A comparison of the comprehension of procedural information using computer and hard-copy media

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A comparison of the comprehension of procedural information using computer and hard-copy media

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University of Nevada, Las Vegas, 1993
A COMPARISON OF THE COMPREHENSION OF PROCEDURAL INFORMATION USING COMPUTER AND HARD-COPY MEDIA

by

Aiessa Moyna Lawrence

A thesis submitted in partial fulfillment of the requirements for the degree of

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in

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University of Nevada, Las Vegas
December 1993
The Thesis of Aiessa Moyna Lawrence for the degree of Master of Arts in Communication Studies is approved.

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ABSTRACT

Users of technical procedures must be able to understand the documents to use them to perform their work. As more companies contemplate putting their procedures on-line, it is important to know whether computer systems will be as effective as traditional hard-copy presentation in communicating procedures to the employees who must use them.

To determine whether there is a relationship between computer usage and the comprehension of technical procedures, an experiment was conducted among employees of a scientific and technical company in Las Vegas, Nevada. A control group read and demonstrated its comprehension of hard-copy procedures only, while an experimental group read and demonstrated its comprehension of a hard-copy and then an on-line procedure.

The experimental group selected fewer correct answers on a comprehension test for the on-line than for the hard-copy procedure. This suggests that when readers accustomed to the hard-copy medium switch to the computer medium, comprehension decreases.
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CHAPTER 1

INTRODUCTION

As a writer and editor of procedures in a technical environment that relies increasingly on personal computers to process, store, and display information, I have begun to retrieve and read information more from the computer and less from the printed page. This has prompted me to question the relative effectiveness of reading and comprehending technical procedures from a computer screen versus paper.

A number of professional communicators and their employers have experimented with computerized information systems in recent years. Rabin (1992) noted that in many companies, employees are unable to find the information they need to do their jobs because they do not have centralized sources of that information. It often is scattered among volumes of paper, including handbooks, manuals, and correspondence files. A way for these organizations to assist their employees is to develop a centralized source of information, and an easy way to manage such a source is through computers. To create an on-line (i.e., computer-based) information system, a company must assess the needs of the users of the system, determine what resources are available to develop and keep up the system, create and install the system, and maintain the
system, updating and refining it as necessary. Not all types of information are appropriate for inclusion in an on-line system, cautions Rabin. Space limitations and issues of confidentiality must dictate what is put on and what is kept off such a system.

Another thing that must be considered is the willingness of employees to use computerized information sources; a new information system will be of little benefit if its intended audience refuses to use it. Parasuraman and Igbaria (1990) surveyed management professionals to determine their levels of computer anxiety and their attitudes toward the microcomputers used increasingly in the work place. Men and women managers did not appear to differ in their levels of computer anxiety or in their attitudes toward microcomputers. It is interesting to note, however, that older, less-educated male managers reported more anxiety than their younger, better-educated counterparts and were less willing to use computers in their daily routines. Men who had high levels of math anxiety also were likely to have high levels of computer anxiety. This suggests that it is especially important to understand the needs and backgrounds of the potential users before implementing any type of computerized system.

Several researchers have investigated ways to present information on-line so that it appeals to and can be used easily by readers. Horton (1990) reported that the visual design of on-line information involves issues typical of normal page layout; for example, typography, white space, line length, and margins. It also involves unique issues, such as color and highlighting techniques like blinking, brightness, and reverse video.
Computer-delivered information also requires a slightly different editorial style than traditional hard-copy texts (Carliner, 1990). This is because the computer screen is physically different from the printed page; it offers less space for written material, and it obscures the reader’s sense of the "whole" of a document. Computers often have more advanced graphics capabilities than hard copy. In addition, the interactive nature of the computer begs for a less formal, more conversational tone than typically is found in printed material.

It appears that computerized information systems may have a place in the work environment. It is important to know, however, whether they convey or have the potential to convey information as effectively as the paper-based systems that most companies now use. Developers of such systems and employers using the systems must answer the question: Is there a difference in how effectively employees read and understand information from a computer screen and from the printed page? This question is addressed by this study on the presentation of technical procedures on computer and its effect on comprehension.
CHAPTER 2

SURVEY OF LITERATURE

A few researchers have examined the utility and structure of paper-based procedure systems. Vink (1983) defines a procedure as a document that implements the house policy of a business or institution. Collections of procedures—manuals—serve as cross-departmental communications, describing company-wide processes that must be performed in a standard manner by all employees (e.g., completing a time sheet, resetting a tripped breaker, or evacuating a building in an emergency). Procedures orient new employees to the operations of a company, and they also serve as records of the company's "conformity to laws affecting safety, equal opportunity, and other matters" (p. 350). Procedures should be approved by managers who determine how company processes will be done or who oversee employees whose work is governed by the procedures.

Writing Style, Design, and Format

Other scholars have studied the design and writing style necessary for technical documents, including procedures. Cherry and Jackson (1989) revised an on-line help text by adding details, removing irrelevant information, inserting step-
by-step instructions, and using tables, among other things. They then evaluated
users' comprehension of the original text and the revision by observing the
performance of tasks and questioning the users on their impressions of the texts.
While there were no differences in performance, the users of the revised text
reported less difficulty in using their on-line help than the users of the original
text.

Feldmann and Fish (1991) studied high-school students who read on
computer to determine whether the use of reading supports would improve
comprehension. Reading supports include such aids as definitions of difficult
words and summaries of the main ideas of paragraphs. The use of reading
supports did not appear to increase the students' comprehension of computer-
presented texts.

Spyridakis and Wenger (1992) surveyed reading research, identifying
models of reading and recommending techniques to improve reader
understanding. Among the recommendations: use short, concrete words;
introduce difficult, abstract concepts with simple concepts familiar to readers;
avoid negative and passive-voice constructions; chunk or group details; and use
signals, such as headings, previews, and transitional connectors. These techniques
could apply to on-line, as well as printed, text.

Reading Comprehension

Reading comprehension (as described in Johnston, 1983) is a process that
involves more than simple rote recall of a text. Comprehension requires that
readers establish logical connections among ideas in the reading passage and be able to express these ideas in an alternate way. If comprehension were thought of as a process, then some of the subprocesses resulting in comprehension might include the following:

- Recalling word meaning.
- Drawing inferences.
- Recognizing the author's purpose, attitude, tone, and mood.
- Following and anticipating the structure of the passage.

A number of researchers have studied the comprehension of printed material, and certainly some of these observations could apply to on-line text. Roberts (1989), for example, studied college students' responses while reading informative discourse, in an attempt to describe "what readers do when they seek information" (p. 147). He discovered that they responded in three basic ways: satisfactory understanding of the text, uncertain understanding of the text, and unsatisfactory understanding of the text. Authors must anticipate uncertain and unsatisfactory understanding on the part of their readers and must employ writing strategies to prevent poor understanding and increase comprehension.

