Lexical Processing of Morphologically Complex Words in the Elementary Years

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Abstract

This study explores emerging lexical processes that may be the foundation for children's acquisition of morphological knowledge and the relation of these processes to reading comprehension. First and third graders were given two tasks involving lexical analysis of morphologically complex words. Two years later, they were given a measure of processing derived words in sentence contexts and a test of reading comprehension. The results support the view that the development of morphological processing in the elementary years might depend on access to representations of full forms, base forms, and affixes. Further, semantic and syntactic knowledge of morphemes was related to morphological processing of sentences and contributed to reading comprehension in the late elementary years.

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Lexical Processing of Morphologically Complex Words in the Elementary Years

The vocabulary explosion that begins around fourth grade is in large part attributable to the increase in affixed words children know (particularly derivatives) (Anglin, 1993; White, Power & White, 1989), but children's learning of morphologically complex words begins much earlier. Behavioral data show that preschool children are acquiring morphological knowledge. They give evidence of implicit understanding of ruleful ways that morphemes can be combined to express particular meanings. For example, Clark's children made statements like, "You be the storyer, Dad" (1995, p. 401). By the late elementary years, children's ability to segment and manipulate morphemes within complex words is related to word reading (Fowler & Liberman, 1995; Singson, Mahony & Mann, 2000) and reading comprehension (Carlisle, 2000). However, there are many questions about how children learn to process words with regard to morphemic structure. How can we characterize the emergent knowledge of morphemes and morphological processing in this period of development? And does it have long-term implications for children's language and reading comprehension? The study reported herein was designed to address these questions.

Linguistic Processing of Morphologically Complex Words

For adults morphological structure facilitates lexical processing of written words (e.g., Feldman & Andjelkovic, 1992; Marslen-Wilson, Tyler, Waksler, & Older, 1994). Models of morphological processing of words generally posit co-activation and processing of submorphemic components (phonological and orthographic features), morphemic components (base morpheme, affixes, and full form), and concepts or meaning (Chialant & Caramazza, 1995; Schreuder & Baayen, 1995; Taft & Zhu, 1995). Of relevance here is the question of how children develop mental representations of morphemes, particularly those that they encounter embedded in words (i.e., bound morphemes). Schreuder and Baayan (1995) have proposed both a model of processing of complex words and an explanation of how children learn morphological processing. Their model posits a mechanism for carrying out symbolic computations on

representations that have become available through activation. These computations take place in three stages. The first (segmentation) entails mapping of the speech input onto form-based access representations of full as well as bound forms (affixes, bound stems). The second stage (licensing) entails determining whether representations that have become co-active can be integrated on the basis of their sub-categorization properties (e.g., syntactic role). The third stage involves the computation of the lexical representation of the complex words from the constituents; this lexical representation entails processing of semantic and syntactic information.

According to Schreuder and Baayen, the crucial component of children's morphological learning is their development of mental representations of bound morphemes (e.g., prefixes and suffixes). Through the affix discovery principle, children monitor the mental lexicon for correspondences between form (phonological or orthographic strings that co-occur regularly in the language, given positional constraints) and meaning. This is a two-stage process. The first stage involves detecting patterns of co-activation of developing semantic representations. If a pattern is detected (e.g., -er in teacher, runner, etc.), a concept node is created for this pattern, and a corresponding representation at the access level begins to develop. Thereafter, the representation can be accessed as it is encountered in words, and it becomes invested with semantic and syntactic information (e.g., -er signifying "one who--"). Evidence that -er is represented apart from specific words comes from neologisms children spontaneously produce, as in the earlier example of storyer (Clark, 1995).

On the basis of Schreuder and Baayen's model, we should be able to observe certain features of children's morphological learning. First, we should be able to find evidence that children gradually develop representations for bound morphemes, particularly those they encounter frequently. Second, we should find developmental changes in the semantic and syntactic knowledge associated with the representations, and this would allow for integrative processing of form and meaning (Taft & Zhu, 1995). Third, lack of familiarity with the full form or any of the constituent morphemes should result in incomplete morphological processing.

