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ABSTRACT

Two studies were undertaken to continue a line of research designed to identify the subskills of word identification that correlate most highly with reading comprehension and to develop empirically based instruments to assess those subskills. The issues studied related to the broad area of structural analysis and concerned assessment of skills in the subareas of inflected endings, possessives, and affixes. In the first study, a prototype of the Inflected Endings Subtest was administered to 143 third and fourth grade children. The results indicated that most students had mastered all of the inflected endings assessed, with the exception of the possessive use of the apostrophe. In the second study, a prototype of the Affixes Test was administered to 275 fourth and fifth grade children. The results indicated that while some of the affixes assessed in the test (un-, -ful, -less, for example) were fairly well known by the children, others (pre-, -ant/-ent, for example) were still not understood by a majority of the children. In general, performance on prefixes was significantly greater than performance on suffixes. Overall, girls significantly outperformed boys and fifth grade students achieved higher scores than did fourth grade students. (Author/FL)

Technical Report No. 526

THE ASSESSMENT OF STRUCTURAL ANALYSIS SKILLS

by

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Report from the Project on
Studies in Language: Reading and Communication

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Abstract

The two studies highlighted in this report continue a line of research designed to (a) identify the subskills of word identification which correlate most highly with reading comprehension, and (b) develop empirically based instruments to assess these subskills. The issues discussed relate to the broad area of structural analysis, and concern assessment of skills in the subareas of inflected endings, possessives, and affixes.

In the first study, a prototype of the Inflected Endings Subtest was administered to 143 elementary school children in grades three and four. Results indicated that most students had mastered all of the inflected endings assessed, with the exception of the possessive use of the apostrophe.

In the second study, a prototype of the Affixes Test was administered to 275 children in grades four and five. Results of the Affixes study indicated that, while some of the 20 prefixes and suffixes assessed in the test are fairly well known by fourth and fifth graders (for example, un-, 81.4%; -ful, 89.3%; -less, 88.3%), others are still not understood by a majority of fourth and fifth grade students (for example, pre-, 48.5%; -ant/-ent, 35.7%). In general, performance on prefixes was significantly greater than performance on suffixes. Overall, girls significantly outperformed boys, and fifth grade students achieved higher scores than fourth grade students.

Based on the results of the two studies, the Inflected Endings and Affixes Subtests will be revised. Consideration is being given to developing a separate subtest to assess possessives and contractions. The revised subtests will be administrated to second- and third-grade students, and particular attention will be given to determining the grade-level appropriateness of the tests.

The ultimate goal of this research is to develop an efficient and reliable empirically based battery of subtests for word identification skills that will provide teachers with important diagnostic information in the areas of structural analysis and phonics.

The work reported in this paper continues a research effort begun in spring 1977 by the Project on Assessment and Analysis of Word Identification Skills in Reading. The ultimate goal of this research is to develop a set of diagnostic tests which assess word identification skills of elementary school children. The test battery consists of subtests within two major areas of skills competency: phonics and structural analysis. These subtests will be constructed, revised, and validated on the basis of empirical data, and will have mastery level cut-off scores determined by reading and comprehension measures, rather than by "conventional wisdom." The purpose of the test battery is to assist teachers in making sound instructional decisions based on accurate assessment of word identification skills.

There are a variety of opinions about the function of structural analysis skills in skilled reading behavior. Reading methods texts differ as to recommended skill emphases; some advocate an analytical approach using word configuration and context, while others promote a synthetic approach stressing letter sound relationships and structural analysis (Witty, Freeland, & Grotberg, 1968). Direct instruction in structural analysis, however, is recommended by many reading professionals (Farr & Roser, 1979; Johnson & Pearson, 1978; Karlin, 1971; Smith & Johnson, 1976; Spache, 1963; Stauffer, 1969) and practice in structural analysis is included in most basal reading series [Ginn 720 (Clymer et al., 1976); Houghton-Mifflin, 1971 (Durr et al., 1971-1974); American Book Company, 1968 (Johnson et al., 1968-1972)].

Despite differences in their approaches to teaching structural analysis, writers of methods texts, basal series publishers, and reading theorists seem to agree on one point: the end result of all instruction in structural analysis should be the understanding of meaning from context. Structural analysis skills should be used (and hence taught) in conjunction with other word identification skills. The goal is to integrate structural analysis skills as one strategy which allows a reader to segment an unknown word into meaningful parts, in order to make the total word recognizable and thereby facilitate comprehension. For this reason, each subtest within the Structural Analysis Component of the Word Identification battery uses a format requiring the student to use context. To the extent that reading instruction stresses reading for meaning and skills practiced in context rather than in isolation, the method of assessment used in the Structural Analysis Subtests is particularly appropriate.

Between summer 1977 and spring 1978, a prototype of the test battery was developed. Over 1,400 public elementary school children in grades three, four, and five, representing five regions of the country, participated in pilot studies. As part of the investigation, a standardized global measure of comprehension was also administered to many of these children. The results of these studies, as well as a summary of the literature on word identification and comprehension, are presented in the report, "Relationships between Word Identification Skills and Reading Comprehension of Elementary School Children" (Johnson, Pittelman, Schwenker, Shriberg, & Morgan-Janty, 1978).

From spring 1978 through spring 1979, an effort was made to refine the subtests in both areas of the Word Identification Test battery (phonics and structure). This paper documents the changes made in the subtests in the area of structural analysis.

