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ABSTRACT

Several text format variables were examined in an attempt to identify the ways in which these variables interact in specific design combinations. The variables include: heading location (embedded or isolated); line length (short or long); space between lines (single or double); paragraph indication (indented or spaced); use of running heads (present or absent); and directive cues (present or absent). Sixty-four computer text types were designed using all possible combinations of the six bivariate text format variables. The text items were distributed to 31 undergraduate students, who sorted them into seven normally distributed categories (Q-sort procedure) based on their perceived study-ability. Data from the Q-sort were analyzed via a six-way repeated measures analysis of variance, and two significant five-way interactions were found. Results suggest several text design considerations: (1) the presence of a running head was preferred, and its interaction with the other variables usually served to improve the study-ability rating of the text type; (2) the presence of a directive cue is also a preferred design condition; (3) while double spaced text was preferred, a single spaced text with running head and/or directive cue would be preferred over a double spaced version without these variables; (4) the location of headings had the greatest effect on the ratings, although this effect was unpredictable; and (5) line length did not appear to be a significant factor for study-ability, though short lines were preferred. A list of references, sample stimuli and instructions for the subjects, four data tables, and three figures are provided. (Author/JB)

Relationships Among Text Format Variables in Computer-Generated Text

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Abstract

Relationships among Text Format Variables in Computer-Generated Text

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Several text format variables were examined in an experiment to identify the ways in which these variables, under specific design combinations, interacted. Text format variables are those elements used to create legible instructional text. The variables examined in this study include heading location (embedded or isolated), line length (long or short), space between lines (single or double), paragraph indication (indented or spaced), use of running heads (present or absent), and directive cues (present or absent).

Sixty-four computer text types were designed using all possible combinations of the six bivariate text format variables. The text types were presented to the subjects, who sorted them into seven normally distributed categories (Q-sort procedure) based upon their perceived **study-ability**. Study-ability was operationally defined as the rating assigned by participants to models of computer-generated text based on the perceived ease with which a text model could be read and studied as if the model were actual text. Data from the Q-sort were analyzed via a 6-way repeated measures analysis of variance. Two significant ($p < .01$) 5-way interactions were interpreted.

Results suggested several text design considerations. The presence of a running head was a preferred design consideration and its interaction with the other variables usually served to improve the study-ability rating of the text type. The presence of directive cues is also a preferred design condition, tending to improve the rating. While double spaced text was preferred, a single spaced text with running head and/or directive cues would be preferred more than a double spaced version without running head or directive cues. The location of headings had the greatest affect on the ratings, probably because it had the most noticeable effect on the image of the text, though its affect on ratings was unpredictable. The more organized and structured appearance of the spaced paragraph condition probably combined with the running head and directive cue conditions to produce a more study-able appearing screen. Line length did not appear to be a significant factor in the study-ability ratings, though all things being equal, short lines were preferred.

Relationships Among Text Format Variables in Computer-Generated Text

Problem Summary

Text format variables are components used to create legible instructional text. Some examples of text elements used within the realm of a cathode ray tube display (CRT) include headings, illustrations, line length, leading between lines, kern between letters, paragraph indication, the use of running heads, heading location, directive cues, type style, type size, empty space, and graphic devices.

Initially, legible text was thought to be function of the size and style of type, therefore research concentrated on the effects of individual symbols upon visibility and recognizability. A symbol considered visible was considered legible. But, as more was learned about the processes of cognition and reading, the overall comprehensibility of instructional text was considered an important element of legibility. Legible pages or screens should designed to look like a collection of ideas, organized and understandable, rather than like a collection of letters; they must flow, and be interpretable as well visible and recognizable (Ryder, 1979). However, there exist no formal guidelines for the design of screen layouts. This experiment investigated the manner in which several text elements interacted when specific arrangements were judged by perceivers.

Research into combinations of text elements presents unique methodological problems for, there is almost an infinite variety of text element combinations. For example, a researcher may compare three type sizes, two line lengths, three types of directive cues. two heading locations, two paragraph indications, three graphic organizers, and two conditions of running heads creating a 3 X 2 X 3 X 2 X 2 X 3 X 2 design with 432 different stimulus combinations--not to mention the implications of performing a 7-way analysis of variance.

In an effort to reduce the number of variables to a manageable, yet realistic number, the chosen text elements were leading, directive cues, paragraph indication, running heads, heading location, and line length.

----------Insert Table 1 here.----------

Leading

Leading was defined as the quantity of empty space between lines of text. For "paper" publications, Tinker (1965) suggested that under optimal conditions, in terms of both line length and type size, the leading between lines be approximately 1.0 and 1.25 point between the bottom of the descender from the upper line and the top of the ascender from the lower line. Hartley (1978) stated that the leading should be equal to the spacing between words, an amount similar to Tinker's suggestion. The key here is "optimal conditions-" for when lines are extremely long more leading is required (Tinker, 1963).

In CRT display research, Kolers, Duchincky, and Ferguson (1981) found that double spacing between lines of text on a CRT marginally increased reading speed cver single spacing. However, they also found that reading single spaced text required less occular effort, because more densely packed text requires smaller and fewer eye muscle movements. Grabinger (1984, 1985) found that perceivers preferred double spaced text; but, this preference was not clear cut and appeared to interact with other text element variables. The two values investigated were single spacing (S1) and double spacing (S2).

Line Length

With regard to line length as a format variable, Turnbull and Baird (1964) recommended that lines of text be between 26 to 65 characters long for a given style and size for paper displays. Keenan's (1981) research with CRT displays supports this. Keenan used a computer to determine the optimal line length in terms of meaningful phrase units for different readability levels and found that line lengths in the vicinity of 45 to 55 characters maintain the integrity of the greatest number of idea units. Yet, despite this research designers often persist in long lines of text. The two conditions investigated were 60 (LL) and 40 (SL) character lines. Both conditions fall within CRT and paper standards, yet are different enough to create distinct differences among the images.

Directive Cues

The use of directive cues is one of the few format elements that has had a positive effect on some types learning in both paper and CRT investigations. Cues such as underlining, upper case letters, or multicolored text have improved recognition and recall tasks when used sparingly and related to desired outcomes (Christ, 1975, 1977; Hartley, Bartlett, and Branthwaite, 1980; Tullis, 1981). Perceiver reactions to direct ve cues are harder to describe. When examined alone, directive cues appeared to have little affect on preferences expressed by participants; yet, in combination with other text elements the cues contributed to the appearance of well organized and structured designs (Grabinger, 1984, 1985). Since a wide variety of cues have been found to be effective, the main questions are related to whether cues are present or not and how they relate to other format variables. The two conditions investigated were Cues Present (CP) o Cues Not present (CN).

Paragraph Indication

The shape of the text on the page or screen can be changed quite noticeably through paragraph spacing and indentation. Efforts to use complicated indenting patterns to represent the structure of the text on paper displays have not improved retention or recall under most circumstances (Frase and Schwartz, 1979; Hartley, 1980; Shebilske and Rotondo, 1981). However, it has also been found that readers' design preferences are affected by spatial changes such as paragraph indication (Siskind, 1979), partly because the text may look more organized and structured (Grabinger, 1984). The use of spatial cues is a highly visible format factor so two conditions were investigated: increased use of white space (PS) (double or triple spacing between paragraphs) and traditional indentation (PI).

Running Heads

Heines (1984) recommended the use of a format variable called hypertext, or running head, to help keep readers apprised of their location in a lesson, the lesson content, their progress, and essential computer commands. A running head is recommended because CRT text pages are short, change frequently, and the nature of a CAI lesson often prevents easily flipping ahead or backward. The running heads are usually placed along the top or bottom of the screen, though may also be found along the sides. Operationally, this variable took two forms: present (RH) or absent (RHN).

Heading Location

Heading location was the final variable included in the investigation. While, the use of headings, particularly in question form, has facilitated learning (Hartley and Trueman, 1982; Holley, 1981) the location of the headings affect the appearance of organization and structure of the page. Since, the presence of headings has facilitated learning it was decided to test two conditions that affect the appearance of the screen: headings were either embedded in the text (HE) or isolated in a separate column (HI).

Research Questions

Several hypotheses could be listed that would predict the effect of one variable and one condition on another. However, the purpose of this study was to explore the way or ways in which these variables interact together. The purpose is analogous to examining the Gestalt of the screen, to inspecting the affect of the whole as a sum of its parts. The purpose of instructional text is to provide material that will promote learning; therefore, instructional text is intended to facilitate an interactive cycle between the learner and the stimulus. The basic problem is the identification of combinations of text element variables that can be constructed or shaped or molded by text designers or CAI writers in ways that facilitate the learning process. Or, how do specific combinations of variables effect each other?

The first step in answering that question was to determine the initial preference reaction of a potential reader to specific text designs. Why examine preferences, especially since preferences are often unrelated to such tasks as recall or retention? First, Tinker and Paterson (1942) found that legibility was positively related to a reader's judged pleasingness of the text. Tinker (1965) also found that readers seldom preferred a text design of less than optimal legibility and tended to equate pleasingness with legibility. Bryant et al. (1981) discovered that preferences affected purchasing behavior when students were more likely to purchase textbooks with illustrations than same textbook without illustrations.

