Frontiers in Education

TYPE Original Research
PUBLISHED 27 December 2023
DOI 10.3389/feduc.2023.1304688

OPEN ACCESS

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RECEIVED 02 October 2023
ACCEPTED 07 December 2023
PUBLISHED 27 December 2023

CITATION
Sparks E and Metsala JL (2023) Morphological awareness predicts reading comprehension in first grade students.
Front. Educ. 8:1304688.
doi: 10.3389/feduc.2023.1304688

Morphological awareness predicts reading comprehension in first grade students

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Research examining a role for morphological awareness in first grade students' reading comprehension is scarce, although it is a well-established predictor for students in mid-to-late elementary school. One question that remains is whether morphological awareness explains unique variance in these young readers' comprehension after accounting for other oral language skills. In this longitudinal study, we assessed Grade 1 students' inflectional morphological awareness as a predictor of their concurrent ($n = 58$) and Grade 2 ($n = 55$) reading comprehension. When controlling for decoding and vocabulary, Grade 1 morphological awareness explained unique variance in concurrent and subsequent reading comprehension (4% and 5%, respectively). In novel analyses that controlled for decoding, vocabulary, and syntactic awareness, morphological awareness explained unique variance in Grade 2 reading comprehension (5%), but not in concurrent reading comprehension. This unique contribution only in second grade may be because decoding skills accounted for less of the overall variance in second than in first grade comprehension or due to the expectation that polymorphemic words are more frequent in second grade texts. Overall, morphological awareness emerged as the strongest oral language predictor in all models. These results support morphological awareness' relevance to reading comprehension from early in children's reading development and highlight the need for research to further explore the effects of targeting English morphological awareness with young students.

KEYWORDS
reading comprehension, reading development, morphological awareness, longitudinal research, early elementary

Introduction

Comprehending written texts is central to success in educational settings and to navigating the demands of a literate society (e.g., Murnane and Levy, 1996; Wilson, 2016). The foundations of skilled reading comprehension begin from the earliest days of children's reading acquisition—reading skills in Grade 1 predict reading comprehension and language abilities ten years later (Cunningham and Stanovich, 1997; Sparks et al., 2014), and preschool language skills are associated with reading comprehension into the elementary school years (Hjetland et al., 2017). Such longitudinal findings highlight the importance of a strong start in oral language and reading comprehension for young students and the need to understand the early phases of reading comprehension development. In the current study, we explore whether Grade 1 students' inflectional morphological awareness—a metalinguistic facility with units of meaning in oral language—predicts their concurrent and subsequent reading comprehension.

Comprehending what one reads refers to making meaning from the text—understanding, for example, the gist, message, information, or scene represented in a text. The act of comprehending connected sentences requires the reader to "…retrieve the meanings of individual words, compute the sense of each sentence, integrate the meanings of successive sentences, and incorporate background knowledge to construct a representation of the state of affairs described in the text" (Cain and Oakhill, 2009, p. 144). When we consider reading comprehension in beginning readers, word-level decoding stands out as a key contributor. A child who cannot decode the words in a text will be unable to comprehend that text, regardless of their oral language skills (Gough and Tunmer, 1986; Lonigan and Burgess, 2017), and thus decoding has traditionally been given primacy in the context of early reading comprehension (e.g., Hoover and Gough, 1990; Gough et al., 1996; Storch and Whitehurst, 2002). Yet even for young readers with somewhat simple texts, on top of decoding the written words they need to know what the words mean, understand the relations between those words in the sentences, and integrate what they are reading with what they know about the world. Indeed, multiple studies have confirmed that individual differences in oral language abilities predict variance in reading comprehension, beyond decoding, from early in children's reading development (e.g., Vellutino et al., 2007; Foorman et al., 2015; *cf.* Storch and Whitehurst, 2002). A question remains about the developmental time-frame for when individual oral language skills make unique contributions to comprehending texts. Answering this question addresses the practical problem of knowing which oral language skills may be candidates for targeted instruction in the earliest years in elementary classrooms. Both theoretical and practical issues highlight the need to understand the various oral language skills that are relevant to young students' developing reading comprehension.

In recent years, morphological awareness has received attention as potentially important in children's reading comprehension (see Levesque et al., 2021 for a review). Morphological awareness is one's ability to recognize and manipulate morphemes, which are the smallest meaningful units of language (Carlisle, 2000). English has a morphophonemic orthography – meaning that our spelling system represents both the sounds and morphemes in spoken English; this deep orthography can be contrasted with orthographies that are more consistent in representing the sounds in the spoken language (e.g., Finnish and Spanish). As explained by Moats (2020, p.8), in English "…the spellings of morphemes are often stable even when pronunciation varies in words with a common root" (e.g., spelling of *jumped* maintains the past-tense morpheme "ed" rather than representing the final /t/ sound). Morphological awareness has been proposed to influence literacy outcomes in multiple ways. According to the Reading Systems Framework (Perfetti and Stafura, 2014), morphology exists as part of the broader linguistic and lexical systems, feeding into text comprehension processes through direct and indirect means. More specifically, the Morphological Pathways Framework proposes that morphological awareness affects comprehension of text through both decoding of morphologically complex words and analysis of word meanings (Levesque et al., 2021). Within this framework, two aspects of morphology can be delineated—inflections and derivations. In English, inflectional morphology involves adding small word parts, suffixes and prefixes, to change the form of a word without altering its basic meaning or category. These changes typically indicate grammatical aspects such as tense, number, possession, or comparison (e.g., signaling the tense and aspect of a verb, as in *walked* or *walking*). Derivational morphology involves adding affixes to a base morpheme and changes the word's meaning or grammatical category (e.g., *walkable*). Both aspects of morphology are represented in the English writing system, allowing readers to make sense of polymorphemic words and determine their grammatical functions in sentences. English-speaking children show a clear awareness of inflections by school entry (e.g., Berko, 1958; de Villiers and de Villiers, 1973), and their derivational awareness shows a particular increase after age 8 (Anglin, 1993; Berninger et al., 2010). Both forms of morphological awareness improve across the elementary school years (Kuo and Anderson, 2006). Given its early development, we focus on children's inflectional morphological awareness in the current study.