In the spring 1978 Word Identification Tests, the structural analysis component consisted of four subtests: Singulars & Plurals, Possessives, Affixes, and Compound Words. Based on a continuing review of the literature, including research by Deighton (1959), Johnson and Pearson (1978), Kean and Personke (1976), Lamb and Arnold (1976), and Schubert (1969), a decision was made to revise the structural analysis component of the test to include the following subtests: Inflected Endings, Affixes, and Compound Words. The Compound Words Subtest of the 1978 Word Identification Test battery was not revised. Considerable changes were made in the Singulars & Plurals, Possessives, and Affixes Subtests in order to develop the new Inflected Endings and Affixes Subtests. The rules for developing the new Affixes Subtest, as well as documentation of the studies conducted to evaluate the Inflected Endings and Affixes Subtests, are presented in this report.

Development of the Inflected Endings Subtest

A completely new subtest was to be developed for inflected endings because, in the original Word Identification Test, inflected endings were assessed in both the Singulars & Plurals Subtest and the Affixes Subtest. The selection of inflected endings for the newly developed Inflected Endings Subtest was based on frequency information from the

scope and sequence charts of selected basal reading series, on published tests for inflected endings (including the Wisconsin Design for Reading Skill Development), and on earlier versions of structure tests developed by Project staff.

To determine which inflected endings to assess, four basal reading series were surveyed: Ginn 720 (1976 edition), Houghton Mifflin (1971 edition), American Book Company (1968 edition) and Heath and Company (Witty, Bebell, & Freeland, 1968 edition). All four series prescribed teaching the following seven inflected endings: i(es), i(ed), ing, er, s, 's (s'), and (i)est.

An analysis of the corresponding subtest from the Wisconsin Design for Reading Skill Development revealed a 12-item subtest containing two items for each of six inflected endings: ed, s, ing, 's, er, and es. Although most of the other published tests that were reviewed assessed a sample of inflected endings, these inflected ending items were incorporated into subtests which assessed other structural analysis skills. The Doren Diagnostic Reading Test of Word Recognition Skills (1973), on the other hand, had separate subtests to assess inflected endings and singulars and plurals. The Inflected Endings Subtest of the Doren Diagnostic Test assessed five inflected endings: ing (six items), ed (four items), er (two items), and r and s (one item each). The Singulars & Plurals Subtest assessed three inflected endings: ies (three items), es (two items), and s (two items).

A total of eight inflected endings were assessed in the Project-developed, spring 1978 Word Identification Test. Table 1 presents the eight inflected endings and the number of times each inflected ending

Table 1

Analysis of the Inflected Endings Assessed in the

Spring 1978 Word Identification Test

Inflected ending	Occurrences in Singular & Plurals Subtest	Occurrences in Affixes Subtest[a]	Total occurrences
s (plural	1		1
(e)s (verb)		1	1
ed		11	11
ing		5	5
es	1		1
ies	2		2
er		4	4
est		2	2

[a] In this tabulation, if a single word contained two affixes, both were included in the count.

occurred in the test.

Based on information from the review of the basal reading series and published tests of inflected endings, and the survey of the literature, it was decided that the new Inflected Endings Subtest should include items which sampled tense markers, adjectives, possessives, and plurals. The inflected endings to be tested were: (e)s (as a verb), s (as a plural), ied, ing, (i)es, er, 's, s', and est.

The number of items for each inflected ending in the test was to be based on the frequency of occurrence in the language of that ending. Therefore, information was gathered from the Ginn Lexicon Project Frequency Listing (Johnson & Baumann, 1979), which is a compilation of four word frequency lists: Carroll, Davies, Richman list (1971); Kucera-Francis list (1967); Moe Picture Book Words (1973); and Moe Oral Language Words (1974). A total of 18,979 different words comprise the Frequency Listing. The frequency count for the words ranged from 164,924 to 20. The 734 words which had a total frequency count of 300 or more were examined for the inflected endings selected for the test. Table 2 presents the results of these tabulations.

A similar review was performed with the American Heritage Word Frequency Book (Carroll, Davies, & Richman, 1971). This word list is based on an examination of published material for children in third to nineth grade, and contains 5,088,721 tokens and 86,741 words. Over 5 million words of running text were extracted for analysis from 1,045 different publications, with a total of 90 schools participating in the study. Table 3 presents the results of the analysis of the 600 most frequent words for the presence of target inflected endings.

Table 2

Presence of Inflected Endings in Words

From the Ginn Lexicon Project Frequency Listing

Inflected ending	Number of words above 300 frequency containing inflected ending	Relative percent of occurrence of each inflected ending
s (plural	39	37
(e)s (verb)	11	10
(i)ed	31	29
ing	22	21
(i)es	2	1
er	1	1
's[a]	0	0
est[a]	0	0

[a] Eight words with the inflected ending 's were found between the frequencies of 127 (highest frequencies for that inflected ending) and 42. Only three words with the inflected ending est were found in the frequency range of 160 to 45.

Table 3

Presence of Inflected Endings in the 600 Most Frequent Words Listed in the American Heritage Word Frequency Book (Carroll et al., 1971)

Inflected ending	Number of words containing inflected ending	Relative percent of occurrence of each inflected ending
s (plural	40	48
s (verb)	4	5
ed	20	24
ing	16	19
ied	2	3
(i)es	1	0.5
er	1	0.5
's	0	0
est	0	0

Method

Stimuli. A 43-item test of inflected endings was developed. The inflected endings and the number of items for each type of inflected ending are presented in Table 4.

The format for the new Inflected Endings Test was as follows: Students saw a sentence with a word missing and were instructed to circle the response choice (from the three response choices provided below the sentence) that best completed the sentence. Within an item, each of the three response choices contained the same root word but had different inflected endings. (Figure 1 is a page from the Inflected Endings Subtest.)

The selection of the correct answers (words with the inflected ending being assessed) was based on the following surveys:

1. A review of the Ginn Lexicon Project Frequency Listing (Johnson & Baumann, 1979) was performed to identify the 15 highest frequency words which contained the target inflected ending. These 15 words were then listed in order of frequency.

