A COMPARISON OF ERRORS DETECTED:
VIDEO DISPLAY TERMINALS VS. HARDCOPY

by

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(ABSTRACT)

Information processing has altered the structure of the traditional office. Typewriters are no longer a necessity to prepare written business communication. As a result of a metamorphosis from manual data manipulation to electronic data processing, microcomputers and their related peripheral equipment are becoming the key link in the information system.

Increased usage of microcomputers and word processing software has been linked to decreased proficiency in detecting errors and in turn to decreased office productivity. Thus a number of questions arise including: Is it better to proofread from a hardcopy or a softcopy document? Does the color and contrast configuration of a video display terminal affect the operator's ability to proofread? The effect on the operator's ability to accurately detect errors in keyboarded text from different media has not been previously determined. This study was therefore completed to ascertain if a difference does exist.

Seventy-two individuals enrolled in four word processing classes at a western North Carolina community college comprised the individuals

participating in this study. Participants completed a demographic questionnaire, a pretest instrument, and one of four error detection instruments. The error detection instruments were presented in either a hardcopy or softcopy format. The softcopy format consisted of three video display terminal configurations. Analyses of covariance with pretest scores used as the covariate were used to compare the quantity and types of errors detected by error detection environment configurations.

Based on the findings from the analyses of data the following conclusions were derived.

1. Postsecondary word processing students have difficulty in finding errors in hardcopy and softcopy documents.
2. Postsecondary word processing students' abilities to detect errors in keyboarded text were <u>not</u> affected by the error detection environment--hardcopy or softcopy--during a ten-minute error detection process. Therefore, the printing of a hardcopy of keyboarded text when detecting errors for a short time period is not necessary.
3. Postsecondary word processing students' abilities to detect errors in keyboarded text were <u>not</u> affected by the video display terminal configurations examined in this study. A video display terminal's color configuration is <u>not</u> a factor in the error detecting process for a short time period--ten minutes. Therefore, the color configuration of a video display terminal should not be a major consideration when purchasing new video display terminals for instructional use.

4. As the spelling verification feature of word processing software does not detect all types of errors, instruction is needed in detecting errors that cannot be detected by the software's spelling verification feature.

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TABLE OF CONTENTS

Chapter Page

Chapter | Page

Chapter	Page

LIST OF FIGURES

LIST OF TABLES

Table		Page
15	Block One: ANCOVA Outcomes for Incorrect Letter Type of Error Subcategories	105
16	Block Two: Error Detection Environment Means and Standard Deviations for Total Errors Detected	108
17	Block Two: Analysis of Covariance Outcome for Total Errors Detected by Error Detection Environment	110
18	Block Two: ANCOVA Outcomes for Types of Errors Detected	112
19	Block Two: ANCOVA Outcomes for Incorrect Letter Type of Error Subcategories	114
20	Block Two: Softcopy Configuration Error Detection Means and Standard Deviations for Total Errors Detected	116
21	Block Two: Analysis of Covariance Outcome for Total Softcopy Errors Detected by Softcopy Error Detection Environment Configurations	117
22	Block Two: ANCOVA Outcomes for Types of Errors Detected	119
23	Block Two: ANCOVA Outcomes for Incorrect Letter Type of Error Subcategories	121
24	Block One: Synopsis of Findings	133
25	Block Two: Synopsis of Findings	137

Chapter One

INTRODUCTION

Electronic data processing equipment and microcomputers are affecting traditional office procedures as typewriters become obsolete in their present form (Naisbitt, 1982) and are no longer a necessity to produce written business communication. As a result of increased usage of electronic typewriters, computer terminals, dedicated word processors, and microcomputers in the office; employers are recruiting individuals who possess not only typewriting skills but related computer skills as well. Office employability is increasingly contingent upon a knowledge of the latest technological equipment and its operations.

Word processing equipment was introduced through the memory typewriter in the early 1970s and soon developed into computerized systems that were dedicated to the use of converting words or ideas into business documents. "Dedicated" or "stand alone" word processing systems created a need for in-service training so the equipment could be used to its fullest potential. With continued technological advancements, the microcomputer altered the structure of word processing equipment. Microcomputers are versatile--they are capable of functioning as a stand alone computer, a "dumb" terminal, or a word processor.

Office personnel, as a result of a metamorphosis from manual data manipulation to electronic information processing, are becoming the key link in the information system--they are the information gatekeepers (Krey, Donin, & Henry, 1985). Employers are concerned about this key link in information systems--concern that work quality has deteriorated as a result of the implementation of modern technology (Pearce, 1986).

Office employees often use microcomputers and related software to proofread and to correct all keyboarding and nonkeyboarding errors (Pearce, 1986). Hence, employers are interested in improving the basic skills taught in both secondary and postsecondary schools. Components of basic skills needing improvement are spelling, grammar, composition, and punctuation--all required for proofreading (Gigliotti, 1986). The usage of more electronic equipment by office personnel is inevitable for the office of the 1990s (J. R. Stewart, personal communication, April 1, 1987). Voice-activated computer terminals may replace typewriters--including electronic typewriters and word processors--creating a need for improved proofreading skills.

A major responsibility of business educators is training potential office personnel to be employable, efficient, and productive in the office. The ability to detect errors is an important component of office productivity and efficiency; therefore, business educators must provide error detection training for today's students, who are tomorrow's electronic office employees.

Office productivity during the 1970s increased only 4% while industrial productivity increased 90% (Connell, 1979). As an explanation of the minute increase in office productivity, Pearce (1986) believes many errors go undetected by the keyboard operator when a computer and its peripheral equipment are used to generate text. Arnold (1986) reports third semester high school typewriting students detected approximately 61% of errors, and the error detectors' attitudes may have been a factor contributing to the minute increase in office productivity during the 1970s. Computer operators believe that they know when an error is keyboarded. Therefore, they do not look carefully for all errors (Arnold, 1988).

America is an information oriented society (Naisbitt, 1982). Information is only useful if it is accurate (Howard, 1984), and office workers are the key link in providing the accurate information needed by management to make decisions. With the implementation of advancing technology and the incorporation of microcomputers equipped with video display terminals into the office work environment, office productivity is affected. For example, Waters (1983) reports an 8% to 20% decrease in operator speed, accuracy, and comprehension at Ryburg of FMI (part of Herman Miller, Inc.) when workers spend more than 20% to 30% of their work day using a video display terminal.

Keyes (S. Keyes, personal communication, March 27, 1987) compared and contrasted word processors and the typewriter. More time is required to produce a final document with a word processor than a typewriter. Apparently, office employees keyboard text with no concern for the text's accuracy. Many copies of the document are printed during the polishing or revising process to produce an acceptable, error-free document. Office personnel believe errors can be easily corrected later when generating text with a word processor; the software's text-editing features can detect all of their keyboarding errors (Camp, 1983). Therefore, representatives of industry believe that microcomputers have yet to be used in their fullest potential to increase office productivity; because, in many cases, multiple copies of an office document are printed and edited before a final copy is distributed.

NEED FOR THE STUDY

Proofreading is a vital skill for office personnel. Word processing software packages contain a component to assist in detecting and correcting errors, but it only verifies spelling. Typographical errors that spell a word; i.e., omitting the "r" from "your" spells "you," will not be detected by a spelling verifier. The spelling verification feature does not analyze correct word usage; therefore, homonyms and certain typographical errors create a problem if word processing operators depend totally upon microcomputer software to proofread keyboarded text. Artificial intelligence or artificial knowledge may someday overcome these spell-check problems, but a time delay is inevitable before its use is widespread (Dyson, 1987). Most word processing software packages only proofread or edit spelling mistakes; therefore, manual proofreading, whether from printed copy or a computer screen, is needed to locate and correct other types of errors.

Labor organizations believe extensive video display terminal use definitely affects the quality of work produced by an operator (Brooks, 1986). The most common video display terminal complaints include headaches, blurring of vision (both far and near), itching and burning eyes, eye fatigue, flickering sensations, and double vision (American Optometric Association, 1983). Vision problems associated with extensive video display terminal use reduce the quality and production of office documents. Verifying a displayed copy from a screen is so unpleasant for many people that they insist upon printing one or more copies of a document for proofreading before corrections are made and a final copy is printed for distribution (R. Reese, personal communication, August 4, 1987).

Accuracy in detecting errors is thought to be lower when proofreading from a video display terminal than from paper (Schell, 1986). Schell (1986) concluded the time to read keyboarded copy from a video display terminal was longer than reading the same copy from paper. Even good keyboardists often become careless and make more errors when they use word processors because they believe the new technology makes error correction easier (Rubin, 1981). Therefore, the error-detecting ability of the keyboardists must be combined with the error-correction capability of the equipment. Technology has apparently given keyboardists a false sense of security (Camp, 1983), as operators depend on today's electronic equipment and its features to detect and indicate errors to be corrected. Reading keyboarded text from a video display terminal or a paper copy to detect errors is no longer perceived as an important task by information processing equipment operators.

Increased operating costs are a major concern of management. Detecting and correcting errors from a video display terminal would reduce paper consumption and use of other supplies associated with correspondence preparation; therefore, office costs would decrease. Also, the type of video display terminal used for information processing may affect office productivity and its operations. Color video display terminals are more expensive than monochrome video display terminals. Therefore, if monochrome video display terminals are found to be more conducive to office tasks, office productivity may increase while office equipment costs may decrease with the purchase of monochrome video display terminals.

STATEMENT OF THE PROBLEM

Is it better to proofread from a hardcopy or a softcopy document? Further, does the color and contrast configuration of the video display terminal affect the operator's ability to proofread? The effect on the operator's ability to accurately detect errors in keyboarded text from different media has not been previously determined. Therefore, this study was completed to ascertain if a difference does exist.

HYPOTHESES OF THE STUDY

The following null hypotheses were formulated on the basis of the statement of the problem.

1. A significant difference will not exist in the number of errors detected when proofreading hardcopy or softcopy documents.

2. A significant difference will not exist in the type of mechanical errors detected when proofreading hardcopy or softcopy documents.

3. A significant difference will not exist in the number of errors detected when proofreading text with a color (dark blue foreground and light blue background) video display terminal, a green on black video display terminal, or a black on white video display terminal.

4. A significant difference will not exist in the type of mechanical errors detected when proofreading text with a color (dark blue foreground and light blue background) video display terminal, a green on black video display terminal, or a black on white video display terminal.

METHODOLOGY OVERVIEW

Copy containing planted mechanical errors was proofread in four word processing classes during Fall Quarter, 1988, at a western North Carolina community college. Four business letters were distributed for proofreading and error detecting in two formats: hardcopy and softcopy. Hardcopy documents were proofread; errors were detected by circling the needed corrections on the distribution copy. Softcopy documents were proofread from three different types of video display terminal color configurations, and errors were detected using DisplayWrite 4's overstrike feature. The types of detected errors were statistically analyzed using an analysis of covariance with a pretest score used as a covariate from a counterbalanced design.

DEFINITION OF TERMS

In order to clarify the meaning of specific terms used in this study, the following words were defined:

Hardcopy refers to keyboarded and printed documents which an individual proofreads to detect errors. Proofreading is the process of using a paper document and a pen or pencil to indicate needed corrections or revisions. Corrections are made to the keyboarded document after proofreading, detecting, and indicating errors.

Softcopy refers to keyboarded documents which have not been printed. Error detection and correction occur as the document is proofread from the video display terminal.

Mechanical errors refers to typographical errors that may or may not be detected by spelling verification features of word processing software, i.e., extra letter or letters, incorrect letter or letters, incorrect punctuation, incorrect spacing, omitted letter or letters, and transpositions. Based upon the operational definition of mechanical errors for this study, formatting errors were not applicable.

Extra letter or letters refers to a type of mechanical error where additional characters are keyboarded by an operator. For example, "sirster" is keyboarded for "sister"--an "r" is keyboarded that is not needed.

Incorrect letter or letters refers to a type of mechanical error where the wrong letter or letters are keyboarded by an operator. For example, "the" is incorrectly keyboarded as "thh"; the second "h" is an incorrect letter--it should have been an "e".

Shift, an incorrect letter or letters error as operationally defined for this study, refers to a capitalization mistake created by an incorrect depression of a shift key by an operator.

Phonetic, an incorrect letter or letters error as operationally defined for this study, refers to an error caused by keyboarding wrong letters based on the sound of the word, i.e., "benefits" for "benifits".

Word choice, an incorrect letter or letters error as operationally defined for this study, results in an acceptable word keyboarded that is not correct for the manner in which the word is used in a sentence, i.e., "to cars" instead of "two cars".

Misstroke, an incorrect letter or letters error as operationally defined for this study, refers to an incorrectly keyboarded character which results in a misspelled word, i.e., "apoken" for "spoken".

Incorrect punctuation refers to a type of mechanical error where a typist keyboards the wrong punctuation mark or omits a punctuation mark.

Incorrect spacing refers to a type of mechanical error that is created when an operator keyboards extra spaces or omits spaces between letters, numbers, symbols, or words.

Omitted letter or letters refers to a type of mechanical error created when an operator leaves out letters, numbers, or symbols in a word.

Transpositions refers to a type of mechanical error that occurs when an operator reverses letters, numbers, symbols, or words by mistake.

Proofreading was the process of reviewing a hardcopy or softcopy document to detect mechanical errors and indicate needed corrections. Proofreading was operationally defined for the purpose of this study; however, a much broader definition of proofreading exists.

Foreground color described the appearance of the characters on the video display terminal.

Background color described the surrounding, contrasting area of the keyboarded material on the video display terminal.

LIMITATION OF THE STUDY

Proofreading in this study was limited to the detection of mechanical errors presented in keyboarded business letters. Proofreading for content, idea development, and organization in a document was not within the scope of this study.

DELIMITATIONS OF THE STUDY

The following delimitations were made to assist in the design and execution of the study:

1. Participants were delimited to four intact word processing classes in a western North Carolina community college, specifically

Wilkes Community College. Word processing classes were taught, and data was collected during Fall Quarter, 1988.

2. Variables measured were delimited to detecting selected errors associated with proofreading a keyboarded document. Any other variables associated with proofing a keyboarded document, e.g. proofreader's marks, were delimited from this study.

3. Formatting errors, i.e, improper margins or style, were delimited from the researcher's definition of mechanical errors and this study.

4. Generalizations derived from the findings of this study were delimited to the individuals who participated in the error detection process.

ASSUMPTIONS

The following assumptions were made:

1. Participants had completed the required prerequisite courses as prescribed by the Business Faculty at Wilkes Community College. Therefore, it was assumed participants had received equivalent keyboarding and proofreading training.

2. Participants received six weeks of microcomputer and word processing software instruction prior to the collection of data. Therefore, it was assumed participants had received equivalent microcomputer and software training.

3. Participants indicated or marked errors at the same speed regardless of error detection processes used. Therefore, it was assumed the

time required to mark errors was equivalent for each error detecting and marking procedure.

RESEARCH ORGANIZATION

The research report is presented in five chapters. The content of the five chapters is as follows: Chapter One defines the problem of the research study and states the hypotheses to be examined. Chapter Two reviews the literature concerning video display terminal effects on detecting errors in keyboarded text and proofreading or text-editing strategies. Chapter Three outlines the research study design, methodology, data collection procedures, and statistical analyses of data. Chapter Four discusses data analysis and indicates the rejection or retention of the four null hypotheses examined during the study. Chapter Five presents the conclusions and recommendations derived from the findings and statistical analyses discussed in Chapter Four. Appendices include documentation, instrumentation, and permissions.

Chapter Two

REVIEW OF LITERATURE

This research study was an exploration of the medium used to detect errors and the medium's effect upon the operator's ability to accurately detect errors in keyboarded text. In addition to the investigator's research using Virginia Polytechnic Institute and State University's library, an ERIC search was conducted to select the literature to be reviewed for this study. A proliferation of literature was found concerning error detection or proofreading, but only a limited amount of the related literature dealt with the process of detecting errors by reading keyboarded text from a video display terminal. Video display terminals, error detection using a video display terminal, and the importance of error detection were the focal points of the literature reviewed. The literature review is presented in six major sections: (1) Video Display Terminals (VDTs), (2) Computerized Text Analysis, (3) Visual Perception and Error Detection, (4) Hardcopy vs. Softcopy Error Detecting, (5) Importance of Error Detection Instruction, and (6) Importance of Error Detection in Today's Information-Oriented Society.

REVIEW OF LITERATURE RELATING TO

VIDEO DISPLAY TERMINALS (VDTs)

The review of literature pertaining to video display terminals is presented in four sub-sections. Each sub-section discusses pertinent issues regarding video display terminal usage in today's society. The four sub-sections address: (1) VDTs and The Office, (2) VDT Health and Safety Hazards, (3) VDT Color and Contrast, and (4) VDT Legislation.

VDTs and The Office

The burgeoning applications of computer technology and the accompanying use of video display terminals (VDTs) are revolutionizing the office work place in America; and in all likelihood, their use will continue to grow at a rapid rate in the coming years (American Optometric Association, 1983). The increased usage of VDTs means important benefits for American business and industry, but VDT usage is not without its problems. Health related complaints concerning the use of VDTs proliferate. Due to prolonged periods of VDT usage, health problems associated with eyestrain and vision are common; but job stress is also emerging as a health problem related to VDTs. Either of these problems may affect office productivity.

Job stress among clerical operators of VDTs is higher than in any other occupational group--including air traffic controllers--according to a study by the National Institute for Occupational Safety and Health (NIOSH) (O'Conner & Regan, 1986). However, job stress in the automated office is usually not the result of advanced technology, nor is job stress unique to the office because numerous employees enjoy using microcomputers to reduce the volume of routine, repetitive chores. Many of the stress-related complaints pertain to non-equipment problems. Areas identified as contributing to stress are less than adequate planning by management, lack of training for the electronic office, or poor scheduling of office tasks using VDTs (O'Conner & Regan, 1986).

Job stress that produces physical symptoms is often attributed to VDTs. The most common complaints of VDT operators include headaches, blurring of vision (both far and near), itching and burning eyes, eye fatigue, flickering sensations, and double vision (American Optometric Association, 1983). VDT usage demands intense concentration on a task close at hand, usually about two feet; which is contrary to the structure of the human eye. The physical symptoms associated with VDTs and the related stress may explain the minute increase of 4% in office productivity (Connell, 1979).

The quality and quantity of work produced in an office may be affected by the type of furniture and lighting in the office work environment. Office furniture and lighting and their relationship with VDT usage are described below.

Furniture. Proper furniture usage and equipment positioning may reduce the physical symptoms associated with stress. The American Optometric Association recommends the following to reduce some of the physical discomforts associated with VDTs which may improve the productivity of office workers: (1) adjustable chairs will improve vision by allowing the operator to sit at the proper angle to the VDT screen; (2)

the distance from the viewer's or operator's eyes to the screen should be approximately 14 to 20 inches; (3) reference materials should be placed as close as possible to the VDT screen to avoid frequent eye and head movements; (4) reference materials should be placed the same distance from the eyes as the VDT screen to avoid having to change focus when looking from one to the other; and (5) VDT screens should be equipped with glare filters (American Optometric Association, 1983).

Lighting. Traditional office lighting is fluorescent. The VDT itself is a light source. Consequently, any light reflecting on the screen directly, whether from an overhead light or a window, can create glare on the VDT resulting in eyestrain. The volume of light needed varies with individuals; but, generally, overall illumination for VDT operation should be 30 to 50 foot candles, which is less than customary office lighting levels. A lower level of general room lighting can be achieved by using fewer bulbs and fluorescent tubes or by replacing cool white tubes with cool white deluxe tubes that provide less light, creating a more comfortable and pleasant working environment and atmosphere. VDT characters, when appearing on the screen, should be in a comfortable contrast to the screen background color and should not be affected by an external light source. Reflected glare on VDT screens can be reduced by positioning VDT screens so that windows and other sources of bright light are not behind the operator (American Optometric Association, 1983).

VDT Health and Safety Hazards

When people and computers communicate, it is done through a video display terminal (VDT)--a unit that combines a television-type monitor or screen with a keyboard. VDTs possessing cathode ray tubes (CRTs) as their main components are the predominant type of display unit used in American industry; however, this may be changing if visual display terminals not containing CRTs come into use (Meister, 1985). With the increased usage of VDT technology, questions have been posed regarding the health and safety hazards associated with VDT usage.

VDT usage has not been proven to cause permanent visual or musculoskeletal damage. Many operators report temporary visual discomfort and musculoskeletal symptoms such as shoulder, back, and neck pain. These problems can be created or aggravated by poor VDT design, inadequate VDT maintenance, poor workstation design, inappropriate illumination, glare, excessively long periods of uninterrupted VDT work, poorly corrected vision, or the wearing of corrective lenses that are not appropriate for VDT work (Meister, 1985).