Research with children in the mid- to late-elementary grades has demonstrated that morphological awareness is a predictor of reading comprehension (e.g., Carlisle, 2000; Deacon and Kirby, 2004; Cunningham and Carroll, 2015). This relationship persists after accounting for the effects of word reading (e.g., Deacon et al., 2014; Levesque et al., 2017; James et al., 2021), vocabulary (e.g., Kirby et al., 2012), and/or a general language measure (e.g., Kieffer et al., 2016; Metsala et al., 2021). Yet research examining morphological awareness and reading comprehension with younger students is sparse by comparison (and as reviewed below, some inconsistent findings have emerged; Carlisle, 1995; Carlisle and Fleming, 2003; Muter et al., 2004; Kirby et al., 2012; Kruk and Bergman, 2013; Apel and Henbest, 2016; James et al., 2021). Notably, the existing studies of morphological awareness as a predictor of first graders' reading comprehension have not simultaneously controlled for decoding, vocabulary, or syntactic awareness—skills that are each implicated in the reading comprehension of somewhat older students (e.g., Quinn et al., 2015; Deacon and Kieffer, 2018) and that relate to morphological awareness (e.g., Kuo and Anderson, 2006; Sparks and Deacon, 2015). In the current study, we address this gap by evaluating morphological awareness as a predictor of Grade 1 students' concurrent and later reading comprehension after first controlling for decoding and vocabulary, and then also controlling for syntactic awareness. We thus distinguish effects of morphological awareness from decoding and a set of related oral language skills.

Vocabulary has long been recognized as an important predictor of reading comprehension (e.g., Beck and McKeown, 1991; Quinn et al., 2015; *cf.* Ouellette and Beers, 2010) and is frequently included in studies that focus on morphological awareness. For instance, James et al. (2021) found that a comprehensive measure of morphological awareness predicted concurrent reading comprehension among 6- to 8-year-olds after controlling for vocabulary and word reading, among other controls (age; nonverbal reasoning; phonological awareness). Similarly, Apel and Henbest (2016) found that, among children in Grades 1–3, knowledge of affix meaning predicted concurrent reading comprehension beyond age, vocabulary, and phonological awareness. Kim (2023) found that morphological awareness in first grade, largely explained the shared variance between word reading and listening comprehension, both major contributors to reading comprehension. These concurrent findings suggest a relationship between early morphological awareness and reading comprehension. They serve as an impetus for further exploring this relationship among Grade 1 students specifically, while controlling for variables such as decoding and vocabulary skill.

Syntactic awareness is another oral language skill relevant to reading comprehension (e.g., Cain, 2007; Deacon and Kieffer, 2018). It captures children's metalinguistic ability to reflect on and manipulate syntax (Nagy, 2007) and may facilitate the parsing of sentences—a skill that appears important to establishing the meanings of texts (e.g., Sorenson-Duncan et al., 2021). Conceptually, syntactic awareness is a valuable skill to include when isolating the effects of morphological awareness on reading, as morphemes serve grammatical functions (e.g., signaling word class; contributing to subject–verb agreement in sentences). Research with somewhat older children suggests that effects of morphological awareness emerge when syntactic awareness and vocabulary are included as controls, uniquely predicting gains in reading comprehension among children in Grades 2 and 3 (Metsala et al., 2021; see Kieffer et al., 2016 for concurrent effects among older students; *cf.* Proctor et al., 2012).

Longitudinal studies have also examined beginning readers' morphological awareness as a predictor of subsequent reading comprehension. Early work found that Grade 1 students' morphological awareness predicted their later reading comprehension when considered as the sole predictor (Carlisle and Fleming, 2003) and when controlling for phonological awareness (Carlisle, 1995). Yet mixed findings have emerged in studies that include additional controls. For example, Kruk and Bergman (2013) found that first graders' morphological awareness—as assessed in a morphological generation task—predicted their Grade 3 reading comprehension beyond variance explained by phonological awareness, vocabulary, and word reading. This aligns with evidence from students in later elementary grades, for whom morphological awareness uniquely predicts gains in reading comprehension beyond vocabulary, word reading, and other relevant controls (e.g., Deacon et al., 2014). Together, this research suggests that morphological awareness' relationship with reading comprehension extends beyond children's knowledge of word meanings. Kirby et al. (2012) reported similar findings at Grades 2 and 3—morphological awareness (measured using a word analogy task with inflected and derived items) predicted Grade 3 reading comprehension beyond vocabulary, phonological awareness, and nonverbal ability. However, morphological awareness at Grade 1 did not uniquely predict students' later reading comprehension. The authors noted floor effects in Grade 1 students' performance on their morphological awareness task, which may have contributed to their nonsignificant results (Kirby et al., 2012). These sparse and conflicting longitudinal findings at Grade 1 point to a need for additional research into morphological awareness as a predictor of beginning reading comprehension beyond both decoding and vocabulary.