2. The American Heritage Word Frequency Book (Carroll et al., 1971) was reviewed to identify the 15 highest frequency words containing the target inflected ending. These words were then listed in order of frequency.

3. Words that were common to both lists were further examined to determine their earliest grade level of occurrence, the grade level of the greatest incidence of the word, and whether the target word had a higher frequency in grades 3 to 5 or grades 6 to 9.

Table 4

Inflected Endings Assessed in the

Inflected Endings Subtest

Inflected ending	Number of items on test
s (plural)	6
es (verb)	5
(i)ed	5
ing	5
(i)es	3
er	3
's, s'	4
est	3
root word	9
Total	43

Inflected Endings
3rd Grade

Each of the sentences below has a word missing. Read each sentence. Then carefully read each of the three words below the sentence. Draw a circle around the word that best completes the sentence.

A.	People use rulers to draw straight _____. line line's lines
B.	The doctor was _____ at the hospital. need needed needs

Figure 1. Directions and practice items from the first page of the Inflected Endings Subtest.

4. Those words with a high frequency of occurrence in third to fifth grade were next checked for their appropriateness to fourth grade using The Living Word Vocabulary (Dale & O'Rourke, 1976). (The Living Word Vocabulary lists 43,000 words and their percentage scores based on how familiar the words are to students in grades 4, 6, 8, 10, 12, 13, and 16.) To be considered for the Inflected Endings Subtest, either the target word with its inflected ending or the root word alone had to be known by at least 85% of fourth-grade students.

Based on information from the four sources described above, a specified number of target words for each inflected ending (Table 4) was chosen along with one or two alternate words.

There were three response choices for each item: the correct answer (which for all but nine items was the root word plus the target inflected ending), the root word alone, and an incorrect response choice of the root word plus a different inflected ending. In the nine items where the root word alone was the correct answer, the other two response choices each consisted of the root word with an inflected ending.

Subjects. A total of 143 students in grades three and four participated in the study (see Table 5). Third-grade students were from a public elementary school in the Oregon, Wisconsin School District. The fourth-grade students were from two Wisconsin public elementary schools, one in the Marshall School District and one in the Waterloo School District. All seven classrooms participating in the study were heterogeneously grouped.

The Oregon, Marshall, and Waterloo school districts serve children

Table 5

Subject Population by School and Grade

District	Grade 3	Grade 4	Total per school
Marshall			56
Classroom A		19	
Classroom B		17	
Classroom C		20	
Waterloo			40
Classroom A		21	
Classroom B		19	
Oregon			47
Classroom A	22		
Classroom B	25		
Total per grade	47	96	143

from primarily rural areas, although a substantial percentage of the Oregon residents commute to the city of Madison for employment. All three school districts have a socioeconomic population ranging from lower to upper middle class. The Marshall School District participates in the Title I Migrant Program, and all three school districts have Title I reading programs.

Procedure. The 43-item, paper-and-pencil Inflected Endings Subtest was administered to an entire class at a time. First, the directions were explained to the children, and two practice items were discussed. (This procedure took approximately 5 to 10 minutes.) The students were then instructed to work on the test items independently. Test administration times ranged from 12 to 15 minutes for fourth-grade students and from 18 to 25 minutes for third-grade students.

Five students from each classroom were selected to participate in an individually administered oral reading task. These students were asked to read aloud a 344-word passage containing a sampling of words from the paper-and-pencil version of the Inflected Endings Subtest. (A copy of the passage is in Appendix A). The selection of students for the oral reading task was based on their alphabetical ranking on class lists. Students listed 1st, 5th, 10th, 15th, and 20th were selected. Administration times for the oral reading task ranged from 2.5 to 9 minutes, with third-grade students requiring the longer times. Except for students in one fourth-grade classroom, all students received the paper-and-pencil version of the Inflected Endings Subtest first and the oral reading task second.

All tests were administered by staff members from the Wisconsin Research and Development Center for Individualized Schooling. Testing was conducted on 3 days in November 1978; testing in each school occurred on separate days.

Results

Summary statistics for the 143 subjects are presented in Table 6. A breakdown of performance by grade revealed no significant differences between third- and fourth-grade students.

An item analysis was performed to identify items needing revision for future versions of the test. The item analysis also produced a Hoyt reliability estimate. Although this statistic is based on criteria used in the development of standardized tests rather than diagnostic tests, it is useful for judging whether the number of items is sufficient and how individual items compare to the total test.

The Inflected Endings Subtest achieved an overall Hoyt reliability estimate of .79, which is somewhat lower than figures from other subtests of the Word Identification battery. When student performance on each of the 10 inflected ending categories was examined separately, however, the reasons for the low reliability became apparent. Data on the 10 categories are presented in Table 7. The students performed with 87% or greater accuracy on all categories except the two involving the possessive use of the apostrophe. In these two categories, students' performance dropped dramatically, with a mean percent correct of 37.7 on apostrophe s items and .06 mean percent correct on the s apostrophe item. Because performance on the total test was high, with a mean

Table 6

Inflected Endings Test:

Summary Statistics for Total Group

Total number of subjects	143
Mean raw score (of 43 possible)	37.04
Percent correct	86.12
Standard deviation	3.93
Range	22-42
Hoyt estimate of reliability	0.79
Standard error of measurement	1.76

Table 7

Inflected Endings Test:

