Computer programs to facilitate detailed analysis of how people study text passages

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Three computer programs are described for an IBM Personal Computer; these programs enable the gathering of detailed data on reading and study processes. The programs (A) present any text of the experimenter's choosing and permit subjects to study the lines and pages of that text in any order; (B) allow for the subject's use of a light pen to record study time per line, to answer questions, and to indicate lines that are, for instance, important or difficult by "highlighting" them (i.e., changing them to reverse video); (C) allow for multiple study sessions and a review session; (D) present and score multiple-choice questions; (E) permit the use of fill-in test items; (F) calculate 176 values, including detailed data on highlighting, quality of study, testing, and times and frequencies on 18 different categories of lines in study and in review; and (G) make a printout of the raw data and the 176 summary statistics. Also described is one example of a 28-page text and a test that have been used in conjunction with the programs. Data are provided to illustrate the usefulness of the programs.

People have been interested for centuries in how people learn from text, but only recently has rigorous research been conducted. Most available research has to do with the study of brief passages quite unlike those encountered in real life (e.g., Brown & Smiley, 1978; Pichert & Anderson, 1977; Sulin & Dooling, 1974; Thorndyke, 1977). Studies of longer passages have generally been limited to rather gross measures, such as time spent studying a passage and the total number of correct answers on a test (e.g., Annis & Davis, 1978; Crouse & Idstein, 1972; Fass & Schumacher, 1978).

A major reason for the lack of detailed research is that detailed study of longer passages has become feasible only with the advent of inexpensive computers. This paper describes computer programs that present lengthy passages to subjects, present and score questions, record time and frequency data, and calculate many different results.

The most obvious goal when studying text is to learn the important information. As Anderson and Pearson (1984) point out, "Perhaps the most pervasive and consistent finding of research on discourse is that important text elements are more likely to be learned and remembered than less important elements" (p. 272). A key question is why subjects emphasize important material. One likely answer is provided by the attention hypothesis (e.g., Anderson & Pearson, 1984; Anderson & Armbruster, 1984). According to this view, subjects attend more to important elements, thereby learning and retaining them

better. The importance of time has also been emphasized by Faw and Waller (1976) who state that a "major difficulty with much of the available research is that inadequate attention has been paid to the study time variable" (p. 703).

The prevailing view has been that increased attention to a text segment will be reflected by an increase in the time spent studying that segment. The approach described in this paper enables an assessment of the selective attention theory by measuring the length of time a subject studies each line of text. By using an individual line of text as the unit of analysis, it is possible to obtain a more detailed analysis than is possible with the typical procedure of timing how long subjects spend on larger blocks of text (e.g., Reynolds, Standiford, & Anderson, 1979) or on entire passages (e.g., Annis & Davis, 1978).

Another possibility is that selective attention can occur without requiring longer time (e.g., Britton, Meyer, Simpson, Holdredge, and Curry, 1979). For example, a subject can spend about the same study time on each line of text, but daydream on some lines and concentrate on others. The programs presented in this paper permit an assessment of this type of selective attention if subjects are asked to select (by highlighting) the lines they attend to the most.

The highlighting feature is also of potential benefit for those who wish to study metacognition. A common approach in such experiments is to ask subjects, at the end of study, how well they understand the text, how difficult the text is, and how well they think they will do on a test (e.g., Raphael, Myers, Tirre, Fritz, & Freebody, 1981). With the approach described here, subjects can be asked to highlight lines they understand (or do not understand), or to highlight lines they feel are particularly difficult. Also, subjects can be asked, for instance, to highlight a

Appreciation is expressed to John Hinson, Ronald Hopkins, and John Wright for their comments on this manuscript. Appreciation is also expressed to Craig Wollen for the preparation of Figure 1, and to Ed Miller and Laura Wilson for their contributions to the analysis. Requests for reprints should be sent to Keith A. Wollen, Department of Psychology, Washington State University, Pullman, WA 99164.

blank line inserted at the bottom of a page if they feel confident they would do well on a question regarding material covered on that page. By such techniques, researchers can obtain evidence concerning metacognition during rather than after study.