Whether morphological awareness predicts reading comprehension in beginning readers after controlling for syntactic awareness is an open question. One study to date has measured both syntactic and morphological awareness as predictors of beginning reading comprehension (Muter et al., 2004). This study—which started at children's school entry at age 4—combined the two constructs into a composite measure of grammatical awareness. The researchers found that kindergarten vocabulary and Grade 1 grammatical awareness predicted unique variance in reading comprehension at Grade 2 (controlling for word reading, phonological awareness, and letter knowledge). This provides evidence for the importance of these metalinguistic skills in predicting early reading comprehension, but the combined measure of grammatical awareness cannot isolate the effect of morphological awareness from that of syntactic awareness. We address this gap in the current study.

In summary, the current study builds on the small body of evidence around the relationship between morphological awareness and reading comprehension among English-speaking readers in Grade 1. Specifically, we examined whether children's Grade 1 morphological awareness would uniquely predict their concurrent reading comprehension and their reading comprehension one year later in Grade 2. We first assessed this question while controlling for decoding and vocabulary. Many prior studies with this age group have controlled for phonological awareness (Carlisle, 1995; Kirby et al., 2012; Apel and Henbest, 2016), but fewer have controlled for the word-level reading skill that are more proximally related to reading comprehension (but see Kruk and Bergman, 2013; James et al., 2021). By controlling for decoding and vocabulary, we isolated morphological awareness' effect on reading comprehension from two widely prioritized predictors of reading comprehension in this age group (e.g., García and Cain, 2014; Quinn et al., 2015). Next, we considered whether morphological awareness would predict concurrent and/or subsequent reading comprehension while controlling for decoding, vocabulary, and syntactic awareness, skills which have not been controlled together in studies of morphological awareness with this age group. We focused on inflectional morphological awareness using task formats that are suited to young children (Muter et al., 2004) to minimize the risk of floor effects in our key predictor (Kirby et al., 2012). Given past research with first-grade students (e.g., Carlisle, 1995; Muter et al., 2004; Kruk and Bergman, 2013), and similar research with older students (e.g., Kieffer et al., 2016; Metsala et al., 2021), we hypothesized that Grade 1 morphological awareness would predict a small, but unique and significant, amount of variance in concurrent (Grade 1) and subsequent (Grade 2) reading comprehension beyond both sets of controls.

Materials and Methods

Participants

At Time 1 (T1), we recruited 75 students from five schools in a largely suburban school district in eastern Canada. Of the 75 students recruited, 8 students were excluded from analyses because they were English language learners, according to parent report, and another 9 students were excluded due to a labor dispute which meant they were unavailable for the second session of T1. Thus, concurrent analyses at T1 included 58 participants (28 females and 30 males; mean age 6 yrs. 9 mos., $SD = 3.55$ months), all of whom were native English speakers. Approximately one year later, 55 of these students were available for the Time 2 (T2) follow-up in the winter of Grade 2 (28 females and 27 males; mean age 7 yrs. 8 mos., $SD = 3.26$ months; 5.1% attrition).

Students who attended each of the five schools were mostly from working- and middle-class families. According to school district data, families served by these five schools did not differ from the larger school district (about 90 elementary schools) in the proportion of households with post-secondary education or the proportion categorized within the lowest-income bracket (Ms = 49 and 7% across the school district, respectively).

Procedure

Trained research assistants conducted all testing in quiet rooms at the participants' schools. T1 testing involved two individual sessions in the winter of Grade 1, each lasting approximately 45 min. T2 testing occurred approximately one year later (mean interval between time points = 334 days; *SD* = 27.1). All testing was completed individually, aside from the Gates-MacGinitie Comprehension subtest at T2, which was administered in small groups of 2–3 students.

Instruments

Oral language and decoding measures were administered at T1; reading comprehension was measured at both T1 and T2. Table 1 shows maximum scores, descriptive statistics, and reliabilities for each task.

Vocabulary (T1)

Receptive vocabulary was measured with a modified version of the Peabody Picture Vocabulary Test (PPVT–IV; Dunn and Dunn, 2007) in which every third item was administered. All manualized procedures were otherwise followed. The shortened task maintains the structure of the original while reducing testing duration to minimize participants' missed class time. Similar shortened versions of the PPVT have been used previously (e.g., Deacon et al., 2014) and validated with children in Grade 1 (Deacon et al., 2013). Children are asked to point to one of four pictures representing the target spoken word (e.g., point to the ball; shoulder; meadow).

Syntactic awareness (T1)

Syntactic awareness was measured with 15 items that required sentence judgment and/or correction. The task was modelled after similar experimenter-constructed measures that assess children's judgment (e.g., Wulfeck, 1993; Geva and Farnia, 2012) and correction (e.g., Tunmer et al., 1988; Cain, 2007; Deacon and Kieffer, 2018) of sentences. All incorrect items involved word order errors, which is an important cue for English sentence comprehension (e.g., Wulfeck, 1993) and none involved morphological violations (*cf.* Geva and Farnia, 2012)—this ensures a focus on syntax. Prior research has shown that children in our study's age range can detect word-order violations, though not at the ceiling levels seen in adults (e.g., Wulfeck, 1993).