Related work environmental features such as furniture and light levels may be the key to reducing the health problems associated with VDTs. Conventional offices were designed and constructed prior to the implementation of VDT and microcomputer technology. Therefore, offices designed for conventional office work may not be suitable for extensive VDT use (Meister, 1985). Changes in the manner in which office tasks are performed result from the implementation of VDT technology, which may cause employee job dissatisfaction that leads to job stress

(Meister, 1985). Problems such as visual discomfort and backache may be experienced and verbalized by VDT users if proper planning does not occur prior to the installation of VDTs in the office.

Diamond (1985) and Waters (1983) both advocate that people are the key element in any past, present, or future office; and if people are not considered, new technology will never succeed in the office. The reason for adopting word processing equipment is to increase office productivity, but productivity may not increase--office workers may perceive themselves as manual laborers since their tasks are primarily data entry. Office workers believe the only needed skill for employment in today's office is the ability to keyboard since the equipment will perform the required revision tasks by depressing a key or a series of keys (Diamond, 1985). Technological unemployment, being replaced by a machine, is another source of stress in today's office.

Waters (1983) also believes lights, chairs, desks, heating and air conditioning systems--all generally designed for the "paper office"--may discredit the advantages of an electronic or automated office. An 8% to 20% reduction in operator speed, accuracy, and comprehension is reported by Waters (1983) when operators at Ryberg of FMI (part of Herman Miller, Inc.) spend more than 20% to 30% of the their work day using a VDT. VDTs or CRTs directly affect the human body because video display terminals impact operators' physical and mental health as well as their productivity (Waters, 1983).

VDT Color and Contrast

The literature concerning video display terminal color and contrast configuration is presented in two sections: (1) color and contrast configurations and (2) color and contrast implications for error detection. The first section discusses the various color configurations and their effects on productivity and related problems. The second section describes visual problems associated with video display terminals that may affect an operator's ability to accurately detect errors.

Color and Contrast Configurations. Much debate exists in the literature regarding the color configurations of video display terminals. No concrete recommendation regarding the best video display terminal color configurations for the character and screen color has been developed. The literature does not present conclusive support for any specific video display terminal color configuration to be easier on the eye.

Dolecheck (1984) concurs with the majority of reported findings in the literature reviewed whereby most authorities consider light characters on a dark screen background better than dark characters on a light background. Yet, Isensee and Bennett (1983) conclude reverse video (dark characters on a light background) is slightly preferable to normal or positive video (light characters on a dark background). However, when an individual works with both hardcopy and softcopy materials; reverse video may be preferable. Less adaptation is required by the operator when moving from white paper with black characters to a display with light background and dark characters than when moving from white paper with black characters to a display with a dark background and light characters.

O'Conner (1986) reports most video display terminal research associated with color foreground and background color contrasts concludes amber text on a green/brown background is the easiest to see. An amber foreground brightens the viewing area, increases the amount of contrast, and reduces glare. Problems with other light sources affecting the readability of an amber foreground decrease because amber is in the middle of the visual spectrum. Red should never be used as a color displayed by a video display terminal since it is placed at the harsh end of the visual spectrum as it may provoke the employee's anger toward the microcomputer system or other office workers (O'Conner, 1986). O'Conner (1986) further recommends operators keyboarding primarily business correspondence or text should consider opting for the high resolution monochrome terminal.

The user's ability to view images projected by a video display terminal is dependent upon the VDT's contrast and stability. Schnure (1986) states a positive contrast (light characters on a dark background) reduces the flicker sensitivity of the eye. Therefore, the eye of the user is allowed to view and interpret a stable character. A negative contrast (dark letters on a light background) only reduces the problems associated with adapting quickly to variable brightness levels of the VDT and does not affect the flicker sensitivity of the eye when reading from a VDT.

The attributes of video display terminal softcopy documents are different from the characteristics of paper or hardcopy documents (Galitz, 1984). Figure 1 outlines Galitz's differences between hardcopy and softcopy documents. The discrepancies, outlined by Galitz, create discomforts temporarily affecting the VDT user.

Edstrom (1987) and Schnure (1986) agree eye problems associated with the use of a video display terminal can be alleviated by using high resolution and no flicker monitors. Dark text on a light background creates a negative contrast. Thus, the eyes can adjust to the change from screen to hardcopy easier. Consequently, the switch from hardcopy to softcopy documents is not as fatiguing; and the negative contrast does not require any special lighting. A positive contrast, light text on a dark background, on a video display terminal creates less flicker and is recommended favorably by Gruning (1985). However, a negative contrast results in greater legibility.

Color Configuration and Error Detection. The relationship between the color or contrast of a video display terminal and an operator's ability to detect and correct errors was not definitively discussed in the literature. Prolonged periods of video display terminal use during a work day may affect an operator's vision, thereby decreasing the quality of work produced. An additional factor impacting an operator's ability to detect and correct errors is the resolution quality of the video display terminal.

VDTs may generate visual problems of a different magnitude and type than are generally found with traditional equipment producing hardcopy

Hardcopy	Softcopy
Dark characters on a light background	Light characters on a dark background
Continuous line characters	Dot-matrix characters
Matte surface	Reflective surface
Horizontal plane	Vertical plane
Manual input	Keyboard input
Easy to manipulate	Difficult to manipulate
Perceptually permanent	Perceptually transient
Data stored physically	Data stored electronically
Information presented simultaneously	Information presented serially

Figure 1. Galitz's hardcopy and softcopy differences.

material (Dainoff, Happ, & Crane, 1981). VDTs present dot-matrix images or characters on a screen that may appear blurred to an operator. The automatic focusing mechanisms of the operator's eyes continually operate in a futile attempt to produce a clear image. The continual operation of the internal and external eye muscles may cause visual fatigue--resulting in an operator's inability to accurately detect and correct errors.

The pain and discomfort experienced by VDT operators during extended use is not the result of the equipment (Kwiecinski, 1985). VDTs are placed in work environments created for paperwork on horizontal surfaces instead of video display terminal work on a vertical surface. Created by a poorly designed work environment, the resulting problems of headaches; sore, tired, red, or burning eyes; or any other visual complaints may affect the quality of work produced in an office. The National Institute of Occupational Safety and Health (Chol, 1985) reports that productivity could be enhanced by 25% by solving visual problems associated with VDTs and their furniture. Prolonged viewing of video display terminals at close distances is suspect as the cause of undue visual fatigue of the eye accommodation and vergence systems (Smith, 1979). Accommodation is defined as the change in the curvature of the lens of the eye, occurring as the eye shifts from an object at one distance to another object at a different distance from the eye (Smith, 1979). Vergence is a movement of both eyes where the visual axes intercept at the same point (Smith, 1979). Eye accommodation and vergence are affected when viewing information from hardcopy material and a video display terminal simultaneously--unneeded stress may be placed on the eye's pupillary system due to differences in media brightness (Smith, 1979). The stress resulting from the difference in media brightness may affect the vision and productivity of the user.

The Harvard Medical School Health Letter reports more than half of VDT operators suffer from some type of eye disorder (McQuade, 1984). The source of the eye disorder is related to the distance between the eye and the printed word. Ordinary desk work normally requires 14 to 16 inches between the eye and the hardcopy document; however, the normal viewing distance between the eye and the video display terminal is 25 inches. Repetitious, focal adjustments are necessary as the keyboarded data is displayed on the VDT screen. Therefore, the reoccurring focal adjustment may result in the likelihood of increased undetected errors.

The majority of video display terminals, as reported by Harvard Medical School, display data using green characters upon a black background. The green on black color configuration provides excellent color contrast for a time, but the operator may see a pink halo after several hours of use (McQuade, 1984). The pink halo may affect an operator's vision, thereby reducing the ability to accurately detect errors.

Conflicting information is reported within the literature concerning the optimum color and contrast configurations of VDTs. However, a common theme is apparent--a video display terminal with a negative contrast is preferable when an operator is primarily preparing text.

VDT Legislation

Legislation enacted by either the federal or state government is virtually non-existent. Congressional hearings conducted concerning VDT usage in the work place did not recommend the enactment of any legislation. Testimony at these hearings indicated that employers, equipment manufacturers, and vendors advocated complete employer flexibility in using VDTs. However, union employee representatives requested legislation be proposed that addressed the introduction, placement, and VDT usage in the work environment (Roper, 1985). The federal government, refusing to regulate VDTs in the work place, will not exercise its prerogative under the Occupational Safety and Health Act to develop VDT standards.

Conclusions drawn from Congressional hearings concur with statements on VDT health-related problems issued by data processing associations. The Data Processing Management Association supports the congressional conclusion that existing labor laws will combine to eliminate the vast majority of health-related issues (Collins, 1986). Congress and the data processing associations agree the employer and its employees are in the optimum position to reduce and eliminate any possible ergonomic complaints.

State legislatures' interest in enacting VDT regulatory statues has declined during the period of 1985 through 1986 (Fitzgerald, 1986). Twenty-five states considered VDT legislation in 1985, but the number has decreased into the teens during both 1986 and 1987. No figures were available for 1988 at this time. A common theme was prevalent in proposed state legislation--(1) formulate guidelines, (2) request studies on the VDT issue, and (3) strictly regulate the VDT environment (Collins, 1986). Proposed state legislation has required employers to provide movable screens and detachable keyboards, adjustable chairs and tables, and glare- and noise-reducing devices. Routine, reimbursable eye examinations for all employees who used a VDT for a specified time period daily were to be funded by the company. Also, the cost of eyeglasses was reimbursable under proposed state legislation if vision problems resulted from VDT usage. No guidelines were suggested in the legislation to determine the relationship between VDT usage and refractive vision problems requiring eyeglass correction (Hyatt, 1985).

The enactment of legislation establishing strict environment regulations has not been successful. If a regulatory bill has been enacted by a state legislature, it has been vetoed by the governor. Successful legislation has appropriated research funds to increase knowledge and develop environmental guidelines for VDT usage (Lewis, 1984).

California is the only state that has enacted a regulatory VDT statute, but it only pertains to the selection or procurement of related peripheral equipment. Executive orders have been issued in New Mexico and the District of Columbia to establish ergonomic standards for public employee VDT usage. Private-sector employees are not mentioned in either the enacted legislation or the executive orders. Five states, California, Colorado, Massachusetts, Nebraska, and Wisconsin, have established guidelines for equipment procurement but did not initiate regulatory orders (Legislative, Regulatory Developments, 1987).

Suffolk County, New York enacted the nation's first statute protecting workers who use VDTs (Verespej, 1988). Companies with more than 20 VDTs must protect all workers who spend more than 26 hours a week in front of computer screens. Companies must provide workers, using a VDT more than 26 hours a week, with periodic 15-minute breaks or a new assignment after three hours of continuous work, pay 80% of the cost of annual eye examinations and the cost of eyeglasses if needed, and warn workers of the potential health problems associated with the operating of a VDT--eyestrain, muscleaches, etc. Any equipment requisitioned after 1989 must include adjustable desks, five-legged chairs, and non-glare screens (Verespej, 1988).

Legislation regulating VDTs in the work place was virtually nonexistent until 1988. The New York law may alter the non-regulatory trend by compelling other states to enact legislation designed to protect their constituents who use VDTs regularly and by forcing industry to redesign and restructure the VDT work environment.

<u>Summary</u>. VDTs are revolutionizing today's office. VDTs and their related peripheral equipment are designed to increase productivity by reducing the volume of routine, repetitive office tasks. However, VDT applications do have problems which affect office productivity and the mental and physical health of employees who consistently use VDTs in executing the tasks associated with their job. Legislation is emerging

to protect VDT operators, but the legislative impact on VDT applications will not be known for some time.

REVIEW OF LITERATURE CONCERNING COMPUTERIZED TEXT ANALYSIS

Programs are available to aide word processing users in improving the mechanics of writing by assisting writers in the detection of selected errors. The most popular type of word processing accessory is the dictionary or spell checker; however, some software now includes a thesaurus. The dictionary or spell check program compares word misspellings and other typographical errors to the words stored within the program's dictionary. Another feature or accessory is the grammar or style checker program that analyzes keyboarded text to a set of rules stored within the software and displays errors on the screen. Punctuation and grammar are checked by the operator as the text is keyboarded or revised. Advanced style check programs indicate awkward expressions, incorrect word usage, cliches, and wordiness (Solomon, 1986).

Writer's Workbench is an example of an advanced style check program. It possesses a series of 30 computer programs designed to edit and analyze the quality of written material by performing many of the same functions as a human editor. However, it does not make changes in the text--it only identifies areas needing improvement (Sterkel, Johnson, & Sjogren, 1986). The programs are capable of reviewing a piece of writing to identify misspellings and simple punctuation errors according to punctuation rules and a dictionary contained within the software

(Cherry, Fox, Frase, Gingrich, Keenan, & MacDonald, 1983). The proofreading program of Writer's Workbench invokes five separate programs to verify spelling and punctuation, to check for consecutive occurrences of the same word or faulty phrasing, and to examine sentence construction for split infinitives (Cherry, Fox, Frase, Gingrich, Keenan, & MacDonald, 1983). The five subprograms are designed to be executed simultaneously: yet, they can function individually. The five subprograms identify as possible misspellings all words not listed in the computer's built-in corpus of words. Therefore, the user must decide if the words are misspelled. Likewise, the five subprograms do not identify all errors in mechanics, tone, and style. Incorrectly used commas, noun/verb disagreements, faulty logic, or incorrect or missing data are examples of errors that would not be flagged as an error by this series of computer programs (Ober & Kocar, 1986).

Writing analysis programs should be used by individuals composing and generating written correspondence, but individuals using writing analysis programs must understand what the programs can and cannot do to avoid disaster (Dauwalder, 1988). Dauwalder (1988) believes writing analysis programs can identify decision points; potential problems; and emphasize the use of a proper readability level, precise wording, active voice, concrete wording, and shorter sentences. Writing analysis programs cannot decide how something must be changed, detect all types of errors, nor comprehend what is written. Therefore, programmers or authors of future text editing or writing analysis programs must consider how the programs will affect the people that use the programs.

Their expanded use will depend upon the program's adaptability to individuals with various aptitudes, backgrounds, and experiences (Gomez, Egan, & Bowers, 1986). Computer programs designed to determine grammar rule violations or pompous writing styles could play an important role in the automated office and classroom (Cherry, Fox, Frase, Gingrich, Keenan, & MacDonald, 1983).

REVIEW OF LITERATURE CONCERNING VISUAL PERCEPTION AND ERROR DETECTION

Proofreading errors occur more often because proofreaders do not see the error than because proofreaders do not know the correct spelling of words or correct grammar rules (West, 1983). Therefore, the visual perception of the word or words when reading or proofreading affects the error detection process. Addressed within this section is the relationship between proofreading visual perception and error detection.

Smith (1986) defines the visual perception process as sensing sensory visual stimuli into specific, segregated units, that does not involve merely a mechanical recording of the stimuli. The visual perception process is further described as:

> The process is also an organization of immediate stimulation wherein the primary units, as an unrelated set of elements, are transformed into segregated units with precise spacial and sensory relationships of such variables as similarity, size, and functional dependence.

The characteristics of the primary units are analyzed in the secondary process by a system of mental steps rendering the primary units more significant for the perceived. This process invokes identification or recognition. This recognition is achieved by categorizing and by inference.

The categorization and inference stage in the perception process is where the "error" occurs. By initial categorizing and inferring, anticipation of missing elements occurs when two or more elements are perceived. This anticipation is "filling in the gaps" process based on the other elements perceived. The filled in gaps take on a visual modality characteristic that cause the gaps to be indistinguishable from the characteristics of the stimuli. This even is variously described as totalization, completion, integration, or closure.

This Gestalt logic indicates that this anticipation constitutes a decision whereby perception occurs before the error detection task is complete. (pp. 1-2)

Smith reviewed business education research and psychological research to describe visual perception and its relationship to detecting errors. Reported within his study were two major themes: (1) specific language arts or spelling instruction had no effect on increasing an individual's ability to detect and correct errors and (2) the way a proofreader perceives words may affect the ability to detect errors.

Smith reaffirmed West's conclusion that explicit instruction in language mechanics can be found to produce improvement in those mechanics. The improvement in those mechanics was not transferable to increasing proofreading proficiency because the reader's eyes move forward when comprehension occurs. Therefore, the composition of the word is not perceived (West, 1983).

Wong (1975) suggests errors are undetected when proofreading because of the perceptual factor in reading and proofreading. Her definition of the visual perception process is quoted below:

> Eyes are the receptors and the channel by which the brain receives information. Through years of practice, beginning at the elementary grades, our eyes have been trained to follow continuing cycles of fixation, saccade, fixation, and saccade along a line of print. During a fixation, our eyes focus on a small area of space; groups of abstract symbols (letters) are transferred to the brain, where they are absorbed and reconstituted into meaningful experience. The direction of a fixation may also be backward, allowing the reader to refocus on previously read material as the need arises. At the completion of a fixation, the eyes advance to the next group of words through the move called a saccade. At the end of a line, the eyes make a special type of saccade--the return sweep--to advance to the next line. Throughout this process, the reader is unconscious of, and cannot control, the movements of the muscles of his visual system. One is typically

> unaware of the number of words perceived during a fixation and of the speed advance during a saccade. For example, in reading the sentence, "The brawn fox jumped over the lazy dog," the reader cannot count the total number of fixations or saccades. Nor can one remember the number of words perceived during any fixation. . . .
>
> The complexity of proofreading lies in what occurs during the fixation phase when the symbols are being processed by the brain. As the eyes focus on the words, the brain is testing alternative hypotheses about the meaning of the symbols. Once the need for comprehension is satisfied by an acceptable solution, a saccade begins and the reader proceeds to the next fixation even though errors may be present. Returning to our sentence, for example, how many of you read the "brawn fox" as "brown fox"? (pp. 16-17)

It is difficult for a reader or proofreader to alter this pattern of reading text when proofreading. If the proofreading instruction to read letter-by-letter is accepted and followed, the reader usually reverts unconsciously to word-group reading by force of habit (Lasky, 1960). Lasky (1960) believes proofreading requires a larger number of fixations than any other type of vision; but even if a proofreader desired to advance or impede his rate and number of fixations and saccades, he cannot control the muscles of his eye. Altering proofreading patterns to generate accurate correspondence is a major problem;

and with the continued increased usage of electronic data processing, the number of errors and their effect will multiply (Wong, 1975).

REVIEW OF LITERATURE CONCERNING HARDCOPY vs. SOFTCOPY ERROR DETECTION

The availability of literature concerning hardcopy and softcopy proofreading or error detecting was limited. The available literature described the advantages and disadvantages of proofreading from a hardcopy or a softcopy document. The advantages and disadvantages associated with hardcopy and softcopy proofreading and the time element involved in proofreading are reviewed in this section.

Editing or proofreading from a hardcopy document is easier than reading from a video display terminal (Fluegelman & Hewes, 1983). Therefore, typographical errors and awkward phraseology are easier to see when proofreading from a hardcopy document. In the future; the quality, readability, and resolution of the video display terminal may alter this belief as both time and paper can be saved when proofreading from a video display terminal (Fluegelman & Hewes, 1983). A major advantage exists when proofreading from the video display terminal--the cursor is your pencil, and the operator moves it while proofreading. Therefore, the operator's eyes never stray from the video display terminal's screen to locate the indicated spot on the hardcopy document that needs to be corrected (Fluegelman & Hewes, 1983). Also, revisions are made only once--as the operator reads from the video display terminal before printing (Fluegelman & Hewes, 1983). Two disadvantages are cited by Fluegelman and Hewes (1983) pertaining to proofreading from a video display terminal: (1) the portion of a document displayed on the video display terminal is limited thereby affecting the operator's ability to sense the flow of the writing when proofreading from a video display terminal, and (2) the ease of creating an additional error when correcting existing mistakes.

Mourant, Lakshmanan, and Herman (1979) concluded (1) visual fatigue is greater when the time required to perform visual tasks on CRTs increases, (2) the time to focus the eyes from a near point to a far point increases when extended visual tasks are undertaken with CRTs, and (3) the amount of information to be processed has an effect on the visual fatigue. The major premise of the study conducted at the School of Engineering, Oakland University, Rochester, Michigan, was the image quality of hardcopy material and cathode ray tube terminal (CRT) screens are different since CRT characters appear relatively blurred and flicker. The blurred CRT characters cause the eye lens to act continuously to maintain the proper focus to see the CRT characters--resulting in visual discomfort and fatigue. Two subjects performed four 3-hour visual tasks--two using hardcopy material and two using softcopy material. The visual tasks required the two subjects to search for a randomly selected letter in a text of random letters and at the completion of each display read a five digit number placed at a far point. Eye movements, recorded by a closed circuit television system, supplied data analyzed by an analysis of variance. Statistical analysis revealed significant differences in the time required to execute and perform the search task existed when the eyes focused on the five digit number from the video display terminal source material and when the eyes refocused on the video display terminal material after reading the five digit number. The time factor increased when performing the search task using a video display terminal. Yet, the time factor for hardcopy visual search tasks remained unchanged.