A second reason for using preferences as a starting base is the nature of the perceptual cycle. If it is accepted that legibility is more than the recognizability of a symbol, then the whole cognitive cycle (Neisser, 1976) provides ground for research. The combinations of the text elements becomes more important that the individual symbols, because the potential affect of the initial perception of the document upon a reader's schema. The reader may have particular study or reading strategies that are activated by specific combinations of format variables

In conclusion, it was proposed that an examination of a "whole" would shed more light on the "parts" than an examination of each part separately. The variables chosen for study cover a range of design decisions from the placement of white space to cues that emphasize particular words. Highly organized and controlled designs were compared in an effort to identify ways text format variables interacted.

Methodology

Sample

This was an opportunity sample composed of 31 undergraduate student volunteers, all single, between the ages of 20 and 25, United States citizens, and predominately female.

Materials

Sixty-four computer text types (see Appendix A for samples) were designed through the use of different combinations of six bivariate format variables. To avoid confounding the treatment with contextual factors the text types were designed using the notation method (Twyman, 1981). In place of actual text, "X"s were used to represent the bulk of the print on a page; "O"s to reflect the occurrences of italics, upper case, bold type, color, headings, or reverse type; and "I"s as a tertiary graphic unit to represent something particularly unique in style. As a result of participant comments in the Grabinger, 1984 study the standard use of the notation method was altered slightly by incorporating spaces to make groups of "X"s look more like words in actual text. Although it can be suggested that the use of the notation system reduces ecological validity, it is argued here that its use emphasizes the image of the page as whole visual entity. Each page was designed on an IBM PC computer with the Multimate word processor program. The stimuli pages were printed on a dot-matrix printer, enlarged on a photocopy machine, and laminated for durability.

Eliciting P eferences

The text types were presented to the subjects together with discriminating and sorting instructions to elicit perceptions about their **study-ability**. Study-ability was operationally defined as the rating assigned by participants to models of computer-generated text based on the perceived ease with which a text model could be read and studied as if the model were actual text.

Utilizing recorded instructions (see Appendix B), subjects were asked to perform an unstructured Q-sort of the 64 text types or stimuli. The Q-methodology was used because of its usefulness in exploratory research, in turning up new ideas and hypotheses (Kerlinger, 1973). Subjects sorted the stimuli into seven piles in quantities that reflected a normal distribution. In this sorting procedure, the four texts perceived to be the highest in study-ability were placed in pile 1, while those four perceived to be the lowest were placed in pile 7. From the remainder of the text types, those eight believed to be the highest in study-ability were placed in pile 2 and those eight considered to be of the lowest in pile 6. The forty stimuli left over were allocated among the remaining inner three piles with the 12 believed to be the highest in study-ability placed in pile 3 and the 12 lowest in pile 5. The remaining 16 were placed in the middle or fourth pile. After completion of the sorting task the participant was interviewed about the criteria used during the task. Responses were written down by the experimenter. Participants were shown the first pile and asked, "Why did you rate these the highest on the study-ability factor?" Then, they were shown their seventh pile and asked, "Why did you rate these the lowest?"

Results

The matrix presented in Table 2 depicts the raw data arrangements of 64 CRT text types generated by the sortings of the subjects in the sample. A single value in each column is a rating of the relative study-ability of the respective text as perceived by the particular subject, represented in the row of the matrix. This data was analyzed via a repeated measures analysis of variance (BMDP, 1981). A conservative .01 level of significance (suggested by Kerlinger, 1973) was accepted to offset the the dependence that may result among stimuli during the Q-sort. The main ANOVA results are presented in Table 3.

----------Insert Table 2 here.----------

----------Insert Table 3 here.----------

The primary ANOVA produced two significant interactions among the text element variables for further analysis. These were the "running head by heading location by cues by spacing between lines by line length" interaction (RHCSL) and the "running head by cues by spacing by line length by paragraph indication" (RCSL^{P}) interaction.

One way of analyzing a multipie interaction is by isolating the interactions at each level or order (Keppel, 1982). In this way we can look at each variable under constant conditions. This, in turn, produces a set of marginal means that may be used to graph the information in a way that allows one to spatially inspect the results. This is accomplished via further ANOVAs. For example, the first step in the RHCSL analysis was to determine which condition of the Line Length variable was interacting with the other variables. ANOVAs were run holding the conditions of RHCS variables constant under both Line Length conditions finding that the short line length (LS) value contributed to the interaction (see Figure 1). Next, Double and Single Spacing were compared while holding RHCL constant. This process was continued for all five variables in the interaction. The ANOVA tables are not printed because there are several hundred. The results of this "slicing-off" process for both five-way interactions are presented in Figure 1.

----------Insert Figure 1 here.----------

----------Insert Table 4 here.----------

RHCSL Interaction

The variable conditions running head present (RH), directive cues present (CP), single spacing (SI), short lines (LS), and embedded headings (HE) contributed to the interaction. This in itself tells little, but by taking the marginal means of the study-ability ratings (see Table 4) the interaction can be "mapped out" in a series of graphs to aid interpretation (see Figure 2). By comparing the graphs of the RHCSL interaction the following statements can be made:

----------Insert Figure 2 here.----------

1. The presence of a running head in a design was always preferred over the same design with no running head (Figures 2a to 2h).

2. The presence of directive cues were preferred over no directive cues (compare 2a and 2b, 2c and 2d, 2e and 2f, and 2g and 2h).

3. Short lines were preferred over long lines (compare 2a and 2e, 2b and 2f, 2c and 2g, and 2d and 2h).

4. Double spacing was usually preferred over single spacing (compare 2a and 2c, 2b and 2d, 2e and 2g, and 2f and 2h).

5. Generally, it seems that isolated headings and directive cues work together to produce favorable designs. It seems that directive cues played an important role with the heading location. Designs using both directive cues (CP) and isolated headings (HI) were favored over those with embedded headings (HE) and directive cues (Figures 2a, 2c, and 2e). However, when directive cues were not present (CN) the embedded heading designs were preferred over the isolated heading designs (Figures 2b, 2d, 2f, and 2h).

6. The interaction of heading location with the running head condition is difficult to predict. The most visible change in a design combination is found in Figure 2e. The blending of isolated heading, running head, cues, single spacing and long lines was significantly preferred over designs with embedded headings, with and without running head. However, in Figure 2d the isolated heading condition combines with the no running head (RHN) condition to improve the appearance of the design.

7. Though, comparison of Figures 2e and 2g show that isolated headings were favored in a single spaced layout while in the same layout with double spacing embedded headings were preferred.

8. The most preferred design combination was composed of running heads, isolated headings, cues, double spacing and long lines (see Figure 2c).

9. The least preferred design combination was composed of no running heads, isolated headings, no cues, single spacing, and short lines (see Figure 2f).

RCSLP Interaction

The significant variables found in the RCSLP interaction were running heads present, directive cues present and absent, single spacing, long lines, and indented paragraphs (see Figure 1). The following statements can be made about the variables, based on Figure 3:

----------Insert Figure 3 here.----------

1. Designs with a running head (RH) were always preferred over designs with no running heads (RHN) (Figures 3a to 3h).

2. Double spacing (S2) was preferred over single spacing (S1) (compare 3a and 3b, 3c and 3d, 3e and 3f, and 3g and 3h). Note especially graphs 3c and 3d where the spacing between lines has a dramatic effect under the running head (RH), short line (LS) indented paragraph condition (PI).

3. Spaced paragraphs (PS) were preferred over indented paragraphs (PI) (compare 3a and 3e, 3b and 3f, 3c and 3g, and 3d and 3h).

4. There seemed to be a general preference for long lines (LL) over short lines (LS) (compare 3a and 3c, 3b and 3d, 3e and 3g, and 3f and 3h).

5. The presence of directive cues (CP) was preferred over the no cue condition (CN) (compare graphs 3a through 3h). Figures 3a, 3c, 3e, 3g, and 3h show the significant effect of cues over no cues. The cues seemed especially sensitive to the running head condition (CP-RHN). When the both cues and running heads were absent from designs the disapproval went up further than when the running head was present without cues (CN-RH) (Figures 3a, 3c, 3d, and 3h).

6. In Figures 3d and 3e the absence of a running head had far greater impact on the design than did the absence of cues under double spacing, short lines, and indenced paragraph combination.

7. The most preferred design combination included running heads, cues, double spacing, long lines, and spaced paragraphs (see Figure 3f).

8. The least preferred design combination included no running heads, no cues, single spacing, short lines and indented paragraphs (see Figure 3c).

Discussion

In terms of study-ability preferences for images of text, the implications for design are many. However, since the effect of these designs on achievement has not yet been established no generalization in that direction should be made.

The use of a running head is one of the most stable results of the study. No design combination without a running head was preferred over designs with a running head. Although it interacted with other variables in affecting preference its interaction was always in a positive direction.

The presence of cues as a preferred element in text design was also a fairly stable influence. The use of cues seemed to improve the study-ability rating in all situations except one (Figure 3d, running head (RH) line). It could be that that particular combination produced the simplest and most spacious design, looking very easy to read and study.