As Devine (1986) and others have pointed out, the prior knowledge of the readers of a text has a tremendous impact on comprehension. That knowledge varies from one reader to the next and is made up of pieces of information, ideas, perceptions, images, and emotional experiences held in the readers' memory. These factors depend on the readers' chronological age, home and family background, social and community background, education, entertainment interests,
and recreational activities. Depending on the size of the intended audience, an
author can have a great deal of previous knowledge for which to compensate!

Johnston (1983) observed that "with adults, social class and race—normally
powerful predictors of reading comprehension performance—become less
influential when content is made more job-relevant" (p. 31). In the business
world, this observation is especially germane. Johnston also noted that the sheer
quantity of information in a text can affect its comprehension. Such factors as
length, density of information, and density of new information influence how well
individuals will be able to recall something they read. In addition, texts generally
are more memorable when they are concrete, imaginable, and interesting to the
reader. They also are remembered more often and with more accuracy when they
state information explicitly, rather than imply it. The fewer inferences readers
have to make, the more likely it is that they will understand what they are reading.
Certainly, this knowledge is as valuable for developers of on-line text as it is for
writers of traditional, printed documents.

Many investigators have concerned themselves with the actual
measurement of reading comprehension (Farr & Carey, 1986; Farr, Pritchard, &
college students to determine what thought processes they used when taking a
multiple-choice comprehension test. In this case, the reading sample and test
questions were presented together. The students displayed four basic reading
strategies:

(1) Reading or skimming all of the text before answering the questions.
Reading or skimming part of the text before answering the questions.

(3) Reading or skimming all of the questions before looking at the text.

(4) Reading or skimming each question one-by-one, searching the text for the answer, and recording that answer before moving on to the next question.

The results of this research indicate that when the questions are presented with the text, students find it difficult to separate the acts of reading the text and answering the questions. The experience becomes more an exercise in test-taking and less an exercise in reading a piece of writing and demonstrating an understanding of it. This would appear to throw comprehension testing into a questionable light. The researchers point out, however, that the act of taking a reading comprehension test may in fact simulate a natural reading experience more closely than would be expected. Readers search for answers to the questions in the same manner that they search for specific details in passages that they read for fun or for work. Thus, taking a comprehension test might actually teach a reader how to read more effectively.

**Computer-Assisted Instruction**

It could be said that adults who read technical procedures are engaging in a form of self-paced instruction. Generally, employees read procedures to learn what role they play in their companies' work processes—to discover what actions they must take to convert raw materials into the products and services they are committed to delivering to their customers.
Several researchers have debated the usefulness of the computer in presenting instructional programs and training. Wepner, Feeley, and Wilde (1989) speak for the majority of these researchers when they endorse the use of computers in reading classes. They studied a group of college student readers and found no significant differences in the performance of readers who received computer-assisted learning when compared with those who received traditional instruction using hard-copy materials. In fact, students who used the computers progressed at a slightly faster rate than the students who used printed materials. Computer users also had more favorable attitudes toward the speed with which they moved through the material, probably because they were able to move at their own pace.

Hoffman and Lundberg (1976) delivered two similar tests to pharmacy students. One test was administered on paper, and the other was administered via two large monitors at the front of a lecture hall. Overall, the researchers found no significant differences in the accuracy of the test results. True-false and multiple-choice test items were answered correctly with about the same frequency on the paper test as on the computer-based test. Matching items, however, were less often correct on the computer-based test than on the paper version.

A study of a number of staff members and students at one university (Palmiter, Elkerton, & Baggert, 1991) revealed that an animated demonstration of how to use a particular function of a software package was a faster way to teach users how to complete the task than an on-line instructional text. After the users learned the task, the demonstration or instructional text was removed, and the
users were asked to complete a similar or totally different task. The on-line text
group was able to adapt to new situations and discover ways to complete new
tasks, while the animated demonstration group had difficulty in applying what they
had learned to new situations. This probably is the case because the
demonstration contains only a visual component, while the on-line text includes
both visual and verbal components.

Several researchers have attempted to identify reasons why computer-
assisted instruction appears to succeed. White (1983) believes that computerized
learning programs work because they directly involve the students in the learning
process. Most programs require students to participate using a keyboard, mouse,
light pen, or other piece of hardware. This challenges students, improving their
motivation and holding their attention longer than a teacher's lecture might.
Rupley and Chevrette (1983) support computer-assisted instruction because it
provides immediate feedback, both positive and negative, for students. This
encourages students to continue on to the next lesson and makes them feel good
about themselves. The fact that students usually must work alone at a computer
terminal also motivates them; they feel that they are receiving more personalized
instruction than they would otherwise receive in a crowded classroom or lecture
hall.

Computer-assisted instruction does have its limitations. Elementary and
secondary students reported in a study that reading from a computer screen hurt
their eyes (Feldmann & Fish, 1988). Gay (1986) found that college biology
students who used program-controlled and learner-controlled software achieved
different levels of success. In general, students whose learning rate was controlled by the computer did better than the students who controlled the learning rate themselves. Students' prior understanding of the material, however, had an impact on how well they did. Students who already understood the material fairly well were able to move along at their own pace with little difficulty. Students who did not have a good grasp of the material, on the other hand, needed more structured learning, such as would be provided by a rigid software program or by an instructor. The needs of the students, therefore, must be considered carefully before a computerized learning system is implemented.

Further proof of this was demonstrated in a study by Gray, Barber, and Shasha (1991). College students were sorted by their locus of control scores and classified as "internals" or "externals." Internals were those who felt and behaved as if they had a great deal of control over their lives. Externals were those who felt and behaved as if external forces were steering the directions of their lives. When these individuals were asked to search for specific items of information from a paper-based or computer-based source, the individuals using the computer-based source located more correct answers. Locus of control did not appear to affect the accuracy of the students' responses. It did, however, appear to affect the speed with which the students were able to locate the requested information. Internals—those deemed to feel personal control over their fates—were faster than externals in finding the answers.

The format and arrangement of text also appears to influence students' comprehension of written material (Schloss, Schloss, and Cartwright, 1984).
Questions increase comprehension when they are located on the screen following the associated instructional text; when placed this way, they force the students to remember the information to answer the questions successfully and proceed to the next lesson. Students also have their own ideas about what design features they like and dislike. A poorly designed program can turn off students, possibly decreasing their potential for success.

Reading from a Computer Screen

The data on whether the computer medium affects reading ability vary. Some investigators have determined that reading speed from a computer screen is slower than from paper (Calvo, 1986; Heppner, Anderson, Farstrup, & Weiderman, 1985; Zuk, 1986). Zuk observed this effect in third- and fifth-graders but also found that the children preferred to read from a computer screen. The American Institutes for Research (as reported in Calvo) stated that people take 20 to 30 percent longer to read text from a computer screen than to read the same text from a printed page. In addition, readers appear less able to detect typographical errors on a screen than on paper. There are ways to improve readability on the computer, however. Calvo noted that high negative contrast presentation (e.g., black-on-white as opposed to green-on-black) improves readability, as does dynamic presentation, such as scrolling, spacing, and blinking.

