Published in final edited form as:

Read Writ. 2016 January 1; 29(1): 47–68. doi:10.1007/s11145-015-9579-7.

Contributions of Morphological Skill to Children's Essay Writing

Mary Northey, Deborah McCutchen, and Elizabeth A. Sanders

University of Washington

Abstract

Morphological skills have previously been found to reliably predict reading skill, including word reading, vocabulary, and comprehension. However, less is known about how morphological skills might contribute to writing skill, aside from its well-documented role in the development of spelling. This correlational study examines whether morphological skill, as measured by a sentence generation task tapping both derivational morphology and meta-syntactic skills, predicts performance on a standardized essay writing task for fifth- and eighth-grade U.S. students ($N = 233$), after controlling for grade level, comprehension, and writing fluency. Multilevel analyses indicated that morphological skill and writing fluency were each uniquely predictive of essay quality, and this finding was consistent regardless of whether accurate spelling was required in the morphological task. Our results suggest that morphological skills play an important role in writing, as has been previously documented in reading and spelling.

Keywords

morphology; writing; spelling; correlation; elementary age; middle school

When Huckleberry Finn found that he and his companion Jim needed to move quickly to escape a gang of murderers, Huck decided “it warn't no time to be sentimentering” (Twain, 1884/2003, p. 73). “Sentimentering” is not an English word, of course, but given the structure of the word and the context in which it is found, a reader might guess its meaning. For anyone familiar with this Samuel Clemens (aka Mark Twain) novel, it would have been quite odd had the protagonist Huck—whose homespun dialect gives *Adventures of Huckleberry Finn* its unique voice—said instead “there was no time for sentimentality.” The choices that Clemens made in crafting the words and syntax of his narrator made Huck Finn and the other characters come alive in readers' minds. Those choices were intentional. Clemens used “sentimentering” as a tool to give readers specific insights into his novel's main character. That is not to say that writers should always make up new words to express their ideas. Rather, good writers know that some words are more effective than others at times. Writing is a craft, and words are tools that writers use to craft meaning (Myers, 2003).

As Clemens clearly understood, critical issues during writing include purpose and audience. For example, children often use different language with their friends than they do with their family, both of which may differ from the language they are expected to use at school

(Schleppegrell, 2012). In each situation, choices are made about how language is used to create meaning, whether those choices are conscious or unconscious. To make effective choices, writers need to be aware, on some level, that language is a system that they can reflect upon and manipulate to fulfill their intentions.

This ability to reflect upon the structural and functional features of language is referred to as metalinguistic awareness, and one type of metalinguistic awareness that has been shown to contribute to literacy skill (and to Clemens' skill in crafting the Huck Finn quote in our opening sentence) is *morphological awareness*. Morphological awareness has been defined as a "conscious awareness of the morphemic structure of words and ability to reflect on and manipulate that structure" (Carlisle, 1995, p. 194). Insight into the morphological structure of words includes recognizing morphemes, the smallest meaningful units of language. For example, the word *careless* is composed of two morphemes: the stem *care* and the suffix *-less*. Morphological awareness thus helps in reading, as well as in oral language, if one can recognize familiar meaningful segments within otherwise unfamiliar words.

Apel (2014) recently argued for a more comprehensive definition of morphological awareness that includes awareness of spoken *and written* forms of morphemes, as well as awareness of the meaning of affixes and the changes in meaning, spelling, and syntactic class that affixes bring to stem words (e.g., *operate* functions as a verb whereas *operation* as a noun). Such a definition helps explain how morphological awareness can be helpful in spelling words as well as reading them, because English is written with a morphophonemic orthography, reflecting both the morphological and phonological structure of words. That is, the spelling of English words does not always map transparently onto their pronunciations, as is the case in some languages. For example, the spelling of *sign* makes more sense when one recognizes the semantic connection (i.e., the morphological relationship) between *sign* and *signature*.

As did Apel (2014), Jarmulowicz and Taran (2013) emphasized the semantic and syntactic aspects of morphological understanding in what they term *lexical morphology*. Their choice of the term *lexical* reflects research suggesting that acquisition of related derivational forms (forms that change grammatical category, such as *operate* and *operation*) results in separate but related entries in the lexicon, unlike inflectional forms (forms that change tense and number, such as *walked* from *walk*, or *birds* from *bird*), which do not change grammatical category. The inclusion of morpho-syntactic understanding in the definitions of morphology offered by Apel (2014) and Jarmulowicz and Taran (2013) implies that morphological awareness can provide insights that may be useful in reading and writing beyond the word level, at the sentence or text level as well. Additionally, Jarmulowicz and Taran distinguish between conscious awareness of morphology, which allows explicit reflection, from more implicit morphological skill, which may still support production of appropriate morphological forms. It is such implicit skill with lexical morphology that is of particular interest here.