The source of headaches and eyestrain associated with video display terminal usage may be the result of using both hardcopy and softcopy documents when proofreading (Silver, 1985). Proofreading from a video display terminal document and a hardcopy document requires an operator to use two completely different media. Each one of the two media requires different lighting; contrasts; and visual angles while presenting the material in different type fonts, pitches, line spacing, and viewing distances. Indicated as a possible solution to headache and eyestrain problems associated with the use of both hardcopy and softcopy materials was the placement of the hardcopy in such a fashion to reduce unnecessary neck, head, and eye movements that may lead to muscle and eye fatigue.

Fitschen (1986) lists three advantages of proofreading hardcopy material: (1) computer and writing anxiety are reduced as the proofreader can verify keyboarded material using a hardcopy document, (2) viewing the text on paper provides a different perspective--the author or proofreader can feel or sense the flow of the text, and (3) it is more familiar to proofread from a hardcopy document. Even though, the thrust of the research was concerned with students' writing abilities; Fitschen believes more spelling and grammatical errors are detected when proofreading from hardcopy material. Proofreading from a video display terminal may create unneeded operator anxiety--cyberphobia (Meister, 1985) or computer phobia.

Research, comparing and contrasting proofreading hardcopy and softcopy material, was limited. The literature reviewed indicated proofreading from a hardcopy document is easier than proofreading from a video display terminal's softcopy document.

REVIEW OF LITERATURE CONCERNING THE IMPORTANCE OF ERROR DETECTION INSTRUCTION

Proofreading instruction and its relationship to increased office productivity is evident from the literature reviewed. Two reoccurring themes were: (1) management perceives proofreading as a vital office skill and (2) business educators should incorporate proofreading or error detection instruction into all business courses offered. The most rapid keyboarder, using the latest equipment, will have a low productivity level if the keyboarder is unable to detect errors. Within the keyboarding course, a major thrust should be to develop effective proofreading or error detecting skills in the students. Therefore, future office workers should be taught to alter their reading patterns when proofreading (Byfield & Labarre, 1985).

Taylor and Stout's research supported the belief that proofreading or error detecting is an important office skill. Taylor and Stout (1985) interviewed clerical and professional employees from Fortune 500 companies in metropolitan Atlanta to validate an instrument for certifying information processing technology skills. Clerical and professional personnel from the Fortune 500 companies, as well as business teacher educators from 163 National Association for Business Teacher Education (NABTE) institutions, participated in the final certification procedure. A five-item Likert scale was used to assess the skills needed for information processing technology. A skill receiving a mean score of 4.0 or greater was interpreted by the researchers as an important skill for information processing. Three skills associated with preparing error-free office documents--proofreading, typewriting with accuracy, and spelling correctly--received mean scores of 4.5 or greater by both the Fortune 500 clerical personnel and the NABTE educators. However, only one of the three office skills mentioned above--proofreading--received a mean score greater than 4.0 from the professional personnel responding to the instrument. Therefore, clerical and professional employees as well as business teacher educators concur--proofreading is a vital office skill (Taylor & Stout, 1985).

A survey, in 13 states of 35 firms employing over 700,000 people, indicates proofreading skills are essential for the success of new employees (Kaisershot, 1987). The ability to proofread received a 3.68 importance rating from a possible 5.0 rating by the communication supervisors who responded to the survey. Consequently, communication supervisors apparently consider proofreading an important skill.

Proofreading or detecting errors is one of the six required steps in producing a mailable document (Wong, 1988). Keyboarding studies, conducted in neighboring Southeastern states in 1984 and 1986, revealed the ability to detect errors or proofread was one of the five specific keyboarding skills used frequently by managers (Sox, 1988). The percentage of managers indicating that proofreading was a frequently used skill decreased from 62 in 1984 to 59 in 1986--a minute change in the number of managers who indicated error detection skills were vital to the office (Sox, 1988).

Employers seek potential office workers who have developed good verbal and written communication skills thereby being capable of composing written correspondence and reports. Consequently, business educators possess a responsibility to develop language arts skills--punctuation, spelling, grammar, business vocabulary, and proofreading-as essential components of the office technology curriculum (White & Quesenberry, 1987).

REVIEW OF LITERATURE CONCERNING THE IMPORTANCE OF ERROR DETECTION IN TODAY'S INFORMATION-ORIENTED SOCIETY

America is an information oriented society (Naisbitt, 1982). Information is only useful if it is instantaneously available when needed, if it is in a usable format, and if it is accurate (Howard, 1984). Business decisions are based upon the information obtained from microcomputer or electronic data processing. Office workers are the key link in the accuracy of the information obtained from microcomputer data processing for managerial decision making. It is imperative that today's office employees accurately detect and correct errors in any format or media, hardcopy or softcopy documents. Office employees still need basic skills, i.e., spelling, punctuation, and grammatical structure, which are types of errors detected by proofreading (Brostrom, 1988); because microcomputer software containing spell check or style check programs cannot detect all errors.

Business educators have been inclined to only teach the features of automated typewriting equipment and eliminate certain fundamental elements of traditional typewriting instruction. Walter (1980) reported some business educators ignore their responsibility to teach basic skills normally covered in typewriting instruction when using electronic equipment. Neglected skills are grammar, spelling, punctuation, sentence structure, and typewriting accuracy--all components of proofreading and error detection (Walter, 1980). Most businesses require good spelling and proofreading skills for entry-level employment. Today's office workers must possess the ability to correctly use the English language, to spell, to punctuate, to correct, and to edit text. "Super skills" should be developed in this area (Howard, 1984). Keyboardists have the responsibility of detecting and correcting errors before a final document is prepared for distribution.

Efficient and effective use of a word processing system depends upon the skills of the individuals who use a word processor to generate mailable business correspondence. Operators, using word processors with video display terminals, should possess certain skills relating to proofreading or detecting errors is a common theme prevalent in the literature. Hulbert (1977), Anderson (1976), and Moody and Matthews (1980) concur excellent keyboarding skills, polished grammatical skills, capable proofreading or error detection techniques, and consistent spelling ability are imperative for an individual to succeed as a word processing operator. Proofreading, grammar, spelling, and formatting skills are the core of the traditional and electronically automated office; therefore, these skills cannot be overemphasized (Moody & Matthews, 1978).

Certain errors, i.e., "ths" for "this" or "gok" for "go", are the result of poor keyboarding or typewriting proficiency instead of poor spelling or proofreading ability, which differs from the majority opinions of business educators (Haggblade, 1988). Eighty-one reports containing 1,000 to 1,500 typewritten words were analyzed by Haggblade to determine what percentage of errors could be detected by microcomputer spell check programs. Seventy-six percent of the errors keyboarded would have been indicated before printing if a spell check program had been used; 24% would have not been detected by the spell check program. Therefore, not all incorrect words appearing in typewritten copy are attributable to the operator's spelling ability (Haggblade, 1988).

The ability to accurately input data and to detect errors are essential skills on the job. Potential office employees must be taught how to locate errors and correct them. Therefore, the development of error detection skills requires knowledge of acceptable typewriting formats as well as basic communication skills--grammar, punctuation, etc. Camp (1983) reports technological advances can multiply the effect of undetected errors, creating a false sense of security. As a result of the ease in reproducing additional copies of a document, paperwork proliferates; and if a document contains a error, the number of reproductions of the document containing an error multiplies the effect of that error.

With modern technology, error correction is easy; but the error correction process is time-consuming and very costly (Rubin, 1981). Office operation costs are rising more rapidly than any other expense of a business--about 12% to 15% per year; but a comparable increase in office productivity has not been noted (Rubin, 1981). Too many office employees believe that it is not important to be accurate today--errors can be detected and corrected later. Consequently, more errors go undetected and appear in final copies of a document (Rubin, 1981). The keyboardist must accept full responsibility for keyboarding accurately and proofreading carefully.

SUMMARY

Today's office environment has been revolutionized by electronic data processing. Microcomputers or computer systems equipped with a VDT are the focal point of electronic information processing. VDTs and data processing systems are designed to improve office efficiency and productivity, but the literature reviewed does not totally support the premise of improved office productivity. The prolonged usage of VDTs by office employees is linked to health and safety hazards, which impact the quality and quantity of work produced.

A component of office productivity, proofreading or detecting errors, may be affected by VDTs. An operator's ability to proofread or detect errors in keyboarded text may be impaired by VDT resolution quality, color, and contrast configurations. A perceptual process, proofreading or detecting errors, may be affected by the way an operator sees words. Conflicting information was found within the literature concerning the relationship between VDT color and contrast configurations and their effects on the operator's vision and the ability to detect errors. Yet, the inability to see an error, due to poor VDT resolution or color configuration, may explain why office productivity is not increasing as anticipated.

The transfer of language arts instruction--appropriate grammar usage--is unlikely during the error detecting process (West, 1983). However, professional personnel believe language arts instruction will improve the ability to detect errors. Therefore, the literature does not present conclusive evidence concerning the relationship between language arts instruction and the error detection process.

Modern office technology can improve office productivity, but word processing equipment and related software are only as good as the operator using the electronic equipment. If the operator cannot keyboard accurately, no amount of expensive equipment will make a difference as keyboarding errors have become too costly to tolerate (Camp, 1983). The ability to proofread and detect errors without computerized assistance or analyses is a vital office skill for the office of today as well as the office of the future.

Chapter Three

RESEARCH DESIGN

As indicated in Chapter One, the objective of this study was to ascertain if the medium used to detect errors affected an operator's ability to accurately detect errors in keyboarded text. This chapter describes the participants, the research design, the procedures to be followed by the participants selected when detecting errors in hardcopy and softcopy documents, the hardware and software to be used by the subjects, and the statistical treatment of the collected data.

THE POPULATION

Participants for this research study were selected from postsecondary word processing students at a northwestern North Carolina community college. The sub-sections below describe the community college selected--Wilkes Community College, the community college's word processing program, the contents of Wilkes Community College's word processing courses, and the word processing skills of the participants.

The Community College Word Processing Program

Word Processing is a required course in the Office Administration Technology programs throughout the North Carolina Community College system. A majority of community colleges and technical institutes within the North Carolina Community College system recommend that a student register for a word processing class during the second year of educational training in the Office Administration Technology programs. If a student demonstrates typewriting or keyboarding proficiency, one may be granted permission by the faculty of the Business Technology department of any of the 58 community colleges or technical institutes to enroll in a word processing class during the first year of study.

The Institution Selected

Wilkes Community College is a comprehensive two-year postsecondary institution accredited by the Southern Association of Colleges and Schools. Wilkes Community College serves three rural counties in northwestern North Carolina. Its overall mission is to provide the population within its service region an educational program that prepares a student for either admission at a four-year university as an advanced undergraduate or trains a student for the job market with entry-level employment skills. Another integral part of Wilkes Community College's mission, centered around community interest, is the routine function of Wilkes Community College's faculty conducting in-service training classes for local industry, i.e., Lowes' Companies, Holly Farms, Inc., and the North Carolina Department of Transportation.

Wilkes Community College's Course Descriptions

Wilkes Community College's word processing program occurs in a two-quarter sequence with students using microcomputers and an institutionally selected word processing software to create, revise, and print a multitude of office documents. Prerequisites, as prescribed by Wilkes Community College's Business Technology faculty for enrolling in the word processing courses, are either satisfactory completion of two quarters of typewriting instruction at Wilkes Community College or the equivalent as judged by Wilkes Community College's registrar when evaluating a student's high school transcript. Based upon a recommendation from the Business Technology department faculty, Wilkes Community College's Business Technology chairperson selected DisplayWrite 4 as the word processing software to be used for both quarters of word processing instruction.

Synopsis of First Quarter. Microcomputer Word Processing I familiarizes students with a microcomputer, its related peripheral equipment, and a selected word processing software package (see above). As part of the instructional program, students are taught text-editing techniques of the selected word processing software for use in creating, revising, manipulating, and printing letters, manuscripts, memoranda, pre-printed forms, or reports.

Synopsis of Second Quarter. Microcomputer Word Processing II expands upon the knowledge gained from the first quarter word processing class. Advanced features of the selected word processing software, i.e, mathematical functions, column design and layout, etc., are taught for use in producing office documents.

Participants

During the 1988 Fall Quarter at Wilkes Community College, eight word processing classes were scheduled by the Business Technology Department Chairperson. A table of random numbers was used by the researcher to select four classes to participate in the error detection process. The participants of this study consisted of 72 students enrolled in four first-quarter word processing classes at Wilkes Community College, Wilkesboro, North Carolina, during the 1988 Fall Quarter (September, 1988 through November, 1988). Permission for this study was obtained from Dr. Jean S. Cashion, Business Technology Chairperson, and Mr. Tony C. Randall, Vice-President of Instruction, at Wilkes Community College. Appendices A and B are copies of Wilkes Community College's authorization to conduct research during the mentioned time period.

Microcomputer Word Processing I and II are scheduled during the day and at night. Course enrollment per section is approximately 20 female students; enrollment is not restricted to females, but males rarely register for the course. Day students in word processing classes are typically full-time female students who may or may not be employed part-time. Night enrollment in word processing courses is predominately female office employees returning to the community college to update their skills in order to be technologically literate. The population selected for the research was limited to the day-time enrollment in first-quarter word processing classes at Wilkes Community College.

DESIGN OF THE STUDY

The ability to detect errors in selected office documents under different error detection environments was investigated. Traditional hardcopy or paper error detecting was analyzed as well as the emerging softcopy error detecting, the process of visually editing or reading keyboarded information from a video display terminal. An additional factor, which was a major component of the research, was the relationship between the foreground and background colors of the video display terminal and its effects upon an individual's ability to detect errors. Discussed within the design of the study section are the error detection instruments, the error detection procedures for hardcopy and softcopy documents, and the hardware and software used by Wilkes Community College.

Error Detection Instruments

Wilkes Community College's word processing students read one of four similar but different office documents to detect errors. Each of the four office documents contained comparable numbers of mechanical errors for detection--extra letters, incorrect letters, incorrect punctuation, incorrect spacing, omitted letters, and transpositions. Permission was obtained from Ms. Evelyn Mareth, Publisher, Office Skills Training, McGraw-Hill Training Systems, to use documents contained within the Proofamatics program. Appendices C and D are copies of McGraw-Hill's authorization to use documents from the Proofamatics program.

Instrument Selection. Business letters are frequently produced in an office. Business letters contain various types of information composed of alphabetic and numeric keystrokes, which may include mechanical errors such as extra letters, incorrect letters, incorrect punctuation, incorrect spacing, omitted letters, and transpositions. Both Ober (1982) and Cecil (1980) indicate letters are the largest portion of documents typed or keyboarded within an office environment. Therefore, business letters were selected as the type of office documents by the researcher to measure error detection using hardcopy and softcopy media.

Instrument Validity. Instruments designed to measure an operator's ability to detect errors were selected from McGraw-Hill Training System's Proofamatics program. Documents within the program contained planted errors designed to measure an operator's ability to detect errors. Therefore, the documents were considered to be valid--the documents measured the ability to detect errors. The validity of the office documents selected for use in this research study was certified during Smith's doctoral study completed at Arizona State University in 1986. Smith (1986) certified content validity of the documents within the Proofamatics program. Documents contained within the Proofamatics program used as error detection instruments for Smith's dissertation were evaluated by three office administration professors at Husson College, Bangor, Maine. The panel of experts concluded the instruments were appropriate measures of error detection, and their statements were documented within Smith's study (Smith, 1986).

Instrument Description. Office documents selected for use as measurement instruments in the study were business letters. These documents were printed in a modified block letter style with mixed punctuation, which is a predominant letter style in typewriting or keyboarding textbooks. The length of the letters range from 100 to 200 words, which is typical of current business correspondence (Datapro Reports on Office Systems, 1979).

Instrument Error Configuration. The four letters, selected by the researcher from the Proofamatics program, contained errors classified into six categories--extra letters, incorrect letters, incorrect punctuation, incorrect spacing, omitted letters, and transpositions. An analysis of the quantities and types of errors contained within each of the four selected office documents revealed comparable percentages of each error type prevailed; therefore, error composition within each letter was considered to be equivalent. Figure 2 details the error configuration within each office document selected from the Proofamatics program. As the incorrect letter category comprised a majority of the mechanical errors within the error detection instruments, the category was subdivided into four subcategories--capitalization or shift-key error, phonetic--vowel or consonant sound error which may influence the spelling of the word, incorrect word choice or usage, and keyboarding misstrokes. Figure 3 details the error configuration within the incorrect letter category for each document selected from the Proofamatics program. Appendices E, F, G, and H are examples of the selected business letters from the Proofamatics program in hardcopy

Type of Error	Document 1 Winthrop: Total by Error Type	%	Document 2 Foxcroft: Total by Error Type	%	Document 3 Provo: Total by Error Type	%	Document 4 Fitschen: Total by Error Type	%
Extra Letter(s)	1	4	2	11	2	7	1	6
Incorrect Letter(s)	14	56	9	50	15	56	9	50
Incorrect Punctuation	3	12	2	11	3	11	4	21
Incorrect Spacing	1	4	1	6	1	4	1	6
Omitted Letter(s)	3	12	3	16	3	11	1	6
Transpositions	3	12	1	6	3	11	2	11
Total	25	100	18	100	27	100	18	100

Figure 2. Error detection instrument error configuration.

Type of Error	Document 1 Winthrop Total by Error Type	%	Document 2 Foxcroft Total by Error Type	%	Document 3 Provo Total by Error Type	%	Document 4 Fitschen Total by Error Type	%
Shift	2	14	1	11.1	7	47	3	33.3
Phonetic	5	35	3	33.3	2	13	3	33.3
Word Choice	6	40	3	33.3	3	20	2	22.2
Misstroke	1	7	2	22.2	3	20	1	11.1
Total	14	100	9	100*	15	100	9	100*

*rounding error

Figure 3. Error detection instrument incorrect letter category error configuration.

format with the mechanical errors as operationally defined undetected and uncorrected.

Four documents selected from McGraw-Hill's Proofamatics program were duplicated by the researcher in two formats--hardcopy and softcopy. Mechanical errors remained undetected and uncorrected in the four letters when distributed to the participants. Participants were instructed to detect and indicate errors in one of the four documents. The four business letters were recorded onto a 3.5 inch diskette, creating softcopy documents for participants to use in error detection. Each of the four letters were selected at random and printed, creating a hardcopy document for randomly selected participants to use in detecting errors.

Error Detection Procedures

The error detection procedures for each error detection environment, hardcopy and softcopy, are discussed in this section. Also, a make-up policy is outlined at the conclusion of the error detection procedure section. The error detection process occurred during the second week of October, 1988. Wednesday, October 12, 1988, and Thursday, October 13, 1988, were scheduled for supervising the participants in the error detection process in the selected word processing classes. The video display color configurations were modified to the three selected softcopy error detection environment configurations on Tuesday, October 11, 1988, prior to the study. Three groups of six microcomputers each were configured to the three color configurations selected.

(Video display terminal color configurations selected are described in the Experimental Design section.) At this point during the first quarter of Microcomputer Word Processing I, all text-processing and text-editing features of the word processing software, DisplayWrite 4, had been taught.

An instruction sheet, developed by the researcher, was distributed to members of the population. The instruction sheet described the error detection procedure for each error detection environment. Appendix I is an example of the instruction sheet for the hardcopy error detecting procedures. The document to be read in hardcopy format was attached to the hardcopy instruction sheet. Appendix J is an example of the instruction sheet for the softcopy error detecting procedures. The softcopy instruction sheet contained the name of the document to be read from the video display terminal. Also, an identification sheet was provided for participants to indicate their name, their identification number, the error detection environment, and the word processing class in which they were enrolled. A time limit of ten minutes was imposed because an individual's attention span and interest may decrease with a longer time period. Finally, a stopwatch was supplied by the researcher for the word processing instructor's use to time the error detection activities.

Hardcopy. Approximately one-fourth of the enrollment in each word processing class selected to participate in the study detected errors from a hardcopy letter on the day of the study. An instruction sheet, Appendix I, for the hardcopy document and an identification sheet,

Appendix K, were provided for each member of the population. Participants were instructed to read and circle any mechanical error detected as operationally defined for the study with a pencil supplied by the researcher. Participants were instructed only to locate and mark any errors detected, not to correct errors. The letters with the indicated detected errors at the end of the ten-minute time period were collected by the researcher for the analysis process of the study.