Gould and Grischkowsky (1984) designed an experiment in which clerk-typists proofread text both on paper and on computer, with all other work conditions held equal. Proofreading on the computer was 20 to 30 percent slower
than on paper and resulted in more undetected errors. The use of the computer medium appeared to produce no unusual physical effects, however. Clerk-typists experienced the same amount of fatigue and eyestrain, regardless of whether they worked on a computer or on paper.

A survey of editors sought to discover their attitudes toward using computers in their daily routines (Rude & Smith, 1992). Of the editors who responded, computer users reported that they spent less time editing than the hard-copy editors. Computer users also were more likely to edit for visual features of text, rather than verbal features. Even editors who use computers said that they do not use them all the time. They would rather look for spelling and typographical errors on paper than on the computer. Editors prefer to use computers for short documents needing only superficial editing. They dislike computers for longer documents needing substantive editing and rewriting because the computer interferes with their "sense of and use of the whole document" (p. 340).

Muter, Latrémoille, Treurniet, and Beam (1982) observed college students who read a novel for two hours using either a book or television-screen format. Differences in comprehension level for the two formats were not significant, but reading speed was deemed 28.5 percent slower from the screen format than from the book format.

In one study, psychology students read either on a computer screen or on paper and then searched for information to answer prepared questions (Askwall, 1985). Reading and search times did not vary significantly from medium to
medium. The number of correct responses also did not vary significantly; however, it took longer for the students searching for information on computer to record their answers than it took for the students searching on paper.

Other investigators have determined that use of the computer medium has no effect on reading ability. Feldmann and Fish (1988) evaluated elementary, junior-high, and high-school students and found no significant differences in the comprehension of on-line and hard-copy texts. Age and gender influenced comprehension somewhat. Older students comprehended more from the computer screen than from paper, and boys performed a bit better than girls.

Still other investigators report that comprehension is better from a computer screen than from paper. Reinking and Schreiner (1985) offered supports, such as definitions, less technical explanations, and background data, to intermediate-grade readers of on-line text. These readers of computer-mediated text comprehended more than readers of hard-copy text. A partial replication of this study (Reinking, 1988) indicated that readers of computer-mediated text took longer to read but comprehended more than their counterparts who read printed material.

Summary

How does the comprehension of technical procedures presented on the computer medium compare with the comprehension of hard-copy procedures? The findings described in the literature surveyed were mixed. Several investigators are of the opinion that computer usage increases reading comprehension. Many
more researchers believe that computer usage has no effect on how well readers understand written texts. Blanchard's (1989) study of fourth-, fifth-, and sixth-graders, for example, indicated that reading comprehension tests delivered on computer yielded about the same results as those delivered on paper, provided the tests were similar in format and contained equivalent questions. The implication here is that, while reading speed and other variables may be affected by the medium, the use of computers, in and of itself, does not affect reading comprehension.

Many of the studies conducted in the past examined how the comprehension of student readers is affected by the use of computers. Others have examined adult readers in academic settings. No study has focused on adult readers in their work environments or has determined whether the comprehension of technical procedures is affected by the use of the computer medium.
CHAPTER 3

PROBLEM STATEMENT AND RESEARCH HYPOTHESES

The comprehension of technical procedures is vital to their proper performance. Being able to understand and follow procedural information could mean the difference between an emergency evacuation procedure being performed properly or not. Regardless of the medium in which procedures appear, they must be understood by users if they are to be performed safely, completely, and correctly. Because computer-based information systems are becoming increasingly popular in business and industry, a number of companies naturally are investigating the implementation of on-line procedure systems.

It is important to know whether these new systems will be as effective as traditional hard-copy procedures in communicating responsibilities and steps to the users who must perform the tasks. In addition, it is important to understand how the presentation of procedures on a computer screen differs from that of procedures printed on paper, as these differences could pose problems for users. In order to determine whether there is any relationship between computer usage and the comprehension of procedural information, an experiment was designed in which two groups of readers read and demonstrated their comprehension of a hard-copy procedure. One of the groups then read and demonstrated its
comprehension of a second hard-copy procedure, while the other group read and demonstrated its comprehension of an on-line procedure.

Because the purpose of this experiment was to determine whether the different presentation media resulted in differences in comprehension, it was postulated that differences in comprehension would result only when the two data sets being compared were generated using different media. The following research hypotheses therefore were formulated. The first two hypotheses apply to conditions in which the data were generated using the same medium, while the last two apply to conditions in which the data were generated using different media.

(H1) There will be no significant difference in the mean comprehension scores of the two groups for the first hard-copy procedure.

(H2) For the readers who read only from hard-copy, there will be no significant difference in the mean comprehension scores for the first and second procedures.

(H3) For the readers who read both from hard-copy and computer, the mean comprehension score for the computer procedure will be significantly lower than the score for the hard-copy procedure.

(H4) The mean comprehension score of the computer group will be significantly lower than the mean score of the hard-copy group for the second procedure, on which they read from different media.
CHAPTER 4

RESEARCH METHOD

Design

For this experiment, the independent variable was computer usage, and the dependent variable was reading comprehension. The study employed both a control group (the "hard-copy group"), which read only procedures printed on paper, and an experimental group (the "computer group"), which read procedures both printed on paper and appearing on a computer screen. Both groups took written comprehension evaluations to demonstrate their understanding of what they read.

Definitions

For purposes of this study, the term "reading comprehension" referred to demonstrating understanding of a piece of written text by answering questions about its content. The questions covered such elements as the following: main idea of the text, cause and effect, factual recall, inference, terminology, and conclusion.

Reading comprehension was reported in terms of the percentage of correct answers marked on an evaluation prepared specifically to test the understanding
and retention of written procedural texts developed for this experiment.

"Reading on paper" required the subjects to evaluate a piece of printed procedural text. "Reading on computer," on the other hand, required them to evaluate a sample that appeared only on a computer monitor; hard-copy printouts of that text sample were not available to readers. The subjects were not required to be proficient with the particular word-processing program (WordPerfect, version 5.1) chosen for the study. They only had to scroll through the text using the up and down "arrow" keys and were not required to know or use specialized function keys.

Finally, "computer experience" was defined as the previous use of any computer system, whether on-line text or not, to do any type of task, including data entry, word processing, design, or repair. When they volunteered for the experiment, the subjects chose one of the following options to describe their levels of computer experience: less than one year, one to five years, five to ten years, ten to 15 years, 15 to 20 years, or more than 20 years.

Subjects

The readers studied were employees of EG&G Energy Measurements, Inc. (EG&G/EM), a scientific and technical company that employs approximately 1,500 people in North Las Vegas, Nevada. The EG&G/EM employees hold a variety of positions, have a wide range of educational backgrounds, and possess varying levels of computer experience. During the three years preceding the study, the company had undergone a major effort to proceduralize its work processes, and it
was in the process of instituting an on-line retrieval and distribution system for its procedures. The employees who participated in the experiment, therefore, were expected to be reasonably uniform in terms of experience using and reading technical procedures.