Summary Statistics for Total Group by Item Categories

Item categories	Number of items	Mean raw score	Mean percent correct score	Standard deviation	Range
Root word	9	8.42	93.5	0.95	4-9
s (plural)	6	5.22	87.0	1.25	0-6
(e)s (verb)	5	4.70	94.0	0.61	1-5
's	3	1.13	37.7	0.87	0-3
s'	1	0.06	0.06	0.24	0-1
ing	5	4.87	97.4	0.37	3-5
(i)ed	5	4.44	88.8	1.00	1-5
(i)es	3	2.66	88.7	0.67	0-3
est	3	2.76	92.0	0.49	1-3
er	3	2.78	92.7	0.60	0-3

percent correct of 86.12, it is clear that most students had mastered all the inflected endings except for the possessive use of the apostrophe. The oral reading task, designed to evaluate the external validity of the written test, was not effective for words having apostrophe endings, because s as a plural, s apostrosphe, and apostrophe s render identical pronunciations. Results at this stage of test development indicate that students had not yet mastered the possessive use of the apostrophe; there was no significant difference in performance between third and fourth graders.

Thirty-five of the 143 students (25%) in the Inflected Endings Study were randomly selected for the oral reading task (see Tables 8 and 9 for results). Of the 35, 12 made no oral errors on the passage. For the remaining 23 students, there was 63% agreement between the errors made orally and those made on the written test. Since apostrophe s items accounted for the majority of errors made by students on the written test, the observed degree of agreement might have been even higher if such errors could have been detected by the oral reading task.

Discussion

The most noticeable feature of the Inflected Endings Subtest results was the ceiling effect for both third- and fourth-grade students. Apparently, by third or fourth grade, most students are familiar enough with inflected endings to be able to select an appropriate one for a root word in context. This high level of performance, however, was not maintained for the categories of items assessing the possessive apostrophe.

Table 8

Inflected Endings Test:

Descriptive Statistics for Oral vs. Written Performance

	Made oral errors	Made no oral errors.
Number of subjects	23	12
Written test (mean percent correct)	89	91
Percent overlap[a/]	63	

[a/] Percent overlap = $\frac{\text{Errors common to both tests}}{\text{Total number of errors}}$

Table 9

Percentage Breakdown of Oral Subjects'

Written Test Performance by Item Type

Item type	Percent of total errors
's or s'	63
s (plural)	7
est	3
(i)es	6
er	5
ed	6
ing	1
(i)es (verb)	5
es (plural)	3

Mean percents correct for apostrophe s and s apostrophe items were 37.7 and .06, respectively. Although the students had not mastered the distinction between the use of these two endings, it is reasonable to question whether this ability is necessary for good reading comprehension. For example, the three words sisters, sister's, and sisters' are pronounced identically by the reader. In most cases, however, context will determine which inflected ending is intended. For this reason, a decision was made to delete s apostrophe and apostrophe s items from the Inflected Endings Subtest. Perhaps, application of the possessive apostrophe should more appropriately be relegated to lessons in grammar rather than to reading instruction.

The reliability of the Inflected Endings Subtest was not as high as was hoped. This can be explained by the ceiling effect mentioned above, the low performance scores on items assessing the possessive apostrophe, and possibly the fact that there were only three response choices for each item. Therefore, a fourth response choice ("none of these") will be included in the revised subtest. Approximately 5 of the 39 items will be revised so that "none of these" is the correct answer.

The final issue raised in this study is the appropriateness of the Inflected Endings Subtest for third and fourth graders. According to a review of textbook series, formal instruction and practice on inflected endings is often greatly reduced by the end of third grade. Perhaps a better level at which to administer the test, to provide diagnostic information, is second grade. Therefore, the revised version of the Inflected Endings Subtest will be administered to second-grade students in late fall 1979.

Development of the Affixes Subtest

The spring 1978 version of the Affixes Subtest consisted of only 20 items, and assessed fourth- and sixth-grade children's knowledge of nine derivational suffixes, one inflectional suffix, and one prefix. The earlier Affixes Subtest for second grade consisted of 15 items and assessed seven derivational suffixes, one inflectional suffix, and one prefix. (A list of the affixes assessed for each level of the spring 1978 subtest is presented in Table 10.)

Because so few affixes were assessed in the spring 1978 subtest, a completely new spring 1979 affixes subtest, increasing the number of affixes and changing the test format, was developed. A multiple choice cloze format had been used in the spring 1978 version, and on that test, vocabulary knowledge could have been a confounding factor affecting students' performance.

The selection of affixes for assessment on the spring 1979 Affixes Subtest was based on frequency information gathered from scope and sequence charts of basal reading series, from published tests of affixes, and from the SWRL Lexicon.

Four widely used basal series were surveyed to determine which affixes are consistently taught to elementary school children. The four series were: Ginn 720 (Clymer et al., 1979 edition); Macmillan (Smith & Wardhaugh, 1975 edition); Houghton Mifflin (Durr et al., 1974-1978); Scott Foresman (Aaron et al., 1976). In most cases, affixes were introduced in the beginning of second grade as syllabic word parts and form class markers. They were later reintroduced as

Table 10

Affixes Assessed in the

Spring 1978 Word Identification Test

Affix	Target items in second grade test	Target items in fourth- and sixth-grade test
Prefix		
un-	3	5
Suffix		
-ful	2	2
-ly	2	2
-land	0	1
-wards	1	1
-ish	1	1
-est	1	1
-less	0	1
-ant	1	1
-able	1	1
-ed	2	3
Root word	1	1
Total items	15	20

meaningful word parts and as affixes in grades four through eight. A total of 11 prefixes and 14 suffixes were common to the instructional sequences of at least three of the four basal series.