Another dependent variable that can be examined with the programs is "lookbacks," which involve a subject's reexamining portions of text previously covered. Lookbacks occur during initial study and are to be distinguished from review that occurs only after initial study is complete, and usually after an interval of time.

Most experimenters view lookbacks as activities that occur when subjects have comprehension and/or memory failures (e.g., Alessi, Anderson, & Goetz, 1979; Garner, Macready, & Wagoner, 1984; Garner & Reis, 1981). Looking back to relevant lines can resolve such failures and provide significant information about metacognition. However, an alternative view is that lookbacks represent a rehearsal activity that avoids comprehension or memory failures in the first place. Our programs offer an objective and easy method for determining the number of lookbacks for each line of text. One need not build ambiguities into the text or use elaborate procedures to document that a lookback has occurred, as some researchers have done (e.g., Garner & Reis, 1981).

The procedures described here have the additional advantage of permitting research on the review process and its relationship to original study. Like lookbacks, the lines reviewed can provide a great deal of information on what the subject considers important and/or does not understand or remember. Review is obviously an integral part of real-world study techniques, but it has received little research attention.

Although a computer holds great promise for research in reading and studying, there have been relatively few attempts to use computers for the presentation of text and the collection of data. One exception is the research by Reynolds et al. (1979), who presented and recorded time on 4-line text segments. However, time was not obtained for individual lines, the segments frequently consisted of sentence fragments, and subjects were not free to return to previous text segments. Thus, if the beginning of a segment were the end of a confusing sentence, then subjects could not look back at the beginning of the sentence to resolve their confusions.

Another approach (Wollen, Cone, Britcher, & Mindemann, 1985) involves mounting pages of text on a monitor table equipped with a sliding cursor that indicates the line of text the subject is reading. This method provides a line-by-line analysis of study time, but it is difficult to calibrate, and the pages of text have to be mounted, one by one, in a very precise fashion. The approach described in this paper is much easier and more precise.

Computers also have been used to present successive words of a sentence one (or more than one) word at a time in serial fashion. These tasks can either be paced by the computer (e.g., Potter, 1984) or by the subject (e.g., Mitchell, 1984). Such approaches are very useful, but it

is possible that subjects' strategies vary considerably from those used when large text segments are presented and subjects are free to look at lines in any sequence.

The following methodology circumvents many of the above problems. The student is free to study in a manner similar to that used for courses, and yet detailed information about that manner of study is obtained.

EQUIPMENT REQUIREMENTS

The system includes an IBM Personal Computer with 64K RAM, two 360K disk drives, an AST Megaplug board with 192K RAM and a real time clock, an IBM Color/Graphics Monitor Adapter board (which has the light pen port), a Symtec¹ Touch-Ring light pen, and a Zenith Model ZVM123 green screen monitor. The pen serves four functions: to indicate which line of text the subject is currently examining, to change a line of text to reverse video (referred to here as highlighting), to change from one page of text to another, and to select the answer for multiple choice questions.

The Symtec pen comes equipped with a ring near its tip which, when touched, enables subjects to highlight and to answer questions. Although unnecessary, we prefer to deactivate the touch ring by inserting a 1K resistor between Pins 3 and 4 of the 6-pin connector that connects the light pen to the IBM Color/Graphics Monitor board. A hand-held switch is then inserted between Pins 5 and 6 of the same connector. These modifications permit subjects to operate the switch with one hand and the pen with the other.

To run the program, the system must have at least 128K RAM, two disk drives (160K is less convenient but sufficient), a light pen port, and a real time clock. Since IBM does not produce a real time clock, an after market board is required. The programs described here are written for an AST Megaplug board, but they will work on other AST boards (except the MPII and MonographPlus).

The Symtec pen works with any monitor that does not have the slow P39 phosphors. Best operation is obtained with color, black and white, or green screen monitors; we use the Zenith ZVM123. Although not strictly required, it is desirable to use a stand to hold the monitor in a nearly horizontal position. The stand puts the text in a position similar to that used in normal reading, increases the subject's accuracy in keeping the pen pointed to the correct line, and reduces the fatigue that results from holding a hand up for long periods of time. The stand we use is shown in Figure 1.