Because the study involved human subjects, approval had to be obtained from the University of Nevada, Las Vegas (UNLV) Office of Research Administration before any experimental sessions could begin. Formal notification of approval by the Office of Research Administration was made on April 2, 1993, by UNLV's Director of Research Administration.

**Materials and Method**

Two procedure texts were developed: the text read solely from hard-copy was called Text A, and it described a process for loaning or borrowing a safety helmet. The text read both from hard-copy and computer was called Text B, and it described a process for inspecting a vehicle from a motor pool. The texts were written in a style and used a format that the participants would recognize. The texts each described an entire process from beginning to end and featured numbered paragraphs that each described one step in the process. The job title of the person who had to perform each step was highlighted in boldface type, and words or phrases needing special emphasis were shown in italicized type.

An attempt was made to match the appearance of the texts using the two media as closely as possible, using resources and equipment available and familiar to most employees in the company. The hard-copy texts were laser printed on
white paper in 14-point Dutch Roman type, a serif font that resembled the font used on the computer screen. The image resolution of the laser printer was 300 by 300 dots per inch, and the texts occupied one 8.5-by-11-inch page. The on-line text appeared in black print on a light gray background and occupied roughly two screens. Boldface type on the computer version was shown in red print on a light gray background, and italicized type was shown in light green print on a light gray background. The computer monitors measured 11.25 by 8.25 inches and featured VGA presentation offering an image resolution of 640 by 480 pixels per screen, or roughly 57 by 58 dots per inch. The average character height on both media was approximately .125 inch.

The two texts contained the same number of paragraphs (eleven) and were approximately the same length—Text A was 302 words, and Text B was 325 words long. They also were of similar levels of difficulty as determined by a computer-run usability/readability program. Text A and B both rated 11 on the Flesch-Kincaid Grade Level measure. Text A rated 58 on the Flesch Reading Ease measure, and Text B rated 60. (The Flesch-Kincaid Grade Level measure indicates the number of years of education an individual would need to understand a given text. The Flesch Reading Ease measure rates the readability of texts on a scale from 0 to 100, with 0 being the most difficult and 100 the easiest to read.)

Next, two comprehension evaluations, A and B, were developed. The evaluations, too, contained the same number of questions—fourteen—and were approximately the same length (Evaluation A was 100 words; Evaluation B was
Evaluation A and B both rated 8 on the Flesch-Kincaid Grade Level measure. Evaluation A rated 64 on the Flesch Reading Ease measure, and Evaluation B rated 71.

Before proceeding with the experiment, I submitted the texts and evaluations to EG&G/EM's Procedure System Handbook Advisory Committee, a group of procedure writers and users that serves as the company's focal point for procedure-related activities. The Committee reviewed the exercises to ensure they were coherent, were accurate, were typical of those encountered in an employee's everyday work, were not confusing, and did not require any specialized knowledge. The Committee suggested several changes to the texts and evaluations. Once those changes were made, the materials were submitted to a second focus group, which also suggested a few minor changes. The final texts and evaluations used in the study appear in Appendix A.

The experiment was conducted at the EG&G/EM complex in North Las Vegas. To introduce as little bias as possible into the procedure, all experimental sessions were conducted in the C-1 building Information Services Division computer training center, which is equipped with tables, chairs, and personal computers that run WordPerfect (version 5.1) word-processing software. Due to the limited number of similarly configured computers, no more than eight readers could participate in any single session. Seven experimental sessions were conducted on seven different days.

The personal computer stations all were set up in exactly the same manner. The units consisted of Gateway 386 PC/ATs, model PMV14 VC Plus, each with
four megabytes of random access memory. These were equipped with Gateway 2000 enhanced keyboards (101 keys), Gateway 2000 color monitors (dot pitch equal to .28 mm), and Professional Plus glare guards. All of the hardware at each station was connected through a Tripllite Command Console surge protector.

Volunteer subjects were obtained through an advertisement in the local company newsletter (Appendix B). The advertisement yielded only about 20 volunteers, so it was followed up with an electronic mail message to all employees connected to one of the company's local area networks in Las Vegas (Appendix B). This message yielded about another 20 volunteers. The volunteers were required to participate in the sessions during their lunch hours, and because they had to participate on their own time, the volunteers were allowed to select which one of the eight scheduled sessions they would attend. One session was selected by none of the volunteers, and it was therefore canceled. Since each volunteer could not be randomly assigned to the control or experimental group on an individual basis, each session was randomly designated as control or experimental. This resulted in three control, or hard-copy, sessions and four experimental, or computer, sessions.

Before each session of the experiment, the computers were turned on, made experiment-ready, and left running with a blank screen showing on the monitors. The keyboards were moved out of the way to allow the subjects room to write; the keyboards could easily be moved into place by the subjects when needed. The equipment was set up this way even for the sessions in which the subjects did not use the computers. When the subjects entered the room, they
were invited to select a seat at a computer station that had already been turned on, and they also were asked not to touch the computer equipment until instructed to do so.

The researcher and assistant then were introduced, and the purpose of the session was explained. The subjects also signed a consent form at this point to acknowledge that they were willing participants in the study. (The instructional script for the sessions, consent form, and memorandum from UNLV's Office of Research Administration approving the study and test materials are contained in Appendix C.)

The research assistant placed a copy of Text A, which was printed on paper, face-down in front of each participant. On signal, the participants turned over the texts and were given exactly three minutes in which to read and study them. The research assistant then placed a copy of Evaluation A face-down in front of each participant. Again, the participants turned over the evaluations on cue and were given exactly five minutes in which to read and answer the questions. The participants were allowed to refer to the text as often as they wished when answering the questions. When the five-minute test period was finished, the participants turned all the materials face-down and moved them out of the way.

For the hard-copy group, this process was repeated with Text B and Evaluation B. The computer group, on the other hand, read Text B from the screen. This experimental design is shown in Table 1.
Table 1

Experimental Design

<table>
<thead>
<tr>
<th></th>
<th>Text A</th>
<th>Text B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control Group</td>
<td>Hard copy</td>
<td>Hard copy</td>
</tr>
<tr>
<td>Experimental Group</td>
<td>Hard copy</td>
<td>Computer</td>
</tr>
</tbody>
</table>

The computers were set up so that the participants could begin to view the text by pressing the down-arrow key once. On signal, the participants began viewing the text and were given three minutes to read. They then were given Evaluation B, which they completed in the same manner as they had completed Evaluation A. At the end of the five-minute test period, the participants stacked the second set of materials face-down on top of the first set. They then completed a one-page affirmation that they were indeed willing participants in the study (see Appendix A) and placed it face down on top of the other materials. All of the participants' affirmations were marked positively, and their evaluations were included in the final data sets. (If a participant's affirmation had been marked negatively, the affected evaluations would not have been included among the final data sets.)