Softcopy. Approximately three-fourths of the enrollment in each word processing class selected to participate in the study detected errors using softcopy material on the day of the study. An instruction sheet for softcopy documents, Appendix J, a 3.5 inch diskette containing only the document to be used for the particular individual's softcopy error detection environment configuration (Appendices F, G, and H are hardcopies of the documents duplicated in the softcopy format), and a participant identification sheet, Appendix K, were provided to the participants on the day of the study. Participants detected and marked errors in one of four different business letters using one of three different error detection environments on the day of the study. (The Experimental Design section explains the softcopy error detection environments.) Participants used DisplayWrite 4's overstrike feature to mark any errors that are detected. (A discussion of this feature of DisplayWrite 4 is included within the description of the software.) Participants were instructed to locate and mark any errors detected. Also, participants were instructed not to correct any errors or print a copy of the document. The 3.5 inch diskettes containing the letters with the indicated detected errors were collected at the end of the ten-minute time period by the researcher for the analysis process of the study.

Dictionary. Participants involved with the study were allowed to consult a dictionary to verify the correct spelling of words contained within the error detection instruments. A dictionary was placed beside each microcomputer in Wilkes Community College's microcomputer laboratory, thereby simulating a realistic office environment.

Spelling Verification Software Feature. Individuals participating in the research study were not permitted to use the spelling verification feature of DisplayWrite 4. On Tuesday, October 11, 1988, the spelling verification software feature was deleted from the microcomputer's fixed disk DisplayWrite 4 directory to prevent participants from accessing its spelling verification feature.

Make-Up Policy. In the event of absences or extenuating circumstances, participants were allowed to detect and mark errors in an error detection environment not completed at the regularly scheduled time. Any error detection procedure not completed by the participants was rescheduled for 1 p.m. on Thursday, October 20, 1988, which is an administratively scheduled time for faculty/student conferences.

HARDWARE AND SOFTWARE

Hardware and software used to conduct this study were limited to the existing hardware and software configurations at Wilkes Community College. A discussion of the microcomputer configuration and the word processing software used by Wilkes Community College for instructional purposes follows.

Hardware

Nineteen IBM Personal System/2 Model 50 microcomputers equipped with an IBM Personal System/2 8513 Color Display are presently installed in Wilkes Community College's microcomputer laboratory. Figure 4 outlines the features and configurations of the 19 IBM Personal System/2 Model 50s. Figure 5 describes the IBM Personal System/2 8513 Color Display features and capabilities.

Software

DisplayWrite 4 is used by Wilkes Community College's Business Technology faculty for word processing instruction. DisplayWrite 4, an IBM developed word processing software package, was selected for word processing instruction at Wilkes Community College because its service area, northwest North Carolina, is dominated by industry which extensively uses IBM equipment and related products.

Any word processing software will allow a skilled, knowledgeable operator to create, store, and print documents. What makes one software different from the others are the required procedures to accomplish these tasks. DisplayWrite 4 is easy to learn and simple to use. When keyboarding a document using DisplayWrite 4, it is not necessary for the operator to remember a complex series of keystrokes to accomplish common editing functions such as insertion, deletion, or reorganization of text. With DisplayWrite 4, nearly all of the word processing

Feature	Model 50 Configuration
Microprocessor	80286, 10 MHz
Permanent memory (ROM)	128KB standard
Memory (RAM)	1MB standard
Integrated functions	Video Graphics Array and display port, serial port, parallel port, pointing device port, keyboard port, and diskette controller
Text/graphics support	Video Graphics Array supports existing color graphics modes and provides up to 256 colors from a palette of over 256,000) and 64 shades of gray (monochrome)
Auxiliary storage	Standard: one 1.44MB 3.5-inch diskette drive and 20MB fixed disk Keyboard
Enhanced keyboard	101 keys, including 12 function keys, 3 lighted mode indicators
Operating systems	IBM PC DOS 3.30, IBM Operating System/2

Note: IBM Corporation, 1987.

Figure 4. Wilkes Community College microcomputer configuration: IBM Personal System/2 Model 50.

Feature	8513 Color Display Configuration
Description	A medium-addressability, 12-inch analog color display that produces enhanced-quality text and graphics. Featuring a selection of thousands of colors, it uses high screen refresh rates to display a steady picture.
Addressability	9 x 16-dot character matrix (maximum); 720 x dot matrix (text mode); 640 x 480 dot matrix graphics mode)
Viewing area	Up to 25 lines of uppercase and lowercase text; 80 characters per line
Screen	12" (diagonal measurement); etched to reduce glare
Colors	256 colors from a palette of over 256,000

Note: IBM Corporation, 1987.

Figure 5. Wilkes Community College microcomputer configuration IBM Personal System/2 8513 Color Display.

capabilities are single function, keydriven operations. Most functions require only two keystrokes.

DisplayWrite 4 offers all major tasks (creating a document or printing a document) through a series of easy-to-use menus, accessed via function keys located on the keyboard attached to the microcomputer. Menus are screen processing choices. When an option is selected from a menu, the DisplayWrite 4 software performs a specific task.

DisplayWrite 4 is designed to simplify the document creation process. Menu selections are numbered for easy reference, and instructions are written on many of the screen displays to indicate what procedures must be followed to complete a task. As the software is used, many messages will automatically be displayed on the screen. Some of these are messages describing the task which the system is currently performing. Others are prompts, which are instructions for the operator to perform a specific procedure before the system can continue with a particular function.

DisplayWrite 4 possesses a self-contained dictionary to assist in correcting misspelled words. Additional words generic to a particular business may be added with minimal difficulty. DisplayWrite 4 is limited in its ability to detect errors as it only verifies spelling. Word choice(s), i.e., "to" for "too" or "one" for "won," are not flagged as being spelling errors. Other grammatical errors cannot be flagged as errors with the spelling verification feature of DisplayWrite 4. Errors may be easily corrected with DisplayWrite 4, but the document must be read by an operator before all errors can be detected and corrected.

Overstrike. Overstrike, an editing feature of DisplayWrite 4, allows text to be marked for revision. Overstrike highlights the text to be revised by allowing the operator to keyboard over the indicated text with a diagonal on the video display terminal. However, when the overstruck material is printed, both the marked material and the diagonal appear on the hardcopy. Errors detected by participants in this study were indicated by DisplayWrite 4's overstrike feature.

EXPERIMENTAL DESIGN

Letters were distributed to students for reading and detecting errors during the sixth week of the 1988 Fall Quarter at Wilkes Community College--the second week of October, 1988. One of four letters was read by each participant in the study. Each participant read and detected errors in one letter during the class meeting on the day of the study. The error detection process for the participants occurred on Wednesday, October 12, 1988, and Thursday, October 13, 1988. Any participant who was absent completed any missed work at 1 p.m. on Thursday, October 20, 1988. Each error detecting procedure contained only one document and was limited to a ten-minute time frame. For the day of the study, participants were randomly assigned to one of two error detection formats--hardcopy or softcopy. The softcopy error detecting procedure included three configurations. The three softcopy configurations were (1) dark blue letters on a light blue background, (2) green letters on a black background, and (3) black letters on a white background. Discussion of the random assignment and the softcopy error detection sub-formats follows. Figure 6 presents the experimental design illustrating the data collection procedures from a counter-balanced design.

Random Assignment of Error Detection Environment Order. A table of random numbers was used to select a starting point to group the participants. The last digit of the number from the table of random numbers corresponded to a number on the class roster. The class roster distributed to faculty members at Wilkes Community College from the Management Information Department listed the students registered for the course in alphabetical order. From the number selected as the starting point, participants were assigned an identification number and an error detection environment as described in Figure 7.

Softcopy Error Detection Environment and Sub-Formats. As previously defined, documents containing planted errors were distributed to participants on a 3.5 inch diskette. Documents distributed via diskette were displayed by the participants on a video display terminal. Each participant read the assigned business letter from the video display terminal without the benefit of a hardcopy--a hardcopy was not provided, and participants were not allowed to print a copy. Each of the three documents distributed to students in a softcopy format appeared on the video display terminal with different foreground and background color configurations (different colors of letters on different background colors).

The video display terminal color configurations used in this study were selected from the results of research described in Chapter Two. A

Error Detecting Environment

C	Light Blue/ Dark Blue I	SN	Black/ White I	SN	Hardcopy I	SN	Green/ Black I	SN
A	Fitschen	1- 5	Foxcroft	6-10	Winthrop	11-15	Provo	16-20
B	Provo	16-20	Fitschen	1- 5	Foxcroft	6-10	Winthrop	11-15
C	Winthrop	11-15	Provo	16-20	Fitschen	1- 5	Foxcroft	6-10
D	Foxcroft	6-10	Winthrop	11-15	Provo	16-20	Fitschen	1- 5

Note: C = Class, I = Instrument, SN = Student Number

Figure 6. Experimental design showing data collection procedures and data analysis procedures using a counterbalanced design.

Student Numbers	Class A	Class B	Class C	Class D
1- 5	Hardcopy	Light Blue/ Dark Blue	Green/Black	Black/White
6-10	Black/White	Hardcopy	Light Blue/ Dark Blue	Green/Black
11-15	Green/Black	Black/White	Hardcopy	Light Blue/ Dark Blue
16-20	Light Blue/ Dark Blue	Green/Black	Black/White	Hardcopy

Figure 7. Assignment of error detecting environment order to participants.

review of related literature indicated an ideal color and contrast configuration for VDTs has not been determined. However, positive video--light characters on a dark background--was easier for an operator to see; but reverse video--dark characters on a light background--provided easier adaptation between a paper copy and the VDT screen. Two forms of reverse video--black characters on a white background and dark blue characters on a light blue background--and one type of positive video--green characters on a black background--were selected to measure the effect of the video display terminal's color and contrast configuration on an operator's ability to detect errors. WordPerfect and DisplayWrite, two major word processing software packages, display dark blue characters on a light blue background as their defaults when used with a color video display terminal. Therefore, the dark blue and light blue color configuration's effect on an operator's ability to detect errors was studied. Green characters on a black background remains a popular monochrome video display terminal color configuration; however, black characters on a white background is emerging as another type of monochrome video display terminal. Therefore, both monochrome colors'--green characters on a black background and black characters on a white background--effects on an operator's ability to detect errors were examined.

<u>Safeguards</u>

Controls or safeguards were designed by the researcher to insure the uniformity of the error detection environments and instruments.

Four subsections describing the procedures implemented to control error detection environmental facilities, video display terminal brightness, instrument accuracy, and the Hawthorne Effect follow.

Environment Facilities. Word processing classes participating in the study were scheduled in the same classroom, the Business Department microcomputer laboratory at Wilkes Community College, between the hours of 11 a.m. and 1 p.m. on Wednesday, October 12, 1988, and Thursday, October 13, 1988. Window blinds were drawn by the instructor prior to error detection process. Therefore, classroom lighting, word processing class times, and sun glare did not affect participants' abilities to read and detect errors from a video display terminal.

Video Display Terminal Brightness. On Tuesday, October 11, 1988, video display terminal brightness controls were preset by the researcher. The brightness controls of the video display terminals could not be adjusted by the participants--the brightness control buttons were taped stationary. Glare filters were not used because sunlight was blocked from entering Wilkes Community College's microcomputer laboratory by adjusting window blinds. Therefore, the brightness of the video display terminals did not affect an operator's ability to read keyboarded text from a video display terminal.

Instrument Accuracy. Prior to the study, another member of Wilkes Community College's business faculty read and reviewed hardcopies of the pretest instrument, the four letters selected as error detection instruments from McGraw-Hill Training System's Proofamatics program, and the score sheets developed by the researcher. Errors from the score sheet were compared to errors on the error detection instruments by the business instructor. Any discrepancies noted by the business instructor were reviewed and corrected by the researcher. The process was repeated until no discrepancies were noted. Therefore, no unintended errors appeared in any of the error detection instruments.

Hawthorne Effect. Participants received an introduction sheet prepared by the researcher. The introduction sheet, Appendix K, was distributed to the students on the day of the study. The introduction sheet described the error detecting process as a diagnostic effort to determine needed error detection skills when reading from a paper document or a video display terminal. Therefore, individuals did not know they were participanting in an experiment.

ANALYSIS OF DATA

Participant demographic information such as age, vision correction, and work experience as well as the quantity and the types of errors detected by participants in the study were the source of data for analysis. Participants completed a questionnaire concerning demographic data prior to conducting the study. As mentioned earlier in the chapter, participants detected errors in one of four business letters to analyze error detecting skills when detecting errors from two different error detection environments--hardcopy and softcopy. Figure 6 on page 63 illustrates the order of the random assignment of error detection environments to study participants by word processing class. Participants were required to use a pencil to circle all errors detected in their copy of the hardcopy document. The overstrike feature of DisplayWrite 4 was used by participants to indicate the errors detected in their softcopy documents. A pretest was administered in early October, 1988, to control for initial differences among the participants in the analysis of data. The following section describes the data collection and analysis process and is presented in five subsections: demographics, blocks of data analysis, pretest, data collection, and statistical analyses of data.

Demographics

Demographic information was collected prior to conducting the research project. Participants completed a questionnaire concerning their age, educational background, vision correction, and employment history. Appendix L is a hardcopy of the demographic instrument. Number Cruncher, a microcomputer statistical analysis system, was used to analyze the information by generating response frequencies and percentages for each question.

Blocks of Data Analysis

Data collected from the error detection process were analysed in two blocks. The analysis procedure for both blocks are reviewed in two subsections: Block One and Block Two.

Block One. Participants were not allowed to used DisplayWrite 4's spelling verification feature in the error detecting process. Therefore, all errors contained within the error detection instruments were analyzed to determine the error detection environment's effect on an operator's ability to detect errors in keyboarded text.

Block Two. DisplayWrite 4's spelling verification feature was not used by participants. However, the researcher used DisplayWrite 4's spelling verification feature to identify the errors DisplayWrite 4's spelling verification feature would detect. The errors identified by DisplayWrite 4's spelling verification feature were deleted from Block Two analysis of data.

Pretest

A pretest was administered to participants enrolled in four first-quarter word processing classes during the 1988 Fall Quarter at Wilkes Community College on Wednesday, October 5, 1988. The instrument used as the pretest was a business letter developed by Arnold (1986) as a pretest/posttest device for her doctoral dissertation completed at the University of Kentucky. Appendix M authorizes the use of the document developed by Arnold. Appendix N is a hardcopy of the pretest instrument with errors uncorrected and undetected. The pretest instrument contained 22 errors to be detected. The types of errors contained within the pretest instrument were comparable to the types of errors contained within the error detection instruments selected for the study. Figure 8 analyzes the error configuration within the pretest instrument.

Scoring. Scores obtained from the pretest were used as covariates to control for initial differences of the word processing students participating in the study. A score sheet, Appendix O, was developed by

Type of Error	Total by Number	Error Type Percentage
Extra Letter(s)	2	9
Incorrect Letter(s)	7	31
Incorrect Punctuation	3	14
Incorrect Spacing	2	9
Omitted Letter(s)	5	23
Transpositions	3	14
Total	22	100

Figure 8. Pretest error configuration.

the researcher to score the pretest (see below). Errors detected by the participants were compared to correct answers reviewed by the researcher. When an error was correctly detected, a red checkmark was placed beside the error on the score sheet. The total number of errors correctly detected was the student's score on the pretest and was used as a covariate during statistical analysis. Errors marked by participants that were not errors as operationally defined for the purpose of the study were noted on the score sheet and were excluded from the analysis.

Score Sheet. Two versions of the score sheet were designed for the pretest. A tally sheet was developed for each of the two blocks of data analyses: (1) the quantity and type of all errors correctly detected by participants without using DisplayWrite 4's spelling verification feature and (2) errors detected by participants after eliminating the errors detected by DisplayWrite 4's spelling verification feature. Appendix O presents both versions of the tally sheet for the pretest error detection instrument.

Data Collection

Both hardcopy and softcopy documents used by the participants for error detection purposes were scored by the researcher. Errors detected by the participants were compared to correct answers supplied by the publisher and reviewed by the researcher. A score sheet for scoring the data collection instruments and to calculate a raw score of the quantities and types of errors correctly detected was developed by the researcher (see below). A copy of the score sheet developed by the researcher for the error detection instruments are provided in

Appendices P, Q, R, and S. Each score sheet contained information regarding the quantities of correctly detected errors categorized by the types of mechanical errors as operationally defined for this study and an error total by document. Another section of each score sheet contained the participant's name, identification number, and error detection environment. Hardcopy and softcopy scoring were somewhat different, and those procedures are explained below.

Score Sheets. Two versions of the score sheet were designed for each error detection instrument. A tally sheet was developed for each instrument for each of the two blocks of data analysis: (1) the quantity and type of all errors correctly detected by participants and (2) errors detected by participants after eliminating the errors detected by DisplayWrite 4's spelling verification feature. Appendices P, Q, R, and S present both versions of the tally sheet.

Hardcopy. The researcher placed a red "x" beside the detected error on each participant's hardcopy document if the error was, in fact, an error. Errors marked by participants that were not errors as operationally defined for the purpose of this study were noted on the score sheet and were excluded from the analysis. Errors not detected were left blank on the score sheet. The data obtained from the subject's hardcopy was transferred to the score sheet. The score sheet, referenced above, organized the detected errors by type and by the total number of errors detected for more extensive data analysis by the researcher.

Softcopy. Errors detected by participants using the overstrike feature of DisplayWrite 4 were scored by similar instruments, Appendices P, Q, R, and S. A score sheet was prepared by the researcher for each of the error detection instruments for each block of data analyses. When errors were correctly detected by a participant, a checkmark was placed beside the error on the score sheet. Errors marked by participants that were not errors as operationally defined for the purpose of the study were noted on the score sheet and were excluded from the analysis. Errors not detected were left blank on the score sheet. The researcher calculated totals for the type of error, for the foreground and background color configurations, and for softcopy error detection environments for more extensive data analysis by the researcher.

Statistical Analysis of Data

The statistical treatment of the data obtained from the score sheets is discussed within this section. The data collected from the error detection process were analyzed in two blocks. The first block of data analysis examined the quantity and type of all errors correctly detected by participants. The second block analyzed scores for errors detected by participants after eliminating the errors detected by DisplayWrite 4's spelling verification feature. The four hypotheses presented in Chapter One were analyzed for both blocks. Three areas are addressed in this subsection: the analysis of covariance (ANCOVA) using a counterbalanced design, the F-ratios to be calculated, and hypotheses analysis.

ANCOVA. An analysis of covariance (ANCOVA) with the pretest score being the covariate was used to examine the four hypotheses presented in Chapter One. Hypothesis One and Hypothesis Three were tested using an ANCOVA with the pretest total number of errors detected used as the covariate to determine if a significant difference existed between the error detection environments used to detect errors and the quantities of errors detected. Hypotheses Two and Four were tested using an ANCOVA with the pretest number of errors correctly detected for each type of error used as the covariate to determine if a significant difference existed among the types of errors correctly detected and error detection environment or softcopy error detection environment configurations. Statistical significance was evaluated by examining F-ratios for the four hypotheses in both blocks. Number Cruncher, a microcomputer statistical analysis package, computed the F-ratios for an a priori alpha level of .05. Hypotheses analyses are described below.

Hypotheses. To test the hypothesis, "a significant difference will not exist in the number of errors detected when proofreading hardcopy or softcopy documents," an analysis of covariance with the participants' pretest total number of errors correctly detected being used as a covariate was applied to the total number of errors correctly detected from hardcopy documents and from softcopy documents. If significant differences were found, the source of the significant difference was determined by the larger of the two error detection environment means.

The hypothesis, "a significant difference will not exist in the type of mechanical errors detected when proofreading hardcopy or softcopy documents," was examined by an analysis of covariance with the pretest number of errors correctly detected for each type of error and by the environment used to detect errors--hardcopy or softcopy. If significant differences were observed, the source of the significant difference was determined by the larger of the two error detection environment means or Duncan's New Mulitple Range Test.

Data to test the hypothesis, "a significant difference will not exist in the number of errors detected when proofreading text with a color (dark blue foreground and light blue background) video display terminal, a green on black video display terminal, or a black on white video display terminal," was generated by combining the total number of errors correctly detected from each type of video display terminal color configuration. An analysis of covariance with the students' pretest scores used as a covariate was applied to determine if significant differences existed among the three video display terminal configurations. If significant differences were observed, Duncan's New Multiple Range Test was used to determine the variance among the three video display terminal color configurations.

To test the hypothesis, "a significant difference will not exist in the type of mechanical errors detected when proofreading text with a color (dark blue foreground and light blue background) video display terminal, a green on black video display terminal, or a black on white video display terminal," an analysis of covariance with the pretest number of errors correctly detected for each type of error used as the covariate was used. If significant differences were identified among the types of errors detected and the three video display terminal configurations, Duncan's New Multiple Range Test was used to determine the source of the variance.