Another fairly consistent trend was found in the preference for double spaced text over single spaced text. However, upon examination of the interactions it was found that spacing was easily influenced by other factors. For example, the absence of a running head had greater impact on the study-ability rating than did spacing when comparing Figures 3g and 3h (compare the RHN dot in each graph). While subjects probably preferred the more spacious look of double spaced text, the spacing of the text did not seem as important in making a study-ability judgment as cues or running heads. This suggests that design features that affect the organization and hierarchical structure of the text are more important than the appearance of spaciousness.

Long lines were preferred over short lines, though this did not seem to be a strong preference. Figure 2 shows this to a greater extent than Figure 3. This is probably due to the heading location conditions in Figure 2 which may have emphasized the difference between the two line length conditions.

The usual interaction between line length and line spacing did not seem to occur. This may be explained by the narrow difference between the two line length conditions since, both the 40 character line and 60 character line fall within legibility recommendations.

The affect of the heading conditions was widely variable. This may be due to the radical effect heading position has on the text design, since it changes the margins, body of the text, and overall image more than any other change.

The affect of paragraph indication is consistent, though not great. Generally the spaced paragraph condition was preferred over indented paragraphs. Its interaction with other variables was positive but slight. The only unusual incident is seen in Figures 3a and 3e. Here the paragraph condition appears to interact with cues and running heads. In Figure 3a there is a wide difference between cues present and the two running head conditions. Figure 3e shows a wide disparity between the two running head conditions in the no cues condition. The more organized and structured appearance of the spaced paragraph condition probably combines with the running head and directive cues to produce a more study-able appearing screen.

Conclusion

Generally, although the variables discussed combine to interact when influencing preference for studying they are for the most part predictable. A designer that followed a practice of utilizing running heads as general organizers, spaced paragraphs, and a few directive cues for emphasis would probably create pages or screens that produce a more positive opinion about study-ability within potential readers. Though the most preferred design in the RHCSL interaction had isolated headings, the position of headings is probably not as critical. The effect of no headings on a study-ability rating would probably be greater. While it appears that readers prefer double spacing and long lines, these factors did not appear to contribute as much to the study-ability of the document as the other variables.

While preference is related to legibility, the ultimate test is learning. Remaining questions include the effect of these designs on learning and the activation of learning strategies.

References

Bryant J, Brown D, Silberberg A, Elliot SM 1980
Humorous illustrations in textbooks: effects on information acquisition, appeal, persuasibility and motivation.
Paper presented at the Speech Communication Association Convention.
New York, November 1980
DRS No. ED 196 071

Christ RE 1977
Four years of color research for visual displays.
Proceedings of the Human Factors Society 21st Annual Meeting.
San Francisco, CA

Christ RE 1975
Review and analysis of color coding research for visual displays.
Human Factors
17 542-570

Grabinger RS 1984
CRT text design: psychological attributes underlying the evaluation of models of CRT text displays.
Journal of Visual Verbal Languaging
4(1)

Grabinger RS and Amedeo D 1985
CRT text layout: prominent layout variables.
Proceedings of Selected Research Paper Presentations at tne 1985 Annual Convention of the Association for Educational Communications and Technology, Eds. Simonson MR and Treimer M.
Iowa State University: Ames, IA

Hartley J 1980
Spatial cues in text
Visible Language
14(1) 62+

Hartley J, Bartlett S, and Branthwaite A 1980
Underlining can make a difference--sometimes.
Journal of Educational Research
73(4) 218-223

Hartley J and Trueman 1982
Headings in text: issues and data.
A paper presented to the American Educational Research Association
New York, March 1982

Heines JM 1984
Screen Design Strategies for Computer Assisted Instruction.
Digital Press
Bedford, MA

Holley CD et al. 1981
Utilizing intact and embedded headings as processing aids in nonnarrative text.
Contemporary Educational Psychology
6 227-236

Keenan SA 1981
Computer projections of the cognitive effects of text changes.
Paper presented at the annual meeting of the **American Educational Research Association**, April 1981.
Boston, MA

Keppel 1982
Design and Analysis: A Researcher's Handbook.
Prentice Hall: Englewood Cliffs, NJ

Kerlinger FN 1973
Foundations of Behavioral Research, second edition.
Holt, Rinehart and Winston, Inc.
New York, NY

Kolers PA, Duchincky RL, and Ferguson DC 1981
Eye movement measurement of readability of CRT displays.
Human Factors
23(5), 516-527

Kramer PH and Amedeo D 1984
Q-Sort Procedure
Unpublished computer program.
University of Nebraska
Lincoln, NE

Neisser U 1976
Cognition and Reality: Principles and Implications of Cognitive Psychology.
W.H. Freeman and Company
San Francisco, CA

Nie NH et al. 1975
SPSS, second edition.
McGraw-Hill Book Company
New York, NY

Rehe RF 1979
Typography: How to Make it Most Legible, third revised edition.
Design Research International
Carmel, IN

Ryder J 1979
The Case for Legibility.
New York: The Moretus Press.

SPSSX: Users Guide 1983
McGraw-Hill Book Company
New York, NY

Tinker MA 1965
Bases for Effective Reading.
University of Minnesota Press
Minneapolis, MN

Tinker MA 1963
Legibility of Print
Iowa State University
Ames, IA

Tinker MA and McCullough CM 1962
Teaching Elementary Reading, second edition.
Appleton-Century-Crofts
New York, NY

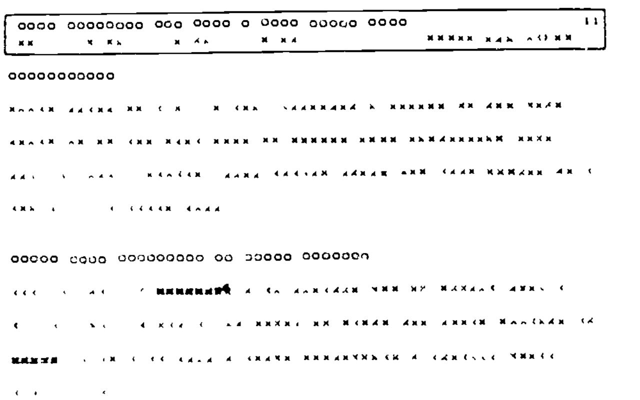
Tinker MA and Paterson DG 1942
Differences among newspaper body types in readability.
Journalism Quarterly
20, 152-155

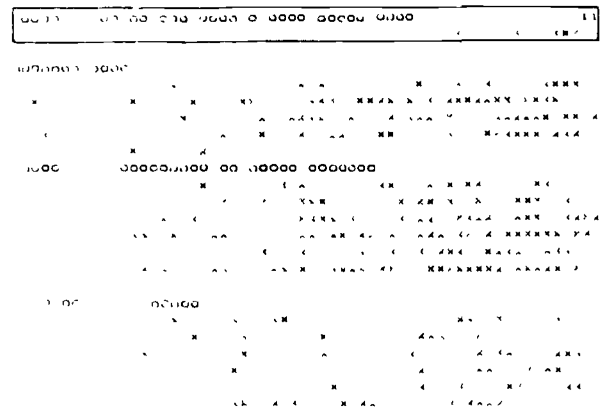
Tullis TS 1981
An evaluation of alphanumeric, graphic, and color information displays.
Human Factors
23(5) 541-550

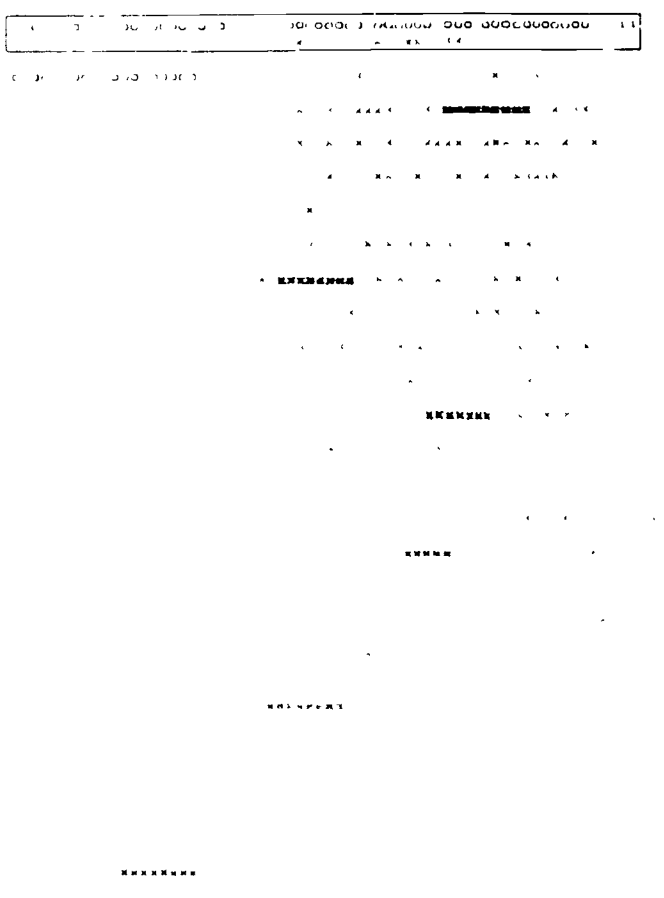
Turnbull AT and Baird RN 1964
The Graphics of Communication: Typography Layout Design
Holt, Rinehart and Winston
New York, NY