COMPUTER PROGRAMS

The three required programs are written in BASICA and compiled for faster execution. Each program is menu driven and easy to use by inexperienced operators. The programs accommodate passages to 98 pages in length and any number of test questions within the limits of memory and disk capacity.

Figure 1. View showing the stand used to hold the monitor. A large plywood panel is normally situated to the right of the chair and stand. The panel provides a visual separation of the experimenter and subject.

Study Program

One program presents the text and saves the time and frequency data for study sessions. Program execution begins with a series of questions pertaining to the filename of the passage, the subject number (from one to seven digits and/or letters in any combination), whether highlighting will be used (Y or N), whether it is the first session for the subject (Y or N), and whether it is a review session (Y or N). Then a blank screen appears and all is ready for the experimental session.

When a subject is ready, pressing any key presents the first page of text, a sample of which is shown in Figure 2. There is a "light band" on both sides of the text. This band of light is three characters wide and extends from the top of the page to the bottom. The purpose of the band is to provide a solid field of light to increase the ease of using the light pen.

The subject is instructed to keep the light pen on the light band beside the line of text being studied. An arrow, shown in Figure 2 at the beginning of the first line of the second paragraph, indicates the line upon which the pen is positioned. Once the pen is beside one line, time on that line starts accumulating until the pen is moved to a different line. Time is recorded to .01 sec, but the accuracy is probably more on the order of .1 sec because of slight delays in reading the clock when the program is performing other activities.

A trap eliminates times too brief to represent actual study. The trap can be set at any value; we used .3 sec, assuming that this represents the minimum time for an eye fixation; any time less than .3 sec on a line is ignored.

If a subject wants to highlight a line by changing it to reverse video, the switch is pushed while the pen is beside that line. Previously highlighted lines can be changed back to normal video by the same method. Either the left or right light band may be used depending on the handedness of the subject. The program saves any highlighting for later use, such as in a review session.

Subjects can study the lines in whatever order they wish. There is an auditory "beep" when the pen encounters a new line, and an intermittent buzz to warn subjects and the experimenter if the pen moves off the band.

The bottom line of the screen permits changing pages by placing the pen on the square of light beside the appropriate symbol and pushing the light pen switch. A down arrow displays the next page and an up arrow the previous page. In addition, the subject can skip to any page in the passage by entering the appropriate number. For example, Page 23 can be displayed by pushing the switch first when the pen is on 2, then on 3, and finally on E (for execute). The left arrow deletes the previous entry. The screen is blank while the chosen page is being loaded into a buffer, and then the entire page appears at once on the screen. There is a blank interval of about 4 sec from the time the page has been selected until it appears on the screen.

When a study session is finished, the subject selects 99 and E from the bottom of the page. A prompt asks if the results are to be saved. The response of Y saves the results, including times, frequencies, and the lines that were highlighted. Informal questioning and observation reveal that subjects readily learn to follow all instructions, and find the use of the pen unobtrusive and enjoyable.

Test Program

A second program presents the test questions and saves the answers on disk. The program accommodates any number of questions within the memory limitations of the computer and disk. Multiple-choice questions are displayed on the screen with a square of light beside each possible response. The subject selects the answer by placing the pen on the light square beside the chosen answer and activating the light pen switch. Display parameters that can be set by the experimenter are the reading time during which the switch cannot be activated (from 0 to any number of seconds), the time of a beep warning that only 5 sec remain, and the total time from the beginning of one question to the beginning of the next. We use a 15-sec period before the switch is activated, 10 more seconds before the warning beep, and 30 sec overall. As soon as the subject selects an answer, the question disappears; the screen is blank until the next question appears. This process continues until all questions have been presented, at which point the results are automatically saved.