SUMMARY OF METHODOLOGY

Individuals enrolled in four Wilkes Community College word processing courses during the sixth week of the 1988 Fall Quarter represented the population for the study. Participants read and detected errors in one of four documents representing office correspondence. A demographic instrument and a pretest were administered to the participants during the first week of October, 1988, with the error detection and indication process occurring during the second week of October, 1988. Participants were instructed to detect and mark errors; they were instructed not to correct any errors detected.

The pretest and the selected error detection instruments contained errors classified by the researcher into six categories: extra letters, incorrect letters, incorrect punctuation, incorrect spacing, omitted letters, and transpositions. Participants reading and detecting errors from a hardcopy document circled with a pencil any errors detected. When reading and detecting errors from a video display terminal, participants used DisplayWrite 4's overstrike feature to indicate any errors detected. Errors detected by the participants were organized for analysis by a score sheet developed by the researcher. Three different video display terminal foreground and background colors were used by participants to investigate the relationship between the foreground and background color of the video display terminal and the participants' abilities to detect errors.

Data obtained from the error detection process were analyzed in two blocks for all participants: (1) the quantity and type of all errors correctly detected by participants and (2) errors detected by participants after eliminating the errors detected by DisplayWrite 4's spelling verification feature The data collected by the researcher were analyzed by an analysis of covariance (ANCOVA) using a counterbalanced design with pretest total number of errors correctly detected being used as covariates. The quantities of errors detected and the types of errors detected were compared to determine if significant differences exist when investigating the hypotheses stated in Chapter One at an a priori alpha level of .05. F-values were used to compare the quantities of errors correctly detected and the error detection environment. If significant differences were derived, the source of the significant difference was determined by the larger of the two error detection environment means or Duncan's New Multiple Range Test. The F-ratios and their related analyses are discussed in Chapter Four.

Chapter Four

ANALYSIS OF DATA

The objective of this study, as indicated in Chapter One, was to ascertain if the medium used to detect errors affected an operator's ability to accurately detect errors in keyboarded text. To achieve this objective, a pretest was administered to 72 subjects at Wilkes Community College. One of four error detection instruments was administered to participants approximately one week after completing the pretest instrument. Error detection instrument means were adjusted to take into account the initial differences between the pretest means by an analysis of covariance. Two error detection environments, hardcopy and softcopy, were compared. Three softcopy error detection environment configurations were also compared to determine the relationship between the color configuration of the video display terminal and an operator's ability to detect errors in keyboarded text. The softcopy error detection environment consisted of three different video display terminal color configurations--dark blue characters on a light blue background, black characters on a white background, and green characters on a black background. The data collected from the error detection procedures were analyzed in two blocks: (1) errors detected by participants without using DisplayWrite 4's spelling verification feature and (2) errors detected by participants after eliminating the errors detected by DisplayWrite 4's spelling verification feature. Demographic data were also collected for each of the 72 participants.

Four business letters from McGraw-Hill's Proofamatics program were used as error detection instruments. Each of the four instruments was randomly assigned to an initial error detection environment and rotated throughout the other error detection environment or softcopy error detection environment configurations. Participants were directed to locate and mark errors within one of the four instruments. Subjects, randomly assigned to the hardcopy error detection environment, circled any errors detected with a pencil. Participants, randomly assigned to a softcopy error detection environment, used DisplayWrite 4's overstrike feature to mark any errors detected. The total number of correctly detected errors and the number of errors correctly detected by type of error were recorded as the raw scores for each subject by error detection environment.

This chapter presents the analysis of data in six sections. Section One, Participants' Characteristics, describes the 72 subjects who participated in the error detection procedures. Demographic data collected included the age, educational background, work experience, and microcomputer ownership.

Section Two, Error Detection Accuracy, presents the mean score for the total number of errors correctly detected by participants. The range of scores for the total number of errors accurately detected and the percent of accuracy are reported by error detection environment--hardcopy or softcopy.

Discussed in Section Three, Excluded Errors, is the range of items incorrectly identified as errors by participants. Items incorrectly marked as errors operationally defined for this study were excluded from the analysis of data.

Information in Section Four discusses the pretest means and standard deviations for both blocks of data analyzed. The pretest mean and standard deviation for the number of errors detected are reported by error detection environment.

Section Five contains a discussion of the analysis of the quantity and types of errors correctly detected by participants. The relationship between hardcopy and softcopy error detection environments, the quantity of errors detected, and the types of errors detected is examined in this section. The participants did not use DisplayWrite 4's spelling verification feature, and all errors contained within the error detection instruments were considered in the analysis process.

Discussed in Section Six is the relationship between hardcopy and softcopy error detection environments by quantity of errors detected and by types of errors detected. Errors detected by DisplayWrite 4's spelling verification feature were eliminated from the analysis process. Therefore, only errors not detected by DisplayWrite 4's spelling verification feature were considered in the analysis process.

PARTICIPANTS' CHARACTERISTICS

One week prior to the administration of the pretest instrument, participants completed a questionnaire requesting demographic information. Demographic data presented in this section include the number of participants by age, race, educational level, employment status, and microcomputer ownership. The following subsections describe each of the characteristics.

Number of Participants

A total of 72 individuals enrolled in four word processing classes participated in the error detection procedure during October, 1988. All 72 subjects completed the demographic questionnaire, the pretest instrument, and one of four error detection instruments.

Age

Table 1 contains information concerning the age of the participants. A majority of the subjects participating in the study, approximately 62%, were in the 18-25 age category. Approximately 20% of the participants were between the ages of 26 and 35, and 18% of the participants were over the age of 35.

Race

Data concerning the race of the participants are presented in Table 1. Sixty-seven of 72 participants were white. Three subjects were black, one subject was Hispanic, and one subject was Asian.

Table 1

Participants Background Information Summary

Category	Frequency	Percent
Age		
18-25	45	62.5
26-35	14	19.4
36-45	10	13.9
46-55	3	4.2
Race		
White	67	93.1
Black	3	4.2
Hispanic	1	1.4
Asian	1	1.4
Education		
High School	64	88.8
GED	5	6.9
Diploma	59	81.9
College	8	11.1
Associate	6	8.3
Bachelor	2	2.8
Employment Status		
Unemployed	27	37.5
Part time	27	37.5
Full time	18	25.0

N = 72.

Education

Information in Table 1 describes the educational background of the individuals participating in the study. A majority had earned a high school diploma or its equivalent--a General Education Development (GED) certificate. Fifty-nine of the 72 had graduated from high school, while five earned a GED. Two had graduated from a four-year university, and six had earned an associate's degree from a junior college or a community college.

Employment Status

Participants were questioned concerning employment status--full time, part time, or not employed at the time of the study. Information in Table 1 indicates 25% of the subjects worked full time while attending Wilkes Community College; 37.5% of the participants worked part time while attending Wilkes Community College, and another 37.5% of the participants were unemployed. A majority of participants were employed while attending classes at Wilkes Community College.

Home Microcomputer

Participants were questioned regarding the ownership of microcomputers and home microcomputer applications. Table 2 contains frequencies and percentages of microcomputer ownership by type of video display terminal--color or monochrome. Microcomputers were not owned by a majority of the participants. Color video display terminals were owned by approximately 17% of the participants, and monochrome video display terminals had been purchased by approximately 9% of participants

Table 2

Participant Microcomputer Ownership Information

Category	Frequency
Ownership by VDT Color	
Color	12
Monochrome	6
Not Applicable	54
Ownership by Application	
Word Processing	9
Fun-games, etc.	7
Spreadsheeting	2
Data Base	2

N = 72.

in the study. Home microcomputer applications used by participants were varied; however, the primary home microcomputer application was word processing. The second highest home application purchased by participants was games. Microcomputer applications owned by participants are indicated in Table 2.

EXCLUDED ERRORS

Items marked as errors by participants that were not errors as operationally defined for the purpose of this study were noted on the score sheet by the researcher and excluded from the analysis of data. The number of items marked that were not errors was minimal. Table 3 contains both the range and mean number of items incorrectly indicated as errors by participants. The mean number of items incorrectly identified as errors was 2.758 for Block One and 1.034 for Block Two.

ERROR DETECTION ACCURACY

Mean scores for the number of errors accurately detected by participants were calculated by error detection environment for both blocks of data analysis. Table 4 contains the range of scores, the mean scores, and the percent of accurately detected errors for the total number of errors correctly detected. The accuracy of error detection was 66% for Block One analysis and 56% for Block Two analysis.

Table 3

Range of Items and Mean Scores for Items Incorrectly Identified as Errors by Error Detection Environment

Error Detection Environment	Range of Items Incorrectly Identified	Mean Items Incorrectly Identified
Block One		
Hardcopy	0-4	2.897
Softcopy	2-6	2.342
Total	0-6	2.758
Block Two		
Hardcopy	0-1	.998
Softcopy	2-3	1.543
Total	0-3	1.034

Table 4

Range of Scores, Mean Scores, and Percent Accurate by Error Detection Environment for Total Errors Detected

Error Detection Environment	Range of Scores	Mean Accurate Score	Percent Accurate
Block One			
Hardcopy	11-24	15.39	69.16
Softcopy	5-25	14.33	64.42
Total	5-25	14.59	65.60
Block Two			
Hardcopy	4-14	9.00	75.00
Softcopy	0-14	6.02	50.13
Total	0-14	6.76	56.37

PRETEST

Mean scores for the pretest number of errors accurately detected by participants were calculated by error detection environment for both blocks of data analysis. Table 5 contains the mean and standard deviation for total errors accurately detected on the pretest instrument by error detection environment. The total number of errors accurately detected by error detection environment ranged from 13.85 to 14.78 for Block One. Block Two pretest means for total number of errors detected ranged 6.07 to 6.67.

Table 6 contains the mean and standard deviation for total errors accurately detected on the pretest instrument by softcopy environment configurations. The means for softcopy environment configurations ranged from 13.78 to 14.00 for Block One and from 5.83 to 6.39 for Block Two.

QUANTITY AND TYPES OF ERRORS CORRECTLY DETECTED BY PARTICIPANTS WITHOUT USING DISPLAYWRITE 4'S SPELLING VERIFICATION FEATURE (Block One)

In this section, data collected from the error detection process were used to analyze participants' abilities to detect errors without allowing them to use DisplayWrite 4's spelling verification feature. Four hypotheses were investigated concerning the quantity of errors detected and the types of errors detected from different error detection environments. A discussion of each tested hypothesis follows.

Table 5

Pretest Error Detection Environment Means and Standard Deviations for Total Errors Detected

Environment	N	Mean	Standard Deviation
Block One			
Hardcopy	18	14.77778	3.606458
Softcopy	54	13.85185	3.798746
Block Two			
Hardcopy	18	6.666667	1.714986
Softcopy	54	6.074074	1.960476

Table 6

Pretest Softcopy Configuration Error Detection Means and Standard Deviations for Total Errors Detected

Softcopy Configuration	N	Mean	Standard Deviation
Block One			
Dark Blue/ Light Blue	18	14.00000	3.865382
Black/White	18	13.77778	3.352884
Green/Black	18	13.77778	4.332579
Block Two			
Dark Blue/ Light Blue	18	6.388889	2.033221
Black/White	18	5.833334	1.723539
Green/Black	18	6.000000	2.169305

Covariate Selection. A basic assumption for an analysis of covariance is the assumption of linearity. To test for this assumption of linearity, a Pearson product-moment correlation coefficient was computed. A comparison of the total number of errors detected from the pretest and the error detection instruments yielded a Pearson product-moment correlation of $r = .4279$. The correlation coefficient explained 18.31% of the variance in the total number of errors detected between the pretest instrument and the four error detection instruments. The covariate, either the pretest total number of errors detected or the pretest number of errors detected for each type of error was significant at an alpha level of .05 for all analyses of covariance conducted.

Hypothesis One

Hypothesis One compares the quantity of total errors detected by error detection environment--hardcopy or softcopy. The null hypothesis, "a significant difference will not exist in the number of errors detected when proofreading hardcopy or softcopy documents," was analyzed using an analysis of covariance (ANCOVA) with the pretest total number of errors detected used as the covariate.

Presented in Table 7 are the means and standard deviations for the total number of errors correctly detected by participants for each error detection environment. The mean for the hardcopy error detection environment was higher than the mean for the softcopy error detection environment.

Table 7

Block 1: Error Detection Environment Means and Standard Deviations for Total Errors Detected

Environment	N	Mean	Standard Deviation
Hardcopy	18	15.38889	4.06041
Softcopy	54	14.33333	4.55159

An analysis of covariance (ANCOVA) with the pretest total number of errors detected used as the covariate was used to analyze whether a significant difference existed between error detection environments--hardcopy and softcopy. Table 8 displays the source table for the analysis of covariance (ANCOVA). The difference between the two error detection environment means was minimal and was not significant.

Summary. Significant differences were not identified for error detection environments--hardcopy and softcopy--and the total numbers of errors detected. Therefore, Hypothesis One, "a significant difference will not exist in the number of errors detected when proofreading hardcopy or softcopy documents," was not rejected.

Hypothesis Two

The question addressed in this subsection concerns the type of errors correctly detected when detecting errors from different error detection environments. The null hypothesis, "a significant difference will not exist in the type of mechanical errors detected when proof-reading hardcopy or softcopy documents," was tested.

An analysis of covariance (ANCOVA) with the pretest number of errors detected for each type of error used as the covariate was used to analyze whether significant differences existed between each type of error and error detection environments--hardcopy and softcopy. Table 9 contains the derived F-values by type of error. A significant F-value of 29.31 with a probability of significance at .0000 was calculated for

Table 8

Block 1: Analysis of Covariance Outcome for Total Errors Detected by Error Detection Environment

Source	df	Sum of Squares	Mean Square	F Value	P>F
Pretest	1	244.7438	244.7438	14.90	.0003
Error Detection Environment	1	4.7116	4.7116	.29	.5940
Error	69	1,133.5340	16.4280		
Total	71	1,393.319			

Table 9

Block 1: ANCOVA Outcomes for Types of Errors Detected

Type of Error	df[a]	F Value	P>F	N	Mean	Standard Deviation
Extra Letters	1	0.16	.6946			
Hardcopy				18	1.500	.51449
Softcopy				54	1.333	.80094
Total Incorrect Letters	1	29.31	.0000*			
Hardcopy				18	1.722	.95828
Softcopy				54	3.000	.82416
Incorrect Punctuation	1	2.17	.1451			
Hardcopy				18	1.833	.70711
Softcopy				54	1.537	.74151
Incorrect Spacing	1	.00	.9684			
Hardcopy				18	1.000	.48507
Softcopy				54	1.000	.72684
Omitted Letters	1	.68	.4125			
Hardcopy				18	1.444	.70479
Softcopy				54	1.500	.92655
Transpositions	1	.81	.3714			
Hardcopy				18	1.500	.85749
Softcopy				54	1.741	1.03131

[a]degrees of freedom for pretest = 1, for error = 69, for total = 71

*$p < .05$.

the incorrect letter type of error according to error detection environment. A significant difference existed between the error detection environments--hardcopy and softcopy--for a particular type of error. Participants detected more incorrect letter type of errors when reading from a softcopy error detection environment than a hardcopy error detection environment.

Table 10 contains the analysis of covariance (ANCOVA) for the subcategories defined for the incorrect letter type of error. The pretest score for each type of incorrect letter error was used as the covariate. A significant F-value did not exist for any of the subcategories of the incorrect letter type of error.

<u>Summary</u>. An analysis of covariance (ANCOVA) with the pretest number of errors detected for each type of error used as the covariate identified a significant difference for the types of errors detected and error detection environment--hardcopy and softcopy. The incorrect letter type of error yielded a significant F-value of 29.31 with a probability of significance at .0000. Participants detected more incorrect letter type of errors when reading from a video display terminal than a hardcopy document. None of the four types of incorrect letter errors yielded a significant difference. Therefore, Hypothesis Two, "a significant difference will not exist in the type of mechanical errors detected when proofreading hardcopy or softcopy documents," was rejected.

Table 10

Block 1: ANCOVA Outcomes for Incorrect Letter Type of Error Subcategories

Type of Error	df[a]	F Value	P>F	N	Mean	Standard Deviation
Shift	1	1.25	.2674			
Hardcopy				18	8.111	3.12276
Softcopy				54	7.111	3.26599
Phonetic	1	.68	.4120			
Hardcopy				18	2.389	2.30444
Softcopy				54	1.981	2.03267
Word Choice	1	.94	.3365			
Hardcopy				18	2.167	.78591
Softcopy				54	1.907	1.16988
Misstroke	1	.03	.8578			
Hardcopy				18	1.833	1.33945
Softcopy				54	1.574	1.10917

[a]degrees of freedom for pretest = 1, for error = 69, for total = 71

Hypothesis Three

Hypothesis Three examined the relationship among three softcopy error detection environments and the quantity of errors correctly detected within the three softcopy error detection environment configurations. The null hypothesis, "a significant difference will not exist in the number of errors detected when proofreading text from a color (dark blue foreground and light blue background) video display terminal, a green on black video display terminal, or a black on white video display terminal," was tested.

Table 11 displays the means and standard deviations for the total number of errors detected by each softcopy error detection environment configuration. The green characters on a black background softcopy error detection environment configuration mean was higher than either of the two other softcopy error detection environment configurations--dark blue characters on a light blue background or black characters on a white background.

An analysis of covariance (ANCOVA) with the pretest total errors detected used as the covariate examined the relationship between the three softcopy error detection environment configurations. Fifty-four of the 72 participants in the study detected errors in one of the three softcopy error detection environment configurations. Table 12 contains the F-values derived from the ANCOVA. A significant F-value was not found for the error detection environment configurations.

Summary. Significant differences were not identified among the three softcopy error detection environment configurations and the total

Table 11

Block 1: Softcopy Configuration Error Detection Means and Standard Deviations for Total Errors Detected

Softcopy Environment Configuration	N	Mean	Standard Deviation
Dark Blue/Light Blue	18	13.1667	5.5967
Black/White	18	14.8333	3.3999
Green/Black	18	15.0000	4.4192

Table 12

Block 1: Analysis of Covariance Outcome for Total Softcopy Errors Detected by Softcopy Error Detection Environment Configurations

Source	df	Sum of Squares	Mean Square	F Value	P>F
Pretest	1	214.983	214.983	12.71	.0008
Softcopy Error Detection Environment	2	42.085	21.042	1.24	.2971
Error	50	846.017	16.920		
Total	53	1,098			

number of errors detected. Therefore, Hypothesis Three, "a significant difference will not exist in the number of errors detected when proofreading text from a color (dark blue foreground and light blue background) video display terminal, a green on black video display terminal, or a black on white video display terminal," was not rejected.

Hypothesis Four

The null hypothesis, "a significant difference will not exist in the type of mechanical errors detected when proofreading text from a color (dark blue foreground and light blue background) video display terminal, a green on black video display terminal, or a black on white video display terminal," examined the relationship between the color configuration of the video display terminal and types of errors detected.

Table 13 contains the F-values derived from an analysis of covariance (ANCOVA) with the pretest number of errors correctly detected for each type of error used as the covariate to analyze the relationship between softcopy error detection environment configurations and type of errors correctly detected. A significant F-value of 4.00 with a probability of significance at .0244 was calculated for the extra letter type of error and softcopy error detection environment configurations. Therefore, a significant difference existed among the softcopy error detection environment configurations for one type of mechanical error.

To ascertain which softcopy error detection environment configuration caused the significant difference for the extra letter type of error, Duncan's New Multiple Range Test was used. Table 14 contains the

Table 13

Block 1: ANCOVA Outcomes for Types of Errors Detected

Type of Error	df[a]	F Value	P>F	N	Mean	Standard Deviation
Extra Letters	2	4.00	.0244*			
Dark Blue/ Light Blue				18	1.111	.75839
Black/White				18	1.722	.75190
Green/Black				18	1.167	.78591
Total Incorrect Letters	2	.55	.5783			
Dark Blue/ Light Blue				18	1.611	.97852
Black/White				18	1.833	.92355
Green/Black				18	1.444	.98352
Incorrect Punctuation	2	.07	.9287			
Dark Blue/ Light Blue				18	1.500	.61835
Black/White				18	1.556	.61569
Green/Black				18	1.556	.98352
Incorrect Spacing	2	.75	.4766			
Dark Blue/				18		
Light Blue				18	.833	.61835
Black/White				18	1.111	.75839
Green/Black					1.056	.80237
Omitted Letters	2	.14	.8719			
Dark Blue/ Light Blue				18	1.500	.92355
Black/White				18	1.556	.78382
Green/Black				18	1.444	1.09664
Transpositions	2	1.54	.2244			
Dark Blue/ Light Blue				18	1.500	.98518
Black/White				18	2.056	.93759
Green/Black				18	1.667	1.13759

[a]degrees of freedom for pretest = 1, for error = 50, for total = 53

*$p < .05$.