For 10 items, participants judged whether an orally-presented sentence was syntactically correct (e.g., correct: "*The goats run and the squirrels climb*," "*The teacher stays and Tim leaves*"; incorrect: "*The*

TABLE 1 Descriptive statistics and task reliabilities.

	Maximum possible score	Mean	*SD*	Reliability
Dependent variables				
Time 1 Reading comp: WJ-Achievement[a,g]				0.96[c]
Raw score	47	16.12	5.94	
Standard score	–	101.26	15.70	
Time 2 Reading comp: WJ Rdg Mastery[a,h]				0.94[c]
Raw score	38	12.42	3.98	
Standard score	–	99.27	13.82	
Time 2 Reading comp: Gates-MacGinitie[b]				0.93[d]
Raw score	48	32.04	10.01	
Standard score	–	48.52	8.48	
Time 1 – predictor variables				
Vocabulary	76	42.45	5.43	0.77[e]
Syntactic awareness	15	8.19	3.29	0.78[f]
Morphological awareness	20	12.75	3.47	0.78[f]
Time 1 – control variables				
Phonological decoding: word attack[a]				0.94[f]
Raw score	45	8.38	6.13	
Standard score	–	102.67	12.88	

[a]Norm referenced test with a mean of 100 and SD of 15.
[b]Norm referenced test with a mean of 50 and SD of 10.
[c]Publisher-reported split-half reliability coefficient.
[d]Publisher-reported Kuder–Richardson coefficient.
[e]Split half-reliability.
[f]Cronbach's alpha reliability coefficient.
[g]Woodcock-Johnson III Tests of Achievement.
[h]Woodcock Reading Mastery Tests – 3rd edition.

baby cries and laughs Jenny"; "*The dog sits and stands the person*"). The remaining five items involved sentence correction (e.g., "*The sisters teach and learn the brothers,*" which can be corrected to "*The sisters teach and the brothers learn.*"; for similar tasks, see Siegel and Ryan, 1988; Deacon and Kieffer, 2018). Both question formats included practice items with feedback.

Morphological awareness (T1)

The morphological awareness task assessed inflectional morphology. English-speaking children are adept at the use and manipulation of inflections by first grade (e.g., Berko, 1958; de Villiers and de Villiers, 1973), though individual differences in inflectional morphological awareness remain (Muter et al., 2004; Robertson and Deacon, 2019). By comparison, first grade students' understanding of derivational morphology is limited (Anglin, 1993; Kuo and Anderson, 2006). By focusing on inflectional morphology, we were able to assess metalinguistic awareness of morphological processes for which participants have a strong foundational knowledge and avoid the floor effects that have been seen in some prior work with this age group (Kirby et al., 2012).

Fifteen items, from the Word Structure subtest of the Clinical Evaluation of Language Fundamentals, 5th edition (CELF–5; Wiig et al., 2013), required students to complete a spoken sentence stem while referring to a picture (e.g., *Here is one child. Here are two ____*). Items captured the following range of inflectional processes: regular and irregular plural (e.g., cat; *cats* and child; *children,* respectively); past tense (e.g., cook: *cooked*); future tense (e.g., Here she is baking; tomorrow she will *bake*); third person singular (e.g., Here the girl plays; here the girl *skips*); superlative (e.g., This ball is bigger; this ball is the *biggest*); present progressive (e.g., Here the girl walks; here she is *walking*). Responses were scored as correct if they involved the appropriate morphological form for the prompt. The final five items involved correcting the errors in a spoken sentence and were included to emphasize metalinguistic awareness by requiring participants to manipulate morphemes. Errors were in subject–verb agreement (e.g., *The tree grow and the flowers dies;* correct responses: *The tree grows and the flowers die* or *The trees grow and the flower dies*). Both question formats included practice items with feedback.

To validate the separability of the three oral language measures, we ran a confirmatory factor analysis using item-level data to create latent factors for syntactic and morphological awareness (see also Deacon and Kieffer, 2018), and a single indicator of vocabulary (based on total raw scores). Wald tests confirmed that all resulting correlations between factors were significantly lower than 1.0. Specifically, the correlation between the latent syntactic and morphological awareness factors was 0.60 (Wald $\chi^2 = 16.6$, $df = 1$, $p < 0.001$), the correlation between morphological awareness and vocabulary was 0.36 (Wald $\chi^2 = 27.4$, $df = 1$, $p < 0.001$), and the correlation between syntactic awareness and vocabulary was 0.36 (Wald $\chi^2 = 28.1$, $df = 1$, $p < 0.001$). These results provide evidence that the oral language measures represent distinguishable skills for the purpose of our analyses.

Pseudoword decoding (T1)

Children completed the Word Attack subtest of the Woodcock-Johnson III Tests of Achievement (Woodcock et al., 2001). This measure involved reading a list of pronounceable pseudowords of increasing difficulty, assessing participants' ability to apply decoding skills to pronounce unfamiliar words. For example, the child would see and read pseudowords like dat, jat, heg, chrobe, and derine. Testing was discontinued after six consecutive errors.