Analysis

At the end of each session, the comprehension evaluations were scored by computing the percentage of correct answers: the total number of correct answers was divided by 14 (the total number of questions), then multiplied by 100. The
maximum possible score on either evaluation was 100, and the minimum was 0.

Next, the scores were logged into a master data file, and the completed evaluations were stored for future reference.
CHAPTER 5

RESULTS

The subjects studied were randomly assigned to the control and experimental groups to eliminate as much bias as possible resulting from differences in gender, job classification (either management, clerical, technical hourly, administrative, or technical salaried), amount of computer experience, and amount of procedure experience. Both groups contained more female than male members. The control group contained primarily administrative and technical salaried employees, while the experimental group contained more employees identified as clerical than any other classification. Approximately 77 percent of the control group and 85 percent of the experimental group reported between 5 and 20 years of computer experience. About 79 percent of the control group reported that they had more than 10 years of procedure experience, while only 35 percent of the experimental group reported more than 10 years of experience reading, writing, or typing procedures. The control and experimental groups, therefore, were relatively well-sorted with respect to the characteristics of gender and computer experience, but not with respect to the characteristics of job classification and procedure experience. Figures 1 through 4 show in more detail the characteristics of the control and experimental groups.
Figure 1  Research Subjects by Gender
Figure 2 Research Subjects by Job Classification
Experience Using Computers

Figure 3 Research Subjects by Computer Experience
Figure 4 Research Subjects by Procedure Experience
The mean scores and standard deviations for the four test conditions are shown in Table 2.

<table>
<thead>
<tr>
<th></th>
<th>Evaluation A</th>
<th>Evaluation B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control Group</td>
<td>81.33, 16.64</td>
<td>85.19, 16.42</td>
</tr>
<tr>
<td>Experimental Group</td>
<td>86.25, 12.78</td>
<td>80.00, 17.06</td>
</tr>
</tbody>
</table>

Comparison of Control and Experimental Groups on Text A

The first research hypothesis predicted that there would be no significant difference in the mean comprehension scores of the two groups for the procedure that both viewed using the hard-copy medium.

The control group averaged 81.33, and the experimental group averaged 86.25 on Evaluation A. An independent t-test was performed to compare these means. The two-tailed probability indicated no significant difference ($t=-1.06, df=39, p=ns$) in the mean scores of the control and experimental groups on Evaluation A. Thus, Hypothesis 1 was supported.

Comparison of Control Group on Texts A and B

The second research hypothesis predicted that, for the employees who read only from hard-copy, there would be no significant difference in the mean comprehension scores for the first and second procedures.
The control group averaged 81.33 on Evaluation A and 85.19 on Evaluation B. A paired t-test was performed to compare these means. The two-tailed probability indicated no significant difference ($t=1.07, df=20, p=ns$) in the mean scores of the control group on Evaluations A and B. Thus, Hypothesis 2 also was supported.

**Comparison of Experimental Group on Texts A and B**

The third research hypothesis predicted that, for the readers who read both from hard-copy and computer, the mean comprehension score for the on-line procedure would be significantly lower than the mean score for the hard-copy procedure.

The experimental group averaged 86.25 on Evaluation A and 80.00 on Evaluation B. A paired t-test was performed to compare the two scores. The one-tailed probability indicated a significant difference ($t=-1.92, df=19, p<.05$) in the mean scores of the experimental group on Evaluations A (hard-copy) and B (computer). Thus, Hypothesis 3 was supported.

**Comparison of Control and Experimental Groups on Text B**

The fourth research hypothesis predicted that the mean comprehension score of the experimental (on-line) group would be significantly lower than the mean score of the control (hard-copy) group for the procedure that the groups viewed using different media.

The control group averaged 85.19, and the experimental group averaged 80.00 on Evaluation B. An independent t-test was performed to compare the two
means. The one-tailed probability indicated no significant difference ($t=0.99$, $df=39$, $p=ns$) in the mean scores of the control and experimental groups. Thus, Hypothesis 4 was not supported, although the scores did differ in the predicted direction.
CHAPTER 6

DISCUSSION

The purpose of this study was to determine whether the use of the computer presentation medium has an effect on the comprehension of technical procedures. The results were mixed, but they generally indicate that the introduction of a computer-based procedure system indeed would result in reduced comprehension for readers accustomed to paper-based procedures, at least initially.

When readers viewed procedures on paper, then viewed procedures on a computer screen, their comprehension scores decreased. This may be attributed to the fact that most (if not all) employees are used to reading procedures on paper, rather than on a computer screen. A computer-based system of procedures would at first be unfamiliar even to those employees who use computer technology as part of their everyday routines and who feel comfortable using computers.

This finding of the study contradicts the observations of Askwall (1985), Feldmann and Fish (1988), and Blanchard (1989), who determined that the comprehension of on-line text did not differ from the comprehension of hard-copy text. It also contradicts the observations of Reinking (1988) and Reinking and
Schreiner (1985), who determined that under certain circumstances, the comprehension of on-line information is better than the comprehension of information from the printed page. These past studies, however, did not measure the differences in comprehension when readers moved from the hard-copy medium to the on-line medium. Instead, they compared individuals who read only from hard-copy to individuals who read only from a computer screen. These investigations also did not study adult readers of technical procedures. Rather, they focused on student readers of academic texts.

The results of this study cannot be used to support the general statement that the comprehension of technical procedures is worse from a computer screen than from paper. There was no significant difference in the comprehension scores of the computer group and the hard-copy group on the one exercise in which the two groups read from different media.

No conclusions can be drawn about the fact that the two groups were poorly sorted with respect to job classification and procedure experience. The differences in the composition of the two groups appear not to have influenced the results, as demonstrated by the groups' similar performance using the hard-copy medium on Text A.

Limitations

Other research has focused on some of the variables contributing to comprehension. Calvo (1986); Gould and Grischkowsky (1984); and Muter, Latrémouille, Treurniet, and Beam (1982) have determined that reading speed
from a computer screen is slower than from paper. The present study did not examine reading speed, background knowledge, content, format, or any other variables that can influence how well a reader comprehends a particular piece of writing. All that can be concluded from the results of this study is that readers were able to answer fewer comprehension questions correctly when they switched from the paper to computer medium. It cannot be concluded why this was so.

In addition, the subject population used in this study was limited to employees of a single scientific and technical company in a single city. The results of this study therefore cannot be generalized to all companies using procedures, nor can they be generalized to all scientific and technical companies in other areas of the country.

This study also was not conducted under the most accurate conditions of procedure usage. In most cases, employees use a procedure by alternating between reading parts of the procedure and performing the steps in the process described. In this case, the participants only read the sample procedures and answered written comprehension questions. They were not given the opportunity to demonstrate their understanding of what they had read by trying to actually complete the actions described in the sample procedures.