The SWRL Lexicon (Rhode & Cronnell, 1977) was also examined to determine the frequency of occurrence of words containing the affixes identified through the basal series survey. The SWRL Lexicon is a 10,000-word lexicon of the basic vocabulary of children in kindergarten through sixth grade. It is a selective compilation of eight sources which include studies of materials written for children, materials written by children, and studies of the oral language of children (Durr, 1970; Entwisle, 1966; Green, Howard, Joerger, & Marino, 1958; Jacobs, 1967; Kolson, 1960; Murphy et al., 1957; Rinsland, 1945; and Weaver, 1955). The prefixes and suffixes found to be common to at least three of the four basal series, and their frequencies from the SWRL Lexicon, are presented in Table 11.

Upon completion of the SWRL frequency check, affixes with frequencies of less than 10 were eliminated from further consideration. This reduced the initial pool of affixes, derived from the review of the basal series, to 8 prefixes and 12 suffixes. One affix, non, was selected for assessment, however, even though it was not listed in the SWRL Lexicon. The affix non- is typically considered to be a useful prefix and it was taught in all four of the basal series.

Comparisons done with other teaching and testing materials (Broska, Hodges, Patrick, Williams, & Oseroff; Northern Valley Schools, 1976; Otto et al., 1972-1975; Shepherd, 1973) showed general agreement with

Table 11

SWRL Frequency Listing of Commonly Taught Prefixes and Suffixes

Affix	Frequency
Prefixes	
anti-	6
dis-	94
in-/im-	135/35
inter-	21
non-	not listed
over-	not listed
post-	not listed
re-	200
sub-	41
super-	10
un-	76
Suffixes	
-able	41
-ance/-ence	35/38
-ant/-ent	46/83
-en	154
-er/-or	945/146
-ful	57
-hood	5
-ic	128
-ion	302
-less	25
-ly	260
-ment	83
-ness	28
-ous	78

Note. Adapted from Rhode and Cronnell (1977), SWRL Technical Report No. 58, "Rank Order of Prefixes and Suffixes," pp. 54-55.

the proposed list of target affixes. The following commonly taught and frequently occurring affixes were finally chosen for the Affixes Subtest.

Prefixes: dis-, in-/im-, inter-, non-, pre-, re-, sub-, and un-

Suffixes: -able/-ible, -ance/-ence, -ant/-ent, -en, -er/-or, -ful, -ion, -less, -ly, -ment, -ness and -ous

The selection of the root words that were to be combined with the target affixes was based on two criteria: (a) the root word had to combine with at least two other affixes, in order to create foils for the test items; and (b) the root word had to be familiar to at least 70% of fourth graders, as indicated in The Living Word Vocabulary (Dale & O'Rourke, 1976). The Living Word Vocabulary presents a percentage score indicating the familiarity of 43,000 words to students in grades 4, 6, 8, 10, 12, 13, and 16.

A set of potential root words was chosen from the fourth-grade vocabulary used in the four basal series that had been reviewed; these were all words that frequently combine with affixes. This list was further modified to obtain at least four root words to combine with each target affix.

The root words were then checked in The Living Word Vocabulary for their appropriateness for fourth grade. Root words that met the 70% familiarity criterion were then combined with appropriate affixes, to create a pool of possible response choices.

The affixed words were further examined to determine meaning and, when appropriate, the form class changes produced by adding the affix. (Prefixes are meaningful units which do not change the form class of a

word, whereas suffixes, while they do not alter the semantic value of the root, do change the part of speech of a word.) This information would be considered in item construction. Four sources were consulted for this purpose: Kean and Personke, 1976; Marchand, 1960; Thorndike, 1941; and Webster's Seventh New Collegiate Dictionary (1977).

Method

Stimuli. An 80-item multiple choice cloze format test was developed, with four items assessing each of the 20 target affixes. The target affixes, along with the four affixed words selected as the correct response choice for each affix, are listed in Table 12. For each item, the student was presented with a two-part incomplete sentence and four response choices. The student was directed to circle the response choice containing the word part(s) that needed to be added to the underlined root word in the sentence in order to form the described word, and thus, complete the sentence. In all 80 items, the first line of the sentence contained the underlined root word and the second line defined the word that would be formed by adding the appropriate affix. The first line of the sentence was always "What would you add to the word _____ to make a word that . . ." The second line always began with one of the following phrases: "means," "describes," "might be used to describe" or "refers to," and ended with the definition of the affixed word. Figure 2 is a page from the Affixes Subtest.

Sentence construction consisted of (a) determining the meaning of the affixed element when combined with a particular root, and (b) writing a sentence so the meaning change would be expressed clearly and

Table 12

Target Affixed Words from the Spring 1979 Affixes Subtest

Target Affix	Selected Affixed Words			
Prefixes				
dis-	disconnected	disappeared	disagreeable	dissatisfied
in-/im-	indecisive	inactive	immobile	invaluable
inter-	interwoven	intertribal	interglacial	interstate
non-	nonviolent	nonreader	nondestructable	nontaxable
pre-	preprinted	prewetted	prejudge	prepay
re-	reemployed	retake	reelected	restate
sub-	subteen	subhead	subArctic	subcommittee
un-	untightened	unflattering	untestable	undetermined
Suffixes				
-able/-ible	governable	paveable	honorable	useable
-ance/-ence	appearance	entrance	tolerance	dependence
-ant/-ent	enterant	dependent	applicant	different
-en	ripen	tighten	blacken	loosen
-er/-or	waxer	printer	collector	actor
-ful	colorful	tasteful	useful	harmful
-ion/-tion/-sion	application	connection	decision	election
-less	valueless	smokeless	skidless	useless
-ly	politely	daily	kindly	clearly
-ment	settlement	treatment	government	pavement
-ness	politeness	fairness	kindness	blackness
-ous	spacious	infectious	famous	dangerous

Affixes

Read each sentence carefully. Notice that there is an underlined word in each sentence. Below each sentence are four answers. Circle the answer that contains the word part or parts that should be added to the underlined word in order to make the word that is described in the sentence.