Morphological skill at the level of the word

Word reading

There is a growing body of evidence that morphological skill (whether conscious awareness or not) plays an increasingly important role in reading as children's literacy skills develop. Performance on tasks presumed to tap morphological awareness positively predicts word reading (Kirby et al, 2012; McCutchen, Green & Abbott, 2008; Singson, Mahony, & Mann, 2000). Morphological skill seems to be particularly useful in reading as children progress beyond the early stages of reading acquisition and encounter the more complex vocabulary (often including more morphologically complex words) that typifies written academic English in later elementary school and thereafter (Lawrence, White & Snow, 2010; Nagy & Townsend, 2012). Due to variation in what defines a unique word, current estimates of the number of English words vary from roughly 500,000 to just over one million. Regardless of how one defines the total number, Nagy and Anderson (1984) identified a smaller but still substantial number (approximately 89,000) of distinct morphological word families in printed school English. With the possibility of encountering so many unique, potentially unfamiliar words in written texts, children should be advantaged if they can strategically use morphological structure to infer meanings of unfamiliar words from knowledge of familiar morphological relatives, and children who were better at such morphological analysis were also found to be better readers (McCutchen & Logan, 2011). Additionally, interventions including morphological awareness instruction have been associated with improvements in word decoding (Vadasy, Sanders & Peyton, 2006) and vocabulary (Baumann, Edwards, Font, Tereshinski, Kame'enui, & Olejnik, 2002; see also meta-analyses by Goodwin & Ahn, 2010, 2013).

Spelling

Contributions of morphological awareness to the development of children's spelling skills are also well documented. More advanced spelling skills among preadolescent and adolescent students have been linked to growing awareness of morphological aspects of orthography across a broad range of writing skill (Bourassa & Treiman, 2008; Carlisle, 1988; Ehri, 1992; Treiman, 1993). According to Nunes and Bryant (2006), morphological insights can demystify many peculiarities in English spelling -- for example, why the same sounds are spelled differently across words with different morphological structures (*lox*, *locks*) or why the same spelling is maintained across different pronunciations (*heal*, *health*). Recent meta-analyses have also documented that, across multiple studies, morphological instruction improves students' spelling (Goodwin & Ahn, 2010, 2013), although gains tend to be larger for younger students (ages approximately 4–8 years) compared with older students.

Word retrieval

In addition to improving the reading and spelling of words, morphological knowledge may play a role increasing fluency of word retrieval processes. Struggling writers are often slower than their higher-skilled peers in accessing individual words (McCutchen, Covill, Hoyne & Mildes, 1994), and even among college writers, more fluent language generation processes (i.e., longer “bursts” of continuous text generation during writing; Chenoweth &

Hayes, 2001) were related to higher quality texts (see also Dellerman, Coirier & Marchand, 1996). Morphological awareness has been proposed as an important driver of the explosive growth in children's vocabulary after approximately age eight, which can lead to both expanded vocabulary and more fluent word retrieval (Anglin, 1993; Derwing, Smith, & Wiebe, 1995; Nagy & Anderson, 1984; Nagy & Scott, 2000), and morphological awareness positively predicts vocabulary (Carlisle, 2000; McCutchen & Logan, 2011; Nagy et al., 2006). Providing theoretical support for such claims, Reichle and Perfetti (2003) developed a computational model that simulated how encounters with morphologically related words can facilitate access to words in the lexicon.

Morphological skill at the level of the sentence and text

Reading comprehension

Performance on morphological awareness tasks also positively predicts comprehension of extended text, as measured in a variety of ways (Carlisle, 2000; Kirby, Deacon, Bowers, Izenberg, Wade-Woolley, & Parrila, 2012; Foorman, Petscher, & Bishop, 2012; McCutchen & Logan, 2011; Nagy, Berninger, & Abbott, 2006). Furthermore, interventions including morphological instruction have led to improvements in children's comprehension (Abbott & Berninger, 1999; see also Carlisle, McBride-Chang, Nagy, & Nunes, 2010, for a review, and Goodwin & Ahn, 2010, 2013, for recent meta-analyses).

Writing

Although there is less empirical research regarding the role that morphological awareness plays in writing extended text compared to reading it, there is research documenting the frequency of various morphological forms in children's written narratives. As in oral language, where children develop inflectional morphology knowledge (tense and plural markers; e.g., *walked* and *birds*) by ages six to eight (Menyuk, 1988), children's use of written inflectional forms also precedes their use of all but the most common derivational forms (Carlisle, 1996; Green, McCutchen, Schwiebert, Quinlan, Eva-Wood, & Juelis, 2003). Children's productive use of derivational (i.e., lexical) morphology develops later than their use of inflectional morphology in writing, typically beginning in the early elementary years (Berninger, Abbott, Nagy & Carlisle, 2010; Carlisle, 1996) and continuing to develop throughout the middle elementary years and beyond (Green et al., 2003; McCutchen & Stull, 2015).

In addition, theoretical models of writing suggest some important possible roles for morphological skill during the production of extended text. Hayes and Flower (1980) offered a model of the writing process that consists of three major processes: planning, translating, and reviewing. Planning includes generating ideas, organizing them, and setting goals; translating includes transforming ideas into language; and reviewing includes reading and revising the existing text. Recognizing the increased challenges that translation processes present for young developing writers, Berninger and Swanson (1994) further articulated subcomponents of translating: text generation and transcription. Text generation involves transforming ideas into language whereas transcription involves converting that language into written symbols. Transcription processes thus include spelling, handwriting,

and typing, whereas text generation entails more fundamental lexical, syntactic, and rhetorical processes involved in translating ideas into words, sentences, and extended multi-sentence texts.

According to Berninger and Amtmann's *simple view of writing* (2003), transcription, text generation processes, and higher order executive processes (e.g., planning, goal-setting, revising) all compete for limited working memory resources during writing, especially for young writers. By such an account, increased fluency of transcription and/or text generation (resulting from increased morphological skill) could result in improved writing either because of specific aspects of the language generated (e.g., more precise word choice and accurate spelling, more varied or sophisticated syntactic structures) or because of increased ability to attend to higher level goals, such as planning and revising, as a result of increased available working memory resources (see also McCutchen, 2000). Consistent with this view, Berninger and Swanson (1994) documented that both transcription and text generation skills contributed significantly to composition quality across the intermediate and junior high school years.