Passage comprehension (T1 and T2)

Participants completed the Passage Comprehension subtest of the Woodcock-Johnson III Tests of Achievement (Woodcock et al., 2001) at T1 and the Woodcock Reading Mastery Tests, 3rd edition, at T2 (Woodcock, 2011). In these tasks, children read short passages to themselves and provided a missing word in each. For young children, items start out as simple sentences with an accompanying picture and the test progresses to longer passages without pictures. The child is required to read the sentence or passage and to supply a word that fits in the blank. Initial items are akin to "The boys are swimming in the ________" or "The book was placed on the _________." The task was administered and scored according to standardized procedures, and testing was discontinued after six consecutive errors.

Gates-MacGinitie reading comprehension (T2)

As an additional measure of T2 reading comprehension, participants completed the Comprehension subtest of the Gates-MacGinitie Reading Tests, 2nd Canadian edition (Level C, Form 3; MacGinitie and MacGinitie, 1992). The grade two students had 35 min to read silently through a series of stories, answering 3–5 multiple choice questions after each story. There are 14 stories in all, ranging from 4 to 11 sentences in length.

In our longitudinal analyses, children's T2 reading comprehension was captured by factor scores reflecting their combined performance on the T2 Woodcock and Gates-MacGinitie tasks. The factor scores were created using a least squares regression approach.

Analytic procedures

We used hierarchical regression analyses to address whether first grade morphological awareness, entered as the final step, predicted unique variance in concurrent and in later reading comprehension. This analytic strategy allowed an increasingly strict set of predictor variables to be accounted for to test our hypotheses. In our first set of hierarchical regression, pseudoword decoding and vocabulary were entered before morphological awareness. The third regression examined if morphological awareness predicted second grade reading comprehension after accounting for first grade reading comprehension. In the second set of hierarchical regressions, syntactic awareness was also entered into the equation before morphological awareness.

Prior to analysis, we examined variable distributions and checked data for outliers. All variables were normally distributed except for pseudoword decoding, which we square-root transformed to address positive skew (Tabachnick and Fidell, 2007). This yielded normally distributed residuals for all models reported below. There were no univariate outliers (defined as 3.0 times the median absolute distance; Leys et al., 2013) or multivariate outliers (based on Mahalanobis-minimum covariance determinant (MCD) distance computed from a central 75% of observations, using $p = 0.001$ as a cutoff for outlier detection; Leys et al., 2018).

One participant was missing a score on the morphological awareness task (0.29% of data). We dealt with this data point through multiple imputation (*mice* package; van Buuren and

Groothuis-Oudshoorn, 2011), imputing 100 data sets using predictive mean matching. The imputation models included all predictor variables used in the regressions reported below (decoding; vocabulary; syntactic awareness; morphological awareness). As a robustness check, we conducted a complete case analysis by excluding the participant with missing data. Doing so yielded the same pattern of regression results that we obtained when using the imputed data. We therefore report results from the imputed data below.

Results

Descriptive statistics

Table 1 shows descriptive data for the reading and oral language measures collected at T1 and T2. All mean standard scores on the normed reading measures fell within the average range (see Table 1), suggesting the sample is representative in their reading achievement. We used raw scores in our analyses (aside from the transformed decoding scores), and Table 2 shows the zero-order correlations between the major variables in this study. All three oral language skills were significantly correlated with reading comprehension at each time point, with the exception that syntactic awareness was not significantly correlated with T2 reading comprehension. Collinearity diagnostics for the regressions reported below indicate that multicollinearity was not an issue in our models (all variance inflation factors <1.68; tolerances >0.59; Freund et al., 2006). Given labor disruptions within the schools, the number of participants was somewhat lower than initially planned; however, the number meets the lower limits, with the total number of participants equal to or exceeding 50 plus the number of predictor variables (Harris, 1985; Green, 1991). Furthermore, the number of participants is similar to previous investigations examining the contribution of young students' oral language skills to reading outcomes (e.g., Lam et al., 2011). We return to this issue in the section on limitations.

Does morphological awareness predict reading comprehension beyond decoding and vocabulary?

We first examined whether Grade 1 morphological awareness predicted concurrent (T1) and/or longitudinal (T2) reading comprehension after controlling for decoding and vocabulary (both measured at T1). Results from these hierarchical regression analyses are shown in Table 3.

Taken together, the predictors accounted for 65.1% of the variance in concurrent (T1) reading comprehension. When entered at Step 1, decoding accounted for 58.8% of the variance ($p < 0.001$). Vocabulary did not account for significant unique variance at Step 2 ($p = 0.083$). When entered at Step 3, morphological awareness predicted an additional 4.1% unique variance ($p = 0.015$). In the final equation, Grade 1 decoding and morphological awareness were both significant predictors of unique variance in concurrent reading comprehension.

A similar pattern emerged in our longitudinal analysis predicting T2 reading comprehension. Together, T1 decoding, vocabulary, and morphological awareness accounted for 42.2% of the variance in reading comprehension one year later. Decoding accounted for 33.3% of the variance at Step 1 ($p < 0.001$), vocabulary's contribution was nonsignificant at Step 2 ($p = 0.069$), and morphological awareness predicted 4.7% unique variance at Step 3 ($p = 0.046$). In the final equation, Grade 1 decoding and morphological awareness were both significant predictors of Grade 2 reading comprehension.