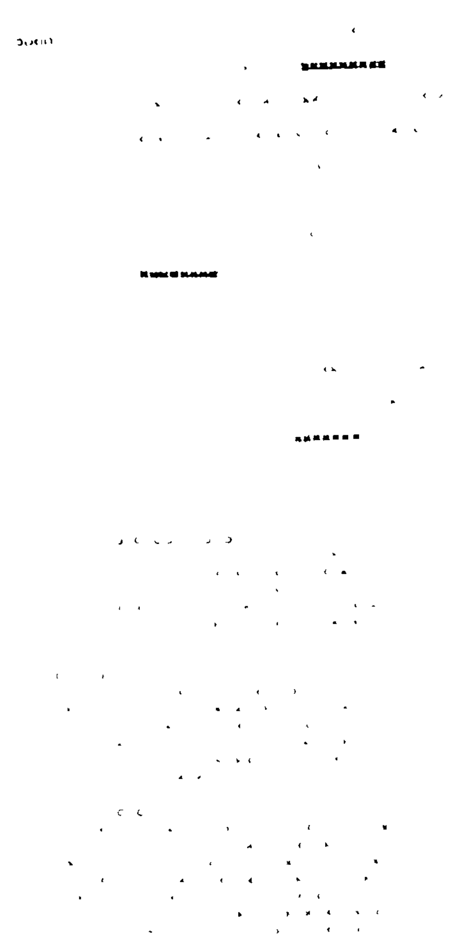
Twyman M 1981
Typography without words.
Visible Language
15(1) 5-12

Appendix A: Stimuli Samples









Appendix B

Instructions to the Subjects

You will examine several models of computer-generated text. These are models of text that may be seen on computer television screens when using computer-assisted instruction.

Before you begin, look at some of the text models in front of you. Note that they are composed of "X"s and "O"s. The "X"s represent the body of the text. The "O"s represent words that are special, such as headings or subheadings. On some of the models you will see three sets of "X"s that are darker than the rest of the text. These dark sets of "X"s represent words that may be in italics, bold type, or underlined. Finally, some of the models have a box at the top of the page. This box is called hypertext and contains a summary of the content of the lesson and a list of computer commands that may help the learner during the lesson.

When you examine the text models evaluate each model on a factor called "study-ability." "Study-ability" refers to both readability and learning characteristics. For example, a text model with a high "study-ability" factor would appear easy to read and easy to study. On the other hand, a text model with a low "study-ability" factor would appear hard to read and hard to study. You are the judge of what appears easy or hard to read and study. There is no right or wrong answer. The best answer is whatever you decide. Look at each model and ask yourself, "If this were actual text would I find this style easy to read and study or hard to read and study?"

Sort the 64 models of computer-generated text into seven piles according to the "study-ability" factor. Remember to base your judgements on how easy the model appears to study as if the model were actual text. Use the sorting procedure described as follows:

In Pile No. 1, place the 4 text models that have the highest "study-ability" factor. In Pile No. 7, place the 4 text models that have the lowest "study-ability" factor. One way to do this is to go through the text models sorting them into high, medium, and low "study-ability" piles. Then return to the "high" pile and find the four with the highest "study-ability" rating and place them in Pile No. 1. Then, go to the "low" pile and find the four with the lowest "study-ability" rating and place them in Pile No. 7.

After placing models in pile numbers 1 and 7 there will be 56 models left. Place all of the models together and repeat the sorting procedure. Place the 8 with the highest "study-ability" rating in Pile No. 2 and the 8 with the lowest "study-ability" rating in Pile No. 6.

Then there will be 40 text models remaining. Place all of the models together again and re-sort them. From these 40 models place the 12 with highest "study-ability" rating in Pile No. 3 and the 12 with lowest rating in Pile No. 5.

There will then be 16 models left and they are all placed in Pile No. 4.

The number of the text models to be placed in each pile also appears on the pile identification cards on the table in front of you. you may rearrange the models until you are satisfied with their placement, but make sure you place the specified number of text models in each pile.

you may refer to these instructions or ask the experimenter for help whenever you wish. Finally, remember to judge each model on how easy it appears to study as if it were actual text.

Table 1

Variables Used in Stimuli Design

Leading:	(S1)	single spacing
	(S2)	double spacing
Directive Cues:	(CN)	no directive cues present
	(CP)	directive cues present
Paragraph Indication:	(PI)	indented paragraph
	(PS)	spaced paragraph
Running Head:	(RHN)	no hypertext present
	(RH)	hypertext present
Heading Position:	(HE)	embedded headings
	(HI)	isolated headings
Line Length:	(LL)	long (60 character) line
	(SL)	short (40 character) line

Table 2

Raw Data Matrix

Subjects

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Text 1	3	3	5	2	3	7	5	5	4	5	2	3	3	1	5	3	1	2	4	4	3	2	1	3	2	4	6	4	2	2	4
Text 2	3	2	1	1	2	5	4	1	3	3	2	3	4	2	3	1	2	2	4	2	4	1	3	3	2	6	5	2	1	3	1
Text 3	3	5	6	2	4	7	5	5	4	6	5	3	2	1	6	6	5	4	4	3	5	2	4	3	2	7	6	6	5	2	3
Text 4	3	2	7	1	6	6	6	3	1	4	5	3	5	4	7	7	3	3	5	2	6	2	4	2	2	7	6	3	1	3	6
Text 5	2	1	4	3	4	4	2	6	2	5	1	2	3	1	6	3	1	2	2	7	1	3	1	2	3	3	5	4	4	1	6
Text 6	2	3	3	3	3	5	3	5	1	4	1	2	3	2	5	2	1	2	3	3	2	3	1	2	2	4	5	4	3	2	4
Text 7	2	5	4	2	3	5	1	5	3	5	4	1	6	1	7	3	2	3	2	3	2	3	4	2	3	4	2	3	1	1	5
Text 8	2	2	2	3	2	4	3	5	2	4	2	2	6	2	5	4	4	3	2	3	3	3	2	2	2	4	3	4	1	3	4
Text 9	4	6	4	1	4	6	5	5	4	4	3	6	4	4	4	3	2	3	6	4	4	4	3	5	4	5	3	4	5	4	2
Text 10	4	3	2	1	2	5	2	1	3	2	2	5	3	4	2	1	2	3	5	4	5	3	4	5	3	5	2	3	3	4	1
Text 11	4	6	6	5	4	7	5	3	5	5	6	6	5	4	4	6	5	4	7	3	3	3	3	5	4	6	4	6	4	4	3
Text 12	4	3	2	3	2	7	4	2	4	7	5	5	5	5	4	5	3	3	5	4	5	4	6	5	3	6	2	3	3	4	2
Text 13	4	4	5	4	5	4	3	6	5	4	1	4	4	3	4	3	4	2	4	4	1	4	3	5	4	3	5	1	2	1	6
Text 14	4	3	3	3	3	5	2	5	5	3	2	5	2	4	3	2	3	3	4	5	3	3	3	5	3	3	5	3	3	6	3
Text 15	4	3	4	4	3	5	1	3	4	5	4	5	5	4	6	4	3	4	3	5	3	3	5	5	4	3	4	1	2	1	5
Text 16	4	4	4	4	2	4	3	5	3	3	4	4	5	5	3	4	3	4	3	4	5	3	5	5	3	3	3	4	2	4	4
Text 17	2	1	1	3	1	3	4	1	3	3	2	3	1	2	5	3	2	1	3	2	4	1	3	2	1	6	1	3	4	3	1
Text 18	2	5	4	5	3	3	2	5	2	4	4	3	1	2	6	3	2	3	3	2	4	2	3	2	2	6	3	4	5	2	4
Text 19	7	4	2	2	2	4	4	2	4	7	5	3	4	2	3	5	1	4	5	1	7	1	6	3	7	7	4	7	6	4	3
Text 20	2	1	2	4	1	4	4	3	3	4	5	3	4	3	5	5	3	3	3	1	6	2	4	2	1	7	1	2	3	3	1
Text 21	1	1	4	3	3	1	3	6	1	4	1	3	3	2	7	4	3	1	1	2	1	2	2	1	3	4	2	5	4	2	2
Text 22	1	4	3	4	2	2	3	4	1	3	2	1	2	2	5	5	4	1	2	2	2	2	2	1	1	4	1	6	2	3	3
Text 23	1	5	6	5	3	2	3	7	4	5	4	3	6	3	7	4	5	2	1	1	3	2	5	1	3	4	4	4	6	2	6
Text 24	1	5	6	4	3	3	1	4	7	7	4	3	6	3	5	5	3	1	1	1	3	1	4	1	1	4	2	5	5	3	5
Text 25	4	6	6	6	4	3	7	5	6	4	3	6	3	5	5	4	4	3	6	3	4	4	4	4	4	5	3	5	5	4	5
Text 26	4	2	2	2	1	3	4	1	4	3	3	5	2	4	4	3	2	3	5	3	5	3	3	4	3	6	1	3	4	4	2
Text 27	4	6	6	5	4	4	7	3	7	6	5	4	5	4	4	7	3	4	6	3	4	4	6	4	4	6	6	7	6	7	7
Text 28	4	2	2	4	1	4	4	3	4	3	6	5	4	6	2	6	3	4	5	3	7	4	6	4	3	6	3	2	3	5	2
Text 29	4	4	5	4	3	1	4	4	5	3	2	4	2	4	6	3	2	2	4	2	2	3	5	4	4	3	4	5	4	4	4
Text 30	4	4	4	2	2	2	3	4	6	3	3	4	2	5	4	4	3	2	4	4	4	3	5	4	3	3	3	4	4	4	3
Text 31	4	5	5	5	4	2	4	3	6	5	4	4	5	5	6	5	3	4	4	2	2	4	6	4	4	3	5	5	7	5	6
Text 32	4	5	5	6	3	3	4	4	5	6	4	4	4	5	4	5	5	3	3	4	4	4	7	4	3	4	3	4	4	5	6

