84.1	91.8	7.7^a	8.21***	77.33***	66.59***
	SD	(30.3)	(30.3)	(29.2)	(18.6)	(18.6)	(25.4)	(14.3)	(14.3)	(18.3)			
Possessive inflections	M	36.5	56.5	20.0^a	57.7	80.5	22.7^a	83.6	93.0	9.4^b	11.27***	187.95***	174.66***
	SD	(30.4)	(33.2)	(36.1)	(32.7)	(24.9)	(34.5)	(23.2)	(14.9)	(25.4)			
Derivational awareness	M	10.9	17.7	6.8^a	15.9	68.4	52.5^b	66.8	79.2	12.4^c	259.55***	1022.34***	716.15***
	SD	(14.6)	(14.2)	(16.4)	(14.6)	(18.4)	(34.5)	(17.3)	(18.2)	(21.2)			
Multivariate F											40.54*** (df=12,1174)	111.72*** (df=12,1174)	191.46*** (df=6,587)

T1, Beginning of second grade; T2, End of second grade; Pairwise differences are noted with small letters, different letter notes significant difference and same letter points to similarity. Difference is calculated as a subtraction of T2–T1

***$p < .001$

Types of readers (low, improved and high DA) and changes in reading scores throughout the year (second hypothesis)

The second hypothesis referred to the variability of improvement in the scores of the respective reading group levels, and was tested with two-way repeated measures MANOVA (for mean improvement scores according to each group, see Table 2 and Fig. 1). An interaction effect was found with respect to all reading measures, indicating that the groups differ in their level of improvement. In order to clarify the differences between the three groups in the dependent variable, we conducted Tukey pairwise post hoc tests between the three DA level groups, on each of the different reading scores.

The between-groups comparisons of difference scores (T2-T1) showed that in word recognition, the low-DA readers and improved-DA readers improved their word recognition more than high-DA readers did. Regarding phonological decoding, low- and improved-DA readers attained higher improvements than high-DA readers whose scores improved to a lesser extent.

Comparison of reading comprehension difference scores showed that the improved-DA readers attained the highest improvement score compared with low- and high-DA readers, who attained a difference score of 19.6 and 19.4 respectively (ns).

Regarding plural inflections, low- and high-DA readers attained less improvement than improved-DA readers. In possessive inflections, the low- and improved-DA readers had similar improvement scores, which were higher than the improvement scores in high-DA readers. In derivational awareness, the three groups differed significantly, with greater improvement in the improved-DA readers than in the high-DA readers or low-DA readers.

Additionally, although not part of the research questions, the results of the comparison pointed to a significant group effect regarding all reading measures. To clarify these differences, Tukey post hoc comparisons were conducted separately for T1
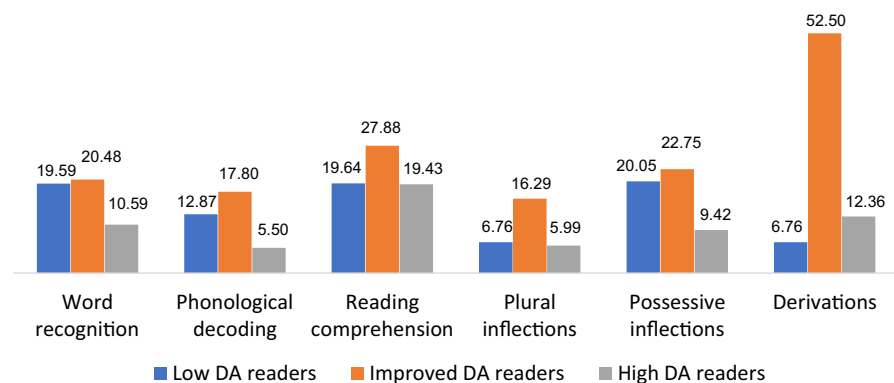

Fig. 1 Change in scores of low, improved, and high DA readers, from the beginning to the end of second grade

and T2. The comparisons showed that at the beginning of second grade low-DA readers performed significantly lower on word recognition, phonological decoding possessive inflections and derivations, compared with improved-DA readers (see Table 2) and with high-DA readers. In addition, improved readers scored lower at the beginning of second grade than high-DA readers in all reading measures. At the end of second grade, all three groups differed in their scores on word recognition, reading comprehension and MA. The lowest group were the low-DA readers, compared with improved- and high-DA readers; improved-DA readers scored lower than high-DA readers in all measures but phonological decoding. In phonological decoding, the improved- and high-DA readers had similar scores.