To date, studies of morphological processing in the early school years have focused predominantly on recognition of word structure (i.e., decomposition). Jones (1991) investigated the underlying representation of morphophonemic segments among first graders on tasks that involved leaving out a part of words such as grandfather or leaves (i.e., decomposition) and discussion of the meaning of the remaining part. She found that compared to language-delayed first graders, language-advanced children gave stronger evidence that they had representations of morphophonemic segments. Somewhat similar findings come from a study by Rubin (1988). Exploring the relation of morphological development and spelling, Rubin gave kindergartners and first graders one- and two-morpheme words, asking whether each word contained a smaller word that was similar in meaning (e.g., "Is there a little word in pinned that means something like pinned?"). Foils (e.g., wind) were similar in phonological structure but contained one morpheme. The child could not be successful on the task if he/she could access only the meaning and phonological representation of the whole word. In terms of Schreuder and Baayen's model, the child might respond "no" to both pinned and wind if he or she could not decompose the words or did not have representation of the past tense. Rubin's results showed that first graders who performed well on this task also tended to have superior implicit morphological knowledge. Derwing and Baker (1979) also investigated understanding of form-meaning relations by asking children and adults whether one word "came from" another (e.g., does bear come from beard?) The results showed that children in grades 3 through 6 tended to be biased by similarities of sound, without regard for differences in meaning, while older students were more likely to base their judgments on both phonological and semantic similarities. However, for the younger children, some of the words were relatively uncommon or complex in meaning, a condition that, given the above theory, would likely impede morphological processing.

These and other studies (e.g., Carlisle, 1995; Fowler & Liberman, 1995) show that early elementary children can decompose phonologically transparent forms but provide little insight into their understanding and use of complex words. In contrast, Anglin (1993) studied access to meanings of complex words. He asked first, third and fifth graders to explain the meaning of

words and to use them in a sentence; included were morphologically simple (e.g., closet) and complex (e.g., stillness) words. Results showed significant growth in knowledge of morphologically complex words by grade level.

Anglin's interview technique provides a way to examine aspects of the morphological processing model proposed by Schreuder and Baayan. Of particular interest is the final stage, called combination, which involves the integrative processing of the semantic and syntactic components of the constituent morphemes. Through scrutiny of the children's responses, Anglin found that children could sometimes figure out the meaning of a word they had never heard, a process he called morphological problem-solving. This they did by recognizing the morphemic constituents of a word and using that knowledge to infer the meaning of the whole word (e.g., inferring the meaning of knotless from knot and –less). He found few instances of morphological problem-solving in first grade but significant increases in grades 3 and 5. Clearly, the process works far better with unfamiliar words that are semantically transparent, like knotless, than those that are semantically opaque, like appliance, as has been found in studies of lexical processing of adults (e.g., Marslen-Wilson, et al., 1994).

According to Schreuder and Baayen, analysis of unfamiliar complex words for meaning is also dependent on the earlier stages in the process (decomposition and licensing). These stages could not be accomplished without access representations of affixes, base form, and full form. For example, children might think they do not "know" treelet because they do not recognize the full form.

Relevance for Sentence Processing and Reading Comprehension

By the late elementary years, children who are sensitive to morphological structure have a way to infer the meanings of unfamiliar morphologically complex words (Nagy & Anderson, 1984). They are also likely to be better readers (Carlisle, 2000; Fowler & Liberman, 1995; Windsor, 2000). Developmental changes between fourth and eighth grade in understanding the meanings and grammatical roles of affixes may be a preresuisite for inferring the meanings of unfamiliar words during reading (Tyler & Nagy, 1989; Wysocki & Jenkins, 1987).

Breadth and depth of word knowledge are moderately correlated with reading comprehension (Anderson & Freebody, 1985), and this word knowledge includes morphologically complex words. However, gradual development of syntactic and semantic knowledge of morphemes is a potentially important additional contributor to comprehension, as this is likely to provide a basis for inferring the meanings of unfamiliar words and interpreting word meanings in texts (Rego & Bryant, 1993). Thus, we explored the possibility that lexical analysis of morphologically complex words in the early elementary years contributes to morphological processing in sentences and to reading comprehension in third and fifth grades.

Summary and Research Questions

The purpose of this study was to see whether we would or would not find evidence to support Schreuder and Baayan's explanation of the process by which children come to access and process morphemes, given tasks of lexical analysis involving morphologically complex words. One of the tasks was an adaptation of the word analysis task developed by Rubin (1988), and the second was Anglin's (1993) word interview. In addition, we selected three derived words from Anglin's interview for close analysis. These words (knotless, stillness, and treelet) varied in terms of familiarity of the full form and the affix. Analysis of responses to these words was used to study the extent to which decomposition and analysis of form and meaning depended on familiarity with word parts and the extent to which first and third graders differed in the semantic and syntactic knowledge of the morphemes.

