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According to a report from the U.S. Congress, Office of Technology Assessment (1988), over 10,000 computer programs are currently being marketed. With such a large and divergent array of materials to choose from, software consumers need to understand exactly how programs they are considering for purchase function before they can be sure that any particular program will actually fit their specific classroom needs. Similarly, it is important to determine whether or not the programs are compatible with the teacher's philosophy of reading — reader-based, text-based or interactive (Leu and Kinzer, 1991).

The purposes of the present paper are to 1) examine the design of three reading software programs to determine their ease of use, format characteristics, and managerial components and 2) to evaluate their text presentation segmentation to determine how closely they conform with current chunking theory in reading. The first purpose basically addresses the practical issues of software use: Does it have a diagnostic component? Does it mainly provide skills practice, or does it teach and/or diagnose specific reading

skills? Can it be used flexibly by both teacher and student (e.g., branching options) or does the program follow a preset linear design? Important information for teachers about the design characteristics of each program are presented first.

The second purpose addresses how each of the programs segment their passages for flashed presentation on the computer screen. Two premises underlie this question: 1) theory suggests that meaningful information is more easily read and remembered than nonmeaningful information (Irwin, 1991; Smith, 1988), and 2) some research has shown that unskilled readers can use organizational strategies provided by teacher/program manipulated text that result in their reading more closely approximating skilled readers (Casteel, 1988-1989; Casteel, 1990; Jandreau, Muncer and Bever, 1986; Weiss, 1983). In other words, pre-organized computer presented text can facilitate poor readers' speed and comprehension.

Theoretical rationale

Comprehending a text required the reader to go beyond decoding the individual words in the surface structure to organizing groups of words into meaningful segments using the text structure, context, and relational information found in the deep semantic structure. As a reader's background knowledge and cognitive processes interact with the text, meaning is constructed. However, Oaken, Weiner and Cromer (1971) discovered that some readers lack the organizational strategies necessary to go beyond word-by-word reading. Even after training in word identification, their less-skilled fifth grade readers continued to perform below skilled readers. The authors concluded that the students' failure to improve was due to their inability to organize the text into a meaningful representation. Pronouncing the words alone was not enough to improve their comprehension significantly. These

findings that poorer readers tended to read words in isolation rather than integrate groups of words into meaningful units were more recently substantiated by Merrill, Sperber, and McCauley (1981).

Weiss (1983), Radebaugh (1983), and Casteel (1990) all found that externally imposing organization on a text by using text segmentation can facilitate readers' comprehension. Weiss (1983) found that using either a pausal phrase format or a syntactic phrase format improved good, average and poor fourth and seventh grade readers' comprehension performances over the traditional prose format of textbooks. Similarly, Radebaugh (1983) found that pre-organized text improved the comprehension performances of good and poor fourth and fifth grade readers. While Casteel (1990) found that chunking text into meaningful phrases improved low-ability eighth grade readers' comprehension performances, it did not significantly improve the reading of the high-ability group. The latter finding suggests that age and/or expertise of the reader may interact with the robustness of the facilitative effects of pre-chunked text.

While chunking text into meaningful segments has proven useful for some readers, particularly the weaker readers who may be lacking this skill, it is a very time consuming task for the teacher and hardly practical in the classroom setting. However, computers and computer programs that segment text could meet this need very efficiently. Gerrell and Mason (1983) examined the effects of presenting the same two passages from a typical basal reader to fifth graders in a syntactically chunked format and in the traditional text format on a computer screen. Students consistently performed better in the chunked condition than they did in the traditional text presentation. Jandreau, Muncer and Bever (1986) achieved similar results with poor

to average community college students using computer presented text that was segmented at phrase structure boundaries versus traditionally formatted text.

Similar results have also been obtained for a learning disabled population and for young readers. Casteel (1988-89) found that chunking computer text into meaningful groups of three to five words improved the comprehension and retention of learning disabled readers over a similar group receiving nonchunked text. Radebaugh (1983) reached a similar conclusion on samples of good and poor fourth and fifth grade readers.