The contribution of MA types (plural, possessive and derivations) to reading comprehension in the three groups of readers (third hypothesis)

As noted earlier, hierarchical regression analyses were conducted with the aim of testing the contribution of each of the reading skills to reading comprehension in each group of readers. The predictors in the regression were entered into the model in forced steps, in order to detect the relative contribution of each measure, or group of measures, and to examine the unique percentage of variance of each step separately, while controlling for possible covarying effects. Because word recognition and phonological decoding are basic reading skills which serve as platforms for reading comprehension, they were entered in the first step. In the second step, plural and possessive inflections, which develop earlier than derivations, were entered into the model. Derivations were included in the model in the third and final step to test their unique contribution to reading comprehension above all other reading measures. The regressions for T1 and T2 measures were performed separately in each reading group: low-DA, improved-DA and high-DA.

Low-DA readers

Word recognition and possessive inflections predicted reading comprehension of low-DA readers (who were found to be also poor readers) both at the beginning and the end of second grade. At the beginning of the year, phonological decoding also predicted reading comprehension for this group (see Table 3), but not at the end of the year. The possessive inflections, which were found to be significant, accounted for approximately 5% of the variance in reading comprehension at the beginning of the year, and approximately 4% of the variance at the end of the year, in addition to the variance in word recognition and phonological decoding. The total explained variance in reading comprehension of this group was 44% at the beginning of second grade, and 32% at the end of second grade.

Improved-DA readers

Word recognition and phonological decoding predicted reading comprehension at the beginning of the year ($R^2 = 0.41$) for the improved-DA readers, while at the end

Table 3 Hierarchical Linear Regression Predicting Reading Comprehension by Reading Skills at the Beginning and the end of Second Grade, in Low, Improved, and High MA Readers (beta values)

MA level	Predictor	T1	T2
Low MA readers n = 149	Word recognition	.38***	.42***
	Phonological decoding	.22**	.04
	R^2	.39***	.28***
	Plural inflections	0	.01
	Possessive inflections	.24**	.23**
	Cumulative R^2	.44*** (.05**)	.32***(.04**)
	Derivations	0	-.03
	Total R^2	.44***	.32***
Improved MA readers n = 191	Word recognition	.44***	.36***
	Phonological decoding	.26***	.03
	R^2	.41***	.26***
	Plural inflections	.02	.05
	Possessive inflections	-.02	.16*
	Cumulative R^2	.41*** (0)	.31***(.05**)
	Derivations	0	.25***
	Total R^2	.41***(0)	.37***(.06***)
High MA readers n = 256	Word recognition	.33***	.21**
	Phonological decoding	.17**	.13*
	R^2	.25***	.11***
	Plural inflections	-.01	.02
	Possessive inflections	.14*	.17**
	Cumulative R^2	.27***(.02*)	.15*** (.04**)
	Derivations	.16**	.26***
	Total R^2	.30***(.03**)	.22*** (.07***)

T1, Beginning of second grade. T2, End of second grade. Numbers in parentheses present change in R^2

*p < 0.05; **p < 0.01; ***p < .001

of second grade, the predictors included word recognition, possessive inflections and derivations (total $R^2 = 0.37$). Awareness of possessive inflections and derivations accounted for an additional 5% and additional 6% of the variance, respectively, at the end of second grade, on top of word recognition. For all of these variables, higher scores were associated with higher reading comprehension scores at both points in time. The total explained variance at the beginning of second grade was 41% and at the end of second grade, and the total variance amounted to 37%.

High-DA readers

For this group, the prediction model at the beginning and at the end of the year was found to be similar, attesting to a positive relation of word recognition, phonological decoding, and possessive inflections and derivations. At the beginning of the year,

the additive explained variance of possessive inflections was 2% of the total variance, which accounted for reading comprehension in addition to word recognition and phonological decoding, and derivations added 1% to the accounted variance of reading comprehension. At the end of the second grade, the explained variance of possessive inflections was 4% above the contribution of word recognition, and derivations explained 7% of the variance on top of the contribution of possessive inflections. In sum, the total explained variance of reading comprehension by reading measures and MA as predictors were 30% at the beginning of second grade and 22% at the end of second grade.

Discussion

The primary goal of the present study was to examine the role of inflectional and derivational awareness in reading comprehension in Hebrew-speaking second graders at two time points, the beginning (T1) and the end (T2) of second grade. To better understand these relations, we addressed this goal in three groups of readers with low, improved or high derivational awareness. We examined changes in reading scores along the course of the school year and investigated how different types of MA (i.e., plural and possessive inflections and derivations) predict reading comprehension at both time points and in each group of readers. Examining reading achievements throughout the year in readers with different DA levels allowed us to look closely at developmental aspects of reading and its relationship with MA at a critical age at which major progress in reading comprehension is established, after basic reading skills are acquired in first grade.