Thus, morphological skill may be implicated in children's syntactic development. With the complex syntax that is common of academic language, the syntax that children are asked to read and write becomes increasingly complex as they progress through school (Hunt, 1970; Lawrence et al., 2010; Nagy & Townsend, 2012). Younger children often write by stringing together independent clauses (Hunt, 1970; Crowhurst, 1983), whereas somewhat older children tend to use more clausal subordination. Still more mature writers (indexed by age and writing skill) are able to vary their syntax to suit their intentions, often packing more information into fewer words by reducing clauses into more semantically dense phrases within syntactically simpler sentences. In a linguistic analysis of adolescents' writing, Myhill (2008) found that weaker writers tended to use less variety in their word choice and syntax, often relying on common organizational markers such as *when*, *also*, and *because*. Stronger writers, in contrast, effectively used a greater variety of organizational markers and syntactic structure (see also Dobbs, 2014).

Knowledge of lexical morphology (Jarmulowicz & Taran, 2013), with its morpho-syntactic aspects, could help a writer manage syntactic choices by assisting with the fluent change of verbs into nominalizations, or the reverse, via manipulation of suffixes. Consistent with such an account, Berninger, Nagy, and Beers (2011) found that, among first-grade students, morphological awareness explained unique variance in a sentence-writing task that required syntactic manipulations, and McCutchen and Stull (2015) reported similar findings among fifth-grade students. Additionally, morphological instruction has also been shown to improve children's use of morphologically complex forms in sentences and in multi-sentence written responses (McCutchen, Stull, Herrera, Lotas, & Evans, 2014). McCutchen and Stull's (2015) data also suggested that children use their morphological skill not only to *retrieve* words they know but also to *construct* novel morphological forms to fit the developing syntax of their sentences (e.g., *solidize*, presumably by analogy with *crystallize*). If students can manipulate words that they already know by altering suffixes, they may be better able to express their intended meaning more precisely and succinctly. Thus,

morphemes may serve as a bridge that relates the word level to the sentence level, with word-level manipulations assisting with sentence-level syntax.

Consistent with Berninger and Amtmann's simple view of writing (2003), influences of morphological skill during the generation of extended multi-sentence text could also help writers manipulate written language more effectively to achieve larger rhetorical goals, as well as maintain syntactic accuracy, by freeing working memory resources to attend to those goals. For example, revising the phrase *the people who lived in the colonies in America* to *the American colonists* does much more than smooth the syntax; it conveys a more nuanced meaning about the emerging identity of the colonists, which could influence interpretation of entire sections of text and thus help achieve the writer's rhetorical goals. As did Clemens with his use of the word "sentimenting," a skilled writer can accomplish much with a single word. Thus, while morphological skill has been found to have well documented relationships with reading at the word, sentence and text level, morphological skill may similarly contribute to writing across words, sentences and extended text.

The Present Study

The goal of the present study was to examine productive use of lexical morphological skill at the word and sentence level and explore relationships between such skill and overall text quality. The focus was the later elementary and middle school grades because of the increase in academic language demands during this period (Lawrence et al., 2010; Nagy & Townsend, 2012). Specifically, the present correlational study investigated whether performance on a morphological production task uniquely predicted quality of extended essay writing in a standardized writing assessment. Our specific research question was: Does skill with lexical morphology, as measured by the number of morphological changes made by children in a sentence writing task, uniquely predict essay quality in a standardized assessment, after taking into account grade level, comprehension, and writing fluency?

Method

Participants

Participants included 233 fifth and eighth grade students (5th grade, $n=112$, 8th grade, $n=121$) from 12 classrooms (half in each of the two grade levels) across three K-8 schools in the U.S. Pacific Northwest. All students who returned parent consent and completed all the research tasks were included as participants. Girls and boys were proportional for each grade level in the sample (50% and 53% female for grade 5 and 8, respectively). The mean age of the fifth grade students was 10 years, 10 months, and the mean age of the eighth grade students was 13 years, 8 months. The subject sample (based on self-report) was 78% White/European American, 8% Asian American, 7% more than one race, 2% Native American/Alaska Native, 2% Black/African American, 1% Pacific Islanders, and 1% other. Most students (91%) were monolingual English speakers, and all students were sufficiently fluent in spoken English to complete the test measures without language support.

Measures

Assessments were administered in English by trained research assistants between November and January, with testing coordinated with school schedules. Students were tested in both group and individual testing sessions at their schools. Assessments are described in more detail below. We note that raw (total) scores were used in all forthcoming analyses.

Essay writing quality—As a measure of extended writing skill, our outcome of interest, students completed the group-administered essay subtest from the Wechsler Individual Achievement Test, Third Edition (*WIAT-III*, Pearson, 2010). The essay subtest provided a standard prompt and a detailed scoring rubric. Following the format for standard administration, we provided students the following instructions: “Write about your favorite game and include at least three reasons why you like it.” Consistent with the standardized administration, students were given 10 minutes to write by hand and were prompted to try to write an entire page. The standardized scoring of the essays yielded three scores: word count, content and organization, and grammar and mechanics (essentially, spelling and punctuation). For the present study, only the content and organization score was used because it was thought to be the most reflective of the overall quality of children's arguments. The content and organization score ranges from 0 to 20 points, reflecting five general criteria: introduction/thesis statement, conclusion, paragraphs, transitions, and reasons/elaborations. To score well on the essay, students were required to introduce the essay with a thesis and include clear, identifiable reasons and elaborations supporting the thesis. The test manual for the *WIAT-III* (Breux & Frey, 2010) reports a reliability of .82 for fifth graders and .75 for eighth graders.