Table 2 Continued

Raw Data Matrix

Subjects

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Text 33	3	4	4	3	5	6	4	6	2	5	5	5	4	3	5	2	4	5	7	4	5	4	3	4	5	5	6	5	6	3	4
Text 34	3	2	4	2	5	5	2	2	2	2	3	5	4	3	4		4	4	5	4	5	5	2	4	4	5	5	3	3	4	4
Text 35	5	5	7	3	6	6	5	6	4	6	7	5	7	5	4		5	6	7	3	3	5	4	4	5	5	7	6	5	7	5
Text 36	5	4	4	3	5	6	2	5	3	2	6	5	5	5	5	5	4	5	5	6	6	5	4	4	4	5	4	2	2	5	4
Text 37	3	4	5	4	7	4	3	7	5	5	3	1	2	3	6	2	4	4	2	7	2	4	2	3	5	2	6	1	5	2	7
Text 38	5	3	3	4	4	5	2	6		4	3	4	4	4	4	2	4	4	2	7	5	4	1	3	4	2	5	3	4	3	4
Text 39	3	5	5	5	4	5	3	4	3	4	4	2	5	4	4	4	5	6	3	6	3	4	4	3	5	3	4	4	2	4	4
Text 40	5	4	2	4	4	4	1	3	2	4	4	2	6	4	3	4	5	5	3	5	4	5	4	3	4	3	5	3	5	5	5
Text 41	7	4	6	2	6	6	6	5	6	5	5	7	4	4	2	2	6	5	5	6	4	6	5	7	6	4	4	5	4	4	4
Text 42	7	3	3	2	5	5	6	2	4	1	5	7	3	3	1	1	4	5	5	6	6	5	4	7	6	4	4	2	6	5	3
Text 43	7	7	7	5	6	6	6	6	5	7	7	7	7	6	3	6	6	7	7	4	6	7	4	7	6	5	7	6	7	5	4
Text 44	7	3	2	5	5	6	5	2	4	2	6	7	7	5	1	6	6	6	6	5	7	7	4	7	6	4	2	2	2	6	2
Text 45	6	6	6	4	7	4	4	4	6	4	3	4	4	4	4	2	5	5	4	7	3	6	5	6	7	1	6	4	6	5	5
Text 46	6	4	3	4	7	5	4	4	5	1	3	4	3	4	2	2	7	5	4	5	4	6	3	6	6	4	6	4	3	6	3
Text 47	6	4	3	5	5	5	5	4	4	5	4	4	5	6	2	4	6	7	4	5	3	6	5	6	6	2	4	1	3	5	5
Text 48	6	4	4	4	5	4	5	4	4	1	4	4	5	5	2	4	6	7	4	5	5	6	5	6	6	2	3	4	3	6	4
Text 49	3	5	5	6	6	3	6	3	5	4	5	4	2	4	4	4	5	5	3	3	4	4	3	4	5	5	4	4	7	2	5
Text 50	3	2	3	4	5	3	2	2	2	2	5	4	1	3	4	3	4	4	3	3	5	4	2	4	4	5	4	3	3	3	2
Text 51	5	6	5	7	6	4	6	4	5	6	7	5	6	7	3	7	5	6	5	4	6	5	6	4	5	5	7	7	6	7	6
Text 52	5	2	4	6	5	4	4	2	3	3	6	3	4	6	3	6	4	6	5	4	6	4	4	4	4	5	2	2	3	5	2
Text 53	5	4	4	4	4	1	3	4	2	4	3	1	2	3	6	3	4	4	2	5	2	4	2	3	5	2	4	6	4	3	4
Text 54	5	5	3	5	4	2	4	4	2	2	3	2	2	3	5	4	4	4	2	4	2	5	2	3	4	2	3	5	4	3	3
Text 55	3	5	5	6	4	2	3	7	4	5	4	2	6	5	5	5	5	5	1	4	3	5	6	3	5	3	5	5	5	4	6
Text 56	3	6	3	6	4	3	5	6	3	6	4	2	4	5	3	5	4	4	3	5	5	5	4	3	4	3	4	5	4	4	5
Text 57	5	7	5	6	4	3	5	3	7	4	5	6	3	6	3	4	7	5	6	4	[illegible]	5	5	5	6	4	3	5	5	5	5
Text 58	5	3	3	6	5	3	4	2	6	2	5	6	2	6	2	3	4	5	6	5	4	5	5	5	5	4	2	3	4	6	3
Text 59	6	7	7	7	6	4	7	3	7	7	7	6	6	7	3	7	6	7	6	6	6	7	7	5	7	4	7	7	7	7	7
Text 60	6	3	1	7	5	4	6	3	6	3	6	6	5	6	2	6	6	6	6	5	7	7	5	5	5	4	3	2	6	5	2
Text 61	5	4	4	5	7	1	5	4	5	2	4	4	3	6	3	4	6	5	4	6	1	5	6	6	7	1	4	5	4	6	4
Text 62	5	3	4	3	4	2	5	4	4	1	3	4	1	2	1	4	3	[illegible]	4	6	4	6	3	6	3	1	4	6	4	4	3
Text 63	6	7	5	7	4	2	4	7	6	6	6	5	4	7	4	5	7	6	4	5	4	6	7	6	7	2	5	4	5	5	7
Text 64	5	6	4	5	4	3	7	4	5	6	4	5	4	7	1	5	7	6	4	6	6	6	7	6	5	2	5	6	5	6	5

Table 3

Repeated Measures ANOVA of CRT Text Models

Source	Sums of Squares	Degrees of Freedom	Mean Square	F	Tail Prob.
Mean	31720.00454	1	31720.00454	6992498.00	0.0000
1 Error	0.13609	30	0.00454		
RngHd	373.64970	1	373.64970	21.42	0.0001
2 Error	523.30343	30	17.44345		
Hdngs	0.84728	1	0.84728	0.07	0.7867
3 Error	347.66835	30	11.58894		
RngHd X Hdngs	0.18196	1	0.18196	0.24	0.62[illegible]
4 Error	23.02117	30	0.76737		
Cues	236.50454	1	236.50454	15.28	0.0005
5 Error	464.44859	30	15.48162		
RngHd X Cues	0.36744	1	0.36744	0.43	0.5161
6 Error	25.52319	30	0.85077		
Hdngs X Cues	13.72228	1	13.72228	12.16	0.0015
7 Error	33.85585	30	1.12853		
RngHd X Hdngs X Cues	2.00050	1	2.00050	2.25	0.1473
8 Error	26.64012	30	0.88800		
Spcg	64.23841	1	64.23841	4.50	0.0424
9 Error	428.65222	30	14.28841		
RngHd X Spcg	4.35937	1	4.35937	4.61	0.0399
10 Error	28.34375	30	0.94479		
Hdngs X Spcg	5.77067	1	5.77067	3.19	0.0841
11 Error	54.24496	30	1.80817		
RngHd X Hdngs X Spcg	0.84728	1	0.84728	0.94	0.3406
12 Error	27.10585	30	0.90353		
Cues X Spcg	0.48437	1	0.48437	0.47	0.5299
13 Error	35.96875	30	1.19896		
RngHd X Cues X Spcg	0.00050	1	0.00050	0.00	0.9763
14 Error	16.89012	30	0.56300		
Hdngs X Cues X Spcg	2.39970	1	2.39970	3.44	0.0735
15 Error	20.92843	30	0.69761		
RngHd X Hdngs X Cues X Spcg	2.00050	1	2.00050	2.91	0.0985
16 Error	20.64012	30	0.68800		

Table 3 (continued)