The results of the study, based on a relatively large sample of students, support our predictions, and point to three major findings. First, all students improved their reading achievements during the year, regardless of group level of DA (low, improved or high). Second, differences in reading-score improvement were found between those three groups of readers. Third, a different prediction for reading comprehension was found for each group of readers. We address each finding below.

As expected, and in line with our first hypotheses, all students improved their scores in all examined reading tasks throughout the year. The elevation in reading scores is probably the result of practicing reading and developing awareness of word structure and of the way morphemes are represented in written form. However, the interaction effect of time and group type, classified according to the change in their DA, suggest that the three groups of readers increased their scores along the course of the year to a different degree. Low- and improved-DA readers developed their word recognition and phonological decoding to a greater extent than did high-DA readers. Similar rapid improvement was obtained with regard to possessive inflections. High-DA readers, although having relatively little room to rise above their high initial starting point, kept their advantage in reading and MA achievements (inflection and derivations) and displayed the highest scores in all examined variables at both time points.

Interestingly, the greatest increase in reading comprehension was observed in improved-DA readers, who also enhanced their phonological decoding, inflectional

and derivational awareness to a greater extent than high-DA readers. Their rapid improvement in both derivational awareness and reading comprehension might suggest that MA in general, and derivational awareness in particular, play a major role in the development of reading comprehension, as suggested in previous studies (Apel & Diehm, 2014; Carlisle, 1995; Wolter & Dilworth, 2014) early as kindergarten and first grade (Manolitsis et al., 2017). Hence, it seems that rapid improvement in MA (DA in particular) boosts the improvement in reading comprehension in young Hebrew readers. The current study's regression results support this notion. MA, both inflectional and derivational, was found to be a significant predictor of reading comprehension only at the end of the year in the improved-DA readers, perhaps suggesting that MA must reach a certain level before it impacts reading comprehension. These findings are in line with previous research showing that morphological intervention, which features an awareness of derivations, leads to significant progress in reading comprehension as early as the first (Apel & Diehm, 2014) and second (Wolter & Dilworth, 2014) grades. Correlational studies, despite not examining the unique contribution of various types of MA to reading comprehension, also support the current findings. They showed that a high score in MA predicted success in reading comprehension in the first three years of elementary school (Colé et al., 2018; Kirby et al., 2012), and that second-graders' MA predicted their reading comprehension in both transparent (Greek) and deep (English) orthographies (Manolitsis et al., 2019).

The current results demonstrate that both possessive and derivational awareness are correlated to reading comprehension, and each imparts its unique contribution. Prediction results for each group of readers (e.g., readers with different DA level) revealed, for example, that derivational awareness has a unique contribution to reading comprehension beyond word recognition and phonological decoding in high-DA readers and in improved-DA readers. However, while awareness of derivations predicted reading comprehension in high-DA readers, at the beginning of the school year, it predicted reading comprehension in improved-DA readers only at the end of the year, after the children had further developed their awareness of morphemes. As was suggested previously by Carlisle (1998), although derivational awareness is not fully developed in young readers, it makes it possible to distinguish between typical and underachieving readers. Indeed, previous studies conducted on elementary-school readers in Hebrew (Vaknin-Nusbaum et al., 2016a; Vaknin-Nusbaum, 2018) and in Arabic (Vaknin-Nusbaum & Saiegh-Haddad, 2020), showed that readers with low derivational awareness exhibited poor reading skills as well.

Awareness of possessive inflections predicted reading comprehension in readers with low and high DA at both time points and in improved-DA readers only at the end of the year. These results partly support our third hypothesis and demonstrate that some readers, such as improved-DA readers, might use their MA in reading only after basic reading skills have been acquired (as suggested by Seymour, 2006) and after they have gained substantial awareness of derivations. That is, improved DA readers is a unique group that can be considered as "late bloomers"—along with their DA they reading patterns become more proximate to the reading pattern of high DA students as demonstrated in the regression analysis pretend in the third table. Other readers, despite exhibiting poor reading achievements, such as readers

with low DA, seem to use their available inflectional possessive awareness for reading comprehension as early as the beginning of second grade. They try to recruit whatever familiarity they have with morphemic units to identify words (Marcolini et al., 2011). High-DA readers, who have already reached a high level of MA and reading achievements at the beginning of second grade, seem to utilize both their inflectional and derivational awareness for reading comprehension from the beginning of the school year. Although all three groups of students participating in this study came from similar low SES backgrounds, vocabulary knowledge can mediate DA. Clarifying whether morphological awareness is directly associated with reading comprehension or through its association with vocabulary in future research, can be a further step in our understanding DA-reading comprehension relationships.