Table 14

Block 1: Duncan's New Multiple Range Test For Extra Letter Type of Error by Softcopy Error Detection Environment Configurations

1.11	1.72
AB..	C
XX..	

Note: A = Dark Blue/Light Blue

B = Green/Black

C = Black/White

X = Softcopy environment configuration mean

. = Significant difference between means analysis indicating the mean for the extra letters type of error was significantly different when reading from a black on white video display terminal than any of the other two softcopy error detection environment configurations. Participants detected more extra letter type of errors when reading from a video display terminal with black characters on a white background than when reading from a video display terminal with either dark blue characters on a light blue background or green characters on a black background.

Table 15 contains the analysis of covariance (ANCOVA) for the subcategories defined for the incorrect letter type of error. The pretest score for each type of incorrect letter errors was used as the covariate. A significant F-value did not exist for any of the subcategories.

Summary. An analysis of covariance (ANCOVA) with the pretest number of errors detected for each type of error detected identified a significant difference for softcopy error detection environment configurations and the types of errors detected. The extra letter type of error yielded a significant F-value of 4.00 with a probability of significance at .0244. Duncan's New Multiple Range Test revealed more extra letter type of errors were detected by participants when reading from a video display terminal with black characters on a white background than when reading from a video display terminal with either dark blue characters on a light blue background or green characters on a black background. None of the four types of incorrect letter errors yielded a significant difference. Therefore, Hypothesis Four, "a significant difference will not exist in the type of mechanical errors detected when proofreading text from a color (dark blue

Table 15

Block 1: ANCOVA Outcomes for Incorrect Letter Type of Error Subcategories

Type of Error	df[a]	F Value	P>F	N	Mean	Standard Deviation
Shift	2	.29	.7484			
Dark Blue/ Light Blue				18	6.722	3.99714
Black/White				18	7.111	3.21993
Green/Black				18	7.500	3.46834
Phonetic	2	.95	.3921			
Dark Blue/ Light Blue				18	1.778	2.26367
Black/White				18	1.667	1.53393
Green/Black				18	2.500	2.22948
Word Choice	2	.02	.9850			
Dark Blue/ Light Blue				18	1.833	1.15045
Black/White				18	1.944	1.34917
Green/Black				18	1.944	1.05564
Misstroke	2	.16	.8524			
Dark Blue/ Light Blue				18	1.500	1.20049
Black/White				18	1.611	1.09216
Green/Black				18	1.611	1.09216

[a]degrees of freedom for pretest = 1, for error = 50, for total = 53

foreground and light blue background) video display terminal, a green on black video display terminal, or a black on white video display terminal," was rejected.

QUANTITY AND TYPES OF ERRORS CORRECTLY DETECTED BY PARTICIPANTS AFTER ELIMINATING ERRORS DETECTED BY DISPLAYWRITE 4'S SPELLING VERIFICATION FEATURE (Block Two)

The design of the study did not allow subjects to use DisplayWrite 4's spelling verification feature. Block Two was used to analyze the errors that would have been detected by participants after eliminating the errors from the analysis process that DisplayWrite 4's spelling verification feature would detect. Errors not detectable by DisplayWrite 4's spelling verification feature were the source of data for analysis in this section. Two types of errors were eliminated from the data analysis in Block Two. DisplayWrite 4's spelling verification feature could detect all extra letter and transposition type of errors contained within the error detection instruments. Misstroke, an incorrect letter type of error subcategory, was also eliminated from Block Two analysis. DisplayWrite 4's spelling verification feature could detect all misstroke type of errors within the error detection instruments. Four hypotheses were examined concerning the quantity of errors detected and the types of errors detected from different error detection environments. A discussion of each tested hypothesis follows.

Covariate Selection. A basic assumption for an analysis of covariance is the assumption of linearity. To test for this assumption of linearity, a Pearson product-moment correlation coefficient was computed. A comparison of the total number of errors detected from the pretest instrument and the four error detection instruments yielded a Pearson product-moment correlation of $r = .3156$. The correlation coefficient explained 9.96% of the variance in the total number of errors detected between the pretest instrument and the four error detection instruments. The covariate, either the pretest total number of errors detected or the pretest number of errors detected for each type of error by environment was significant at an alpha level of .05 for all analyses of covariance conducted.

Hypothesis One

A comparison of the errors not detected by participants after eliminating errors detected by DisplayWrite 4's spelling verification feature was completed to examine the null hypothesis, "a significant difference will not exist in the number of errors detected when proofreading hardcopy or softcopy documents." An analysis of covariance (ANCOVA) with the pretest total number of errors detected used as the covariate tested the null hypothesis.

Table 16 displays the means and standard deviations for the total number of errors detected by participants after eliminating errors capable of being detected by DisplayWrite 4's spelling verification feature by error detection environment. The mean for the hardcopy error

Table 16

Block 2: Error Detection Environment Means and Standard Deviations for Total Errors Detected

Environment	N	Mean	Standard Deviation
Hardcopy	18	9.0000	3.0486
Softcopy	54	6.0185	3.5046

detection environment was greater than the mean for the softcopy error detection environment.

An analysis of covariance (ANCOVA) with the pretest total number of errors detected used as the covariate examined the data collected to determine whether significant differences existed between error detection environments--hardcopy and softcopy. Table 17 displays the source table for the analysis of covariance (ANCOVA). A significant F-value of 8.81 with a probability of significance at .0041 was derived for the total number of errors detected and error detection environment. Therefore, a significant difference existed between the total number of errors detected and the error detection environment. The hardcopy error detection environment mean was 9.000, and the softcopy error detection environment mean was 6.0165. Therefore, the total number of errors detected by participants was greater when reading from a hardcopy error detection environment.

<u>Summary</u>. An analysis of covariance (ANCOVA) with the pretest total number of errors detected being used as the covariate yielded a significant difference between the error detection environments--hardcopy versus softcopy. A significant F-value of 8.81 with a probability of significance at .0041 was derived for total errors detected and the error detection environment. Participants detected more errors when reading from a hardcopy instrument than when reading from a video display terminal. Therefore, Hypothesis One, "a significant difference

Table 17

Block 2: Analysis of Covariance Outcome for Total Errors Detected by Error Detection Environment

Source	df	Sum of Squares	Mean Square	F Value	P>F
Pretest	1	76.0746	76.0746	7.16	.0093
Error Detection Environment	1	93.5558	93.5558	8.81	.0041*
Error	69	732.9069	10.6218		
Total	71	928.9861			

*$p < .05$.

will not exist in the number of errors detected when proofreading hardcopy or softcopy documents," was rejected.

Hypothesis Two

The question examined by hypothesis two concerns the types of errors correctly detected when detecting errors from different error detection environments--hardcopy or softcopy. The null hypothesis, "a significant difference will not exist in the type of mechanical errors detected when proofreading hardcopy or softcopy documents," was tested.

Table 18 contains the F-values derived from an analysis of covariance (ANCOVA) with the pretest number of errors detected for each type of error used as the covariate. The relationship between the types of errors correctly detected and the error detection environment--hardcopy or softcopy--was examined. Three types of errors yielded significant F-values for the error detection environment: incorrect letter, a F-value of 5.74 with a probability of significance at .0193; incorrect punctuation, a F-value of 6.73 with a probability of significance at .0116; and incorrect spacing, a F-value of 8.42 with a probability of significance at .0050. Therefore, a significant difference existed between the error detection environment--hardcopy or soft-copy--and the types of errors detected. The means for the hardcopy error detection environment were significantly higher than the means of the softcopy error detection environment for incorrect letter, incorrect punctuation, and incorrect spacing types of errors. Participants detected more incorrect letter, incorrect punctuation, and incorrect spacing types of

Table 18

Block 2: ANCOVA Outcomes for Types of Errors Detected

Type of Error	df[a]	F Value	P>F	N	Mean	Standard Deviation
Total Incorrect Letters	1	5.74	.0193*			
Hardcopy				18	9.278	4.87256
Softcopy				54	5.926	4.40348
Incorrect Punctuation	1	6.73	.0116*			
Hardcopy				18	1.778	.64676
Softcopy				54	1.148	.95971
Incorrect Spacing	1	8.42	.0050*			
Hardcopy				18	.667	.48507
Softcopy				54	.296	.46091
Omitted Letters	1	.00	.9828			
Hardcopy				18	.555	.78382
Softcopy				54	.629	1.0149

[a]degrees of freedom for pretest = 1, for error = 69, for total = 71

*$p < .05$.

errors when reading from a hardcopy document than a video display terminal.

Table 19 contains the analysis of covariance (ANCOVA) for the subcategories defined for the incorrect letter type of error. The pretest score for each type of incorrect letter was used as the covariate. A significant F-value of 7.02 with a probability of significance at .0100 was calculated for the shift type of incorrect letter error. The mean for the hardcopy error detection environment was significantly different from the softcopy error detection environment mean. Participants detected more shift type of incorrect letter errors when reading from a hardcopy document than a video display terminal.

Summary. An analysis of covariance (ANCOVA) with the pretest number of errors detected for each type of error used as the covariate identified significant differences for three types of errors operationally defined for this study and one subcategory of incorrect letter type of error. Incorrect letter (F-value of 5.74 with a probability of significance at .0193), incorrect punctuation (F-value of 6.73 with a probability of significance at .0116), and incorrect spacing (F-value of 8.42 with a probability of significance at .0050) were the types of mechanical errors yielding significant F-values at an a priori alpha level of .05. Shift, an incorrect letter type of error, yielded a F-Value of 7.02 with a probability of significance at .0100. At the .05 level of significance; more incorrect letter, incorrect punctuation, and incorrect spacing and shift incorrect letter types of errors were detected

Table 19

Block 2: ANCOVA Outcomes for Incorrect Letter Type of Error Subcategories

Type of Error	df[a]	F Value	P>F	N	Mean	Standard Deviation
Shift	1	7.02	.0100*			
Hardcopy				18	4.944	2.38802
Softcopy				54	3.185	2.20697
Phonetic	1	2.90	.0928			
Hardcopy				18	2.167	2.25571
Softcopy				54	1.333	1.73748
Word Choice	1	2.21	.1417			
Hardcopy				18	2.167	1.42457
Softcopy				54	1.389	1.18826

[a]degrees of freedom for pretest = 1, for error = 69, for total = 71

*$p < .05$.

when reading from a hardcopy error detection environment. Therefore, Hypothesis Two, "a significant difference will not exist in the type of mechanical errors detected when proofreading hardcopy or softcopy documents," was rejected.

Hypothesis Three

Hypothesis Three examined the relationship among the three softcopy error detection environments. The null hypothesis, "a significant difference will not exist in the number of errors detected when proofreading text from a color (dark blue foreground and light blue background) video display terminal, a green on black video display terminal, or a black on white video display terminal," was tested.

The means and standard deviations for the total number of errors detected by softcopy error detection environment configurations are shown in Table 20. The green characters on a black background mean was greater than either of the other two softcopy error detection environment configurations--dark blue characters on a light blue background or black characters on a white background.

An analysis of covariance (ANCOVA) with the pretest total errors detected being used as the covariate examined the relationship between the three softcopy error detection environment configurations. Fifty-four of the 72 subjects in the study detected errors in one of three softcopy error detection environment configurations. Table 21 contains the F-values derived from the analysis of covariance (ANCOVA). A

Table 20

Block 2: Softcopy Configuration Error Detection Means and Standard Deviations for Total Errors Detected

Softcopy Configuration	N	Mean	Standard Deviation
Dark Blue/Light Blue	18	6.2222	3.7971
Black/White	18	5.4444	2.9748
Green/Black	18	6.3889	3.8062

Table 21

Block 2: Analysis of Covariance Outcome for Total Softcopy Errors Detected by Softcopy Error Detection Environment Configurations

Source	df	Sum of Squares	Mean Square	F Value	P>F
Pretest	1	62.2294	62.2294	5.37	.0246
Softcopy Error Detection Environment	2	6.5384	3.2692	.28	.7555
Error	40	579.6040	11.5921		
Total	53	650.9815			

significant F-value was not found for the error detection environment configurations.

Summary. Significant differences were not identified for softcopy error environment configurations and the total numbers of errors detected. Therefore, Hypothesis Three, "a significant difference will not exist in the number of errors detected when proofreading text from a color (dark blue foreground and light blue background) video display terminal, a green on black video display terminal, or a black on white video display terminal," was not rejected.

Hypothesis Four

The null hypothesis, "a significant difference will not exist in the type of mechanical errors detected when proofreading text from a color (dark blue foreground and light blue background) video display terminal, a green on black video display terminal, or a black on white video display terminal," examined the relationship between the color configuration of the video display terminal and types of errors detected.

Table 22 contains the F-values derived from an analysis of covariance (ANCOVA) with the pretest number of errors correctly detected for each type of error used as the covariate when examining the relationship between softcopy error detection environment configurations and the type of errors correctly detected. A significant F-value was not calculated for any of the four types of errors.

Table 22

Block 2: ANCOVA Outcomes for Types of Errors Detected

Type of Error	df^a	F Value	P>F	N	Mean	Standard Deviation
Total Incorrect Letters	2	.12	.8838			
Dark Blue/ Light Blue				18	6.111	5.20055
Black/White				18	5.555	3.46787
Green/Black				18	6.111	4.63857
Incorrect Punctuation	2	1.26	.2927			
Dark Blue/ Light Blue				18	1.000	.84016
Black/White				18	1.000	.84016
Green/Black				18	1.444	1.14902
Incorrect Spacing	2	.47	.4766			
Dark Blue/ Light Blue				18	.222	.42779
Black/White				18	.389	.50163
Green/Black				18	.278	.46088
Omitted Letters	2	.73	.4853			
Dark Blue/ Light Blue				18	.778	1.06028
Black/White				18	.389	.77754
Green/Black				18	.722	1.17851

[a]degrees of freedom for pretest = 1, for error = 50, for total = 53

Table 23 contains the analysis of covariance (ANCOVA) for the subcategories defined for the incorrect letter type of error. The pretest score for each type of incorrect letter error was used as the covariate. A significant F-value did not exist for any of the subcategories and softcopy error detection environment configurations.

Summary. An analysis of covariance (ANCOVA) with the pretest number of errors correctly detected for each type of error used as the covariate did not identify significant differences for softcopy error detection environment configurations and the types of errors detected. Therefore, Hypothesis Four, "a significant difference will not exist in the type of mechanical errors detected when proofreading text from a color (dark blue foreground and light blue background) video display terminal, a green on black video display terminal, or a black on white video display terminal," was not rejected.

SUMMARY OF DATA ANALYSIS

Seventy-two students enrolled in four word processing classes at Wilkes Community College participated in the error detection procedures during the 1988 Fall Quarter. Subjects completed a questionnaire, a pretest instrument, and one of four error detection instruments. The questionnaire was designed to collect demographic information about the participants. Error detection instrument means were adjusted to take into account the initial difference between the pretest means through an analysis of covariance. Participants detected errors on one of four instruments on the day of the study.

Table 23

Block 2: ANCOVA Outcomes for Incorrect Letter Type of Error Subcategories

Type of Error	df[a]	F Value	P>F	N	Mean	Standard Deviation
Shift	2	.24	.7849			
Dark Blue/ Light Blue				18	3.389	2.56994
Black/White				18	2.889	1.74521
Green/Black				18	3.278	2.32139
Phonetic	2	.36	.3921			
Dark Blue/ Light Blue				18	1.167	1.94785
Black/White				18	1.167	1.33945
Green/Black				18	1.556	1.94701
Word Choice	2	.02	.9759			
Dark Blue/ Light Blue				18	1.444	1.24722
Black/White				18	1.444	1.19913
Green/Black				18	1.278	1.17851

[a]degrees of freedom for pretest = 1, for error = 50, for total = 53

Number Cruncher, a microcomputer statistical analysis system, was used to analyze the collected data. Demographic information was tabulated by selected variables--age, race, educational background, employment status, and microcomputer ownership--for presentation. An analysis of covariance (ANCOVA) with the pretest total number of errors detected used as the covariate was used to analyze the relationship between the total number of errors detected and error detection environment and between the total number of errors detected and softcopy error detection environment configurations. A second analysis of covariance (ANCOVA) with the pretest number of errors correctly detected for each type of error used as the covariate was performed to examine the relationship between the types of errors detected and error detection environments. Another analysis of covariance with the pretest number of errors correctly detected for each type of error used as the covariate analyzed the relationship between the total number of errors detected and softcopy error detection environment configurations.

Participants in the study were not allowed to use DisplayWrite 4's spelling verification feature during the error detection procedure. However, the data collected from the error detection procedure was analyzed by the researcher in two blocks. Block One was used to evaluate the errors detected by participants without using DisplayWrite 4's spelling verification feature. Block Two was used to analyze the collected data after eliminating errors that could be detected by DisplayWrite 4's spelling verification from the analysis process. The analysis of data are reviewed in six subsections: (1) Demographics, (2) Accuracy, (3) Excluded Errors, (4) Pretest, (5) Block One, and (6) Block Two.

Demographics

Of the 72 participants; 45 were between the ages of 18 and 25, 14 were between the ages of 26 and 35, 10 were between the ages of 36 and 45, and 3 were over the age of 45. Ninety-three percent of the subjects were white, 4% were black, and approximately 3% were Hispanic and Asian.

A majority of the participants were employed while attending classes at Wilkes Community College. Twenty-five percent of the subjects were employed full-time. However, 37.5% of the participants were employed part time while attending college; and another 37.5% of the subjects were not employed.

Microcomputers had been purchased by a minority of the participants--approximately 25% of the subjects owned microcomputers. A majority of participants who owned a microcomputer had purchased a color video display terminal. Two major microcomputer applications--word processing and games--were frequently used by these participants.

Accuracy

Mean scores for the total number of errors correctly detected by participants were computed by error detection environment. Errors contained within the error detection instruments ranged from 18 to 27 for Block One analysis. For Block Two analysis, errors contained within the error detection instruments ranged from 9 to 15. The mean number of correctly detected errors for total errors detected ranged from 14.33 to

15.39 for Block One analysis and from 6.02 to 9.00 for Block Two analysis. The average percentage of accurately detected errors was 66% for Block One and 56% for Block Two.

Exclusions

Mean scores for the items incorrectly identified by participants were computed by error detection environment. Items incorrectly identified as errors ranged from 0 to 6 for Block One analysis. For Block Two analysis, items incorrectly marked as errors ranged from 0 to 3. The mean score for items incorrectly indicated as errors by participants ranged from 2.342 to 2.897 for Block One analysis and from .998 to 1.543 for Block Two analysis.

Pretest

Mean scores for the pretest total number of errors correctly detected by participants were calculated by error detection environment. The pretest error detection instrument contained 22 errors for Block One analysis and 11 errors for Block Two analysis. The mean score for errors correctly detected by participants on the the pretest ranged from 14.33 to 15.39 for Block One analysis and from 6.02 to 9.00 for Block Two analysis.

Block One

Block One data from the error detection process was used to analyze participants ability to detect errors without permitting them to use DisplayWrite 4's spelling verification feature. F-values from an analysis of covariance (ANCOVA) with the pretest total number of errors detected used as the covariate did not yield a significant difference between the total number of errors detected and the error detection environment--hardcopy and softcopy. However, another analysis of covariance (ANCOVA) with the pretest number of errors correctly detected for each type of error used as the covariate did reveal a significant difference between the types of errors detected and the error detection environment--hardcopy or softcopy. A significant F-value was derived for only the incorrect letter type of error. More incorrect letter type of errors were detected by participants when reading from a softcopy error detection environment. Another analysis of covariance (ANCOVA) with the pretest total number of errors detected used as the covariate did not yield a significant difference between the total number of errors detected and any of the three softcopy error detection environment configurations. However, a significant F-value from a fourth analysis of covariance (ANCOVA) with the pretest number of errors correctly detected for each type of error used as the covariate was derived for the extra letter type of error. More extra letter type of errors were detected by participants when reading from a video display terminal with black characters on a white background than a video display terminal with either dark blue characters on a light blue background or green characters on a black background.