This study did not account for the difference in image resolution between the two media used. The resolution of the hard-copy texts was 300 by 300 dots per inch, while the resolution of the on-line text was approximately 57 by 58 dots per inch. It is possible that this difference could have affected the results of the study, but no attempt was made to eliminate or compensate for the difference.
Rather, the materials used in the study were produced with equipment most of the subjects use on a regular basis. In addition, the personal computer stations used were not enhanced in any way because they were typical of those used routinely by most of the subjects.

Suggestions for Future Research

The results of this study could benefit developers of computerized procedure systems by predicting that reading comprehension will decrease when procedural information is transferred from printed to computer-based media. This may assist them in designing such systems or in training users of the systems to maximize their comprehension of on-line procedural information.

An interesting avenue for future research would be to repeat the evaluation of the employees of EG&G/EM, once their computerized procedure system is in place. After they have implemented and become accustomed to the new system, it is possible that the comprehension differences observed during this study would decrease or disappear.

A future study also could focus on employees reading a procedure then using it to actually perform a process. The success with which the participants would be able to complete the task could indicate much about how well they understand what they read.

It also might be useful to expand the study to include users of procedures from a variety of other companies. Because many employees of EG&G/EM have scientific and technical backgrounds, it is possible that they may have different
levels of experience using computers and procedures than most of the general adult working population. The results of this study might have varied if it had been conducted at a bank, automotive repair shop, or military installation, for example.

In addition, a future study could examine the issue of comprehension in more depth, seeking to discover explanations for the observations made. Elements such as reading speed, background knowledge of the readers, and formatting could be scrutinized to explain any differences in comprehension test scores. In this manner, developers of on-line procedure systems could focus on specific ways in which to improve their products and make them easier for their audiences to understand and use.
APPENDIX A

PROCEDURE TEXTS, READING COMPREHENSION EVALUATIONS, AND SUBJECT'S AFFIRMATION OF WILLINGNESS TO PARTICIPATE
1. Before entering an area in which objects may fall from above, the employee meets with his or her organization's safety professional to borrow a protective helmet.

2. The safety professional measures the circumference of the employee's head at eyebrow level to judge the proper helmet size.

3. The safety professional gets a Helmet Loan Form, then picks a suitable helmet from the shelf in the Safety Gear Storeroom and gives it to the employee.

4. The employee, with help from the safety professional, tries on the helmet to see that it fits well. If the helmet fits, skip to step 6.

5. If the helmet does not fit, the safety professional replaces it in the storeroom and picks another one. Return to step 4.

6. The safety professional fills in blocks 1 through 5, 8, and 10 of the Helmet Loan Form and gives it to the employee.

   NOTE: The return date (in block 10) must always be the Friday after the loan date (in block 1). If an employee takes a helmet on a Friday, he or she must return it by 5 p.m. that day.

7. The employee reads the form, prints his or her name in block 6, signs in block 7, and initials block 9.

8. The safety professional gives the pink copy of the form to the employee, sends the green copy to the property administrator, and puts the white copy in the Loan-Return File.

9. The employee uses the helmet and returns it to the safety professional by or on the return date.

10. When the employee returns the helmet, the safety professional takes the Helmet Loan Form from the Loan-Return File, checks that the serial number on the helmet matches the one in block 3 of the form, initials block 11, files the form in the Completed-Loans File, checks the helmet for damage or wear and makes needed repairs, and replaces the helmet in the Safety Gear Storeroom.
1. An employee would have to follow this procedure when:
   a. Working under a scaffold on which others are using hammers and nails
   b. Using a hammer and nails on a scaffold under which others are working
   c. Using a crowbar to remove roofing tiles from the top of a building

2. Which copy of the loan form goes in the Completed-Loans File?
   a. Green
   b. Pink
   c. White

3. Block 4 on the loan form is filled in by the:
   a. Employee
   b. Safety professional
   c. Property administrator

4. If the first helmet chosen does not fit, the safety professional:
   a. Adjusts it and tries again
   b. Replaces it in the storeroom
   c. Fills in part of the loan form

5. Who enters the Safety Gear Storeroom?
   a. The safety professional and the employee
   b. The safety professional only
   c. The employee and the property administrator

6. If an employee took a helmet on Wednesday, November 8, when would it be due back?
   a. November 17
   b. November 8
   c. November 10

7. An employee borrows a helmet and returns it with a broken chin strap. When the safety professional replaces the helmet in the storeroom, the chin strap will be:
   a. Broken
   b. Repaired
   c. Removed
8. In this procedure, the term "return date" refers specifically to the date the helmet:
   a. Is used
   b. Is returned
   c. Is due back

9. The property administrator is sent the green copy of the loan form:
   a. After the employee completes his or her part
   b. After the safety professional completes his or her part
   c. After the employee returns his or her helmet

10. The employee tries on a helmet, and the helmet fits. The next step to be completed is:
    a. Step 4
    b. Step 5
    c. Step 6

11. Helmet size is based on:
    a. Eyebrow length
    b. Head circumference
    c. Forehead width

12. The employee's initials appear on the loan form in:
    a. Block 9
    b. Block 6
    c. Block 7

13. The Loan-Return File contains:
    a. Completely blank forms
    b. Fully completed forms
    c. Partly completed forms

14. In summary, what is this procedure about?
    a. How to borrow or loan a protective helmet
    b. How to fill in a Helmet Loan Form
    c. How to fit someone for a protective helmet
1. Before removing a previously assigned government vehicle from the motor pool, the employee unlocks the vehicle and removes the Operator Inspection Sheet from the glove compartment.

   **NOTE:** If there is no inspection sheet in the glove compartment or anywhere else in the vehicle, the employee must obtain one from the motor pool attendant in the office, which is in the rear of the garage.

2. The employee enters his or her name, organization number, and phone extension in blocks 1 through 3 of the Operator Inspection Sheet.

3. The employee copies onto the sheet (block 4) the vehicle identity number (VIN) from the lower, driver-side corner of the front windshield. He or she also enters the license plate number, vehicle make, model, and body color (blocks 5 through 8, respectively).

4. The employee verifies the air pressure in each tire, including the spare, is between 196 and 245 kPa (28 and 35 psi). If the pressure in each tire is within the accepted range, skip to step 6.

5. If the air pressure in at least one tire is outside of the range (low or high), the employee drives the vehicle into the garage area, where the motor pool attendant corrects the pressure. Return to step 4.

6. The employee initials block 9 on the Operator Inspection Sheet, signifying the pressure in all tires is within the accepted range.

7. The employee signs and dates block 10 on the sheet, signifying the information is, to the best of his or her knowledge, complete and correct.

8. Next, the employee drives the vehicle to the motor pool exit and submits the inspection sheet to the guard at the gate.