Both meaningfully chunked text presentation segments and randomly parsed text segments were easier for these young readers to comprehend than the longer, traditional text display. Radebaugh (1983) concluded that any pre-organized text presentation that reduced the load on memory for novice readers improved their comprehension, a conclusion similar to Casteel's (1988-89) for the LD population.

According to Clay and Imlach (1975) and Isakson and Miller (1976), all poor readers typically do not make good use of syntactic and semantic structures to understand what is read. On the other hand, good readers are sensitive to meaningful propositional units in text in a manner similar to the way they comprehend speech. They use their knowledge of syntactic and semantic strategies to facilitate their construction of meaning in both listening comprehension and reading comprehension (Muncer and Bever, 1983). Evidence suggests that poorer readers, as well as developing readers, may not have acquired these strategies essential to chunking, or may not know when it is appropriate to apply them.

Building upon the research findings of the facilitative effects of chunking as a strategy to improve reading performance, three commercially available software programs were assessed to first determine how the programs divided their passages for presentation on the computer screen. Secondly, each program was examined to identify the design characteristics of practical concern to classroom or lab instructors by asking these questions: What teacher/student controls exist? What skills/strategies are addressed? What diagnostic information is provided? What length passages are used and how are they presented? What comprehension questions are provided and where are they placed in relation to text?

Methods

Program selection. The three commercially available software programs selected for this study, Milliken's Comprehension Power (1981), Davidson's Speed Reader (1985), and Milliken's Comprehension Connection (1987), were designed for use in a variety of educational settings, from elementary and secondary classrooms to college developmental reading laboratories and adult vocational learning centers. An informal survey of local reading settings showed that the programs selected were considered popular by both teachers and students (J. Smith, personal communication, 1992). In fact, two of the programs were cited by a survey of two-year college reading programs as being among the most frequently used nationally (Swartz, 1985). The third program, The Comprehension Connection, was marketed after that survey was completed. All three programs are currently available in both the Apple and DOS versions.

Procedures

While the programs selected are available on multiple levels, for comparison purposes only one level of reading passages was evaluated for each program. Four passages from

comparable levels of each software program were selected for examination based on the potential appeal of the topics for both genders. To address the question of program design characteristics, each level selected was assessed both from the teacher's manual and from engaging in the computer program itself.

To assess the type of textual segmentation employed in each program, four stories from one level of each of the three programs were randomly selected for review. One exception to this procedure involved the speed Reader II program. Since its stories varied greatly in length, two sets of four stories were reviewed, one set for the short story length and one set for the long. All stories selected were on the same level of difficulty across programs.

To implement an assessment of text segmentation, a pencil slash was made on a printed copy of each passage as the segmentations flashed on the computer screen. From this descriptive data, percentages were calculated for the classifications of text presentation segments. For the purposes of this research, two categories of text segmentation were used: meaningful text segmentation and nonmeaningful text segmentation. Meaningful text division was a combination of pausal phrase formats and syntactic phrase formats, as in the Weiss (1983) study. This category included all naturally occurring breaks in oral reading, word structure division, punctuation cues and grammatical phraseology and function. By contrast, nonmeaningful segmentation referred to divisions in text that do not contain any of the aforementioned characteristics, but appear at random, as a matter of convenience or without a discernible rationale.

The major findings for each of the three software programs are outlined below. Descriptive information on the

programs' design characteristics is presented first, followed by the analysis of the programs' text segmentation presentation.

Design characteristics

All three selected programs are comprised of passages and questions to assess comprehension; however, from there on there are more differences than similarities. Speed Reader II is primarily concerned with increasing students' reading rate. Comprehension Power diagnostically assesses 25 comprehension skills and allows students to work on their reading rate. While comprehension is the main focus of Comprehension Connection, it stresses the use of reading strategies (e.g., main idea, text supportive graphics and vocabulary defined in context) rather than diagnosis or reading speed. In addition, the programs also vary in the length of the passages they present (see Table 1), with Speed Reader having the shortest passages and Comprehension Power the longest.