Since morphological awareness was a significant contributor to grade 2 reading comprehension, we tested whether this remained significant when accounting for the autoregressive variable. This final analysis helps to determine if morphological awareness contributed to gains in reading comprehension that students made across this one-year period. As can be seen in the final regression reported in Table 3, morphological awareness was not a significant predictor of gains in reading comprehension.

Does morphological awareness predict reading comprehension beyond decoding, vocabulary, and syntactic awareness?

Next, we added syntactic awareness to our models as an additional control, allowing for a more stringent analysis of Grade 1 morphological awareness as a unique predictor of concurrent (T1) and subsequent (T2) reading comprehension. Results from these hierarchical regression analyses are shown in Table 4. The first two steps of each regression were identical to those of the models reported above.

In the concurrent analysis, syntactic awareness predicted a unique and significant 3.1% of the variance in T1 reading comprehension when entered at Step 3 ($p = 0.034$). At Step 4, morphological awareness did not make a unique contribution to T1 reading comprehension ($p = 0.058$). Together, the Grade 1 predictors accounted for 66.5% of

TABLE 2 Zero-order correlations among oral language and reading variables.

		1	2	3	4	5
1.	Reading comprehension (Time 1)	–				
2.	Reading comprehension (Time 2)	0.80***	–			
3.	Morphological awareness	0.58***	0.52***	–		
4.	Vocabulary	0.37**	0.37**	0.42***	–	
5.	Syntactic awareness	0.28*	0.13	0.39**	0.31*	–
6.	Phonological decoding	0.77***	0.58***	0.48***	0.30*	0.09

*$p < 0.05$; **$p < 0.01$; ***$p \leq 0.001$.

TABLE 3 Hierarchical regressions predicting Time 1 concurrent ($n = 58$) and Time 2 longitudinal ($n = 55$) reading comprehension, controlling for decoding and vocabulary.

Step	Predictor	ΔR^2	Initial β [95% CI]	Final β [95% CI]
Concurrent analysis: predicting Time 1 reading comprehension				
1	Pseudoword decoding	0.588	0.767*** [0.599, 0.935]	0.629*** [0.449, 0.809]
2	Vocabulary	0.022	0.156^ [−0.017, 0.329]	0.076 [−0.101, 0.253]
3	Morphological awareness	0.041	0.245* [0.054, 0.436]	0.245* [0.054, 0.436]
Longitudinal analysis: predicting Time 2 reading comprehension				
1	Pseudoword decoding	0.333	0.583*** [0.361, 0.805]	0.418*** [0.176, 0.659]
2	Vocabulary	0.041	0.211^ [−0.012, 0.435]	0.132 [−0.099, 0.363]
3	Morphological awareness	0.047	0.257* [0.010, 0.503]	0.257* [0.010, 0.503]
Longitudinal analysis: predicting gains in Time 2 reading comprehension				
1	T1 reading comp	0.645	0.803*** [0.669, 1.017]	0.760*** [0.583, 1.012]
2	Morphological awareness	0.004	0.074 [−0.133, 0.284]	0.074 [−0.133, 0.284]

*$p < 0.05$; ***$p < 0.001$; ^$p < 0.10$ (ns).

TABLE 4 Hierarchical regressions predicting Time 1 concurrent ($n = 58$) and Time 2 longitudinal ($n = 55$) reading comprehension, controlling for decoding, vocabulary, and syntactic awareness.

Step	Predictor	ΔR^2	Initial β [95% CI]	Final β [95% CI]
Concurrent analysis: predicting Time 1 reading comprehension				
1	Pseudoword decoding	0.588	0.767*** [0.599, 0.935]	0.644*** [0.468, 0.826]
2	Vocabulary	0.022	0.156^ [−0.017, 0.329]	0.054 [−0.127, 0.229]
3	Syntactic awareness	0.031	0.187* [0.019, 0.355]	0.130 [−0.043, 0.305]
4	Morphological awareness	0.024	0.196^ [−0.003, 0.395]	0.196^ [−0.003, 0.395]
Longitudinal analysis: predicting Time 2 reading comprehension				
1	Pseudoword decoding	0.333	0.583*** [0.361, 0.805]	0.406** [0.157, 0.655]
2	Vocabulary	0.041	0.211^ [−0.012, 0.435]	0.143 [−0.095, 0.382]
3	Syntactic awareness	0.001	0.039 [−0.194, 0.271]	−0.054 [−0.297, 0.189]
4	Morphological awareness	0.048	0.279* [0.011, 0.546]	0.279* [0.011, 0.546]

*$p < 0.05$; ***$p \leq 0.001$; ^$p < 0.10$ (ns).

the variance in concurrent reading comprehension; in the final equation only decoding made a significant unique contribution.

Turning to the longitudinal analysis, syntactic awareness did not uniquely predict T2 reading comprehension when entered at Step 3 ($p = 0.744$), whereas morphological awareness predicted a significant 4.8% unique variance when entered at Step 4 ($p = 0.047$). Together, the Grade 1 predictors accounted for 42.4% of the variance in reading comprehension one year later; in the final equation, decoding and morphological awareness made significant unique contributions.