9. The guard ensures the VIN and plate number have been copied correctly (in blocks 4 and 5), signs block 11 on the sheet, and places the completed sheet on his or her clipboard. He or she then gives the employee a blank sheet to complete upon returning the vehicle to the motor pool.

10. The employee places the blank Operator Inspection Sheet in the glove compartment and exits the motor pool.
1. An employee would have to follow this procedure:
   a. Before operating a government vehicle off company property
   b. Before removing a government vehicle from the motor pool
   c. Before returning a government vehicle to the motor pool

2. In this procedure, what does the acronym "VIN" stand for?
   a. Vehicle inspection number
   b. Velocity identification number
   c. Vehicle identity number

3. The employee signs the Operator Inspection Sheet to signify the:
   a. Pressure in all tires is within the accepted range
   b. Information on the sheet is complete and correct
   c. Vehicle is ready to be removed from the motor pool

4. The Operator Inspection Sheet is considered complete when the:
   a. Guard signs block 11
   b. Employee signs block 10
   c. Motor pool attendant signs block 12

5. If the air pressure in the spare tire is 180 kPa (26 psi), what action should the employee take?
   a. Select another vehicle and begin the process again
   b. Initial block 9 on the Operator Inspection Sheet
   c. Ask the motor pool attendant to adjust the pressure

6. After completing these steps, when is the next occasion an employee would have to complete an Operator Inspection Sheet?
   a. When requested by the guard at the motor pool exit
   b. When checking out another vehicle from the motor pool
   c. When returning the same vehicle to the motor pool

7. An employee looks in a government car and discovers there is no inspection sheet anywhere in the vehicle. The employee then would go to:
   a. The motor pool exit
   b. The motor pool garage
   c. His or her private vehicle
8. In step 5, the phrase "outside of the range" refers to:
   a. Higher than 196 kPa and lower than 245 kPa
   b. Lower than 196 kPa and lower than 245 kPa
   c. Lower than 196 kPa or higher than 245 kPa

9. The motor pool attendant works on the vehicle after the employee:
   a. Moves the vehicle into the garage
   b. Removes the vehicle from the garage
   c. Removes the vehicle from the motor pool

10. The employee checks the vehicle's tire pressures, and they appear to be acceptable. The next step to be completed is:
    a. Step 4
    b. Step 6
    c. Step 5

11. The employee must check the air pressure in:
    a. All four tires
    b. All five tires
    c. A random tire

12. The guard is stationed:
    a. In the garage
    b. In the office
    c. At the exit gate

13. A particular vehicle is red. The employee notes this on the inspection sheet in:
    a. Block 8
    b. Block 5
    c. Block 4

14. In summary, what is this procedure about?
    a. How to inspect a vehicle before leaving the motor pool
    b. How to check the tire pressure on an assigned vehicle
    c. How to ensure a government vehicle is safe to drive
I am a willing participant in this study.

My completed questionnaires may be included in the final data sets.

☐ Yes  ☐ No
APPENDIX B

ADVERTISEMENTS FOR VOLUNTEER RESEARCH SUBJECTS
You can be part of a special research project at EG&G

Who says there’s no such thing as a free lunch? During July, you have eight chances to get lunch for free.

"I don’t believe it," you say. "Nothing is totally free." All right, you do have to earn this lunch by participating in a fun, interesting research project that has the potential to benefit employees throughout EG&G/EM. The research project will take about 30 minutes, then the rest of your lunch hour is yours to enjoy!

The free lunches will take place from 12 to 1 p.m. in the Information Services Division training center (C-1 building, Room 6626). You can participate on one of the following days:

- Thursday, July 1
- Friday, July 2
- Tuesday, July 6
- Friday, July 9
- Thursday, July 22
- Friday, July 23
- Thursday, July 29
- Friday, July 30

If you are interested in taking part in this research project, which is sponsored by EG&G/EM’s management information office, please fill out the form below, and return it to Alessa Lawrence (M/S B2-11) by Monday, June 28. If you have any questions, call Lawrence at 5-0534.

What do you have to lose? Have fun, contribute to a worthy project, and get a free lunch at the same time.

---

Yes! I want to take part in the management information office’s research project!

Name: ____________________________ Phone: ______________________

Gender: ☐ Male ☐ Female

Job Class: ☐ Management ☐ Technical hourly ☐ Technical salaried
☐ Clerical hourly ☐ Administrative salaried ☐ Plant hourly

Amount of total experience using computers (at EG&G/EM and elsewhere; includes data entry, programming, word processing, design, repair, etc.):

☐ Less than 1 year ☐ 1-5 years ☐ 5-10 years
☐ 10-15 years ☐ 15-20 years ☐ More than 20 years

Amount of total experience using procedures or instructions (at EG&G/EM and elsewhere; includes reading, writing, publishing, formatting, etc.):

☐ Less than 1 year ☐ 1-5 years ☐ 5-10 years
☐ 10-15 years ☐ 15-20 years ☐ More than 20 years

Preferred date of participation:

☐ July 1 ☐ July 2 ☐ July 6 ☐ July 9
☐ July 22 ☐ July 23 ☐ July 29 ☐ July 30
From: Aiessa Lawrence (LAWRENCE_AM)
To: Y:\APPL\OFFICE\GRP\NLV.GRP
Date: Monday, June 28, 1993 8:00 am
Subject: Looking for volunteers

Two weeks ago, there was an advertisement in the Desertscope looking for volunteers to help with a fun (but serious) research project sponsored by the Management Information Office.

The purpose of the project is to learn something about how people use procedures, and it has the potential to benefit employees throughout EG&G/EM.

There will be eight sessions. These will be held during the lunch hour (from 12 to 1 p.m.) in the Information Services Division training center (C-1 building, room 6626) on the following days:

<table>
<thead>
<tr>
<th>Thursday, July 1</th>
<th>Friday, July 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tuesday, July 6</td>
<td>Friday, July 9</td>
</tr>
<tr>
<td>Thursday, July 22</td>
<td>Friday, July 23</td>
</tr>
<tr>
<td>Thursday, July 29</td>
<td>Friday, July 30</td>
</tr>
</tbody>
</table>

Because you are being asked to give up one lunch hour to help, you will be rewarded for your efforts. All volunteers will receive LUNCH FREE OF CHARGE.

If you have not yet signed up to help with this project, please consider doing so today. You will have fun, get lunch for free, and help us gather valuable information at the same time.

To sign up or to find out more about the project, call Aiessa Lawrence at 9-0534.
"Good afternoon. My name is Aiessa Lawrence, and I am a technical writer in the Management Information Office here at EG&G/EM. I will be conducting the session today. This is Steve Endow, who also works in the Management Information Office, and he will be assisting me. In addition to being a technical writer, I also am a graduate student in Communication Studies at the University of Nevada, Las Vegas. You are here today to help me collect some data that eventually will find its way into my thesis.

I have been a writer and editor for several years, and during that time, I have heard and read much about the concept of a ‘paperless society.’ How many of you also have heard something about this concept?"