To explore the relevance of children's lexical analysis of complex words to language and literacy acquisition, we administered the Test of Morphological Structure (TMS), an oral task that required decomposition or production of derived forms (Carlisle, 2000), and a standardized test of reading vocabulary and comprehension.

Our primary questions were as follows: (a) Is evidence from first and third graders' lexical analyses of morphologically complex words compatible with the development of morphological processing proposed in Schreuder and Baayen's (1995) model? (b) Are performances on the Year 1 lexical analysis tasks significantly related to the Year 3 task

involving morphological processing in sentence contexts? (c) Does performance on the Year 1 lexical analysis measures significantly predict Year 3 reading vocabulary and comprehension?

Method

Subjects

The participants included 34 third graders and 26 fifth graders. The younger group included 18 boys and 16 girls (mean age 6.7 years in grade 1); the older group included 11 boys and 15 girls (mean age 8.9 years in grade 3). The children attended a private school in a suburban community outside of Chicago. All of the children were native speakers of English. Receptive vocabulary was assessed at the start of the study (Year 1) with the Peabody Picture Vocabulary Test-Revised (Dunn & Dunn, 1981); for first graders, the mean standard score (SS) was 113.6 (11.9 SD) and for third graders, the mean SS was 113.1 (15.5 SD).

Materials

In year 1, the children were given two measures of morphological processing of words. These were as follows:

(a) The Word Analysis Test (WAT). Adapted from Rubin (1988), this test was designed to determine whether children could distinguish two-morpheme from one-morpheme words. The children were asked, "Is there a little word in __ that means something like __? " Successful performance required both phonological segmentation and attention to whether the segment that was extracted was a word and whether it was related in meaning to the presented word. Test items included 6 words with the suffix –y (e.g., sunny), 6 agentives and instrumentals (e.g., teacher), and 6 past tense verbs (e.g., pulled), suffixes that should be familiar to first graders (Berko, 1958; Clark, 1995). Each of these words was matched to a monomorphemic word with the same final sound (e.g., silly for hilly). There were 4 training items (one modeled by the examiner and three for practice and feedback). Performance was scored using Rubin's system of giving credit only when the child responded correctly to both items in a pair (e.g., "yes" to hilly and "no" to silly).

(b) Definition: This measure was drawn from children's performance on the Test of Absolute Vocabulary Knowledge (TAVK) (Anglin, 1993). Anglin's test was designed to estimate the number of dictionary entries children knew. He developed his word list by systematic sampling of words from Webster's Third New International Dictionary of the English Language. Words types included root words, inflected words, derived words, literal compounds, and idioms. (See Anglin, 1993, for a detailed explanation.) The task involved an interview in which the child was asked to tell what a given word means. When the child could not explain the meaning and use the word in a sentence, he/she selected a meaning from a set of four possible meanings. For the present study, testing ended when the child did not know the meaning of seven successive words, five of which also yielded incorrect multiple-choice selections.

The interview responses were tape-recorded, transcribed, and scored using Anglin's criteria for what counted as an acceptable definition. However, the definition and sentence conditions were combined to yield one score, hereafter called Definition. The Definition score consisted of instances in which a child defined a base morpheme in a morphologically complex word (inflected and derived forms and compounds) and used the complex word correctly in a sentence. (The multiple-choice responses were not included in this measure.) Interscorer reliability, determined by comparing Definition credit awarded by the two researchers, was 94.9% for the first grade and 94.8% for the third grade. Differences were resolved by discussion.

Analysis of three words from the interview (knotless, stillness, and treelet) was carried out to provide further insights into children's processing of complex words. The three words had base morphemes that are generally familiar to first and third graders. The suffixes differed in this respect: -less is likely to be understood as meaning "without"; -ness is likely to be familiar but is abstract in meaning, and children would not be likely to understand its grammatical role; -let is not generally familiar to first and third graders (see Windsor, 1994). First and third graders' explanations of these words were scored on the following criteria: Decomposition. Does the child mention the base morpheme spontaneously? If so, this would be evidence of segmentation of the morphemic structure of the word. Definition of the base morpheme: Does the child define

the base word? This would provide evidence that the child has a mental representation for the base morpheme. Sentence: Does the child use the word appropriately in a sentence? If so, the child would be likely to have encoded semantic and syntactic information associated with the morphemes. The two researchers scored all responses to the words independently. Interrater reliability was 97%. Differences were resolved by discussion.