Source	Sums of Squares	Degrees of Freedom	Mean Square	F	Tail Prob.
Lgth	237.88760	1	237.88760	27.55	0.0000
17 Error	259.00302	30	8.63343		
RngHd X Lgth	0.48437	1	0.48437	0.45	0.5070
18 Error	32.21875	30	1.07396		
Hdngs X Lgth	19.96018	1	19.96018	9.40	0.0046
19 Error	63.68044	30	2.12268		
RngHd X Hdngs X Lgth	4.17389	1	4.17389	10.30	0.0032
20 Error	12.15423	30	0.40514		
Cues X Lgth	0.42389	1	0.42389	0.51	0.4815
21 Error	25.02923	30	0.83431		
RngHd X Cues X Lgth	0.93196	1	0.93196	1.19	0.2837
22 Error	23.45867	30	0.78196		
Hdngs X Cues X Lgth	1.52470	1	1.52470	3.01	0.0928
23 Error	15.17843	30	0.50595		
RngHd X Hdngs X Cues X Lgth	0.00454	1	0.00454	0.01	0.9200
24 Error	13.26109	30	0.44204		
Spcg X Lgth	12.74244	1	12.74244	8.96	0.0055
25 Error	42.64819	30	1.42161		
RngHd X Spcg X Lgth	0.26663	1	0.26663	0.55	0.4624
26 Error	14.43649	30	0.48122		
Hdngs X Spcg X Lgth	26.43196	1	26.43196	16.11	0.0004
27 Error	49.20867	30	1.64029		
RngHd X Hdngs X Spcg X Lgth	1.11341	1	1.11341	2.31	0.1391
28 Error	14.46472	30	0.48216		
Cues X Spcg X Lgth	0.31502	1	0.31502	0.60	0.4430
29 Error	15.63810	30	0.52127		
RngHd X Cues X Spcg X Lgth	0.02470	1	0.02470	0.03	0.8613
30 Error	23.86593	30	0.79553		
Hdngs X Cues X Spcg X Lgth	0.26663	1	0.26663	0.30	0.5863
31 Error	26.43649	30	0.88122		
R x H x C x S x L	2.98841	1	2.98841	7.78	0.0091*
32 Error	11.52722	30	0.38424		

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Table 3 (continued)

Source	Sums of Squares	Degrees of Freedom	Mean Square	F	Tail Prob.
Para	136.81502	1	136.81502	18.81	0.0001
33 Error	218.13810	30	7.27127		
RngHd X Para	9.46018	1	9.46018	10.89	0.0025
34 Error	26.05544	30	0.86851		
Hdngs X Para	0.31502	1	0.31502	0.25	0.6176
35 Error	37.13810	30	1.23794		
RngHd X Hdngs X Para	0.69002	1	0.69002	0.95	0.3365
36 Error	21.70060	30	0.72335		
Cues X Para	5.14163	1	5.14163	5.53	0.0254
37 Error	27.87399	30	0.92913		
RngHd X Cues X Para	2.26260	1	2.26260	2.72	0.1094
38 Error	24.94052	30	0.83135		
Hdngs X Cues X Para	1.63760	1	1.63760	2.91	0.0983
39 Error	16.87802	30	0.56260		
RngHd X Hdngs X Cues X Para	3.47228	1	3.47228	5.52	0.0255
40 Error	18.85585	30	0.62853		
Spcg X Para	57.24244	1	57.24244	15.96	0.0004
41 Error	107.58569	30	3.58619		
RngHd X Spcg X Para	2.68599	1	2.68599	6.34	0.0174
42 Error	12.70464	30	0.42349		
Hdngs X Spcg X Para	0.01260	1	0.01260	0.01	0.9197
43 Error	36.56552	30	1.21985		
RngHd X Hdngs X Spcg X Para	0.54889	1	0.54889	1.47	[illegible]
44 Error	11.21673	30	[illegible]		
Cues X Spcg X Para	3.30696	1	3.30696	4.04	[illegible]
45 Error	24.58367	30	0.81946		
RngHd X Cues X Spcg X Para	12.74244	1	12.74244	25.[illegible]	[illegible]
46 Error	14.83567	30	.49452		
Hdngs X Cues X Spcg X Para	0.54889	1	.54889	1.63	[illegible]
47 Error	[illegible]	30	[illegible]		
R H X C X S X P	4.17389	1	4.17389	[illegible]	[illegible]
48 Error	24.52923	30	.81764		

Table 3 (continued)

Source	Sums of Squares	Degrees of Freedom	Mean Square	F	Tail Prob.
Lgth X Para	2.00050	1	2.00050	1.92	0.1765
49 Error	31.32762	30	1.04425		
RngHd X Lgth X Para	0.02470	1	0.02470	0.05	0.8290
50 Error	15.61593	30	0.52053		
Hdngs X Lgth X Para	5.77067	1	5.77067	7.72	0.0093
51 Error	22.43246	30	0.74775		
RngHd X Hdngs X Lgth X Para	1.21018	1	1.21018	3.75	0.0623
52 Error	9.68044	30	0.32268		
Cues X Lgth X Para	2.12954	1	2.12954	3.19	0.0841
53 Error	20.01109	30	0.66704		
RngHd X Cues X Lgth X Para	1.11341	1	1.11341	1.45	0.2372
54 Error	22.96472	30	0.76549		
Hdngs X Cues X Lgth X Para	3.30696	1	3.30696	8.30	0.0073
55 Error	11.95867	30	0.39862		
R x H x C x L x P	0.93196	1	0.93196	1.94	0.1737
56 Error	14.39617	30	0.47987		
Spcg x Lgth X Para	6.21018	1	6.21018	4.74	0.0373
57 Error	39.24294	30	1.30810		
RngHd X Spcg X Lgth X Para	2.00050	1	2.00050	4.70	0.0382
58 Error	12.76512	30	0.42550		
Hdngs X Spcg X Lgth X Para	2.00050	1	2.00050	3.19	0.0843
59 Error	18.82722	30	0.62759		
R x H x S x L x P	0.42389	1	0.42389	0.61	0.4408
60 Error	20.84173	30	0.69472		
Cues X Spcg X Lgth X Para	0.06099	1	0.06099	0.14	0.7097
61 Error	12.95464	30	0.43182		
R x C x S x L x P	4.94002	1	4.94002	9.55	0.0043*
62 Error	15.51310	30	0.51710		
H x C x S x L x P	1.63760	1	1.63760	2.28	0.1411
63 Error	21.50302	30	0.71677		
R x H x C x S x L x P	0.61744	1	0.61744	1.21	0.2805
64 Error	15.33569	30	0.51119		

Figure 1

Variable Conditions and Interactions

Conditions	RHCSL	RCSLP
Running Head: present (RH)	X	X
absent (RHN)		
Directive Cues: present (CP)	X	X
absent (CN)		X
Spacing (Leading): single (S1)	X	X
double (S2)		
Line Length: long (LL)		X
short (LS)	X	
Heading Location: embedded (HE)	X	
isolated (HI)		
Paragraph Indication: indented (PI) X		
spaced (PS)		

X = This condition was preferred significantly more than the other in the specified combination of text element variables.