TABLE 1
Passage lengths for computer reading programs

	Speed Reader II, Short	Speed Reader II, Long	Comprehension Power	Comprehension Connection
A	152 words	409 words	1423 words	213 words
B	493 words	1523 words	1523 words	260 words
C	437 words	1456 words	1456 words	233 words
D	325 words	1404 words	1404 words	160 words

Milliken Comprehension Power. *Presentation format.* Twelve typically expository stories stored on four floppy disks are provided for each level of this program. The organizational format of the passages breaks each text into nine segments with two to four questions following each segment. Text segments are flashed on the computer screen line by line

at speeds varying from 50 to 650 words per minute, depending on the preset selection of the student or teacher.

The questions, reflecting 25 different comprehension skills identified by the program, are broadly categorized as either literal understanding, interpretation, analysis, evaluation and appreciation. By definition, literal understanding is composed of recalling information and details, following sequences of ideas and events and identifying the speaker. In contrast, interpretation centers on identifying main ideas, making inference, predicting outcomes, drawing conclusions, interpreting figurative language, visualizing and paraphrasing. Analysis involves the skills of comparing and contrasting, recognizing cause and effect, classifying, reasoning and identifying analogies. Evaluation includes the skills of detecting the author's purpose, understanding persuasion, recognizing slant and bias, distinguishing between fact and opinion, judging validity and determining relative importance of ideas. Appreciation encompasses the skills of interpreting character, recognizing emotional reactions, identifying mood and tone, as well as identifying the setting.

Managerial component. Both teacher and student have input in the management of the Milliken Comprehension Power Program. Teacher control embodies such factors as adding up to 100 students and/or five classes to a disk, or making individual and group assignments. In addition, teachers can review individual and class progress either on the screen or with a printed record; however, this feature of the program is protected by a security system to maintain confidentiality.

Student management is limited to the selection of available activities preassigned by the instructor. Possible activities included are key word sentences, preview, passage selection

and rate of speed. Key word exercises place each targeted vocabulary word within the context of a sentence. The preview option for each passage is a shortened version of the text. It allows preparation (e.g., schema activation) and confidence building before the longer text passage is read.

Diagnostic information. Diagnostic information for Comprehension Power is provided in a protocol report that displays each story completed and/or the number of segments completed of a partially read story, reading speed, percentage of comprehension questions correct out of the total questions posed, and a reading index. The reading index is the rate of speed in words per minute multiplied by the value obtained for comprehension accuracy. In addition, information on the frequency of rereads for each segment is shown. The rereads allow the student an opportunity to read a portion again before selecting an answer to a question. The number of question attempts for each segment of reading is also disclosed on the screen.

Information on individual student's performance on each comprehension skill addressed in a text passage is automatically recorded for the teacher and student. A total score for all segments read that support a specific comprehension skill is also given. A record reflecting an individual's performance on all 25 comprehension skills described earlier is provided either through an on-screen format or in a printed copy with problem areas highlighted by an asterisk.

Speed Reader II. *Presentation format.* Speed Reader presents both narrative and expository stories in text lengths that vary from short passages of approximately 150-200 words to longer passages between 300-500 words. Passages are presented in segments of print of 1 to 12 lines that appear on the

screen at any one time at a speed preset by the student. Questions are provided at the close of each passage, followed by feedback, encouragement and rewarding messages and/or melodies. However, the Timed Reading Test is one whole page presented on screen. When reading is completed, students press the space bar for a new text passage to appear. The program also includes exercises to encourage the use of more efficient eye movements by the reader.

Managerial component. The Speed Reader II Program appears to be primarily a student controlled program. The student is able to choose from the various options in the menu — warm-up exercises using letters or words, setting the speed from 100 to 200 wpm for the reading passages, choosing a new reading selection, and ending the lesson.

Teacher control exists as well to add or remove items from the data disk file. The instructor may prepare a written version of reading materials as well as corresponding questions. The reading level of the new text can be analyzed via the program; however, the newly created passage must not be more than 200 words in length. Lastly, a printout can be obtained about student progress in terms of created text and the original passages on the disk. Progress is portrayed in terms of the skills emphasized in the program — comprehension, rate of retention, rate of reading and eye efficiency. According to the program, this complement of skills is designed to engender ease and enjoyment of reading.