A.	Which would you add to the word <u>happy</u> to make a word that describes a person who is not happy? un_____ _____iest _____ily un_____ness
B.	Which would you add to the word <u>sweet</u> to make a word that means the quality of being sweet? un_____ened _____ness _____er _____est
C.	Which would you add to the word <u>drive</u> to make a word that describes a car that cannot be driven? _____ing _____er _____able un_____able

Figure 2. Directions and practice items from the first page of the Affixes Subtest.

succinctly. Every effort was made to make the format of the sentences as consistent as possible throughout the test.

The response choices consisted of prefixes, suffixes, and inflected endings, and were selected so that, by combining each root word with a response choice, a real word was formed. Only one root word and affix combination, however, created a word with the specific meaning described in the second line of the sentence.

The purpose of the Affixes Subtest was to assess the degree to which students use affixed elements to identify the meaning of words. The sentences were therefore carefully constructed to include a definition of the affixed word, so that students' prior knowledge of the base word would be minimized as a confounding factor in performance.

Subjects. A total of 257 students in grades four and five participated in the study (see Table 13). The students were from two elementary schools in the Unified School District of Antigo, Wisconsin, and three elementary schools in the Eagle River, Wisconsin School District.

The Antigo and Eagle River school districts serve children from rural areas in northern Wisconsin. Both districts have a socioeconomic population ranging from lower middle to middle class.

Procedure. Each class was given the 80-item paper-and-pencil Affixes Subtest. The test administrator distributed the test booklets, explained the directions, and reviewed the three practice items. This procedure required approximately 9 minutes. The children were then directed to work independently until they finished the test. Throughout the test, assistance in reading the target root words was provided if

Table 13

Subject Population by School and Grade

District/School	Grade 4	Grade 5	Total per school
Eagle River School District			
St. Germaine	22	21	43
Eagle River	60	18	78
Conover	14	21	35
Unified School District of Antigo			
Antigo North	34	27	61
Spring Valley	18	22	40
Total per grade	148	109	257

requested. Fourth-grade students took from 30 to 50 minutes and fifth-grade students from 20 to 45 minutes to complete the test.

All testing was conducted by staff members from the Wisconsin Research and Development Center for Individualized Schooling. Testing was conducted on two consecutive days in May 1979, with testing in each school accomplished on a separate day.

Results

Summary statistics for the 257 fourth- and fifth-grade students are presented in Table 14. Of the total of 80 items, students obtained a mean score of 54.6 (68.3%) correct. In order to identify items on which students performed poorly and to obtain an estimate of the reliability of the total Affixes Subtest, the raw score data were analyzed using an item analysis program. The resultant Hoyt reliability estimate for the total test was extremely high at .95. Through the analysis, several test items were identified for revision prior to future testing.

A rank-ordered breakdown of students' performance on each of the 8 prefix and 12 suffix item categories is presented in Table 15. Four items were used to assess each affix category. Within prefixes, the mean percent correct on an affix category ranged from 81.4 (for un-) to 48.5 (for pre-). Within suffixes, performance ranged from 89.3% correct (for -ful) to 35.7% correct (for -ant/-ent).

The data were also analyzed for differences due to the sex, grade level, and school district of the children. Results of t-tests comparing these groups are summarized in Table 16. The comparison of boys' with

Table 14

Summary Statistics on Affixes Test

Number of items	80
Number of subjects	257
Mean raw score	54.62
Mean percent correct	68.3
Standard deviation	15.09
Range [raw score]	17-78
Hoyt estimate of reliability	0.95
Standard error of measurement	3.45

Table 15

Performance on Prefix and Suffix Categories in Rank Order by Mean Percent Correct

Categories	No. of items	Mean percent correct
Prefixes		
un-	4	81.4
dis-	4	78.5
non-	4	77.8
re-	4	76.8
in-/im-	4	56.3
inter-	4	54.5
sub-	4	51.3
pre-	4	48.5
Suffixes		
-ful	4	89.3
-less	4	85.3
-ment	4	84.3
-er/-or	4	80.4
-en	4	79.6
-ous	4	73.3
-ion	4	66.2
-ness	4	65.4
-able/-ible	4	62.4
-ly	4	61.0
-ance/-ence	4	57.4
-ant/-ent	4	35.7

Table 16

Summary of t-tests for Significant Differences

Due to Sex, Grade Level, and School District

Variable	Number of subjects	Mean percent correct	SD	SE	t-value	df	Two-tailed probability
Boys	139	.6533	.207	.018			
					-2.75*	255	.006
Girls	118	.7175	.158	.015			
Grade 4	149	.6558	.189	.015			
					-2.73*	255	.007
Grade 5	108	.7200	.183	.018			
School district A	102	.6474	.200	.020			
					-2.46	255	.014
School district B	155	.7060	.177	.014			

*Denotes t-values significant at the .01 level.

girl's performance revealed that overall, girls significantly outperformed boys, with a t-value of -2.75 ($p = .006$).

The second t-test compared the performance of fourth-grade students with fifth-grade students. Not surprisingly, the fifth-grade students performed significantly better than fourth graders, with a t-value of -2.73 ($p = .007$).

The final t-test in this set of analyses compared performance by students in the Antigo School District with that by students in the Eagle River School District. Although Eagle River students performed somewhat higher than Antigo students (mean difference, .058), the t-value of -2.46 ($p = .014$) was not significant at the $p \leq .01$ level.