Discussion

The relationship between morphological awareness and reading comprehension has been widely explored among children in the mid-elementary grades and beyond (e.g., Deacon et al., 2014; Kieffer et al., 2016; Levesque et al., 2017), but research with younger readers is less prevalent. Our study adds to this sparse literature by evaluating morphological awareness as a predictor of Grade 1 students' concurrent reading comprehension, and prospective reading comprehension one year later, after controlling for decoding and two important oral language skills—vocabulary and syntactic awareness. We found that Grade 1 students' morphological awareness predicted unique variance in both concurrent and subsequent reading comprehension beyond decoding and vocabulary, two widely prioritized aspects of early reading skill (e.g., Garcia and Cain, 2014; Quinn et al., 2015). In analyses that also controlled for syntactic awareness, Grade 1 morphological awareness predicted significant unique variance in children's reading comprehension one year later, but not in their concurrent reading comprehension. Furthermore, morphological awareness was not a significant predictor of gains in reading comprehension across the year. Together, these findings suggest that individual differences in morphological awareness are relevant to reading comprehension from early in children's formal reading instruction.

Our finding that morphological awareness uniquely predicted reading comprehension when controlling for decoding and vocabulary builds on the small body of similar research with beginning readers. The concurrent results align with those of two prior studies (Apel and Henbest, 2016; James et al., 2021). Both studies grouped together children in Grades 1–3 and found that morphological awareness predicted unique variance in children's concurrent reading comprehension (beyond age, phonological awareness, and vocabulary, and in James et al., 2021, word reading and nonverbal reasoning). The current study affirms this pattern of results while focusing on a narrower age range, increasing our confidence that morphological awareness uniquely predicts reading comprehension among Grade 1 readers specifically.

Past longitudinal results with this age range have been more conflicting. Kirby et al. (2012) found no effect of Grade 1 morphological awareness on Grade 3 reading comprehension, whereas in Kruk and Bergman's (2013) examination of the same grade levels, morphological awareness did uniquely predict subsequent reading comprehension. Our longitudinal findings align with the latter study—in our sample, first graders' morphological awareness uniquely predicted their Grade 2 reading comprehension beyond decoding and vocabulary (see also Carlisle, 1995; Carlisle and Fleming, 2003 for similar patterns without these controls). Notably, these converging findings occurred despite the different morphological awareness task formats across studies (generating inflectional forms and correcting morphological errors in the current study; (de) composition of morphological forms in Kruk and Bergman, 2013). This suggests that the pattern is robust to differences in the measurement of morphological awareness, provided the task is sufficiently sensitive to individual differences among children (*cf.* Kirby et al., 2012, who found floor effects in Grade 1 students' morphological awareness). Morphological awareness did not contribute specifically to gains in reading comprehension over the year. First grade morphological awareness does contribute to second grade readers' comprehension, but is not restricted to the association between these two variables over this one year of time. In other words, morphological awareness was not observed to be a driver of gains in reading comprehension from first to second grade.

Our second set of analyses added syntactic awareness as a control variable (along with decoding and vocabulary). Inflectional morphemes serve grammatical functions in sentences, making syntactic awareness a conceptually valuable control that isolates children's metalinguistic awareness of morphemes from that of other aspects of grammar. However, syntactic awareness has not been incorporated into prior work with this age group (but has been with older children; see Proctor et al., 2012; Kieffer et al., 2016; Deacon and Kieffer, 2018; Metsala et al., 2021). Our concurrent results underscore the importance of doing so—once shared variance between morphological and syntactic awareness was accounted for, the unique effect of morphological awareness on Grade 1 reading comprehension was nonsignificant.

Interestingly, a different pattern emerged longitudinally—Grade 1 morphological awareness explained unique variance in Grade 2 reading comprehension beyond decoding, vocabulary, and syntactic awareness. Broadly, this aligns with prior work by Muter et al. (2004), who found that Grade 1 grammatical awareness—a composite capturing awareness of morphology and syntax—predicted reading comprehension one year later beyond vocabulary, word reading, and other controls. Our results built on this finding by isolating morphological awareness from syntactic awareness. Indeed, the pattern we found supports distinguishing the two predictors; in our sample, first graders' syntactic awareness did not predict their subsequent reading comprehension, whereas their morphological awareness did.

Why might morphological awareness have predicted later, but not concurrent, reading comprehension when controlling for syntactic awareness? One explanation is that decoding accounted for a larger proportion of variance in concurrent than subsequent reading comprehension (see also Garcia and Cain, 2014), leaving less variance to be explained by other skills in the concurrent analysis. Here, we note that morphological awareness was more strongly related to concurrent reading comprehension than vocabulary or syntactic awareness, as shown in the bivariate correlations and the magnitudes of their regression coefficients. Thus, although decoding explained the bulk of variance in Grade 1 reading comprehension, morphological awareness outperformed the other oral language skills. We should also note that our relatively small sample size (see limitations section), may have contributed to morphological awareness not meeting traditional levels of statistical significance in this more stringent concurrent analysis. It may also be that students' morphological awareness may have accounted for unique variance in second versus first grade as the number of morphologically complex words increases with higher text levels (e.g., Dawson et al., 2023). An additional explanation concerns the negligible relationship between syntactic awareness and Time 2 reading comprehension. The reason for this is unclear—there were no apparent issues with the syntactic awareness task or the distribution of scores in our sample, its association with Time 1 reading comprehension was significant, and similar measures have been significantly associated with reading comprehension among slightly older children (e.g., Deacon and Kieffer, 2018; Metsala et al., 2021). Although syntactic awareness was not an especially powerful control when predicting Grade 2 reading comprehension in our sample, the longitudinal results suggest that children's early morphological skills were more relevant than their syntactic skills to the reading comprehension demands they faced in Grade 2.