Figure 2

RHCSL Interaction

Figure 2a

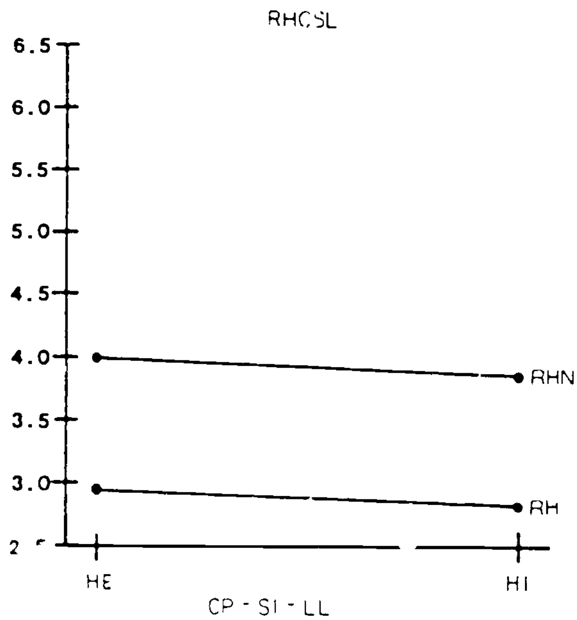


Figure 2b

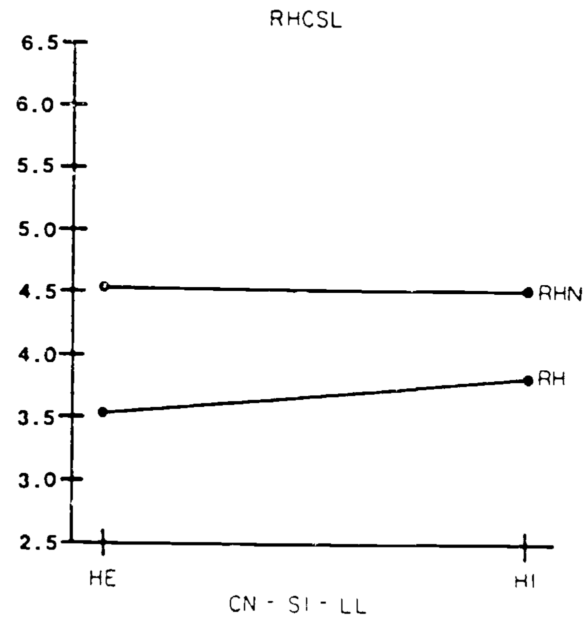


Figure 2c

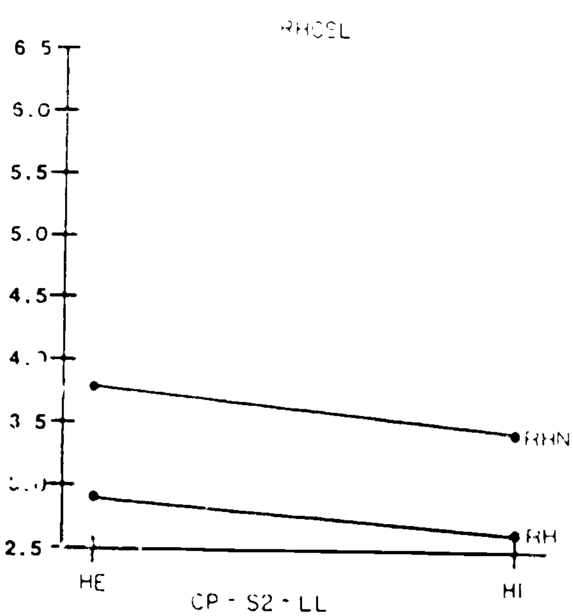


Figure 2d

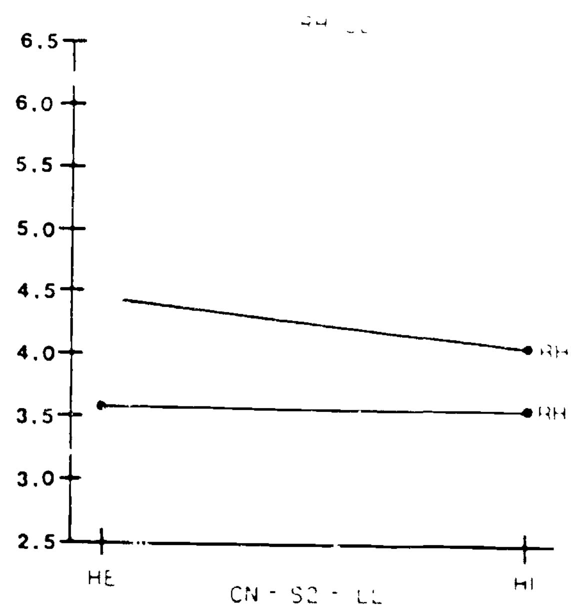


Figure 2 (continued)

RHCSL Interaction

Figure 2e

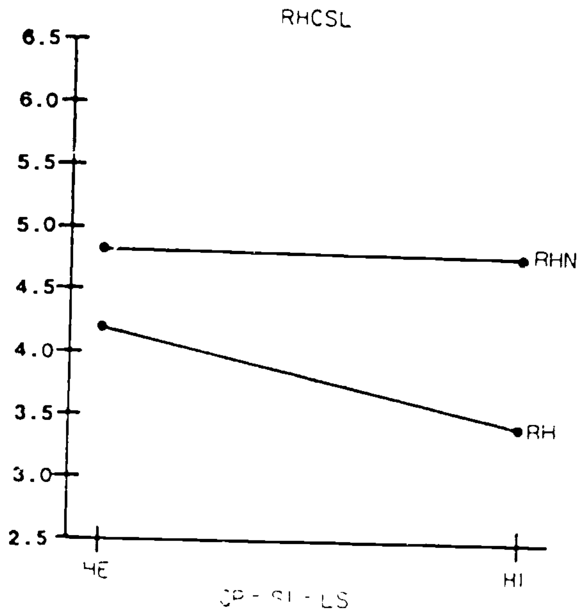


Figure 2f

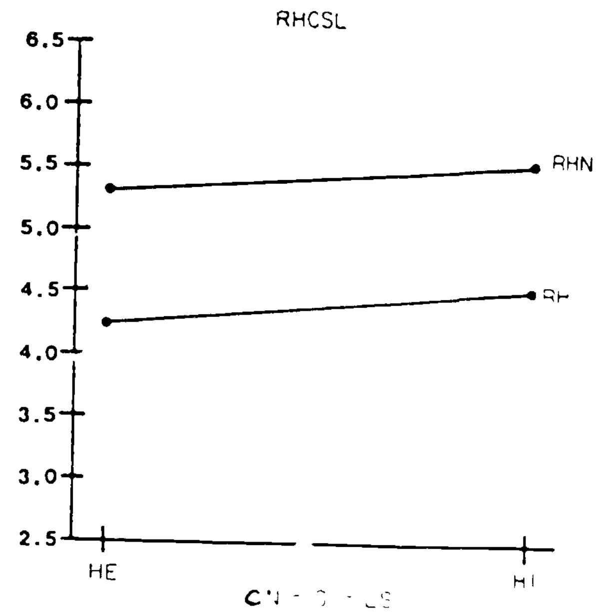


Figure 2g

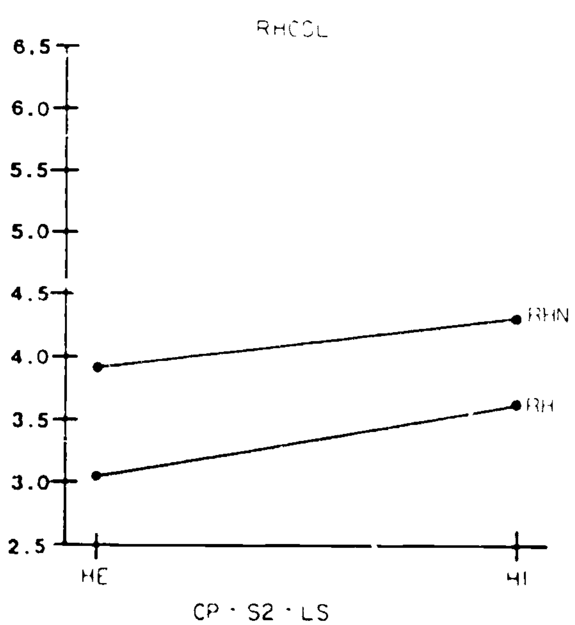


Figure 2h

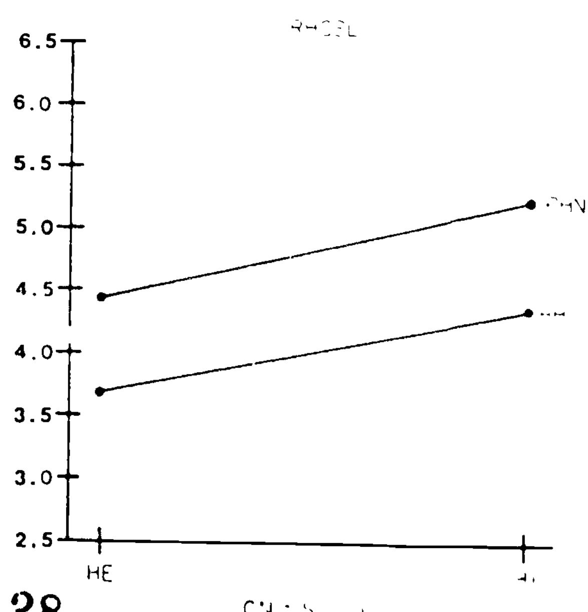


Figure 3

RCSLP Interaction

Figure 3a

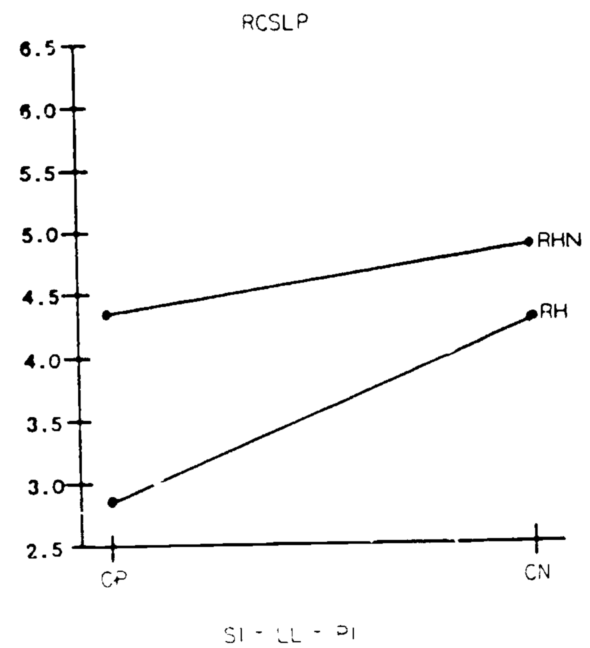
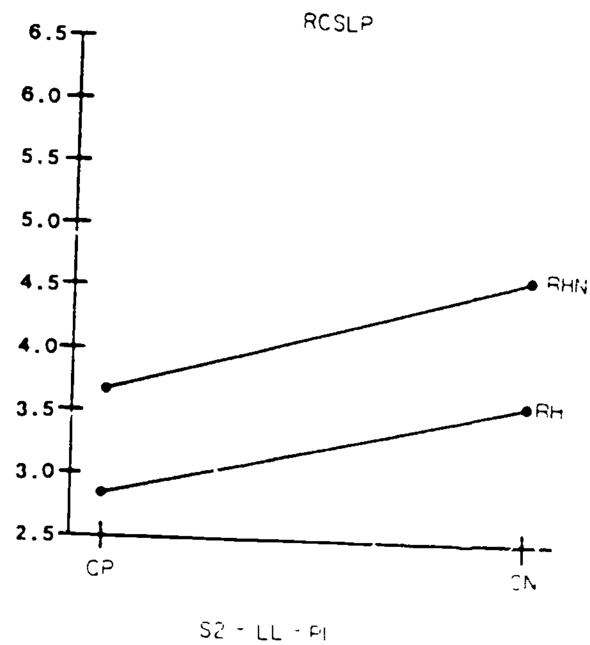