A puzzling finding is the insignificant effect of plural inflections in the prediction of reading comprehension in all three groups of readers at both examined time points. Looking at a previous study conducted on second-graders in Hebrew, which examined only inflectional awareness (Vaknin-Nusbaum et al., 2016b), we expected that awareness of plural inflections would have a unique contribution to reading comprehension. This was found to be true only before derivational awareness is entered into the regression analysis, thereby suggesting that its contribution to reading comprehension is not sufficiently strong. In fact, its contribution is reduced after other more complex, morphological variables such as possessive and derivational awareness are entered into the analysis. The correlations between the three MA parts indeed show that these subtests share some of the variance. Additionally, to obtain a more accurate picture of the role of MA in reading comprehension, the readers in the present study were grouped according to the change in their DA scores during the year – a grouping that might be reflected, to a certain degree, in the regression analysis. One way or another, the involvement of possessive and derivational MA in reading comprehension seems to be dependent on the students' reading level and the development of their MA, in particular with regard to complex forms.

Looking closely at the behavior of the improved-DA readers, it seems that they develop their ability to use MA for reading comprehension later than the other (low- and high-MA) readers. As suggested by Vaknin-Nusbaum (2018), being aware of morphemes, and using them in reading to attain meaning, might reflect two processes which, although developed in parallel (Share, 2018), are distinctive, at least for some readers. A reader can ostensibly have some awareness of morphemes, yet lack the ability to use this awareness in reading comprehension. It is possible, as suggested by Seymour (2006), that this group of readers can benefit from MA mainly after basic reading skills have been acquired and well established. The converse can also serve as a reasonable explanation. That is to say, after children understand the morphological principle (Vaknin-Nusbaum, 2018; Nunes & Bryant, 2011) that underlies derivations (roots and patterns) and reach a certain level of derivational awareness, they can effectively rely on it to analyze words and extract meaning from a text.

As noted earlier, although all three groups of readers improved their ability to comprehend a text along the course of the year, the most robust change was observed among readers who had developed their derivational awareness. Following Seymour's model (2006), we can assume that these readers built an internal storage

of morphographic representations and acquired basic reading skills. Even if this storage is built up gradually along the reading development process, as suggested by Share (2018), the capability to benefit from it might be available to some readers after both reading and morphographic representation are developed sufficiently. Thus, it is suggested that the development of reading comprehension and the building of morphographic storage, despite developing simultaneously, correspond with each other differently in different types of readers. High-DA readers, for example, can reach this level of proficiency, and use their MA for reading at the beginning of second grade or perhaps even earlier, while others, such as improved-DA readers, can use their awareness only at the end of the year, after expanding their morphographic representation storage to a greater extent. Others, such as low-DA readers, who develop their derivational awareness only slightly and exhibit difficulties in phonological decoding, seem to rely on their poor inflectional awareness and word recognition for reading comprehension. They might be able to use their limited MA for reading only when simpler forms (such as inflections) are involved. The awareness of more complex forms, such as derivations for comprehending a text, might develop in the upper elementary-school grade level in these readers, if at all.

Furthermore, with the development of MA and reading over the course of the year, the role of phonological decoding seems to decline, mainly in low- and improved-DA readers. Phonological decoding, which predicted success in reading comprehension at the beginning of second grade in all three groups of readers, was a predictor at the end of the year only in students with high DA. A closer look at what predicts reading comprehension among the different groups of readers reveals two types of reading strategies: readers who seem to rely on all resources available to them for reading comprehension (high-DA readers), as suggested by Frost (2012), and readers who shift from a phonological decoding preference to a more morphological strategy, after rapidly developing their MA and gaining well-established basic reading skills (improved-DA readers), as suggested by Seymour (2006). Indeed, a previous study conducted on Hebrew-speaking second-graders with varying reading levels, showed that awareness of possessive inflections predicts reading comprehension only after phonological decoding skills have been well-developed (Author, 2016b). The current study's findings suggest that this might be true for some of the readers. Low-DA readers do not fall into one of these reading developmental categories. They exhibit low reading performance throughout the year, despite their improvement in phonological decoding and inflectional awareness. They seem to be trying to compensate for their inferiority in reading by trying to use available, yet under-developed resources, such as word recognition and awareness of possessive inflections for reading comprehension. We should also consider that other linguistic and background knowledge (Adams & Bruce, 1982; Perfetti, 2007; Wolf, 2008) is involved in the process, and might impede the development of reading comprehension in some struggling readers, despite their improvement in basic reading skills.