The program also provides for use of fill-in-the-blank questions. If fill-ins are used, the subject's responses must be recorded by hand, scored, and then entered into the computer by picking the appropriate choice on the menu and following the instructions.

Figure 2. A sample page of text as it appears to the subject on the monitor. The arrow left of the first line of the second paragraph indicates that the light pen is on this line. A status line in the lower left corner indicates the number of the line corresponding to the pen position.

Calculations and Printout

A third program permits the user to specify headings, important lines (based on whatever criteria the experimenter wants), supporting lines, lines having questions, blank lines (lines separating paragraphs), number of pages in text, and number of questions. This program also performs the calculations and makes the printout of the results.

Raw data printout. The printout begins with a line-by-line listing of the line number in the text followed by an H if that line was highlighted, the cumulative study time on the line, the number of different times the subject studied that line, the cumulative review time, and the number of times the line was studied during review. One sheet of printout summarizes six screen pages of text.

The answers to multiple-choice test questions appear on a separate sheet. Each question number is followed by a letter (a, b, c, or d) indicating the answer picked, and a + if that answer was correct. If a fill-in-the-blank test is used, this page consists of the question number followed by a 1 signifying a correct response or a 0 for an incorrect answer.

Summary statistics printout. The first page of the summary statistics printout for one sample subject is shown in Table 1. As can be seen, the passage is divided into headings, blanks, and text. Also presented are all possible combinations of important vs. supporting lines, lines with questions vs. those without questions, lines highlighted vs. those not highlighted, and lines from which correctly answered questions were derived vs. those from which incorrectly answered questions were derived.

Two statistics in the middle of the table require clarification. The standard deviation of times on text lines can be used to determine whether a subject emphasizes some lines more than others (producing a large standard deviation), or whether all lines are emphasized almost equally (producing a small standard deviation). Quality of study time is the percentage of the total study time on all lines that was spent on important lines. The greater this percentage, the higher the study quality.

The lower portion of Table 1 presents the number of lines of each type that were in the text (first column), followed by the frequency with which a subject studied, looked back to, and reviewed each type of line. The third

column contains what have been termed "lookbacks" (Alessi et al., 1979). Basically, the values in this column represent the number of lines of each type to which subjects looked back. Lookbacks are based on, but different from, the values of N shown in the raw-data printout. The number of lookbacks are derived by subtracting 1 from the N values in the raw data. The N values have the advantage of distinguishing between lines that were studied once and those not studied at all. The table makes it easy to compare the number of lines across categories.

Table 2 shows the second page of the summary statistics printout from the sample subject. The blanks on the left are to be read by substituting the column headings into the blanks. Thus, the top value in the middle column

Table 1
Page 1 of the Summary Statistics Printout:
Time and Frequency as Functions of Line Type

Type of Line	Study Time		Review Time	
	Sum	Mean	Sum	Mean
All lines	3171.47	4.72	364.44	0.54
Heads	1.82	0.07	22.72	0.81
Blanks	31.03	0.44	18.14	0.26
Text	3138.62	5.48	323.58	0.56
Supporting	2150.04	5.05	218.29	0.51
Highlighted	490.88	6.63	87.66	1.18
Nonhighlighted	1659.16	4.71	130.63	0.37
Important	988.58	6.73	105.29	0.72
Without questions	671.24	6.92	65.35	0.67
Highlighted	396.07	8.25	47.02	0.98
Nonhighlighted	275.17	5.62	18.33	0.37
With question	317.34	6.35	39.94	0.80
Correct	180.94	7.87	14.04	0.61
Highlighted	120.34	13.37	4.92	0.55
Nonhighlighted	60.60	4.33	9.12	0.65
Incorrect	136.40	5.05	25.90	0.96
Highlighted	44.46	4.94	9.40	1.04
Nonhighlighted	91.94	5.11	16.50	0.92
Mean time on all highlighted lines			7.5120	1.0640
Mean time on all nonhighlighted lines			4.8200	0.4030
Standard deviation of times on text lines			3.4698	0.9975
Quality of study time			31.171%	