Reading comprehension—In an attempt to disentangle writing skill from the related literacy skill of reading, we asked students to complete the comprehension subtask from *Woodcock Johnson III Tests of Achievement (WJ-III*, Woodcock, McGrew, & Mather, 2001). The individually administered measure is a cloze task, requiring students to provide aloud any missing words they encounter in running text as they read silently. The test manual (McGrew, Schrank & Woodcock, 2007) reports test-retest reliabilities ranging from .81 to .88 for ages 8–17.

Writing fluency—In an attempt to distinguish transcription from text generation as much as possible, we included the group-administered writing fluency subtest from the *Woodcock Johnson III Tests of Achievement (WJ-III*, Woodcock et al., 2001), which places heavy emphasis on writing speed and legibility (transcription processes). For each item in this timed task, students were shown a picture together with three words and asked to construct a sentence about the picture using the three words, with no changes to the words permitted. Students were thus required to quickly generate and transcribe as many sentences as they could within the 7-minute time limit, with a total of 40 points possible. Although the writing fluency subtest requires construction of simple sentences (e.g., *The boy is happy*, given the words *boy*, *happy*, and *is*) and so taps basic text generation processes, it is often used as a measure of handwriting fluency. The test manual (McGrew et al., 2007) reports test-retest reliabilities ranging from .70 to .77 for ages 8–17.

Morphological skill—To assess students' skill with lexical morphology and morpho-syntactic manipulations within sentences (text generation processes), we administered a researcher-developed sentence-combining task adapted from McCutchen and colleagues (McCutchen et al., 2014; McCutchen & Stull, 2015). The task required students to make morphological changes to words and manipulate other syntactic aspects of multiple short sentences as they combined them into one longer sentence. (The complete measure is provided in Appendix A.) The task correlates significantly with traditional measures of morphological awareness (McCutchen & Stull, 2015), and although it invites derivational changes to words to create more conceptually dense phrases, it allows students choices in the words and syntax they produce. Multiple correct responses are thus possible for each item. An example item is provided below.

The campers slept under the sky.

The sky looked like ink.

Their sleep was deep.

Correct responses to this item might include “*inky* sky,” slept *deeply*,” or even “the *deeply sleeping* campers.” This task thus differs from traditional morphological production measures (e.g., Carlisle, 1995) because it invites students to produce written morphological derivations without being explicitly instructed to change a specific word to fit a predetermined sentence frame. Thus, theoretically the sentence-combining task may relate more closely to writing skill because it requires flexibility with syntax manipulation as well as retrieval of appropriate word forms to fit the developing syntax.

In the present study, the task included six items (i.e., six sets of multiple short sentences), plus a practice item with a sample response that was discussed with students as a group. Students then wrote their individual responses to the remaining six items. Although an exact maximum score is difficult to specify because students had options in the sentences that they generated, sixteen is a reasonable estimate of the number of possible morphological changes across the six items. Responses were then scored in two ways, one requiring correct spelling (consistent with Apel's (2014) definition of morphological awareness that includes knowledge of written forms) and the other allowing phonologically accurate misspellings (more consistent with orally presented morphological tasks). In the first scoring, students received 1 point for each *accurately spelled* derivational morphological change they made as they changed a word from a kernel sentence to fit their constructed response. For example, if in response to the sample item presented above, a student wrote *The campers slept deeply under the inky sky*, the student received two points: one for changing *deep* to *deeply* and one for changing *ink* to *inky*. Interrater reliability between two scorers using this criterion was $r = .99$ (Pearson's r), and internal consistency was .87 (Cronbach's alpha).

Our second scoring method did not require that the morphological change be accurately spelled to receive credit; instead, a student received credit if the change reflected a decodable phonological approximation of an appropriate English derivation form that fit the sentence syntax. That is, we evaluated misspelled attempts at morphological changes, and if the misspelling contained an error in a single letter (e.g., *solidfy* for *solidify*) or if its pronunciation were a close dialectical variation of the appropriate morphological form (e.g.,

glisning for *glistening*), it was scored correct (i.e., phonologically accurate). Relaxing the requirement for correct spelling better aligns with many traditional measures of morphological awareness using oral responses. Interrater reliability between two scorers was .98 (Pearson's *r*), and sample internal consistency was .90 (Cronbach's alpha).

In sum, our first scoring method for the morphological skill task reflected word production and spelling skill (reflecting text generation and transcription processes, according to Berninger and Swanson, 1994), while the second reflected primarily word production (text generation).

Analysis strategy

We embarked first on a quantitative analysis of relationships among the multiple measures completed by the students. We then followed with a qualitative analysis of the language students used in their texts to further explore the nature of any observed relationships.