Block Two

Participants were not allowed to use DisplayWrite 4's spelling verification feature during the error detection process. However, the data collected were analyzed after eliminating errors that could be detected by DisplayWrite 4's spelling verification feature from the analysis. F-values from an analysis of covariance (ANCOVA) with the pretest total number of errors detected used as the covariate did reveal a significant difference between the total number of errors detected and the error detection environment--hardcopy and softcopy. More errors were detected by participants when reading from a hardcopy error detection environment than a softcopy error detection environment. Another analysis of covariance (ANCOVA) with the pretest number of errors correctly detected for each type of error used as the covariate revealed a significant difference between the types of errors detected and the error detection environment. Significant F-values were derived for three types of errors operationally defined for this study: incorrect letter, incorrect punctuation, and incorrect spacing. More incorrect letter, incorrect punctuation, and incorrect spacing types of errors were detected by participants when reading from a hardcopy error detection environment. Shift, a type of incorrect letter error, yielded a significant F-value from an analysis of covariance (ANCOVA) with the pretest number of shift errors correctly detected used as the covariate. More shift type of incorrect letter errors were detected by participants when reading from a hardcopy error detection instrument. A fourth analysis of covariance (ANCOVA) with the pretest number of errors detected used as a covariate did not yield a significant difference between the total number of errors detected and any of the three softcopy error detection environment configurations. Another analysis of covariance (ANCOVA) with the pretest number of errors correctly detected for each type of error used as the covariate did not reveal a significant difference between the types of errors detected or the types of incorrect letter errors and any of the three softcopy error detection environment configurations.

Summary

Significant differences were identified in both blocks of data analysis. For Block Two, more differences were identified than for Block One; however, neither the hardcopy error detection environment nor any of the three softcopy error detection environment configurations consistently yielded a significant difference in either data analysis block.

CHAPTER FIVE

SUMMARY, FINDINGS, CONCLUSIONS, AND IMPLICATIONS

This study was conducted to explore the relationship between the environment used to detect errors and an operator's ability to accurately detect errors in keyboarded text. Specifically, the researcher investigated an operator's ability to accurately detect errors in keyboarded text presented in hardcopy or softcopy format. The researcher also examined the relationship between a video display terminal's color configuration and an operator's ability to detect errors.

SUMMARY

A metamorphosis from manual data manipulation to electronic information processing has occurred with the incorporation of the microcomputer into the office. Microcomputers and word processing software are replacing the typewriter as the predominant mode of preparing written business communication. Office personnel, who are information gatekeepers, often use microcomputers and related software to detect errors in keyboarded text. A spelling verification feature is a component of numerous word processing software packages; however, not all types of errors are detected by this feature. Typographical or keyboarding errors made in spelling a word which is not the word intended by the keyboardist may not be detected by the spelling verification feature of word processing software packages. Also, the spelling verification feature is not capable of analyzing correct word usage. Therefore, homonyms and certain typographical errors may create a problem if word processing operators depend totally upon word processing software's spelling verification feature to detect all errors in keyboarded text.

Procedure

Individuals enrolled in four Wilkes Community College word processing courses during the sixth week of the 1988 Fall Quarter represented the individuals participating in this study. A pretest was administered to the participants during the first week of October, 1988, with the error detection and indication process occurring during the second week of October, 1988. Participants read and detected errors in one of four error detection instruments presented in either a hardcopy or softcopy error detection environment. Three different video display terminal configurations were used for softcopy error detection. Participants were instructed to detect and mark or indicate errors; they were instructed not to correct any errors detected.

The pretest and the error detection instruments contained errors classified by the researcher into six categories: extra letter, incorrect letter, incorrect punctuation, incorrect spacing, omitted letter, and transposition. The incorrect letter type of error category was divided into four subcategories: shift, phonetic, word choice, and misstroke. Participants reading and detecting errors from a hardcopy document circled with a pencil any errors detected. When reading and detecting errors from a video display terminal, participants used DisplayWrite 4's overstrike feature to indicate or mark any errors detected. Errors marked by the participants were organized for analysis on a score sheet developed by the researcher.

Participants were not permitted to use DisplayWrite 4's spelling verification feature during the error detection process. However, data obtained from the error detection process were analyzed in two blocks. Block One evaluated the errors detected by participants without using DisplayWrite 4's spelling verification feature. However, Block Two analyses were completed as if DisplayWrite 4's spelling verification feature had been used by participants--errors that could be detected by DisplayWrite 4's spelling verification feature were eliminated from the error analysis score sheet and data analysis for Block Two. The data collected by the researcher were analyzed through an analysis of covariance (ANCOVA) using a counterbalanced design with pretest scores being used as covariates. The quantities of errors detected and the types of errors detected were compared to determine if significant differences existed when investigating the hypotheses stated in Chapter One at an a priori alpha level of .05. ANCOVAs were performed to compare the quantities of errors correctly detected by error detection environments and the types of errors correctly detected by error detection environments or softcopy error detection environment configurations. If significant differences were identified, the source of the significant difference was determined by the larger of the two error detection environment means or Duncan's New Multiple Range Test. Findings derived from the F-ratios and their related analyses follow.

FINDINGS

A description of the individuals participating in the study is presented in the first section of the findings. Since the data collected to test four hypotheses were analyzed in two blocks, the error detecting abilities of participants without using DisplayWrite 4's spelling verification feature are described in Block One. Participants were not allowed to use DisplayWrite 4's spelling verification feature; however, data for Block Two were analyzed after eliminating the errors DisplayWrite 4's spelling verification feature would detect.

Demographics

Forty-five of the 72 individuals participating in the study were between the ages of 18 and 25--approximately 63%. The remaining 37% were between the ages of 26 and 55. Sixty-seven participants were White, 3 were Black, 1 was Hispanic, and 1 was Asian. All participants were female. Twenty-five percent of the participants were employed full-time while attending Wilkes Community College. However, 37.5% percent of the participants were employed part-time while attending classes; and another 37.5% were not employed. Eight of the 72 participants had earned a college degree; 64 had earned only a high school diploma or its equivalent--a General Education Development certificate.

Eighteen participants owned a microcomputer. Twelve participants had a microcomputer equipped with a color video display terminal; six with a monochrome video display terminal. Word processing was the primary home microcomputer application used by a majority of these participants.

Block One

The error detection procedures for Block One did not allow the participants to use DisplayWrite 4's spelling verification feature during the error detection process, and the data were analyzed accordingly. Four null hypotheses were examined at the 0.05 level of significance using an analysis of covariance with either the pretest total number of errors detected used as the covariate or the pretest number of errors correctly detected for each type of error used as the covariate. If significant differences were derived, the source of the significant difference was determined by the larger of the two error detection environment means or Duncan's New Multiple Range Test. Each hypothesis is discussed separately. Table 24 contains a synopsis of the findings for Block One.

Hypothesis One. Hypothesis One, "a significant difference will not exist in the number of errors detected when proofreading hardcopy or softcopy documents," was not rejected. Significant differences were not identified by an analysis of covariance with the pretest total number of errors detected being used as the covariate for error detection environments--hardcopy or softcopy. The F-Ratio for the error detection

Table 24

Block One: Synopsis of Findings

Hypothesis	Significant	Not Significant
1. Total errors detected by error detection environment		X
2. Types of errors detected by error detection environment	X--Total incorrect letters; Softcopy	
3. Total errors detected by softcopy environment configurations		X
4. Types of errors detected by softcopy environment configurations	X--Extra letters; Black/White	

environment and the total number of errors detected was .29 with a probability of significance at .5940. Therefore, the error detection environment used to detect errors--hardcopy or softcopy--did not affect the total number of errors detected by the participants.

Hypothesis Two. Hypothesis Two, "A significant difference will not exist in the type of mechanical errors detected when proofreading hardcopy or softcopy documents," was rejected for one type of error. A significant F-value of 29.31 with a probability of significance at .0000 was calculated for the incorrect letter type of error. The softcopy error detection environment mean was greater than the hardcopy error detection environment mean. More incorrect letter type of errors were detected by participants when reading from a softcopy error detection environment. Therefore, participants detected an incorrectly keyboarded character more often when reading from a video display terminal than from hardcopy.

Hypothesis Three. Hypothesis Three, "a significant difference will not exist in the number of errors detected when proofreading text from a color (dark blue foreground and light blue background) video display terminal, a green on black video display terminal, or a black on white video display terminal," was not rejected. The derived F-ratio for the softcopy error detection environment configurations was 1.24 with a probability of significance at .2971. Therefore, the color configuration of the video display terminal did not relate to the total number of errors detected by participants.

Hypothesis Four. Hypothesis Four, "A significant difference will not exist in the type of mechanical errors detected when proofreading text from a color (dark blue foreground and light blue background) video display terminal, a green on black video display terminal, or a black on white video display terminal," was rejected for one type of error. A significant F-value of 4.00 with a probability of significance at .0244 was derived for the extra letter type of error. Duncan's New Multiple Range Test indicated more extra letter type of errors were detected by participants when reading from a video display terminal with black characters on a white background than a video display terminal with either dark blue characters on a light blue background or green characters on a black background. Therefore, the color configuration of the video display terminal did relate to the number of this type of error detected by participants.

Block Two

Participants were not allowed to use DisplayWrite 4's spelling verification feature during the error detection process. However, the data collected were analyzed in Block Two after eliminating errors capable of being detected by DisplayWrite 4's spelling verification feature from the analysis process. Two types of errors operationally defined for this study were eliminated from the data analysis in Block Two. DisplayWrite 4's spelling verification feature can detect all extra letter and transposition types of errors. Misstroke, an incorrect letter type of error, was also eliminated from the data analysis as

DisplayWrite 4's spelling verification feature can detect all misstroke type of errors. Four null hypotheses were examined at the 0.05 level of significance through an analysis of covariance with the pretest total number of errors detected used as the covariate or the pretest number of errors detected for each type of error used as the covariate. If significant differences were identified, the source of the significant difference was determined by the larger of the two error detection environment means or the use of Duncan's New Multiple Range Test. Each hypothesis tested is discussed separately. Table 25 contains a synopsis of the findings for Block Two.

Hypothesis One. Hypothesis One, "a significant difference will not exist in the number of errors detected when proofreading hardcopy or softcopy documents," was rejected. An analysis of covariance with the pretest total number of errors detected used as a covariate identified a significant difference between the error detection environment--hardcopy or softcopy--and the total number of errors detected. A F-ratio of 8.81 with a probability of significance at .0041 was calculated for the error detection environment. The hardcopy error detection environment mean was greater than the softcopy error detection environment mean; participants detected more errors when reading from a hardcopy document.

Hypothesis Two. Hypothesis Two, "a significant difference will not exist in the type of mechanical errors detected when proofreading hard copy or softcopy documents," was rejected for three types of errors. Significant F-values were derived for the following errors: incorrect letter, F-value of 5.74 with a probability of significance at .0193;

Table 25

Block Two: Synopsis of Findings

Hypothesis	Significant	Not Significant
1. Total errors detected by error detection environment	X; Hardcopy	
2. Types of errors detected by error detection environment	X--Total incorrect letters; Hardcopy X--Incorrect punctuation; Hardcopy X--Shift; Hardcopy	
3. Total errors detected by softcopy environment configurations		X
4. Types of errors detected by softcopy environment configurations		X

incorrect punctuation, F-value of 6.73 with a probability of significant at .0116; and incorrect spacing, F-value of 8.42 with a probability of significance at .0050. The hardcopy error detection environment mean was greater than the softcopy error detection environment mean for each of the three types of errors; participants detected more incorrect letter, incorrect punctuation, and incorrect spacing types of errors when reading from a hardcopy error detection environment. An analysis of covariance for each of the incorrect letter types of errors with the pretest number of errors detected for each type of incorrect letter error used as the covariate yielded a significant difference for one type of incorrect letter error. A significant F-value of 7.02 with a probability of significance at .0100 was derived for the shift type of incorrect letter error. The hardcopy error detection environment mean was greater than the softcopy error detection environment mean; participants detected more shift type of incorrect letter errors when reading from a hardcopy error detection environment. Therefore, more incorrect letter, incorrect punctuation, incorrect spacing types of errors and shift type of incorrect letter errors were detected by participants when reading from a hardcopy document.

Hypothesis Three. Hypothesis Three, "A significant difference will not exist in the number of errors detected when proofreading text from a color (dark blue foreground and light blue background) video display terminal, a green on black video display terminal, or a black on white video display terminal," was not rejected. The calculated F-ratio for softcopy error detection environment configurations and the total number of errors detected was .28 with a probability of significance at .7555. Therefore, the color configuration of the video display terminal did not relate to the total number of errors detected by participants.

Hypothesis Four. Hypothesis Four, "a significant difference will not exist in the type of mechanical errors detected when proofreading text from a color (dark blue foreground and light blue background) video display terminal, a green on black video display terminal, or a black on white video display terminal," was not rejected. An analysis of covariance with the pretest number of errors detected for each type of error used as the covariate did not identify any significant differences for any of the types of errors operationally defined for this study. Also, no significant differences were derived from an analysis of covariance with the pretest number of incorrect letter errors detected for each type of incorrect letter error used as the covariate for the incorrect letter type of errors. Therefore, the color configuration of the video display terminal did not affect the types of errors or incorrect letter type of errors detected by participants.

CONCLUSIONS

Conclusions derived for this study are based on data analyzed for both blocks of data analysis and on the four hypotheses tested.

1. Postsecondary word processing students have difficulty in finding errors in hardcopy and softcopy documents.

Postsecondary word processing students participating in this study demonstrated difficulty in detecting errors when reading from a hardcopy or softcopy error detection environment. Difficulty in detecting errors was also evident when participants read from different video display terminal configurations. Regardless of the error detection environment or the softcopy error detection environment configurations, participants consistently had difficulty in detecting all errors and all types of errors contained within the error detection instruments.

Errors contained within the error detection instruments ranged from 18 to 27 for Block One analysis. For Block Two analysis, errors contained within the error detection instruments ranged from 9 to 15. The mean number of correctly detected errors ranged from 14.33 to 15.39 for Block One analysis and from 6.02 to 9.00 for Block Two analysis. The average percentage of accurately detected errors was 56% for Block One and 66% for Block Two.

These accuracy levels are consistent with the findings of other researchers. Arnold (1986), for instance, reported third-semester high school typewriting students had difficulty in proofreading. They demonstrated an average accuracy level of 69.09% when proofreading various office documents in hardcopy format. A 31% to 72% accuracy range was reported by Staples (1971) for college keyboarding students and secretaries when proofreading from a hardcopy format.

2. Postsecondary word processing students' abilities to detect errors in keyboarded text were <u>not</u> affected by the error detection environment--hardcopy or softcopy--during a ten-minute error detection process. Therefore, the printing of a hardcopy of keyboarded text when detecting errors for a short time period is not necessary.

An error detection environment which is more conducive to detecting errors in keyboarded text was not identified from any of the statistical analyses of data. Regardless of the block of data analyzed or the type of error being compared, neither error detection environment--hardcopy or softcopy--nor softcopy environment configurations--dark blue characters on a light blue background, black characters on a white background, or green characters on a black background--was identified as the more effective environment for detecting errors in keyboarded text.

Data analysis procedures for Block Two eliminated from the analysis process errors that could be detected by DisplayWrite 4's spelling verification feature. Analysis of Covariance outcomes for Block Two indicated participants detected more errors and more types of errors when reading from a hardcopy document. However, overall participants did not detect more errors in hardcopy documents.

Fitschen (1986) advocated more spelling and grammatical errors are detected when reading from a hardcopy document. Video display terminals perpetuate cyberphobia--unneeded computer anxiety (Fitschen, 1986); therefore, grammatical and spelling errors may not be detected when reading from softcopy documents. The error detection instruments used for this study contained a variety of errors which included spelling and grammatical mistakes. Neither the quantity of errors detected nor the types of errors detected were significantly different when participants read from a hardcopy error detection instrument. Fitschen's statement concerning the number of spelling and grammatical errors detected when reading from a hardcopy document is not supported by this study.

3. Postsecondary word processing students' abilities to detect errors in keyboarded text were not affected by the video display terminal configurations examined in this study. A video display terminal's color configuration is not a factor in the error detecting process for a short time period--ten minutes. Therefore, the color configuration of a video display terminal should not be a major consideration when purchasing new video display terminals for instructional use.

None of the analyses of covariance indicated one video display terminal color configuration was more effective or conducive to detecting errors in keyboarded text. The conflicting information reported in the literature reviewed in Chapter Two concerning an optimum video display terminal color configuration is supported by this study. None of the three video display terminal configurations--dark blue characters on a light blue, black characters on a white background, or green characters on a black background--consistently yielded significant differences for the total number of errors or the types of errors detected. Therefore, the color configuration of a video display terminal is not a factor in the error detecting process.

4. As the spelling verification feature of word processing software does not detect all types of errors, instruction is needed to teach in detecting errors that cannot be detected by the software's spelling verification feature.

Error correction is easy with modern technology (Rubin, 1981), but a computerized error detection and correction process is not sufficient to detect and correct all errors (Camp, 1983). Keyboardists should review their material to visually check for errors incapable of being detected by the spelling verification feature of word processing software. The errors detected by participants in this study that could not be detected by the word processing software's spelling verification feature were minimal. Apparently, the errors were not seen by the participants. West (1983) believes proofreading errors occur more often because proofreaders do not see the error than because proofreaders do not know the correct spelling of words or correct grammar rules. West's statement was verified as many obvious spelling and grammatical errors contained within the error detection instruments were undetected.

IMPLICATIONS

Based upon the findings and conclusions of this study, the following implications for instruction and additional research are indicated. Implications are presented in two sections: Implications for Additional Research and Implications for Error Detection Instruction.

Implications for Additional Research

1. Neither block of data analysis consistently identified one error detection environment as the more effective environment for detecting errors. The artificialness of the error detection procedures may explain why one of the two error detection environments was not identified as the more effective or conducive for detecting errors. When detecting errors in an office situation, operators are not timed during the error detection process. In this study, only ten minutes was allotted for the error detection process. A similar study is recommended, which simulates an office situation, to determine whether an increased time allotment would affect error detection accuracy and

identify either a hardcopy or softcopy error detection environment as more conducive for the error detection process.

2. Smith (1986), West (1983), and Wong (1975) suggest errors are not detected because a reader does not see an error. In this study, the relationship between the error detection environment and the visual perception of errors was not examined. A study is recommended to determine whether the reader's ability to see an error is affected when reading from a video display terminal.

3. Additional research is warranted with more participants from more than one postsecondary institution involved to improve the generalizability of the study. Increasing the number of participants and the number of postsecondary institutions would eliminate restrictions evident in this study and determine whether the participants used in this study were typical or atypical of all postsecondary word processing students.

Implications for Error Detection Instruction

1. With the quantity and types of errors undetected by participants in this study, it is recommended that error detection instruction be incorporated into the postsecondary business curriculum. A component of any business course dealing with office correspondence should have an emphasis on error detection and correction techniques. Keyboarding, typewriting, and word processing courses should contain systematic error detection and correction instruction.

2. An error detection instructional program should be developed for teaching error detection techniques when reading from a video display terminal. By encouraging individuals to detect errors when reading from the video display terminal, time associated with preparing business correspondence may be reduced. The time required to print multiple copies of document for detecting errors would decrease.

3. Postsecondary word processing students should be introduced to the spelling verification feature of word processing software early in the instructional program. Students should be allowed to use the spelling verification feature of word processing software for error detection. Error detection instruction should emphasize only with the types of errors that cannot be detected by word processing software's spelling verification feature.

5. America is an information-oriented society (Naisbitt, 1982) dependent upon accurate and timely information from office personnel. As the ability to detect errors is a major component of office tasks, business educators face a tremendous challenge to prepare future office employees with proper and efficient error detection skills. Business educators teaching error detection need assistance from other faculty members in their own discipline and other disciplines to develop students' error detection skills. Therefore, error detection instruction should receive more emphasis in all educational programs if office productivity is to be improved.

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APPENDICES

APPENDIX A: Approval from Dr. Jean Cashion

Drawer 120 · Collegiate Drive · Wilkesboro, North Carolina 28697 · 919/667-7136
A COMPREHENSIVE COLLEGE SERVING NORTHWEST NORTH CAROLINA

WILKES
COMMUNITY COLLEGE

July 14, 1988

Mr. Randy Joyner, Instructor
Business Department
Wilkes Community College
PO Box 120
Wilkesboro, NC 28697

Dear Mr. Joyner:

This letter is authorization for you to use students enrolled in fall quarter word processing classes as subjects for your dissertation.

Sincerely,

Dr. Jean S. Cashion, Chairperson
Business Department

tgh

AN EQUAL OPPORTUNITY AFFIRMATIVE ACTION EMPLOYER

APPENDIX B: Approval from Mr. Tony Randall

WILKES COMMUNITY COLLEGE

July 13, 1988

Mr. Randy L. Joyner
Wilkes Community College
P. O. Box 120
Wilkesboro, NC 28697

Subject: Permission to Conduct Research at
Wilkes Community College

Dear Randy:

You may use students enrolled in our word processing classes to conduct research that will assist in completing your dissertation.

Good luck!