Figure 3b



F e 3c

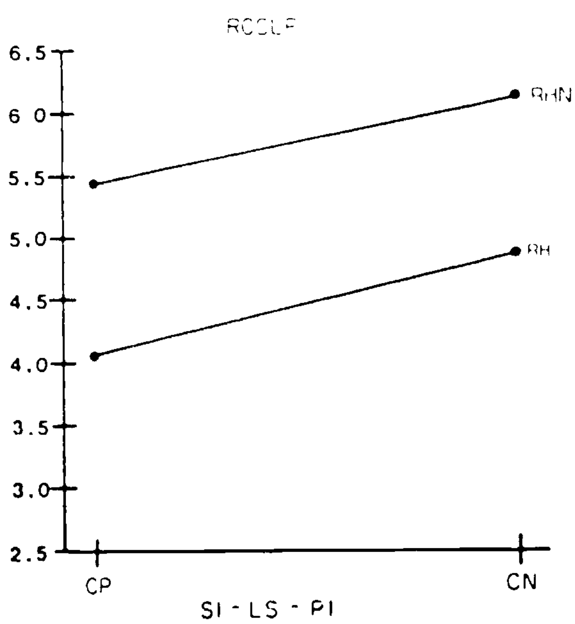


Figure 3d

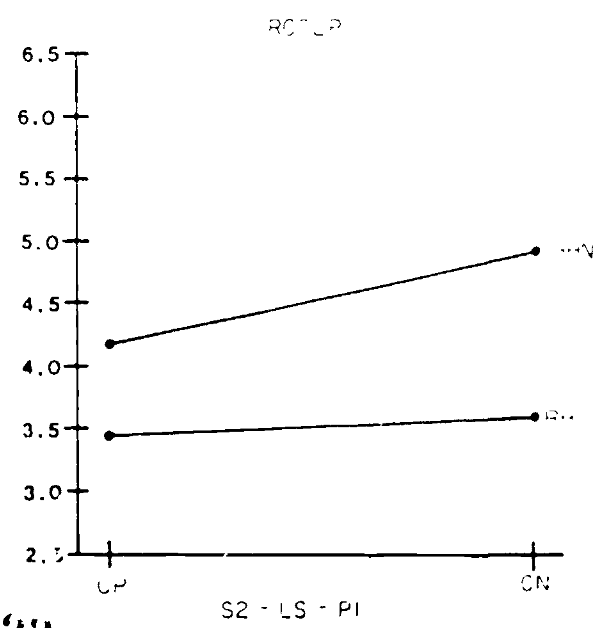


Figure 3 (continued)

RCSLP Interaction

Figure 3e

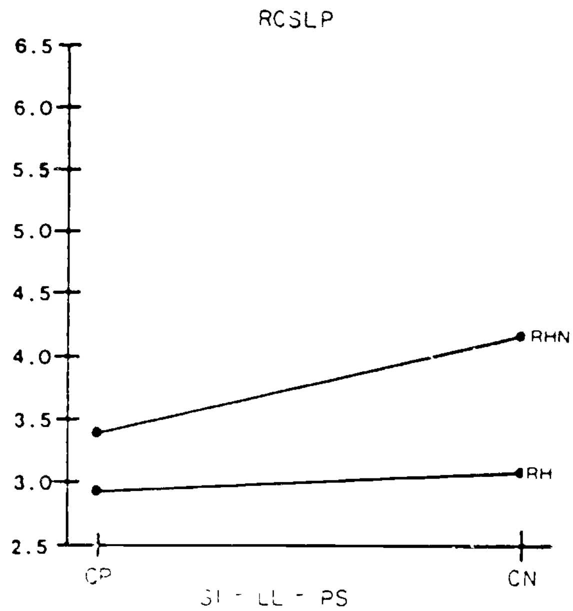


Figure 3f

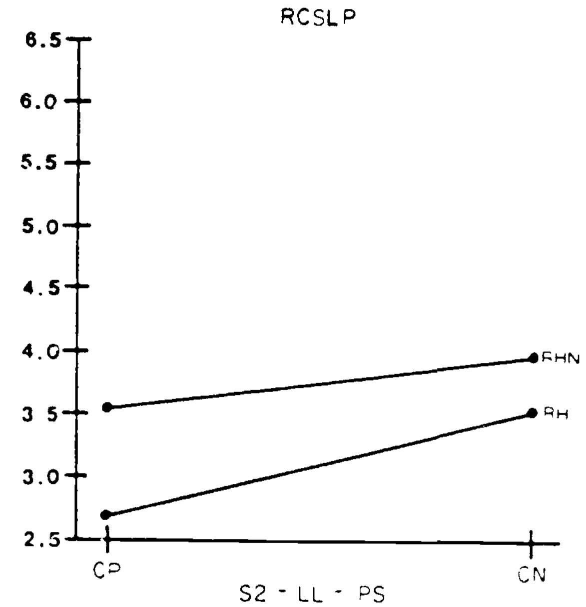


Figure 3g

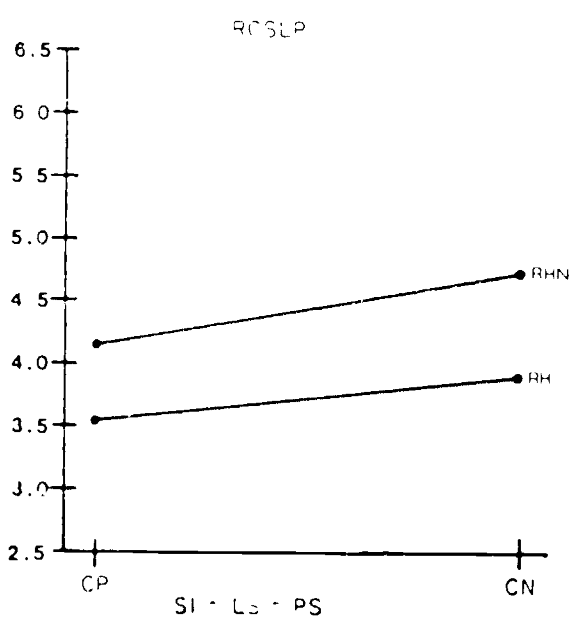


Figure 3h

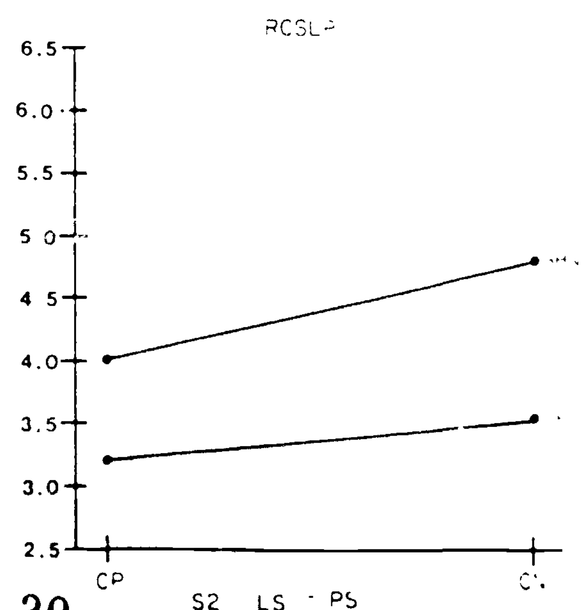


Table 4

Marginal Means of Study-ability Ratings

Running Heads Present	Running Heads None	Heading Locat. Embed	Heading Locat. Isolate	Direct. Cues Present	Direct. Cues None	Spacing Single	Spacing Double	Length Long	Length Short	Paragr. Indent	Paragr. Spaced
								2.968		3.323	2.613
						3.581			4.194	4.387	4.000
								2.935		3.065	2.806
				3.290			3.000		3.065	3.129	3.000
								3.548		4.032	3.065
						3.903			4.258	4.613	3.903
								3.581		3.61[illegible]	3.548
		3.534			3.778		3.653		3.726	3.710	3.742
								2.839		2.419	3.258
						3.121			3.419	3.774	3.065
								2.613		2.645	2.581
3.565				3.121			3.113		3.613	3.774	3.452
								3.839		4.516	3.161
						4.177			4.516	3.129	3.903
								3.548		3.581	3.516
			3.595		4.069		3.960		4.371	4.419	4.323
								4.016		4.484	3.548
						4.419			4.823	5.290	4.355
								3.790		3.871	3.710
				4.141			3.863		3.935	4.000	3.871
								4.548		4.903	4.194
						4.944			5.339	6.000	4.677
								4.468		4.742	4.194
		4.421			4.702		4.460		4.452	4.484	4.419
								3.758		4.258	3.258
						4.266			4.774	5.581	3.968
								3.419		3.452	3.387
				4.060			3.855		4.290	4.837	4.194
								4.500		4.839	4.161
						5.008			5.516	6.226	4.806
								4.065		4.387	3.742
	4.432		4.444		4.827		4.645		5.226	5.323	5.129