The following tests were administered in Year 3:

(a) Test of Morphological Structure (TMS): The task assesses relational knowledge of derived words and analysis of morphologically complex words in meaningful sentences. There were two parts. Production required the children to produce a derived form that completed the sentence accurately (e.g., "Farm. My uncle is a ___"); this task required syntactic and semantic knowledge of suffixes. Decomposition required the children to find the base word to complete the sentence meaningfully (e.g., "Driver. Children are too young to ___.") For each part, half of the items were derived words whose base and complex forms were phonologically transparent (e.g., enjoy, enjoyment), and half required a phonological shift (e.g., nature, natural). (See Carlisle, 2000, for further details and test items.)

(b) Gates-MacGinitie Reading Test (MacGinitie & MacGinitie, 1989): Appropriate forms were administered to the third and fifth graders. The Reading Vocabulary subtest assesses ability to read and select the best meaning for a word from an option set; the Reading Comprehension subtest assesses ability to read short passages and select the best answers to multiple-choice questions about the passages.

Procedures

For both Year 1 and Year 3, the experimental tests were administered to each child individually during the winter. The TAVK was administered in several sessions (lasting about1/2 hour each). The Gates-MacGinitie Reading Test was administered by the classroom teachers in the spring.

Results

Performance on Lexical Analysis Measures

Performances on the experimental tests administered at Year 1 and Year 3 are shown in Table 1. Grade-level comparisons were carried out to determine the extent to which first graders differed from the third graders on WAT and Definition. For the Definition measure, third graders were significantly stronger than first graders, $t(59) = 6.23$, $p < .001$ ($d = 1.6$). On the WAT, two of the first graders did not understand the task requirements on practice items and so were not administered the test. Third graders performed significantly better than first graders, $t(59) = 3.32$, $p < 01$ ($d = .86$).

Table 1 about here

Analysis of Definition Items

Analysis of the first and third graders' responses to three derived words yielded measures of Decomposition, Definition of the base word, and Sentence; the percentages of the children who received credit for each aspect are shown in Table 2.

Table 2 about here

Fisher exact probability calculations were used to determine whether differences in first and third graders' responses were significantly different. As Table 2 shows, for knotless and stillness the groups differed only on the use of the word in a sentence. For treelet, however, third graders were significantly more likely than first graders to decompose the word and to use the word correctly in a sentence.

Relationship of Lexical Analysis Tasks to TMS

Was children's morphological processing of words in Year 1 significantly related to their performance on the TMS in Year 3? For the younger group, the WAT was significantly related to TMS Production ($r = .37$, $p < .05$) but not to TMS Decomposition ($r = .13$). For the older group, WAT was not significantly related to either subtest (for Production, .25, for Decomposition, .37). Definition was significantly related to both TMS subtests for both grade-level groups: for Definition and Production, younger group, .57, $p < .001$, and older group, .54, $p < .01$; for Definition and Decomposition, younger group, .48, $p < .01$, and older group, .46, $p < .05$.

Prediction of Reading Comprehension

Did performance on the lexical analysis tasks in first and third grades predict reading vocabulary and comprehension two years later? Two standard multiple regression analyses were carried out for each comprehension measure, one for the younger group and one for the older group. Table 3 shows the results of these analyses.

Table 3 about here

For the younger group, the lexical analysis tasks did not significantly predict reading vocabulary, $F(2, 29) = 1.86$, $p = .17$; only 11% of the variance was accounted for. However, lexical analysis accounted for 23% of the variance in reading comprehension, $F(2, 29) = 4.33$, $p < .05$. For the older group, the lexical analysis tasks accounted for 41% of the variance in reading vocabulary, $F(2, 23) = 7.86$, $p < .01$; they accounted for 27% of the variance in fifth-grade reading comprehension, $F(2, 23) = 4.29$, $p < .05$. In each of these analyses, Definition but not WAT accounted for a significant portion of the variance

Discussion

This study was designed to explore the development of morphological processing in the early elementary years. We took as our starting point a developmental model of the acquisition of morphological knowledge proposed by Schreuder and Baayan (1995), examining whether children's performance on tasks of lexical analysis conformed to expectations based on this model. Further, we explored the relevance of early elementary lexical processing of complex words to language and reading comprehension two years later. Our results suggest that third graders, more than first graders, were capable of morphological processing that is meaning-driven, but that even for the first graders, emerging lexical analysis of complex words was related to morphological analysis in sentences and contributed to reading comprehension two years later.