We adopted multilevel modeling for testing our primary research question to account for dependencies among student scores due to classroom nesting. Preliminary analyses indicated that school membership did not account for significant variation in student scores after classroom membership was taken into account; however, classrooms accounted for substantial variation in essay writing quality (intraclass correlation = .22, indicating that classroom accounted for approximately 22% of the variance in scores). Hence, we used 2-level models to test the unique relationship between morphological skill and essay writing quality, with students (Level 1) nested within classrooms (Level 2). To tease out the unique contribution of student morphological skill (with or without correct spelling assumed) to student essay writing quality, we purposefully controlled for classroom grade level, student reading comprehension, and student writing fluency. Additionally, for consistency across measures, raw (total) scores were employed for each variable in analyses; and for ease of results interpretation, we effect coded grade level (+1=grade 8, -1=grade 5) and standardized the remaining predictors (i.e., z-scores). Finally, because preliminary analyses indicated a significant interaction between grade level and reading comprehension on essay writing quality (but not between any other predictors), we included a cross-level interaction term between these two variables in our model analyses. Our general model, conducted using each of the two kinds of morphological change scores separately, was as follows:

$$EWQ_{ij} = \gamma_{00} + \gamma_{01} * G_j + \gamma_{10} * RC_{ij} + \gamma_{11} * G * RC_{ij} + \gamma_{20} * WF_{ij} + \gamma_{30} * MS_{ij} + U_{0i} + r_{ij}.$$

Our model above indicates that the essay writing quality (EWQ) score for the i^{th} student in the j^{th} classroom is equal to the sum of the conditional mean across classrooms (γ_{00}), the effect of classroom grade level (γ_{01}), the effect of student reading comprehension (γ_{10}), the interaction between grade level and student reading comprehension (γ_{11}), the effect of student writing fluency (γ_{20}), the effect of morphological skill (γ_{30}), and the residual error between and within classrooms (U_{0i} and r_{ij} , respectively).

Results

Descriptive statistics

Children's observed scores on all measures are presented in Table 1 for each grade level. Although significant differences between grade levels on the raw scores were apparent ($ps < .001$), the norms for the raw scores indicated that the two groups of students were similar when age was taken into account. Specifically, for the three norm-referenced measures, the fifth grade sample averaged in the 57th percentile on essay writing quality, 52nd percentile on reading comprehension, and 56th percentile on writing fluency; similarly, the eighth grade sample averaged in the 61st, 52nd, and 63rd percentiles on essay writing quality, reading comprehension, and writing fluency, respectively. In sum, our study sample was representative of typically developing U.S. children in grades 5 and 8.

Observed zero-order correlations among all variables used in analyses are presented in Table 2. Importantly, all predictors were positively correlated with the outcome as well as with each other. Moreover, the two scoring methods for the morphological skill variable were nearly perfectly correlated, at $r = .98$, but the first scoring method (entirely correct spelling of morphological changes) showed slightly higher correlations with the outcome and other predictors than the second scoring method.

Multilevel model results

Table 3 displays our multilevel model results for each of the two analyses (in Model 1, the morphological skill score was based on entirely correct spelling, and in Model 2, the score was based on phonologically correct spelling).

As anticipated from the high correlation between the two scoring methods of the morphological task, results from the two models yielded the same substantive (nearly identical) results. Across both models, neither grade level nor reading comprehension was uniquely predictive of essay writing quality ($ps > .30$; although we note that this finding takes into account shared variance among all predictors), whereas both writing fluency and morphological skill were positively predictive ($ps < .05$). Further, the interaction between grade and reading comprehension was significant in both models ($ps < .01$).

Because both sets of results were substantively the same, we will focus on interpreting the meaning of the significant findings in the first model, in which correct spelling was required in the scoring of morphological skill (following Apel, 2014). For writing fluency, the significant coefficient indicates that, for every standard deviation increase in writing fluency, a 1.14-point increase in essay writing quality was predicted, holding all else constant. If we translate the coefficient into a unit-free value, the approximate effect size (d^* which is computed as the coefficient divided by the square root of the sum of the variance components) is 0.33. In other words, for every standard deviation increase in writing fluency, we expect an increase of approximately 0.33 standard deviations in essay writing quality.

The effect of morphological skill on essay writing quality was similar to that of writing fluency; the results indicate that, for every standard deviation increase in morphological

skill, a 0.70-point increase in essay writing quality was expected, all else held constant. We again computed the effect size and found $d^* = 0.20$, indicating that, for every standard deviation increase in morphological skill, an approximately 0.20 standard deviation increase in essay writing quality was predicted. To further contextualize these two key findings, consider that the model predicted improvement of nearly two grade levels in essay quality scores for a fifth grade student who moved from one standard deviation below the mean to a mean score on either the morphological skill or writing fluency measure.

Finally, to gain a better understanding of the nature of the significant grade-by-reading comprehension interaction on essay writing quality, we computed model-implied scores for students with relatively low, average, and high reading comprehension levels for each of the two grade level groups. The computed values indicated that eighth graders had an advantage in essay writing quality over fifth graders, but only for students scoring relatively low on reading comprehension. For example, there was a 2.19-point predicted writing advantage for older students in essay quality for those who were one standard deviation below average in reading comprehension, but only a 0.83-point predicted advantage for students with average reading comprehension levels (a difference that was not uniquely significant in our model).

Linguistic analysis

To explore further the possible source of the relationship between morphological skill and essay quality, we undertook a qualitative examination of the texts using corpus linguistic analysis, which allows for the identification of language use patterns in large samples of text (McEnery & Hardie, 2012). As an example of the qualitative effects of morphological skill, consider the essay written by an eighth grade student in the present study, reproduced in Table 4.

This student fluidly signaled the move from one thought to the next by her effective use of transition words and phrases, including the affixed *secondly* and *finally*. Thus, one potential (albeit somewhat mundane) explanation for the quantitative findings could reflect students' use of transition words in their essays, especially since sentence-initial transition words figured in the standardized scoring of the *WIAT-III* essay task.