	Number of Lines			
	In Text	Studied	Looked Back to	Reviewed
All lines	672	602	112	274
Heads	28	4	0	14
Blanks	71	32	1	19
Text	573	566	111	241
Supporting	426	419	73	162
Highlighted	74	74	26	48
Nonhighlighted	352	345	47	114
Important	147	147	38	79
Without questions	97	97	28	52
Highlighted	48	48	15	32
Nonhighlighted	49	49	13	20
With questions	50	50	10	27
Correct	23	23	7	10
Highlighted	9	9	5	4
Nonhighlighted	14	14	2	6
Incorrect	27	27	3	17
Highlighted	9	9	2	8
Nonhighlighted	18	18	1	9

Table 2
Page 2 of Summary Statistics Printout:
Summary of Frequency Data and Test Results

	Type of Response		
	High-lighted	Looked Back to	Reviewed
% of important lines that were —	44.90	25.85	53.74
% of supporting lines that were —	17.37	17.14	38.03
% of highlighted lines that were —		34.29	65.71
% of — lines that were important	47.14	33.93	28.83
% of — lines that were supporting	52.86	65.18	59.12
% of — lines having questions	12.86	8.93	9.85
(Read above lines by substituting column headings, one by one, into the blanks.)			
Total number of highlighted lines		140	
Total number of nonhighlighted lines		433	
Quality of highlighting		30.084	
Total number correct		14	50.00%
Number highlighted and correct		6	42.86%
Number nonhighlighted and correct		8	57.14%
Probability of a correct answer given:			
(a) Highlighting of lines questions was based on			0.5455
(b) No highlighting of lines questions was based on			0.4706
(c) Review of lines the question was based on			0.4444
(d) No review of the lines the question was based on			0.6000

(25.85) represents the percentage of important lines to which subjects looked back. The value of 12.86 in the bottom of the first column represents the percentage of highlighted lines having questions based on them, and so forth.

At the bottom of Table 2, the total number of highlighted and nonhighlighted lines refers to the study session. Quality of highlighting refers to the observed frequency of highlighting important lines minus the chance frequency, as defined by the following formula:

$$Q = \text{NIHL} - \frac{\text{NHL}}{\text{NTL}}(\text{NIL})$$

where Q = quality; NIHL = number of important lines that were highlighted; NHL = total number of highlighted lines in the passage; NTL = number of text lines in the passage (excluding heads and blank lines); NIL = number of important lines in the entire passage.

Test data. Compilations of the major test data are shown in the bottom section of Table 2. The values are self explanatory.

Sample Passage

Any passage up to 98 pages in length can be used. However, we wrote and will describe a sample passage we find useful. The passage is on the subject of computers, which we judged would be of sufficient interest and usefulness to encourage students to return for multiple-session experiments. The passage meets the following criteria: (A) Each page fills a 24-line computer screen; (B) each page begins with a heading and consists of either two or

three paragraphs; (C) each line of text is 62-65 characters long, including spaces between words. If needed, a maximum of three additional spaces per line were added to right justify each line to make the text appear more like printed material; (D) each sentence was 1, 2, or 3 lines long and ended at the right margin, enabling an examination of the time spent on each line of text without the ambiguities that arise if some lines consist of parts of two different sentences; (E) each screen page of text had from 4-6 lines that were judged important. Not one of the many subjects we asked was aware that the text had these features.

Three judges (the first three experimenters) evaluated the text for important lines. The instructions were to select exactly six lines of text per page that best answered three questions that could be asked about the page heading. These questions were as follows: (A) What is ___? (B) What are the main characteristics of ___? (C) What are the main uses of ___? The key word(s) of each heading was (were) substituted into the blanks. For each heading, only those questions that made sense for that heading were considered. For example, it makes no sense to ask "What are the main uses of the major divisions of a computer," and so the question would not be used.

Text lines were considered important only if selected by all three judges. If three judges picked four or more lines in common, the page was acceptable. Otherwise, the page was rewritten to place more emphasis on some lines and less on others. The page was then reevaluated by the judges. The end result was 28 screen pages. A sample of two pages is presented in the Appendix. Of course, a different procedure can be used to define important lines or to create an entirely new text if desired.