Comprehension skills addressed by Speed Reader include reading for main ideas and details. By contrast, rate of retention determines how much one can remember after reading. The main objective of this program is to increase a reader's reading speed. The program recommends adjustments of rate in increments of 25 to 50 words per minute

when the student's comprehension per passage is 75 percent or more. Eye efficiency, a related speed factor, is concentrated on broadening the eye span or peripheral vision, while increasing the rate of recognition and eye movement patterns. Eye span involves increasing the number of words seen at a fixation or pause through using peripheral vision. Rate of recognition refers to amount of time spent at a pause or fixation in reading. Decreasing the pause time increases reading speed. The program suggests that efficient eye movement patterns avoid excessive wandering, slowing and undue regressions.

Diagnostic information. Diagnostic information can be obtained from the personal record sheet kept by the student. Such information as date, number of attempts for warm-up exercises and final reading speed are shown on the screen. Other pertinent information includes the title of the exercise or passage and percentage correct of the comprehension questions. A progress chart with a graphic display is provided to demonstrate reading speed. Students manually complete the written chart after each session.

Milliken's Comprehension Connection. *Presentation format.* Comprehension Connection is designed to improve comprehension through the active processing of textual information. In addition, it supports the effective understanding of main idea strategies, vocabulary development and graphic aids to generate meaning. Since the program tends to approach reading in a holistic fashion, text presentation options include presenting a number of sentences at a time, presenting one sentence at a time, or using the arrow key to continuously scroll the text. Speed of reading is not approached directly in this computer program.

Of the 20 passages available on the five disks examined, 19 were expository while only one was narrative. Five multiple-choice comprehension questions follow each passage. While question types are varied in presentation order, they generally include one vocabulary question about a difficult word in the passage, one query for a stated or implied main idea, one literal question relating to information of an explicit nature in one sentence of passage and two inferential items which necessitate the use of information stated explicitly or implicitly in one or more sentences in the passage. Upon completion of the questions, feedback is given.

Managerial component. The teacher and student have input into the management of the Comprehension Connection Program. Teacher control includes the ability to make both individual and group assignments, add up to 100 students to a disk, or modify the criterion for moving to the next program disk. In addition, the instructor can enter the program to modify individual assignments affecting the student's ability to return to a passage and use various program options. For example, unless the program is altered, students can 1) branch to an easier less technical version of the passage; 2) have immediate access to the definition of difficult vocabulary; 3) have the main idea of each paragraph identified; and 4) access graphic aids related to the passage content. This type of information has been shown to aid student's comprehension of expository text (Reinking, 1988; Reinking and Schreiner, 1985).

If the student does not meet the criterion of three out of five correct questions, a reread is optional. The first time through, students are not informed which questions are in error, only that the criterion was not met. After the second reading of the passage and responses to the questions, the student is told which questions were correct and which were

incorrect. This procedure is designed so that students read to understand the whole passage and not just the parts answering a specific question. Student progress can be reviewed either on the screen or in a printout. The total questions correct for each category described earlier are listed. Furthermore, the cumulative total of the number of times an assistance option was used by a student is displayed. From this, a pattern of strengths and weaknesses as well as progress can be viewed by the instructor.

Text segmentation presentation

All three programs had the option of segmenting their stories for on screen presentation. Figure 1 illustrates the percentage of segments found in the randomly selected stories from each program that represented meaningful breaks and which were randomly segmented, conforming only to a range of spaces. Approximately 50 percent of the breaks in both Comprehension Power and Comprehension Connection adhered to semantic or syntactic boundaries, while Speed Reader presented 71.3 percent of the passages reviewed as meaningfully segmented. Since the Speed Reader passages varied greatly in length, with shorter passages ranging from 148 to 185 words and longer passages ranging from 325 to 394 words (see Table 1), two sets of four stories were analyzed, one set for the short condition and one set for the long. Table 2 reports the meaningful and nonmeaningful passages divisions for both the short condition and the long condition, along with allowing comparison of segmentation conditions across all three programs. In this table it becomes clear that the longer stories in the Speed Reader program are semantically chunked at approximately the same rate as the other two programs; however, the shorter passages are more consistently presented in meaningful chunks. This information can be used by the teacher when matching learners to the most appropriate program for them.