Another series of t-tests were performed to analyze the various components of the Affixes Test. Comparisons were made on performance between prefixes and suffixes, and between items where the spelling of the root word is not changed when the affix is added (eg., color, colorful) versus items where the spelling is changed (e.g., apply, application). Summaries of t-tests for these two comparisons are presented in Table 17. Although performance was significantly greater on prefixes than on suffixes, no significant difference was obtained in performance on items in which the root word spelling is changed versus items in which the spelling is not changed.

The final group of t-tests was conducted to determine the degree to which the familiarity rating of the affixed target word affected students' performance. Word familiarity ratings for each root word used in the test had been obtained from The Living Word Vocabulary

Table 17

Summary of t-tests for Differences in Affix Performance Due to Prefix-Suffix Items and Due to Regularity of Root Word Spelling during Affixation

Variable	Number of subjects	Mean percent correct	SD	SE	t-value	df	2-tailed probability
Prefix	257	.7003	.183	.011	6.89*	256	.000
Suffix		.6565	.212	.013			
Irregular spelling	257	.6023	.253	.016	-.59	256	.554
Regular spelling		.6075	.161	.010			

*Significant difference at $p \leq .01$ level.

(Dale & O'Rourke, 1976); the root words had to be known by at least 70% of fourth-grade students. No criterion was established regarding students' knowledge of the affixed target word. During analysis, an issue was raised as to whether factors other than knowledge of the root word (as indicated by the familiarity rating) and knowledge of the affix element (as indicated by performance on other test items within the affix category) might be affecting students' performance on particular test items. To examine this possibility, all-ways comparisons of the affixed target words were carried out, based on grade-level familiarity ratings for the affixed target words obtained from The Living Word Vocabulary. Table 18 summarizes the results of the t-test comparisons for these grade level familiarity groupings. In the comparisons of grade four- to grade six-rated affixed words, grade six- to grade eight-rated affixed words, and grade eight- to grade ten-rated affixed words, there is a strong, consistent pattern--performance was greater on the affixed target words with the higher familiarity ratings. In the last two comparisons, however, the pattern quite unexpectedly reverses. In comparing the affixed target words with familiarity ratings for grades eight, ten, and twelve, performance was greater on the less familiar (grade twelve) than on the more familiar (grades eight and ten) affixed target words.

Performance on affixed words with comparable familiarity ratings varied considerably, regardless of whether or not these words were rated at or above the grade level of the students. The following factors may account for the observed variations in performance: (a)

Table 18

Summary of t-tests for Significant Differences in Performance on Affixed Words of Different Levels of Familiarity to Subjects

Familiarity level of words	Mean percent correct	SD	SE	t-value	df	2-tailed probability
Grade 4	.7315	.200	.012	2.69*	256	.008
Grade 6	.7069	.204	.013			
Grade 6	.7069	.204	.013	9.78*	256	.000
Grade 8	.5825	.258	.016			
Grade 8	.5825	.258	.016	10.73*	256	.000
Grade 10	.4187	.277	.017			
Grade 8	.5825	.258	.016	-5.96*	256	.000
Grade 12	.6965	.274	.017			
Grade 10	.4187	.277	.017	-12.46*	256	.000
Grade 12	.6965	.274	.017			

*Significant difference at $p \leq .01$ level.

variations in the familiarity of foil choices; (b) the fact that familiarity ratings from The Living Word Vocabulary are based on children's knowledge of isolated words rather than on words in context; and (c) a psychological factor which might dispose children to reject a correct response choice simply because the affixed word is unfamiliar, despite their knowledge of the meanings of both the root and affix.

Discussion

A basic premise behind teaching and assessing affixes is that children will be able to determine the meaning of an affixed word by combining knowledge of the meaning of the root word with knowledge of the meaning of the affix. An examination of the ways in which affixes combine with root words, however, demonstrates quite clearly that this process works for only a fraction of the affixed words in the English language. Several features intrinsic to the formation of affixed words limit the possibilities for children to successfully use their knowledge of a root word and affix to correctly define an affixed word.

One feature is the type of base to which an affix is attached. Affixes combine with free bases and bound bases. A free base is an independent word in the language. For example, care is a free base which occurs alone and in combination with a variety of affixes, as in the words careful, and carefully. Toler, however is a bound base. It does not occur independently in the language, but rather has meaning only when it is combined with one or more affixes, as in tolerate or tolerable. The independent meaning of a bound base is apparent only to

linguists who have investigated its etymology or historical entrance into the English language.

An investigation of affix frequencies, as reported in the SWRL Lexicon, revealed that suffixes occur with equal frequency on bound and on free bases. Prefixes, on the other hand, attach to bound bases much more frequently (approximately 73%) than to free bases (approximately 27%). To minimize the possibility of problems resulting from the type of base target affixes attach to, several items in the Affixes Subtest will be revised, so that whenever an affix attaches to a bound base, the bound base will appear in the same form in all four response choices. For example, the root word permit, which contains the bound base mit, would appear in all four response choices, (permission, permissive, permits, permissible). Hence, the word remit would not qualify as a response choice.

A second feature of the affixation process which can interfere with students' ability to recognize a root word is the spelling and pronunciation changes which sometimes occur when a root word combines with an affix. According to frequency information reported in the SWRL Lexicon, spelling changes of the root word occur in almost one-third of the affixed words listed. Several items in the Affixes Subtest included root words in which spelling changes occur during affixation. These items will remain in the test, however, because as indicated in the Results section, no significant difference was noted in performance on items in which the root word spelling is changed compared to items in which the spelling is not changed.

A third feature of the affixation process which can cause difficulty is the change in the part of speech resulting from the addition of suffixes. On target test items, the phrasing in the second line of the sentence subtly indicated the part of speech for the correct response choice. The phrase indicating the part of speech, however, was not always consistent. Such sentences will be revised so that, for example, a sentence calling for the response choice to be an adjective will always include the phrase "a word that describes."