Transition words, a common characteristic of expository writing, can help to sequence writing, support the organization of the writer's thoughts, and guide the reader from one thought to the next. When used well, such word-level choices can improve sentence-level coherence and text-level organization (Halliday & Hasan, 1976; McCutchen, 1986). In addition to sentence-initial transition words, other transition words embedded within sentences (referred to here as organizational markers) can serve a similar purpose in organizing and signaling the movement of ideas through a text.

Under the *WIAT-III* scoring guide (Pearson, 2010) each unique, sentence-initial transition word in an essay received a point in the content and organization score (with 5 points possible due to transitions, of the 20 maximum points). In the list of 207 unique transition words and phrases identified in the *WIAT-III* scoring guide, many are affixed derivations such as *secondly*, *additionally*, and *finally*. If the relationship between skill with lexical morphology and essay quality results simply from students' use of morphologically complex

transitions in their writing, we might expect to see significantly more of these affixed, sentence-initial transition words in higher-quality essays.

The essays ($n=233$) were transcribed into a digital format and divided into two corpora using the grand mean of the *WIAT-III* organization score ($M=9.53$, $SD=3.88$) as a dividing point. The “lower” quality corpus ($n=119$) contained approximately 14,370 words, while the “higher” quality corpus contained approximately 15,856 words. We examined the variety (i.e., types) and frequency (i.e., tokens) of sentence-initial transition words and organizational markers used in the two corpora and conducted Chi-square tests with Bonferroni adjustment to determine whether frequency of use differed significantly between higher and lower quality texts. Of the 207 words and phrases that earned points in scoring the *WIAT-III*, 40 unique sentence-initial transition words from that list (i.e., types) were found in the higher quality corpus, and 31 were found in the lower quality corpus, with 23 shared across the two. Given such small differences between the two corpora in occurrences of unique sentence-level transitions, a Chi-square test of *total* frequency of sentence-initial transitions (i.e., tokens) was performed, and the analysis revealed significantly more sentence-initial transition words in the higher quality corpus (214 total) than in the lower quality corpus (127 total), $\chi^2 = 14.67$, $p < 0.001$. We could not conduct tests of significance on the use of morphologically complex sentence-initial transition words across the two corpora because morphologically complex transitions were used too rarely.

In addition to sentence-initial position, students also embedded the 207 *WIAT-III* transition words throughout their texts as additional organizational markers. Although such sentence-embedded organizational markers did not earn specific points in the *WIAT-III* scoring scheme, we further queried the corpora to examine potential relationships with essay quality. We found a total of 805 organizational markers in the lower quality corpus (sentence-initial plus sentence embedded) and 919 total in the higher quality corpus. A Chi-square test indicated no significant difference between total frequency of organizational markers across the two corpora, $\chi^2 = 0.53$, $p = 0.47$. Lastly, a list of the 10 most common organizational markers found in each corpus and their frequencies was compiled to better assess specific word choice (see Table 5). In this case, Chi-square tests revealed significant differences in use across the two corpora for two transition words: *when* ($\chi^2 = 10.37$, $p = 0.001$) and *also* ($\chi^2 = 12.56$, $p < 0.001$), with both occurring more frequently in the lower quality corpus. The remaining words in Table 5 did not differ significantly across the two corpora.

Discussion

Main Findings

Substantial evidence exists demonstrating that morphological skill contributes to improvements in children's word reading, vocabulary, and comprehension (Goodwin & Ahn, 2010, 2013). The results of the present study suggest that morphological skill may also have implications for students' writing skills, documenting important but understudied productive aspects of children's morphological skill at the word, sentence, and text level.

The purpose of this study was to examine whether children's morphological skill (specifically, morphologically manipulating words to condense syntax in a sentence-

combining task) was uniquely predictive of the quality of their essay writing. Both morphological skill and writing fluency were uniquely predictive of the content and organization score of the students' essays, and although the coefficients were rather small, they correspond to meaningful changes (i.e., multiple grade levels) in estimates of essay quality.

Despite the theoretical distinction between transcription and text generation provided by Berninger and Swanson (1994), it can be difficult to isolate the two in practice, especially in examinations of extended essay composition. However, the two writing measures in the present study were selected purposefully, one weighted more heavily toward transcription fluency (the timed *WJ-III* writing fluency subtest) and the other toward text generation (the untimed morphological sentence-combining task). Consistent with Berninger and Swanson's (1994) finding that transcription and text generation skills contribute to composition quality across the intermediate and junior high school years, results of the present study indicate that both transcription (the *WJ-III* writing fluency subtest) and text generation processes (the sentence combining task) contribute uniquely to essay quality across similar ages, as assessed by a standardized assessment of writing. Moreover, results were robust regardless of whether or not correct spelling was taken into account in the scoring of the morphological sentence combining measure. We provided here more detail on the results of scoring that required correctly spelled responses, following Apel's (2014) emphasis on knowledge of written morphological forms. However examination of Tables 2 and 3 reveal that the correlations and regression coefficients were nearly identical when the spelling requirement was relaxed.

The specific mechanism underlying the observed relationship between morphological skill and essay quality is not entirely obvious. Given that the scoring rubric of the standardized essay assessment from the *WIAT-III* assigned points for students' use of sentence-initial transition words (including morphologically complex transitions such as *secondly* and *finally*), it was reassuring to find that the relationship between morphological skill and essay quality was not driven solely by formulaic use of morphologically complex transition words. In fact, the infrequent use of morphologically complex transitions precluded an analysis of them in isolation. Although an analysis of the 207 transition words identified in the *WIAT-III* scoring indicated that sentence-initial transitions occurred more frequently in higher quality texts than in lower quality texts, the same was not true for transition words in sentence-embedded positions.