FIGURE 1

Meaningful & Nonmeaningful Phrase Divisions for Three Reading Software Programs

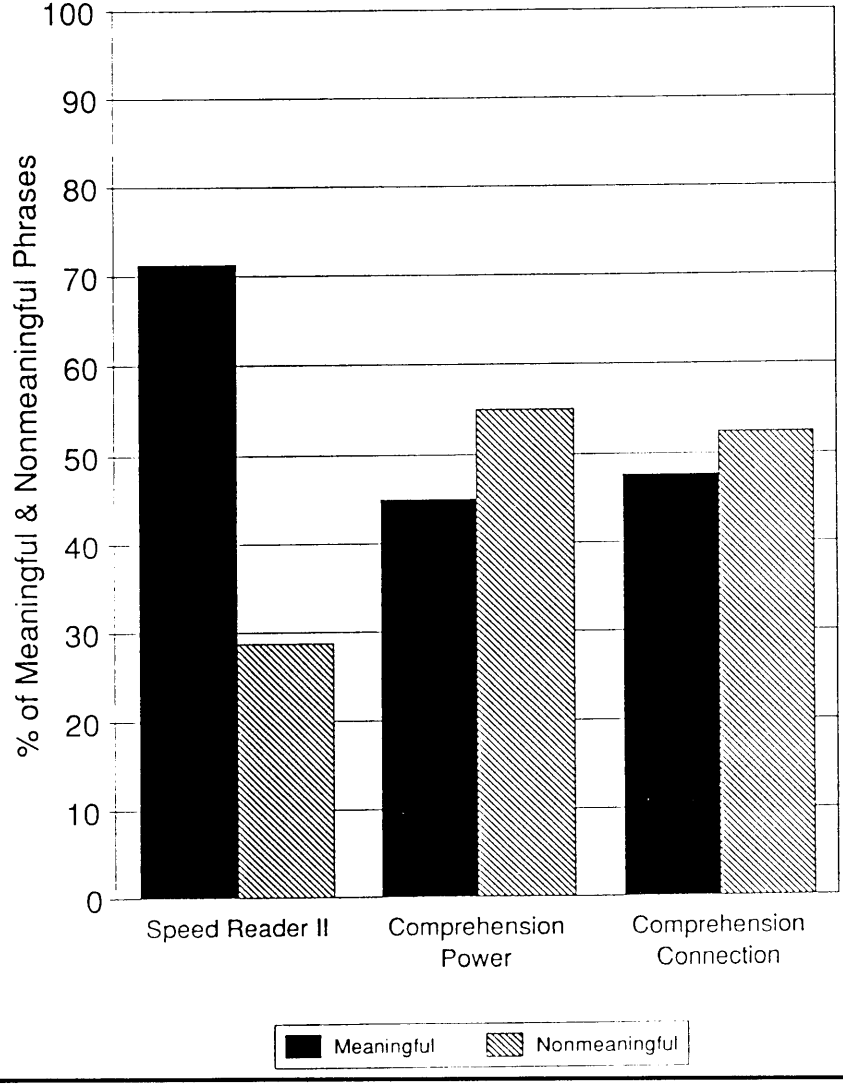

TABLE 2
Text segmentation % for each passage

	Comprehension Connection		Comprehension Power		Speed Reader II, Short		Speed Reader II, Long	
	meaningful	non-meaningful	meaningful	non-meaningful	meaningful	non-meaningful	meaningful	non-meaningful
A	11 50%	11 50%	130 48%	141 52%	54 96.4%	2 3.6%	30 49.2%	31 50.8%
B	15 55.9%	11 44.1%	100 36.1%	177 63.9%	66 85.7%	11 14.3%	43 56.6%	33 43.4%
C	14 46.7%	16 53.3%	114 42.2%	155 57.6%	52 82.5%	11 17.5%	39 57%	30 43%
D	9 52.9%	8 47.1%	150 53.4%	131 46.6%	53 88.3%	7 11.7%	28 56%	22 44%