A fourth feature is the variance of meaning of a given affix. Only one item in the test assessed more than one meaning for an affix (in as in invaluable vs. indecisive). To improve the diagnostic usefulness of the test, this item will be eliminated in future development. The direction manual for the final test packet will provide an explanation of the specific meanings assessed for each of the affixes in the test.

Summary and Future Directions

Results of item analyses from the Inflected Endings and Affixes Subtests raised some interesting speculations about children's acquisition of structural analysis skills.

Performance on the Inflected Endings Subtest was generally high, with a mean percent correct of 87 or higher on all inflected endings except those involving the possessive use of the apostrophe, where mean scores were less than 37% correct. Moreover, the oral reading

substudy, which was planned to evaluate the external validity of the subtest, was ineffective for the apostrophe items, because s as a plural, s apostrophe, and apostrophe s are indistinguishable when read aloud.

Results from the Affixes Subtest indicated that the fourth- and fifth-grade students tested had mastered some, but not all, of the affixes assessed. Mean scores on specific prefix categories ranged from 81.4% correct for the prefix un-, to 48.5% correct for the prefix pre-. There was a larger range in performance on suffixes, with students obtaining a mean percent correct of 89.3 on -ful items, but averaging only 35.7% correct on -ant/-ent items. Girls significantly outperformed boys, and fifth-grade students achieved significantly higher scores than fourth graders.

As a result of the data analyses, several changes are being considered for revised versions of the Inflected Endings and Affixes Subtests. Four changes are being planned for the Inflected Endings Subtest. First, the items assessing apostrophe s and s apostrophe will be deleted, because performance on these items was extremely different from performance on other items in the test. Similarly, response choices containing apostrophe s and s apostrophe will be dropped from all items. (A separate subtest to assess possessives and contractions may be developed.)

Second, as a consequence of deleting the apostrophe s and s apostrophe response choices, new root words will be selected to replace those root words for which substitute real word response choices cannot be identified.

Third, the item sentences will be shortened and simplified wherever possible to decrease the reading load of the test, and to make the test more appropriate for younger students.

The fourth change will involve the addition of a fourth response choice, "none of these", to each item. This addition will: (a) make the number of response choices for the Inflected Endings Subtest consistent with the other structure subtest, and (b) raise the reliability of the test, by minimizing the likelihood of correct guessing.

Several changes are also being planned for the revised Affixes Subtest. First, two affixes will be dropped. Items assessing the -ant/-ent and -ance/-ence affixes showed markedly lower performance than items assessing other affixes. Moreover, these affixes tend to attach to root words which are above the vocabulary level of the general second- through fourth-grade population at which the test is aimed.

Second, the number of test items to assess each affix will be reduced from four to three. The least desirable item for each affix will be eliminated. This will be an item on which students performed either too well or too poorly.

The third category will involve changes to correct for variation in the familiarity levels of root words and response choices. The vocabulary of the target words and response choices will be checked for grade-level appropriateness for second-, third-, and fourth-grade students.

The final set of revisions will focus on making the Affix Subtest "linguistically clean." A new format is being considered in which the

root word will be presented separately and the response choices will be the affixed forms of the root word rather than the isolated affixes. Root words containing bound bases will either be eliminated or revised to include the full root word form in all the response choices for that item.

In winter 1979-80, the revised Structure Subtests will be administered to several classes of second- and third-grade students. The data will be analyzed with particular attention to the grade level appropriateness of the tests. An item analysis will be carried out and test items will be revised as indicated.

The total Word Identification Test battery, consisting of the Structure and Phonics Subtests, will be administered in April 1980 to several hundred elementary school children. The reading subtest of the Metropolitan Achievement Tests, a standardized measure of comprehension, will also be administered to obtain correlational information. All-ways correlations will be run between each of the Phonics and Structure components of the total Word Identification Test battery and the reading subtest of the Metropolitan Achievement Tests.

It is believed that the information gained through administration of the test battery will provide insights which will result in a better understanding of the relationships of the various components of word identification to comprehension, and that, ultimately, this knowledge will have practical application for instruction in the classroom.

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Appendix A

Subjects' Copy of the Story from the Oral Reading Task for the Inflected Endings Subtest

A Jungle Story

For years the two boys lived in the jungle with the animals. They thought that they were the only people on earth.

For, you see, the boys came to the jungle when they were babies. Years ago, a king's family was going across a dangerous river, when suddenly the waves became very high. The king's family and the horses drowned. Luckily, two of the babies were being carried in baskets which were able to stay afloat, even with the high waves. After floating down the river for miles, the baskets landed under a tree at the lowest part of the river.

The babies called and looked and turned in their baskets. But no one came. Two days later the smallest animals in the forest came upon the baby boys in the baskets. "Look what we found! What are they? What should we do?" they asked each other. "Let's call the other animals and show them what we found," said the youngest rabbit. "I wonder what they will say?"

The rabbit ran a mile to get the great and wise lion who lived on the highest hill in the jungle. The wise lion followed the rabbit to the baskets and looked at the babies. Later that day the lion called an animal council meeting. At the meeting he told the animals some stories about Man and how Man lives in countries all over the world. The animal council decided to make friends with the babies.

Early the next morning all the animals came running. They were eager to get started helping with the babies. The smallest animals gathered sweet fruits from the trees to feed the babies. Other animals built a small hut for the babies to live in. The babies liked being cared for. They clapped their hands and laughed to show that they were happy.

The days and years went by. The babies grew to be boys. They were loved by their animal friends and were very happy.

And so, my friend, this story ends.