**PAUSE FOR RESPONSES FROM PARTICIPANTS.**

"A paperless society basically would require us to receive and send the information we work with during the day using computers, rather than the printed page. The idea of a paperless society is even catching on in our company. Some of you may know that EG&G/EM is developing an on-line procedure system that our managers hope will eliminate some of the problems we have maintaining the huge volume of hard-copy, or printed, documents that we have to send, receive, and use every day. In fact, we already have set up MIODOCS, which is an on-line retrieval system that you can use to view unofficial copies of our controlled procedures, minus the flowcharts and figures. Some of you might have used MIODOCS in the past.

Because of my background and educational interests, I wondered how easy it would be to convert to a paperless procedure system. Specifically, I wondered whether people would read or use information from a computer screen in the same way that they would from the printed page. So, I designed an experiment to collect some data on how people read and understand procedures from the computer. You are going to participate in that experiment today.

Before we go any further, I want to assure you that I am doing this research project because I want to, not because anyone at EG&G/EM requested it, suggested it, or forced me to do it. I had an interest in the topic, so I designed an experiment to see whether I could find any answers to my questions. I did, however, approach the management of the company because I thought it might be interested in the results, and I also hoped it might be willing to provide some material support for my research. The managers of the company generously..."
allowed me to use this computer lab, as well as some of the communication resources in the company, like the newsletter and the local area network mail system.

Because of budget constraints, however, there was a limit to the support the company could give me. That is why you are here on your own time, and that is why I cannot give you a charge number for the time you will spend here. I know that some of you might only have a half hour for lunch, and if that will preclude you from participating in this experiment today, I understand. Will any of you not be able to stay for the entire hour?"

**PAUSE FOR RESPONSES. EXCUSE PARTICIPANTS WHO CAN'T STAY.**

"Because you are giving up your own time to help me, I felt that I should provide you lunch in return. I would like to point out that lunch is being brought to you courtesy of an educational grant I received from the Society for Technical Communication, which is a professional organization that I belong to. Please feel free to go back for seconds or to take a snack with you on the way out.

Because you are here on your own time, you also should know that you have complete control over your participation today. If at any time you feel that you do not want to continue—if this just isn't what you expected or if you feel uncomfortable in any way—simply turn the materials face-down in front of you. You can then sit here and watch everyone else complete the experiment, or you can leave the room, and there will be no impact on you personally or on your job because of it. In fact, if you didn't tell anyone that you were coming here today, then only the people in this room right now even know that you are here. The company managers do not know who volunteered for this project, and they will not be told.

Are there any questions about anything I have covered so far?"

**ANSWER QUESTIONS.**

"Because I am completing this project to get a degree at UNLV, there are some rules that I have to follow. One of those requires me to have all of you sign a consent form verifying that you are willing participants in this study and that none
of you is participating only because someone forced you to do it. Steve is passing these forms out now. Please take a few minutes to read the form, then signal me when you have finished reading. *Please do not write or sign anything yet.*

WHEN ALL HAVE FINISHED READING, ASK IF THERE ARE QUESTIONS. ANSWER QUESTIONS, THEN HAVE PARTICIPANTS COMPLETE FORMS. COLLECT COMPLETED FORMS.

"Do any of you have any more questions before we begin?"

ANSWER LAST-MINUTE QUESTIONS, THEN BEGIN.

BEFORE RELEASING THE PARTICIPANTS, SAY THE FOLLOWING:

"I want to thank you again for giving up your own time to help me with my research. I also would like to ask one favor. There are a number of employees still scheduled to participate in one of these sessions during the next few weeks. Please do not discuss the details of your participation today with anyone. I wouldn't want anyone to have an unfair advantage that you didn't have, and I'm sure you would like everyone else who participates to be just as in-the-dark as you were when you walked through the door!"
A Comparison of the Comprehension of Procedural Information Using Computer and Hard-Copy Media

Investigator: Alessa Lawrence

PURPOSE

You are here to participate in a study that I am conducting to earn a degree in communication studies at UNLV. With your help, I hope to learn whether there is a difference in how EG&G/EM employees comprehend procedures printed on paper and procedures appearing on a computer screen.

PARTICIPATION

I have asked you to help in this research because you work for a technical company that describes its work processes in written procedures. As a group, therefore, you and your coworkers have experience reading and using written procedures to do your jobs.

Your participation in this project is strictly voluntary.

METHOD

If you decide to participate, I will give you an excerpt from a procedure like one we might use here at EG&G/EM. You will have three minutes to study the excerpt. You then will complete a short questionnaire about what you just read. You will have five minutes to do this, and you will be allowed to use the excerpt to answer the questions. This process will last about ten minutes.

I then will give you a second excerpt and ask you to repeat the process. The entire session will last about 25 minutes.

RISKS

There will be no risks to you as a participant in this study. Your questionnaires will be completely anonymous. The questionnaires will be numbered, but you will not be asked to give a name, employee number, organization number, or any other information that could possibly tie your completed questionnaire to you.

Again, your participation in this project is strictly voluntary. You may stop at any time you wish by simply turning the materials face-down and leaving the room. At the end of the session, I will verify that you are still a willing participant. If you are not, I will destroy your questionnaires, and your work will not be included in the research data.

BENEFITS

The results of this study could help developers of on-line procedure systems in designing and creating the systems and in training people to use them. This has the potential to benefit you, as a user of on-line procedure systems, by making the systems easier to use and learn.
CONFIDENTIALITY

I will maintain your confidentiality by making your questionnaires anonymous. The only identification on
them will be a preassigned number. They will not contain your name or any other personal information.

I will report my data in terms of an average "score" on each of the questionnaires: I will not report
individual results. The averages will be used to compare the comprehension of procedures appearing on
the two different media (paper and computer screen).

I will report the data in a thesis to be published through UNLV. The general public will have access to
the thesis once it is published, but I expect it to be used primarily by communications students and
professionals. The data also may appear in one or more articles written for professional communications
journals.

RIGHT TO REFUSE OR WITHDRAW

You may refuse to participate in this study by not signing this consent form and leaving now.

Once the session has started, you may end your participation by turning the materials face-down and
leaving.

You also may change your mind about participating at the end of the session. If you request it, I will
separate your questionnaires from the others and will destroy them so they cannot be included in my data
sets.

QUESTIONS

If you have any questions during the session, please ask them. If you have questions later, you may
contact me at 295-0534 or M/S LVAO B2-11.

You will be sent a completed copy of this form to keep.

Your signature below will serve as proof that you have volunteered to participate in
this study as a research subject and that you have read the information above.

Participant's name (please print)  
Mail stop

Participant's signature  
Date

Investigator's signature  
Date
TO: Alesa Moyna Lawrence
FROM: Dr. William E. Schulze, Director, Research Administration
DATE: 2 April 1993

This memorandum is official notification that the protocol for the project reference above has been approved.

If you have any questions or require any assistance, please give us a call.
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