From a theoretical standpoint, the Morphological Pathways Framework (Levesque et al., 2021) sheds light on our findings by proposing three paths to explain the effects of morphology on reading comprehension—one direct path, and two indirect paths mediated by children' use of morphemes to read, and determine the meaning of, morphologically complex words (morphological decoding and morphological analysis, respectively). The framework has empirical support from research with older elementary-school students. For instance, Levesque and colleagues (2019) found that Grade 3 morphological awareness predicted subsequent gains in children's morphological analysis for derived words—a skill that allows children to infer the meaning of morphologically complex words (e.g., using knowledge of the base word *question* and suffix *–able* understand the meaning of *questionable*). Morphological analysis, in turn, predicted gains in reading comprehension. Although this indirect path might plausibly contribute to our findings, we suspect that morphological analysis of inflections may be less useful than analysis of derived words in English, which has a limited system of inflections (Kuo and Anderson, 2006).

The direct path of the Morphological Pathways Framework posits a link between morphological awareness and text comprehension processes, through which readers parse and interpret texts to build a situation model (Kintsch and van Dijk, 1978). One proposed explanation for this direct path is that morphological awareness captures general metalinguistic and/or oral language skills (Levesque et al., 2021). Consistent with our longitudinal findings, prior research suggest that morphological awareness predicts reading comprehension after controlling for other metalinguistic skills (e.g., Carlisle, 1995; Kirby et al., 2012) and general language abilities (e.g., Kieffer et al., 2016; Metsala et al., 2021). A second, yet-to-be-explored possibility is that children's awareness of inflections might facilitate text comprehension directly by signaling the temporal and causal relationships involved in building strong situation models (Morrow, 1986; Zwaan et al., 1995). As one example, grammatical tense and aspect indicate when an action took place (past, present, future) and whether that action has been completed or is ongoing (e.g., *Sally walked down the street* vs. *Sally was walking down the street*). Adult readers are sensitive to grammatical aspect's role in signaling temporal information (Magliano and Schleich, 2000) and use it to define narrative event boundaries (Feller et al., 2019). Indeed, some have argued that morphology provides a set of processing instructions for situation model construction (Givón, 1992). Our findings of a unique relationship between Grade 1 morphological awareness and reading comprehension highlight the need to further explore the role of inflectional morphology in these comprehension processes in general, and in young readers specifically.

Limitations

As with all research, limitations need to be considered when interpreting our findings. Central among them is the modest sample size, which was largely a result of labor negotiations that disrupted our planned participant numbers. Our achieved sample size was sufficient for our purposes, but constrained the analyses we could run. We present our findings as preliminary evidence that beginning readers' morphological awareness predicts later reading comprehension beyond decoding and a comprehensive set of oral language controls, but encourage future research that reproduces these analyses in larger samples. Longitudinal research with these controls in young children is limited; this study contributes to initial understandings and to inform further research. Another limitation is our morphological awareness task, which only captures inflections—one aspect of English's wider morphological system. This focus was motivated by a desire to target morphological skills that are well-developed among first-grade students, though we fully support calls to assess morphological awareness in a comprehensive way (Apel et al., 2013). Recent work by James et al. (2021) found that awareness of inflections, derivations, and compounds comprised a single factor among 6- to 8-year-old children, which suggests that inflectional awareness taps into the broader morphological awareness construct. Even so, we must be clear that our morphological awareness task does not capture the full scope of English morphology.

Conclusion

In summary, our study speaks to morphological awareness' role in predicting early reading comprehension. We took the important step of including vocabulary and syntactic awareness—oral language skills linked with both morphological awareness and reading comprehension—as controls, alongside decoding. In doing so, we were able to isolate morphological awareness' contribution to early reading comprehension. Grade 1 students' morphological awareness predicted their concurrent and prospective reading comprehension beyond decoding and vocabulary, and the longitudinal effect remained when further controlling for syntactic awareness. Indeed, morphological awareness emerged as the strongest oral language predictor of reading comprehension in our models. Although more work remains to be done with this age group, this study points to the relevance of morphological awareness to reading comprehension from early in children's reading development—a finding that adds to our understanding of the oral language contributors to beginning reading comprehension. Our findings also point to the need for further research to guide assessment and instruction of morphology in the earliest elementary grades.

Data availability statement

The datasets presented in this article are not readily available because the consent forms signed for this study preclude making the data for this manuscript openly available. Requests to access the datasets should be directed to Jamie.Metsala@msvu.ca.

Ethics statement

The studies involving humans were approved by Mount Saint Vincent University's University Research Ethics Board. The studies were conducted in accordance with the local legislation and institutional requirements. Written informed consent for participation in this study was provided by the participants' legal guardians/next of kin.

Author contributions

ES: Formal analysis, Investigation, Methodology, Writing – original draft. JM: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Resources, Writing – review & editing, Project administration.

Funding

The author(s) declare financial support was received for the research, authorship, and/or publication of this article. This research was supported by an Inter-University Research Network grant from the Nova Scotia Department of Education and Early Childhood Development and by the Gail and Stephen Jarislowsky Chair in Learning Disabilities Endowment to Mount Saint Vincent University.

Acknowledgments

The authors wish to thank participating students, their teachers and principals, and the project team, including research assistants and individual collaborators, for their contributions to this research.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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