A detailed structural analysis of a lengthy text is extremely complicated; however, each sentence of the passage was divided into propositions following the procedure described by Thorndyke (1977). Basically, a proposition was defined to be a clause or sentence that had an action or stative verb. Supporting and important lines were similar. The percentages of supporting sentences that were 1, 2, or 3 lines long were 44, 51, and 5; the corresponding values for important sentences were 45%, 52%, and 3%. The mean number of propositions for supporting (important) lines was 1.81 (1.78) for 1-line sentences, 1.67 (1.69) for 2-line sentences, and 1.72 (1.33) for 3-line sentences. Because there were very few 3-line sentences (only 3 were important sentences), there is more variability for these scores. Based on all sentence lengths, the mean number of propositions per line was 1.71 for supporting lines and 1.68 for important lines.

The division into important and supporting lines is given empirical support by data collected from 36 freshmen who studied the sample passage for two 30-min sessions separated by a 5-min break. The subjects were brought back two days later for a 10-min review and given the multiple-choice test described below. Subjects spent longer per important line than per supporting line in original study (6.00 sec vs. 4.99 sec) and in review (.93 sec vs. .62 sec). As

would be expected, the same amount of time was spent on important lines whether they had questions (6.01 sec) or not (5.97 sec).

A second study using 35 introductory psychology students had two study sessions but no review. Subjects were instructed to highlight from 4-6 lines per page that were important in answering the three questions used by the judges to evaluate importance. The mean times for important and supporting lines were 7.21 sec and 4.52 sec, respectively. Moreover, subjects highlighted 59% of the important lines but only 12% of the supporting lines. Considerably more time was spent on highlighted lines (9.19 sec) than nonhighlighted (4.01).

Test Over the Sample Passage

The mean test score was 17.06 for students taking the immediate test vs. 14.70 for subjects who had the test after a two-day retention interval. Thus, neither floor nor ceiling effects are present.

The test consists of multiple-choice test questions written following the guidelines of Anderson (1972). Anderson called these paraphrase or transformed paraphrase questions. All substantive words (nouns, verbs, and modifiers) were changed except the technical terms (e.g., printer, pixel), and a few less technical terms (e.g., key on a keyboard). A transformed paraphrase question involves a reordering of paraphrases. Examples of the questions are shown in the Appendix.

Each question represented a paraphrasing of an entire sentence (or, rarely, nearly all of a sentence) from the original text, with the omission of one word or short phrase indicated by an underlined blank. The four choices for each multiple-choice question were approximately equal in length. The choices were randomized for each question with the restriction that, within each block of four, the correct answer would appear once as a, b, c, and d. Alternatives such as "all of the above" and "none of the above" were avoided.

An item analysis of the questions was obtained by having 37 subjects take a pretest in which they were asked to define seven common computer terms, read a 28-page printed version of the passage for a total of 50 min, paying particular attention to the main points covered under each heading, and take a 28-item test over the passage, with one question from each page of the passage, and 30 sec to answer each item. The questions were in booklets with one question per page.

In most classroom situations, many students have some knowledge of the subject at the beginning of the course. This knowledge showed in our pretest: The mean percentage of correct answers was 33.4.

The difficulty level and discrimination index were determined for each multiple-choice item. The difficulty level ranged from 27% to 89% correct, with a mean of 16.32 (58.3%) and a standard deviation of 4.94. Thus most items avoided floor or ceiling problems, which is important for researchers who plan to examine different training techniques. The discrimination indexes, which

ranged from $-.01$ to $.65$, were satisfactory. In fact, 20 of the 28 items had values of $.30$ or higher and are considered to be good to very good items (Guilford, 1965).