Discussion and implications

Each of the three software programs contained practical features to assist classroom teachers, such as student/teacher controls, strategy development, processing support, diagnostic information and comprehension questions. However, there was enough variation among the three programs to make them all valuable assets within the same classroom to meet different learners' needs. Recent studies have found computers to be highly motivational for disabled (Keene and Davey, 1987; Kincade, Kleine, Johnson, and Jacob, 1989) and at-risk (Kincade, et al., 1989; Wepner, 1990) learners, increasing their attitudes toward reading and their time on task.

Cohesive organization of text contributes to the meaningful processing and memory of that text by the reader (Irwin, 1991; Marshall and Glock, 1978-79); however, nonsemantic or random breaks in the text's visual display can interfere with an expert reader's textual processing to the point of ultimately confounding comprehension and reducing the

reader to word calling. Kincade and Greene (1992) verified this perception when their expert college readers reported that randomly segmented text interfered with their comprehension of computer-presented text. The implications are that the more semantically consistent segmentation of the short stories on the Speed Reader would be more appropriate for skilled readers seeking to improve speed.

The value of pre-organized text has been reconfirmed in studies with learning disabled readers (Casteel, 1988-89), poor to average adult readers (Jandreau, Muncer and Bever, 1986), elementary-middle school readers (Gerrell and Mason, 1983; Radebaugh, 1983; Weiss, 1983) and high school sophomores (Stevens, 1981). In fact, novice readers and poor readers of any age seem to profit from pre-parsed text that reduces the load on working memory from that normally encountered in a traditional text format. Finding that all of the programs parsed their text presentations into units smaller than a sentence implies that any of them would provide useful practice for these types of readers since they have been found to profit from any segmentation that reduces the visual display to less than a sentence (Casteel, 1988-1989; Radebaugh, 1983; Weiss, 1983). Furthermore, studies such as Gerrell and Mason's (1983) have confirmed the value of computer presented chunked text.

Other assets of the programs for classroom teachers include the valuable diagnostic information from Comprehension Power on 25 different comprehension skills. This type of immediate identification of specific problem areas can facilitate teachers' development of an individualized, prescriptive plan that minimizes repetition of already learned skills. Similarly, Comprehension Connection offers unique branching capabilities that provide the reader with knowledge assistance specific to the text being read. The use of such

information has been shown to improve children's comprehension of expository text (Reinking, 1988; Reinking and Schreiner, 1985). This type of assistance is not available on either of the other two programs.

In conclusion, the issue of matching texts and materials to specific learner needs has long been a concern of educators. When choosing reading software for the classroom, it is important to directly examine the programs and manuals to determine whether the specific goals and format of the program match the needs of the targeted students. In many remedial reading classrooms, multiple reading programs are necessary to adequately accommodate diverse learner needs. The emphasis of the program, length of passages, type of comprehension questions, diagnostic capabilities, and managerial efficacy are all issues to be addressed when evaluating whether a particular program is appropriate for an individual setting.

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The 1994 themed issue of *Reading Horizons* will be devoted to efforts that promote literacy through university-school collaboration. Guest editors are Janet Dynak and Ronald Crowell of Western Michigan University. Contributions in the form of research reports, commentaries, case studies, and articles discussing the area of literacy relating to university-school collaboration are welcomed. Preference will be given to manuscripts co-authored by classroom teachers and university faculty. Manuscripts should be submitted following *Reading Horizons* guidelines appearing on the inside cover of this journal. Manuscripts intended for the themed issue should be postmarked by **March 1, 1994**. Address all manuscripts to Dr. Jeanne M. Jacobson, Editor, *Reading Horizons,* WMU, Kalamazoo MI 49008.