Still, to score highly during the 10 minutes spent writing their essays, students had to make many choices beyond including sentence-initial transitions. They had to include a clear thesis, multiple supporting reasons, elaborations of those reasons, and a conclusion—all of which require maintaining relationships among concepts across sentences and longer sections of text. Succinct sentences, traditional paragraph structuring, and clear transitions all made for higher scores on the *WIAT-III*.

A further review of the student essay presented in Table 4 suggests that perhaps more interesting than the writer's use of affixed transition words was her strategic use of syntactic parallelism, exemplified in the third sentence, "... *he is always there cheering ... and giving*

me tips.” Again in the concluding sentence, the writer used a series of noun phrases to summarize the reasons she likes basketball: “... due to my family's connection to the sport, my ability to grab rebounds, and the team environment.” As this text illustrates, control over syntax and the requisite appropriate morphological word forms may assist in the generation of succinct and clearly organized text.

Consistent with Berninger and Amtmann's (2003) simple view of writing, improvements in transcription or text generation processes may not necessarily manifest as differences only in language use. Increased fluency with word retrieval, word construction, spelling, and sentence construction could reduce the working demands of those transcription and text generation processes, thereby allowing more attention to higher order goals such as planning, organizing and revising (see also McCutchen, 2000; Saddler & Graham, 2005). With more available working memory resources, the young writers in the present study may have been better able to attend to the overall clarification of their ideas and the organization of their texts. Indeed, the syntactic parallelism in the concluding sentence in Table 5 succinctly summarizes the reasons provided previously by the writer to support her thesis. In contrast, essays in the lower quality corpus showed more evidence of strings of independent clauses (as evidenced by more frequent use of *also* as a transition) and simple temporal clausal subordination (as evidenced by use of *when*), both previously identified as markers of weaker writing (Myhill, 2008).

Somewhat surprisingly, the quantitative analysis indicated that the reading comprehension measure was not uniquely predictive of essay writing quality in the presence of the two writing measures, aside from the interaction with grade. We initially hypothesized that the content and organization score from the essay writing quality measure (*WIAT-III*) may be sensitive to differences in comprehension skill, because both the standardized essay and comprehension measures entail interaction with extended text. Despite the significant zero-order correlation between comprehension and essay quality shown in Table 2, in the regression, that relationship seemed to be subsumed by comprehension's relationship with the other predictors. We found considerable shared variance between morphological skill (scored either with or without correct spelling required) and reading comprehension ($r_s = .64$; see Table 2). This observation is not necessarily surprising, given that measures of word reading and vocabulary (both highly correlated with comprehension) have previously been found to correlate with performance on similar morphological sentence-combining tasks (McCutchen et al., 2014; McCutchen & Stull, 2015). Thus, with morphological skill in the model, comprehension may have been associated with little unique variance.

Limitations and Further Research

One obvious limitation of this study is the nature of our measure of extended essay writing. Although use of a standardized measure of essay writing (*WIAT-III*) provided detailed scoring rubrics and psychometric support for the reliability and validity of the assessment instrument, the standardized administration procedures allowed little flexibility in topic or presentation. The genre of the essay prompt was an argumentative essay, which required that students provide a clear thesis supported by at least three reasons. Future research should include other genres and other topics of more potential interest to students. Secondly, the

nature of the scoring system for the essay rewarded students who wrote a traditionally structured essay. That being said, the outcome measure used in the present study may be reflective of the way writing will be evaluated in high-stakes standardized testing, especially as the Common Core State Standards (CCSS; National Governors Association Center for Best Practices, 2010) place increasing emphasis on argumentative/persuasive writing for K-12 students. Nevertheless, future research could extend this study's findings by using other scoring systems to evaluate student writing, together with different genres. Such scoring systems might include, for example, more detailed analysis of syntactic maturity, word choice, or sentence structure (see Myhill, 2008), or perhaps computer-driven textual analysis (Graesser, McNamara, & Kulikowich, 2011).

Overall, the evidence presented here suggests that skill in producing complex morphological forms uniquely predicts variance in essay writing quality for middle and upper elementary students, even when a measure of writing fluency is taken into account. Future research might use an experimental intervention design to better explore possible causal links between morphological skill and writing quality.

Conclusions

Writing is all about choices. Whether their choices are guided by explicit awareness or more implicit intuition, successful writers must constantly self-regulate and make word-level, sentence-level, and text-level decisions about the meaning they wish to communicate. Even if writers have considerable knowledge about a subject, they may not be able to write about it well (Butterfield, Hacker & Plumb, 1994; DeGroff, 1987; Langer, 1984; McCutchen, 1986). As they juggle the multiple components of the process of writing, students who can better control word-level morphological forms to fit their evolving sentence syntax may be better able to achieve their writing goals at the sentence and discourse levels.

In any literacy task, awareness of how language works (whether fully conscious or not) is necessary in the process of making meaning. This study documents that text quality in an extended writing task was predicted by students' skill in making word-level changes to enable sentence-level syntactic changes. It appears that an awareness of words – their spellings, their syntactic functions, their rhetorical connotations – is an important tool in making meaning in both reading and writing.

Acknowledgments

The research reported here was supported by the Eunice Kennedy Shriver National Institute of Child Health & Human Development, Grant P50HD071764. The opinions expressed are those of the authors and do not represent the views of the NICHD.

Appendix A

Table A1

Morphological Skill Sentence-Combining Task

Example item:	The girl had lots of energy.
	The girl talked.