BENEFITS OF THE APPROACH

The experimental procedures presented in this paper provide the following benefits: (A) Detailed time and frequency data can be collected easily even for very long passages. (B) There is great flexibility in the types of study that can be examined, including reading, review, lookbacks, metacognition, and test performance, to name just a few. The approach is especially suited to testing the selective attention hypothesis. (C) Passages can be presented in a "normal" fashion in that subjects are free to go to any line on any page at any time. (D) The task is relatively unobtrusive and enjoyable for the subject. The use of the light pen is similar to pencils or markers and hence similar to what many subjects use when studying. (E) A passage and test are provided for researchers who do not wish to generate their own. (F) Times, frequencies, and many other statistics are determined automatically and objectively to facilitate data collection and comparisons among different laboratories.

AVAILABILITY

The programs and documentation can be obtained on disk by sending \$15.00, to cover the cost of disks and mailing, to the first author. Checks should be made payable to Washington State University Department of Psychology. Unless specified otherwise, it is assumed that the requestor has double sided, double density disk drives. The sample text and test questions are included.

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NOTE

1. Symtec, 15933 West 8 Mile, Detroit, MI 48235.

APPENDIX
Two Pages and Questions from the Sample Passage

385	DISK FORMATTING	17
386		
387	Information cannot be stored on a disk in a disorderly manner.	
388Q	The fundamental process of organizing disks so that we can record	
389Q	information on them is generally referred to as formatting disks.	
390	Formatting a disk is somewhat like arranging books in a library.	
391	If we have any hope of finding a book, a library must be arranged	
392	in a particular format, and we need to know what that format is.	
393	If we went to a strange library and did not know its format, we	
394	could not locate books because we would not know where to look.	
393	Similarly, different computers use different formats which means	
396	that disks made for one computer will not usually work in others.	
397		
398	Formatting divides a disk into concentric rings called tracks.	
399	Each track is divided into many short segments called sectors.	
400	Formatting is analogous to dividing a garden into sections where	
401	seeds will be planted and spaces in between where they will not.	
402	Formatting is accomplished by running a special program in DOS.	
403	Depending upon the computer system, a disk will be organized into	
404	from 35 to over 80 tracks and each track into 8 or more sectors.	
405	Some portions of a disk are not available for storage by a user.	
406	For example, formatting reserves some space for a directory and	
407	for keeping track of which disk segments are used for each file.	
408	Some firms try to impress users by citing unformatted capacity.	
505	PROGRAMMING FUNDAMENTALS: SEQUENCE AND SUBSTITUTION	22
506		
507	BASIC will be used to illustrate the fundamentals of programming.	
508	We will consider the notion, important in every language, that	
509	a computer must execute instructions in a particular sequence.	
510	In BASIC, the execution of statements in the correct sequence is	
511	made possible by giving every statement its own unique number.	
512Q	The CPU first locates and executes the statement with the lowest	
513Q	number, then the statement having the next lowest number, etc.	
514	Any numbers can be used provided they contain no decimal places.	
515	However, it is customary to give each statement a number that is	
516	divisible by 10 and is ten larger than the previous line number.	
517	Thus, a typical sequence might be 120, 130, 140, 150, 160, etc.	
518	Separating statements by 10 enables a programmer to insert new	
519	instructions between statements if the need is discovered later.	
520		
521	Another fundamental notion is substituting one value for another.	
522	There are many situations in which such exchanges must be made.	
523	For example, consider the following BASIC statement: $80\ N=N+1$,	
524	where N stands for some number that can have different values.	
525	This statement tells a computer to take the old value of N (which	
526	is the N to the right of the equals sign), to add 1 to it, and to	
527	call the result the new value of N (the N left of the = sign).	
528	In other words, the new value of N would be the old value plus 1.	
17.	The basic procedure of setting up a disk, in order to be able to store data on it, is usually called ____.	
	a. booting up	
	b. organizing	
	c. formatting	
	d. flowcharting	
22.	The instruction that the microprocessor finds and carries out first is the one having ____.	
	a. a line number of 10	
	b. the smallest line number	
	c. the largest line number	
	d. a START command	

Note: The line numbers are not presented to the subject. Boldfaced line numbers refer to lines designated as important, and a "Q" after the line indicates that a question was based on that line.