Early Morphological Processing

The initial stage of developing representations of morphemes (bound and free) depends on the child’s recognition of recursive elements within word--those consistent in form and

meaning. For decomposition of complex words to occur, the individual must have access to representations of morphemes (i.e., base word and bound morphemes) (Schreuder & Baayan, 1995). We used the Word Analysis Test as a way to determine whether first and third graders had mental representations of familiar morphemes in familiar words, as shown by their ability to distinguish phonological segments on the basis of meaning relations. The third graders were better than the first graders at determining whether or not a simple word (e.g., pinned or wind) could be decomposed morphologically. First graders correctly responded to 57% of the word pairs, whereas third graders were correct on 71% of them.

First graders' responses suggested inattention to meaning relations, as Jones (1991) had found. This was evident from two common kinds of errors. One was ignoring dissimilarities in the meaning of the word presented to them and the meaning of the short word they found in it (e.g., doll in dollar)--the most common error for third graders, too. The second was creation of nonword responses (e.g., giving "hap" as the small word in happy), an error that suggested syllabic segmentation without regard for meaning. This result is similar to Derwing and Baker's (1979) finding that third to sixth graders relied more on phonological than semantic relations in judging word relations. In terms of Schreuder and Baayen's model, we infer that the third, more than first, graders had access representations for base words and suffixes and used these at the segmentation and licensing stages. However, third graders sometimes stumbled at the final stage (combination), which required integration of semantic and syntactic features of constituent morphemes.

We found that WAT focused attention to phonological segmentation, while Definition was a better measure of semantic/syntactic aspects of morphological processing. Performance on WAT and Definition was not significantly related (.25 for younger and .35 for older group, both $p > .05$). The Definition measure provided a rich picture of children's understanding of the meaning of morphological complex words. Not surprisingly, first graders struggled with the job of explaining the meaning of morphologically complex words and using them in sentences. Providing definitions of words out of context is a challenging metalinguistic activity (Snow,

Cancino, DeTemple, & Schley, 1991). Third graders were significantly better than first graders at defining morphologically complex words and using them in sentences. In terms of Schreuder and Baayen's model, decomposition and explanation of the meaning of the complex word provided evidence that children had "discovered" the constituent morphemes (particularly bound morphemes). However, wide variation in ability to explain word meanings showed differences in encoding of syntactic and semantic features of morphemes.

To examine children's morphological processing in more detail, we selected three words within the first 30 words of Anglin's interview. These words (knotless stillness, and treelet) had high frequency bases, but the suffixes varied in familiarity. We used performance on these words to look for evidence that the children had access to representations of the full forms and bound morphemes. One indication was mention of the base morpheme. About half the first and third graders mentioned the base form spontaneously for knotless and stillness. First and third graders did not differ on this or on the definitions of the base words, knot and still. In contrast, the unfamiliarity of the suffix -let on treelet appeared to prevent them from recognizing the familiar base word, tree. Few first graders (10.8%) were able to decompose the word. Their most common response was "I don't know that word." About half the third graders mentioned tree. Thus, decomposition appears to be affected by the presence or absence of accessible representations for the morphemic constituents of a word.

Difficulties using the words in sentences often revealed lack of awareness of the meaning or grammatical role of a suffix. For the word stillness, for example, only 10% of the first graders and 36% of the third graders formed a sentence that took into account the grammatical and semantic role of the suffix. The children tended to use stillness as if it were the grammatical equivalent of still, as in the following example: "I was very stillness when the teacher read the story." In contrast, knotless was used in sentences more accurately by both first and third graders (25% and 51.7% respectively) than stillness was. The semantic and syntactic features of -less appeared to be familiar to many of the children. Acquiring semantic and syntactic information

about morphemes is a critical aspect of children's developing knowledge of the meaning of complex words (Tyler & Nagy, 1990; Windsor, 1994).

Finally, we found grade-level differences in morphological problem solving with regard to knotless and treelet, both unfamiliar words to these children. While first graders generally did not attempt to explain the meaning of treelet, quite a few third graders came up with acceptable definitions. Some of their responses suggested that they were guessing about the suffix (e.g., "the top of a tree," "a part of a tree"). Other children had some understanding of the suffix but were not sure what was "little" about a tree (e.g., explaining that treelet meant "a baby squirrel" or "a little branch").

It should not be inferred from these results that third graders had altogether become morphological "problem solvers." Later in the test, they had many of the same problems as the first graders. These tended to arise when they encountered less familiar and less transparent words, such as workable. Other researchers have noted similar limitations in fourth graders' morphological awareness in comparison to that of older students (Tyler & Nagy, 1989; Windsor, 1994; Wysocki & Jenkins, 1987). In particular, derived words that lack semantic transparency are not likely to be processed by access to their morphemic components (Chialant & Caramazza, 1995; Schreuder & Baayan, 1995).