Readers can benefit from the way morphemes are represented in the orthography. Hebrew readers have the advantage of reading in a morphologically transparent orthography. The root morpheme, the core of a family of words, is usually represented in a continuous salient manner which facilitates its extraction even

by young readers who are aware of word structure. Because both words and root morphemes are represented in the mental lexicon and are interconnected, the recognition of printed words is often aided by access to their respective roots (Velan et al., 2005). This explanation seems to be supported in the current research results, which show that students who are capable of extracting a root morpheme in order to build or decompose words (derivational awareness) also attain better scores in reading comprehension. As suggested by Carlisle (2010) and Frost (2012), readers can benefit from this process to capture the meaning of complex forms and new words that appear in a text. Lacking this awareness might be an obstacle to the development and mastery of reading comprehension not only in the first grade but also in upper elementary-school grades, when complex morphological forms appear frequently in texts (Vaknin-Nusbaum, 2021).

By acquiring, in parallel to phonological decoding, other linguistic information inherent in words, such as their root morphemes, young readers can attain a higher level of reading comprehension, as can be seen in the present study among improved-DA readers. At the end of second grade, reading comprehension of high- and improved-DA readers was predicted by their derivational awareness, after having developed their awareness of internal word structure. These readers seem to be able to use their available properties of language awareness to support the cognitive process of reading (Frost, 2012). It is hard to delineate the precise level of MA, in general, or of derivational awareness, in particular, which is needed for success in reading comprehension. Surely, closer developmental follow-up research is required to address this issue. Nonetheless, based on the current study's results, one may assume that because Hebrew readers learn to read in a transparent orthography (both in terms of morphology and phonology), some of them not only acquire basic reading skills as early as the end of first grade, but also may develop morphographic representations more rapidly, in contrast to readers in opaque orthographies. Most of them can utilize their morphographic representations for the purpose of reading comprehension as early as second grade.

To sum up, the present results expand and deepen our understanding of MA and reading comprehension relationships in several ways: first, they shed light on developmental aspects of MA types-reading comprehension relations at a critical age for reading development; second, they show the significant role of awareness of both possessive inflections and derivations in reading comprehension in young readers; third, they show the importance of differentiating between readers with different levels of morphological awareness; and fourth, they give us an opportunity to widen our perspective regarding MA-reading comprehension relationships, by looking at a language that has morphological and orthographic features which differ from English.

In terms of practical implications, current results suggest that derivational awareness can serve as a valuable tool for educators to identify students at literacy risk at the early beginning of reading acquisition. As a sensitive measure to reading comprehension difficulties DA might serve as a tool to diagnose reading underachievers at word and text level. As such, it is recommended to be used as part of testing batteries to assess reading levels and diagnose reading difficulties.

Finally. interventional studies aimed to promote reading skills might use current findings to examine whether improving MA—mainly DA, might entail improvement in reading skills. In particular low SES students who might be at risk because of their low literacy background. Such focused interventional programs can be used as useful tools for educators and parents as well to promote young children's literacy.

Limitations

Notwithstanding the unique contribution of MA to reading comprehension in young readers possessing different levels of DA, several limitations should be addressed. First, due to practical reasons, the morphological task that has been used in this research, although read to the students, was presented in a printed version. Thus, some reading might have been involved in fulfilling the task. Using oral testing in the future might provide a complete picture of the role MA has in reading. Second, the present results are correlational in nature, and should be interpreted with caution. Future interventional research in Hebrew that will corroborate the current results will be able to support some of our assumptions regarding the use of morphemes in reading. Third, vocabulary should also be examined, in order to obtain a more accurate picture of the contribution of MA to reading comprehension. Follow-up research should also examine developmental aspects of low-DA readers, to learn more about the development of reading comprehension and the role which derivational awareness plays in it, particularly in the upper elementary-school grades, when texts contain a large amount of morphologically complex forms. Apart from word complexity, Hebrew-speaking readers experience reading, beginning in third grade, in a deep orthography. They shift to reading in an unpointed orthography—one that represents solely the consonantal information of spoken words. Due to this shift, students no longer read in a transparent orthography. This highlights the importance of examining whether MA in general and derivational awareness in particular can compensate for the lack of phonological representation in print and can aid in the development of reading comprehension.

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