	Her talking was constant.
Example response:	The <i>energetic</i> girl talked <i>constantly</i> .
<hr/>	
Test items:	
1.	The campers slept under the sky. The sky looked like ink. Their sleep was deep.
2.	The students ate the soup. Steam rose from the soup. The soup had flavor.
3	The snake was slow. The snake moved his coils down the tree. The tree had moss. The coils glistened.
4.	The motorcycle backfired. The backfire was loud. The motorcycle sputtered. The motorcycle had dents.
5.	The baker placed the cookies on the tray. The cookies had icing. The tray shimmered. The baker was in a hurry.
6.	The seal swam toward the penguins. The penguins felt terror. The seal's path was direct. The seal had spots.

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Table 1

Unadjusted Observed Sample Means and Standard Deviations by Grade Level

Measure	Grade 5 <i>n</i> = 112		Grade 8 <i>n</i> = 121	
	<i>M</i>	(<i>SD</i>)	<i>M</i>	(<i>SD</i>)
Essay Writing Quality (WIAT-III)	8.18	(3.35)	10.78	(3.93)
Reading Comprehension (WJ-III)	31.96	(3.64)	35.44	(3.66)
Writing Fluency (WJ-III)	19.21	(4.09)	24.89	(5.78)
Morphological Skill (Researcher-developed task)				
Entirely Correct Spelling Required	4.85	(3.80)	8.56	(4.31)
Phonologically Correct Spelling Required	5.53	(4.10)	9.11	(4.38)

Note. Grade 8 higher than Grade 5 students on each measure (simple *t*-test *ps* < .001; *t*-tests not adjusted for classroom membership dependencies or multiple comparisons).

Table 2

Unadjusted Zero-Order Correlations

Measure	1.	2.	3.	4.	5.	6.
1. Essay Writing Quality (WIAT-III)	--					
2. Classroom Grade Level (+1=Grade 8)	.34	--				
3. Reading Comprehension (WJ-III)	.30	.43	--			
4. Writing Fluency (WJ-III)	.43	.49	.58	--		
Morphological Skill (Researcher-developed task)						
5. Entirely Correct Spelling Required	.32	.39	.66	.53	--	
6. Phonologically Correct Spelling Required	.30	.42	.64	.51	.98	--

Note. Pearson's *r* reported (unadjusted for classroom membership or multiple comparisons); all correlations significant at the .001 level.

Table 3

Multilevel Model Results Predicting Essay Writing Quality with Two Different Scoring Methods for Morphological Skill

Fixed Effects	Model 1: Entirely Correct Spelling Scoring of Morph. Skill			Model 2: Phonologically Correct Spelling Scoring of Morph. Skill		
	<i>Coeff</i>	<i>(SE)</i>	<i>t</i>	<i>Coeff</i>	<i>(SE)</i>	<i>t</i>
Adjusted Mean Essay Writing Qual.	9.88	(0.45)	22.06***	9.87	(0.45)	22.14***
Classroom Grade Level (Grade)	0.42	(0.46)	0.91	0.43	(0.45)	0.95
Reading Comprehension (RC)	0.01	(0.32)	0.04	0.03	(0.32)	0.08
Grade * RC	-0.68	(0.26)	-2.66**	-0.67	(0.26)	-2.63**
Writing Fluency	1.15	(0.30)	3.86***	1.17	(0.30)	3.97***
Morphological Skill	0.70	(0.30)	2.35*	0.66	(0.29)	2.26*

Random Effects	<i>Var</i>	<i>(SD)</i>	χ^2	<i>Var</i>	<i>(SD)</i>	χ^2
Between Classrooms	1.68	(1.30)	40.29***	1.66	(1.29)	40.27***
Within Classrooms (Residual)	10.33	(3.21)		10.35	(3.22)	

Note. Classroom grade level effect coded (+1=Grade 8 and -1=Grade 5); all remaining predictors grand mean standardized (*z*-scores).

*
 $p < .05$,

**
 $p < .01$,

 $p < .001$.

Table 4

Example of a Highly Rated Essay by an Eighth Grade Student

As I reflect on my favorite games, one sport instantly comes to mind: basketball. To begin with, basketball is a sport in which [sic] my mom's side of the family cherishes. My grandpa is a huge basketball fan, so he is always on the sidelines, cheering me on, in his booming voice, and giving me tips on ways I can improve. Secondly, I am a small girl, with the height of 5'2", on a good day. As a result, I love jumping to grab a rebound, especially when I am surrounded by a multitude of tall people. Finally, I enjoy the atmosphere that is created from playing basketball. Not only do I have buddies to rely on, but I get to strengthen relationships with my teammates. I have, and will continue to gain, memories through basketball! Therefore, basketball is one of my favorite games to play due to my family's connection to sport, my ability to grab rebounds, and the team environment.
--

Author Manuscript

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Table 5

Frequently used organizational markers

Lower Quality			Higher Quality		
	Freq.	%		Freq.	%
because	208	0.014	because	224	0.014
also	88	0.006	one	69	0.004
when	85	0.006	when	54	0.003
one	59	0.004	also	53	0.003
other	43	0.003	other	51	0.003
like	42	0.003	first	41	0.003
then	27	0.002	another	39	0.002
another	26	0.002	that is/that's	33	0.002
that is/that's	26	0.002	like	25	0.002
even	21	0.001	second	26	0.002

Note: 14370 total in Lower corpus; 15856 in Higher corpus. Freq. is the total number of occurrences in a corpus, % is proportion of target word to total words