Development of Morphological Processing and Reading Comprehension

Was lexical analysis of complex words in the early elementary years related to later processing of derived words in sentences and to reading comprehension? First, the lexical analysis tasks differed in their relation to morphological processing, assessed two years later. Definition, but not WAT, was significantly related to performance on the TMS. Second, of the TMS subtests, correlations were somewhat stronger between Definition and Production (.57 for the younger and .54 for the older students) than Definition and Decomposition (.48 for the younger and .46 for the older students). Decomposition may be an initial (and necessary) stage, but knowledge of the meanings and grammatical roles of morphemes is an important aspect of

morphological development, as has been noted by researchers working with older students (Singson et al, 2000; Tyler & Nagy, 1989; Windsor, 2000).

Even though third graders were more advanced than first graders, at both grade levels performance on Definition was significantly related to processing of derived words in sentence contexts on the TMS two years later. Thus, even in the beginning stages of learning to analyze complex words for meaning, the children with more extensive morphological knowledge are likely to be the ones who are particularly successful at manipulating and understanding derived words in meaningful contexts several years later.

Results also showed an association between early elementary lexical analysis of complex words and reading comprehension in the third and fifth grades. Of the two lexical analysis tasks, only Definition significantly contributed to prediction of the children's performance on the reading measures; the amount of variance in the reading measures that was accounted for was greater for fifth than third graders. Again, phonological segmentation and decomposition (as on the WAT) may be an important step, but children's access to meaning representations and the richness of information encoded therein is strongly related to reading comprehension. We might be tempted to conclude that Definition was a significant contributor because vocabulary measures generally account for significant variance in reading comprehension (Anderson & Freebody, 1985). However, the Definition task tapped children's morphological problem-solving, too--that is, their ability to infer the meaning of complex words by analysis and integration of the constituent morphemes. It is not just the lexical processing but the morphological processing children are capable of that contributes to reading comprehension by fifth grade.

In conclusion, the results of the present study have provided some support for a model of emerging morphological knowledge and some evidence that lexical analysis of complex words in the early elementary years contributes to vocabulary and reading comprehension by the late elementary years. While there is much we still need to understand about the process of acquiring morphological knowledge, the results of this study suggest that this process is educationally relevant to our understanding of vocabulary and reading comprehension acquisition.

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Table 1

Performance on Measures in Years 1 and 3

	Year 1		Year 3			
	WAT	Definition	TMS Derivation	TMS Production	VOC	COM
Younger group	57.2 (14.4)	5.1 (2.9)	75.2 (14.6)	85.1 (11.6)	75.3 (17.9)	69.4 (16.7)
Older group	71.0 (17.8)	11.7 (5.3)	75.9 (12.2)	94.4 (.06)	80.3 (22.0)	78.5 (13.4)

Note. WAT = Word Analysis Test; VOC = Reading Vocabulary; COM = Reading Comprehension; Definition is the raw score; all others are % correct.

Table 2

Percent of First and Third Graders Who Earned Credit for Lexical Analysis

Variable	Grade 1 (%)	Grade 3 (%)	Fisher exact probability
Knotless			
Decomposition	42.5	62.1	.087
Definition of base	30.0	37.9	.332
Sentence	25.0	51.7	.021
Stillness			
Decomposition	72.5	62.1	.255
Definition of base	85.0	82.8	.528
Sentence	10.0	35.7	.007
Treelet			
Decomposition	10.8	55.2	.001
Sentence	0	17.2	.047

Note. Children were not asked to define the base of treelet; three first graders' interviews were terminated prior to treelet.

Table 3

Prediction of Reading Vocabulary and Comprehension from Lexical Analysis

	Beta	St. Error of B	t	p-level
GRADE 3				
RVOC				
WAT	.04	.181	.24	.81
Definition	.32	.181	1.19	.08
RCOM				
WAT	.14	.168	.85	.40
Definition	.42	.168	2.51	.02
GRADE 5				
RVOC				
WAT	.13	.176	.74	.46
Definition	.57	.176	3.25	.004
RCOM				
WAT	.21	.195	1.09	.29
Definition	.40	.195	2.04	.05

Note. WAT = Word Analysis Test; RVOC = Reading Vocabulary; RCOM = Reading Comprehension.