Sincerely,

Tony C. Randall
Vice President for Instruction

TCR/hgc

Ashe County Center
Wilkes Community College

Small Business Center

Alleghany County Center
Wilkes Community College
PO Box 229 Main Street
Sparta NC 28675
919/372 5061

APPENDIX C: Approval request McGraw-Hill

Route 2, Box 706
Wilkesboro, NC 28697
July 21, 1988

Ms. Evelyn Mareth
Publisher, Office Skills Training
McGraw-Hill Training Systems
29th Floor
1221 Avenue of the Americas
New York, NY 10020

Dear Ms. Mareth:

Would it be possible for four of the documents used as learning exercises or test items in McGraw-Hill's Proofamatics program to be used as data collection instruments for my dissertation? The four documents that would be used as are follows:

Pretest/Posttest	Letter to Mr. Peter Provo
Supplement	Letter to Mr. Harold Winthrop
Supplement	Letter to Mr. Fred W. Foxcraft
Training Material	Letter to Mr. Jeffrey Fitschen

The four documents would be duplicated as follows: one document would be duplicated in hardcopy format and the three remaining documents would be duplicated as softcopy documents on a 3.5 inch diskette. My research pertains to proofreading using a video display terminal as compared to proofreading from a paper copy. Reliability and validity of these documents have been established and certified in Douglas Smith's doctoral study at Arizona State University.

What is the appropriate procedure for securing approval for use of the four documents? May I hear from you soon as possible regarding the appropriate procedure for securing approval for use of these documents. Thank you for your help and assistance.

Sincerely,

Randy L. Joyner

APPENDIX D: Approval from Ms. Evelyn Mareth

McGraw-Hill Training Systems
McGraw-Hill Publishing Company
1221 Avenue of the Americas
New York, New York 10020
Telephone 212/512-3153

Office Skills Training

August 19, 1988

Mr. Randy L. Joyner
Route 2, Box 706
Wilkesboro, NC 28697

Dear Mr. Joyner:

You have McGraw-Hill's approval to use the four documents from Proofamatics as requested in your letter of July 21, 1988. Best of luck with your dissertation.

Sincerely,

Evelyn Mareth
Publisher
Office Skills Training

APPENDIX E: ERROR DETECTION INSTRUMENT

January 27, 1988

Mr. Harold Winthrop
Secretery
R. M. Maslow and Company
Plaza Building
Dallas, TX 68457

Dear Mr. Winthrop:

My letter of January 19, 1988, failed too address the question of corporate indemnity.

Corporate Indemnity is required in every bonding arrangment. Because a surety bond is not insurance, but rather an extension of credit, the surety anticipates no loss. It the surety company is called upon to back up its bond, it will require the the principal to indemnity it for the loss.

If the principal is a subsidiary of a parent corporation the surety will require the indenmity both of the principal and of it's parent. This is required for reasons ralated to the merger movement of the 1980s. Holding companies acquired subsidiaries and then had them yeild large dividents immediately. Surty companies that wrote bonds for these subsidiarys found themselves writing bonds four cash-poor corporations. When lossed occured: the indemnity agreements from the subsidary companies were worthless. The subsidiaries didnot have the assets to indemnify the surety.

The surety industry reacted to this sitaution by requiring that whenever a partent-subsidiary relationship exists, the parent's indemnity must be obtained as a condition for issuing bonds.

R. S. Maslow and Company has a number of subsidiaries that require bonds. An indemnity agreement must be signed for each bond that is ussued, and it should be accompanies by an audited financial discloture statement each time.

Very Truly yours,

Julie R. Matesanz
Underwriter

JRM/cj

APPENDIX F: ERROR DETECTION INSTRUMENT

April 12, 1988

Mr. Fred W. Foxcroft
2970 Kohler Road
Columbus, Ohio 45918

Dear Mr. Foxcroft:

I am in receipt of your letter of Aprio 6, 1988. Please be be advised that the deposit ticket which you enclosed in your letter is a standard bank deposit slip which can be acquired on our banking floor. The code at the bottom of the deposit slip is merely the Bank code. To insure timely account credit, please use you personalized deposit slips whenever possible.

As of this data, we have not recieved Treasure Form 1199. I have forwarded an additional form to Mrs. Obolensky for for Mrs. Foxcroft"s signature. I hope we can get this matter attended to before Mrs. Foxcroft leaves for Alaska.

I have apoken to Mr. Smithson's office, and they informed me that they have send you a copy of Mrs. Foxcroft's checking account statement. The original had be sent to her address in Foxboro. Additional correspondence dated April 6, 1988, indicates that her 6-month certificate will have matured by the first, of next month.

I look forward to seeing you on your next visit. If I can be of any additional assistance in the mean time, please do not hesitate to get in tough with me.

Sincerely your,

Pierre R. Meyers
Assistant Treasurer

PRM/afm

APPENDIX G: ERROR DETECTION INSTRUMENT

February 2[illegible], 1988

Mr. Peter Provo
4949 East 13th Street
Minneapolis, MN 55404

Dear Mr. Provo:

I have received the medical documents pertaining to Mrs. Silver's confinement in Billings Community Hospital from Septembre 1 to October 30. I have also received a copy of your letter to Dr. Walter Chan, dated November 20.

The medical documents received include Mrs. Barnett's notes from September 1 to october 30, progress reports' for the term September 5 to October 41, and a copy of Form 3847 (Skilled Nursing Care Report) completed by the Nurse in charge for those samb days.

In my review ot the medical documents, I note that during the portion of the confinement from September 1 to October 15, Mrs. Silver was ambulatory, her medications included only one prescription drug, and she did not require assistance in meeting the activities of daily living. In fact, Mrs. Silver was permitted to leafe the hospital with her sirster to go to the beauty parlor on several occasions. My review of the above indicates that the car which Mrs. Mrs. Silver received durint this period was, for the most part, custodial in Nature.

I also note that the level of medical care which your Sister-In-Law received become primarily skilled in nature after October 15. Therefore, benefits are payable under her Safeguard Insurance Ex-N (Expanded Skilled Nursing Facility) policy for the 16-day period October 15-October 30 (inclusive).

In order ot provide every considation to your sister-in-law in this matter, the medical documents were referred to a Physician in our company's medical department for review. His evalaution concurs with my findings as states above. Although we realize that the care your sister in law received from September 1 through October 14 was indeed benefisial to her well-being, it is not the type of care considered eligible for benefits under Mrs. Silver's policy.

Benefits in the amount of $320 (16 days paid at $20 per day) are Payable for the eligible portion of the confinement, and enclosed in our check in that amount made payable to the policyhoder.

Should you require farther assistance, please do not hesitate to call.

Sincerely yours;

Alice Hendricks
Executive Communications Representative

AH/ha

APPENDIX H: ERROR DETECTION INSTRUMENT

April 6, 1988

Mr. Jeffrey Fitschen
100 Short Hills Road
Bracton, PA 07801

Dear Mr. fitschen,

RE: Individal Scheduled Acciednt Benefit Policy #R3620894

The Accident claims department has received your claim for an acccident you sustained on March 22, 1988.

You will note that your Individual Scheduled-Accident Benefit, policy contains a listing of the injuries it covert and of the benifits payable for each. In addition to these benefits, the policy provieds a Miscellanious Hospitalization and Diagnostic X-Ray benefit for accidental injuries. However, miscellaneous expenses such as emergency room services and doctors' fees are not covered bu the policy.

The Claim information we have recieves endicates you did have an accident. However, the injury you sustained is unfortunately not among those insured by the policy.

We are sorry we cant be of service to you in this instance.

Sincerely yours,

Joan Rivera
Claims Department

rj

APPENDIX I: HARDCOPY ERROR DETECTION ENVIRONMENT DIRECTIONS

HC

______________________________ Name

______________________________ Class

DIRECTIONS:

The attached letter has many errors. Errors may be misspelled words; incorrect grammar--incorrect capitalization, incorrect punctuation, incorrect number usage, incorrect subject and predicate agreement; extra or omitted spaces between words; and transposed letters or words.

The format and placement of the letter are correct. However, proper names are spelled correctly, but the proper names may not be capitalized when they should be capitalized. Numbers and dates are correct unless invalid.

Your task is to use a pencil to circle the errors that you find. Do <u>NOT</u> correct any errors that you find; you are <u>only</u> to find and circle the mistakes.

Return the instruction sheet and the letter with the circled errors when requested.

REMEMBER, CIRCLE THE ERRORS THAT YOU FIND. DO NOT CORRECT THE ERRORS!!

APPENDIX J: SOFTCOPY ERROR DETECTION ENVIRONMENT DIRECTIONS

VDT

_____________________________ Name

_____________________________ Class

DIRECTIONS:

The diskette that you have been given contains a letter with many keyboarding or typewriting mistakes. The errors may be misspelled words; incorrect grammar--incorrect punctuation, incorrect number usage, incorrect capitalization, incorrect subject and predicate agreement; extra or omitted spaces between words; and transposed letters or words.

The format and placement of the letter are correct. However, proper names are spelled correctly; but the proper names may not be capitalized when they should be. Numbers and dates are correct unless invalid.

Your task is to use DisplayWrite 4's Overstrike (Control S) to mark the errors that you find when reading the letter from the video display terminal. Do NOT print a copy of the letter or correct any errors; you only find and mark the errors.

When your instructor indicates you are to begin, select the document named ____________________. The document has already been keyboarded onto the diskette that you have been given. Mark any errors that you find by using DisplayWrite 4's Overstrike feature.

Return the instruction sheet and the diskette to the instructor when requested.

REMEMBER, MARK THE ERRORS YOU FIND USING DISPLAYWRITE 4'S OVERSTRIKE (CONTROL S). DO NOT PRINT A COPY OF THE LETTER OR CORRECT ANY ERRORS.

Thank you.

APPENDIX K: PARTICIPANT INTRODUCTION OR EXPLANATION INFORMATION

To The Student,

You are participating in a diagnostic effort to determine if different skills are needed when proofreading or finding errors from a paper document and from a video display terminal (VDT).

During the class period, you will look for errors in one of four business letters; and you will find and mark errors in one of four formats: paper and pencil, green and black colors, black and white colors, or dark blue and light blue colors.

Please read the directions carefully before you begin. Thank you for your help.

APPENDIX L: DEMOGRAPHIC DATA COLLECTION INSTRUMENT

PLEASE CIRCLE OR PROVIDE THE REQUESTED INFORMATION

1. Age: 18-20 21-25 26-30 31-35 36-40 41-45
   46-50 51-55 56+

2. Race: White Black Hispanic
   Other (please identify) ____________________

3. Highest grade completed:
   9 10 11 12 13 14 15 16 17 18 19 20
   Other (please identify) ____________________________

4. Degrees earned (may be more than 1):
   High School Diploma Associate Master
   GED Bachelor Doctor

5. Employed: Not employed Full-time Part-time

6. Total length of employment:
   less than 6 months 6 to 11 months 1 to 5 years
   more than 5 years

7. Type of video display terminal if own a microcomputer:
   color monochrome Other (please identify) __________________

8. Primary use of home microcomputer:
   data base word processing spreadsheeting
   other (please identify) __________

9. Do you wear glasess or contact lenses? Yes No

10. If you wear glasses or contact lenses, what type of correction?
    single lens bifocal lens trifocal lens

11. If you wear glasses or contact lenses, do you find it difficult to read from a video display terminal?
    Yes No

12. If you answered yes to question 11, please explain briefly.________
    ____

APPENDIX M: Approval from Vivian Arnold

Vivian O. Arnold
500 Lake Tower Drive, No. 5
Lexington, Kentucky 40502

July 28, 1988

Mr. Randy L. Joyner
Route 2, Box 706
Wilkesboro, NC 28697

Dear Randy:

Your request to use the documents which I developed to measure proofreading skills is of interest to me. One of the recommendations which I made was to use CRTs or computer-assisted instruction to further test the results of proofreading instruction.

You herewith have my permission to use the enclosed pretest and posttest in your research with the stipulation that you report your findings to me. Specifically, I would be interested in a description of your sample, precisely how the research was conducted, and the results of your study. In addition, this permission is granted for your study only to protect the marketability of the instruments.

I trust that you will not find these stipulations to be too stringent, but you should be aware that it is my intention to further refine the instruments and then market them. With this limited permission, I intend to protect the publisher and myself to guarantee my exclusive copyright. Therefore, you can see that your information will be useful to me as well. When do you expect to complete?

Good luck to you in your research pursuit. I fully realize that you have undertaken a mighty task, and I have great respect for your commitment. If I can be of further aid to your study, please let me know.

Sincerely,

Vivian Arnold

Enclosures

APPENDIX N: PRETEST ERROR DETECTION INSTRUCTIONS AND PRETEST ERROR DETECTION INSTRUMENT

______________________________Name

______________________________Class

Instructions

Please write your name and the name of the class in which you are enrolled in the blanks provided. Also, please answer the questions below.

Each person will receive a letter to be used in detecting errors. The letter is a diagnostic tool; therefore, it will be timed. Do not turn the page until you are instructed to do so.

Read the attached letter and look for errors. If you find an error on the letter, please circle the error. DO NOT CORRECT THE ERROR!

APPENDIX N: PRETEST ERROR DETECTION INSTRUCTIONS AND PRETEST ERROR DECTION INSTRUMENT

3535 Bruce Street
Lexington, KY 40503
August 1, 1988

Mrs. Leila Dorris
1900 Nicholasville Road
Lexington, KY 40503

Dear Mrs. Dorris:

You have probably allready heard of our customary mid-year sale that has become such a important occasion with out customers. This sale will be anounced in the newspapers immediatly after our customers' and those with who we have been incorrespondence, have had an opportunity to examine the offerings and make purchases.

This is an opportunity to view the largest and most varied collection of furniture, both simple and elaborate, that has been produced by this house in the last half century.

It may be stated without farther referrence to the substantial reductions in affect, that each group or peice in the entire exhibit has been marked at a pricd that cannot fail to be impressive--reductions ranging up to 50 percent.

As usual, pruchases may be booked for delivrey if you so desire

We shall be pleased, indeed, to have you visit our gallaries on Monday, August 15 or as soon therafter as you can.

Very Sincerely Yours,

David S. Dodson

rj

APPENDIX O: PRETEST TALLY SHEET

PRE

BLOCK ONE

____
Name

____
Identification Number

____
Course and Section Number

ERROR ANALYSIS TALLY SHEET
Pretest

I. Extra Letter(s)

______ allready for already
______ referrence for reference

______ correctly detected from a possible 2

II. Incorrect Letter(s)

Shift
______ Sincerely for sincerely
______ Yours for yours

______ correctly detected from a possible 2

Phonetic
______ gallaries for galleries

______ correctly detected from a possible 1

Word Choice
______ out for our
______ farther for further
______ affect for effect

______ correctly detected from a possible 3

Misstroke
______ pricd for price

______ correctly detected from a possible 1

______ correctly detected from a possible 7

III. Incorrect Punctuation

______ customers' for customers
______ desire for desire.
______ Monday, August 15 for Monday, August 15,

______ correctly detected from a possible 3

IV. Incorrect Spacing

______ incorrespondence for in correspondence
______ had an for had an

______ correctly detected from a possible 2

V. Omitted Letter(s)

______ a for an
______ anounced for announced
______ immediatly for immediately
______ who for whom
______ therafter for thereafter

______ correctly detected from a possible 5

VI. Transpositions

______ peice for piece
______ pruchases for purchases
______ delivrey for delivery

______ correctly detected from a possible 3

COMPOSITE

Number Correctly Detected	Error Type
________	Extra Letter(s)
________	Incorrect Letter(s)
	______ Shift
	______ Phonetic
	______ Word Choice
	______ Misstroke
________	Incorrect Punctuation
________	Incorrect Spacing
________	Omitted Letter(s)
________	Transpositions
________	Total

APPENDIX O: PRETEST TALLY SHEET

PRE

BLOCK TWO

____
Name

____
Identification Number

____
Course and Section Number

ERROR ANALYSIS TALLY SHEET
Pretest

I. Incorrect Letter(s)

<u>Shift</u>

______ Sincerely for sincerely
______ Yours for yours

______ correctly detected from a possible 2

<u>Word Choice</u>

______ out for our
______ farther for further
______ affect for effect

______ correctly detected from a possible 3

______ correctly detected from a possible 5

II. Incorrect Punctuation

______ customers' for customers
______ desire for desire.
______ Monday, August 15 for Monday, August 15,

______ correctly detected from a possible 3

III. Incorrect Spacing

______ had an for had an

______ correctly detected from a possible 1

IV. Omitted Letter(s)

______ a for an
______ who for whom

______ correctly detected from a possible 2

COMPOSITE

Number Correctly Detected	Error Type
______	Incorrect Letter(s)
	______ Shift
	______ Phonetic
	______ Word Choice
______	Incorrect Punctuation
______	Incorrect Spacing
______	Omitted Letter(s)
______	Total

APPENDIX P: WINTHROP ERROR ANALYSIS TALLY SHEET

HC BB

BW GB

BLOCK ONE

______________ Name

______________ Identification Number

______________ Course and Section Number

ERROR ANALYSIS TALLY SHEET
Winthrop Letter

I. Extra Letter(s)

_____ the the principal for the principal

_____ correctly detected from a possible 1

II. Incorrect Letter(s)

Shift

_____ Indemnity for indemnity
_____ Truly for truly

_____ correctly detected from a possible 2

Phonetic

_____ Secretery for Secretary
_____ ralated for related
_____ dividents for dividends
_____ four for for
_____ ussued for issued

_____ correctly detected from a possible 5

Word Choice

_____ too for to
_____ indemnity for indemnify
_____ it's for its
_____ subsidiarys for subsidiaries
_____ lossed for losses
_____ accompanies for accompanied

_____ correctly detected from a possible 6

Misstroke

_____ discloture for disclosure

_____ correctly detected from a possible 1

_____ correctly detected from a possible 14

III. Incorrect Punctuation

______ comma not needed after 1988
______ comma omitted after corporation
______ colon after occured when should be a comma

______ correctly detected from a possible 3

IV. Incorrect Spacing

______ space omitted: didnot for did not

______ correctly detected from a possible 1

V. Omitted Letters

______ Surty for Surety
______ occured for occurred
______ subsidary for subsidiary

______ correctly detected from a possible 3

VI. Transpositions

______ indenmity for indemnity
______ yeild for yield
______ sitaution for situation

______ correctly detected from a possible 3

COMPOSITE

Number Correctly Detected	Error Type
________	Extra Letter(s)
________	Incorrect Letter(s)
	______ Shift
	______ Phonetic
	______ Word Choice
	______ Misstroke
________	Incorrect Punctuation
________	Incorrect Spacing
________	Omitted Letter(s)
________	Transpositions
________	Total

APPENDIX P: WINTHROP ERROR ANALYSIS TALLY SHEET

HC BB

BW GB

BLOCK TWO

____
Name

____
Identification Number

____
Course and Section Number

ERROR ANALYSIS TALLY SHEET
Winthrop Letter

I. Extra Letter(s)

______ the the principal for the principal

______ correctly detected from a possible 1

II. Incorrect Letter(s)

Shift
______ Indemnity for indemnity
______ Truly for truly

______ correctly detected from a possible 2

Phonetic
______ four for for

______ correctly detected from a possible 1

Word Choice
______ too for to
______ indemnity for indemnify
______ it's for its
______ lossed for losses
______ accompanies for accompanied

______ correctly detected from a possible 5

______ correctly detected from a possible 8

III. Incorrect Punctuation

______ comma not needed after 1988
______ comma omitted after corporation
______ colon after occured when should be a comma

______ correctly detected from a possible 3

COMPOSITE

Number Correctly Detected	Error Type
________	Incorrect Letter(s)
	______ Shift
	______ Phonetic
	______ Word Choice
________	Incorrect Punctuation
________	Incorrect Spacing
________	Omitted Letter(s)
________	Total

APPENDIX Q: FOXCROFT ERROR ANALYSIS TALLY SHEET

HC BB

BW GB

BLOCK ONE

____
Name

____
Identification Number

____
Course and Section Number

ERROR ANALYSIS TALLY SHEET
Foxcroft Letter

I. Extra Letter(s)

______ for for Mrs. Foxcroft instead of for Mrs. Foxcroft
______ be be advised for be advised

______ correctly detected from a possible 2

II. Incorrect Letter(s)

<u>Shift</u>
______ Bank for bank

______ correctly detected from a possible 1

<u>Phonetic</u>
______ insure for ensure
______ data for date
______ send for sent

______ correctly detected from a possible 3

<u>Word Choice</u>
______ Treasure for Treasury
______ tough for touch

______ correctly detected from a possible 2

<u>Misstroke</u>
______ Aprio for April
______ apoken for spoken

______ correctly detected from a possible 2

______ correctly detected from a possible 8

III. Incorrect Punctuation

______ " instead of ' in Mrs. Foxcroft's
______ , not needed after 1988
______ , not needed after first

______ correctly detected from a possible 3

IV. Incorrect Spacing

______ mean time for meantime

______ correctly detected from a possible 1

V. Omitted Letter(s)

______ you for your
______ be for been
______ your for yours

______ correctly detected from a possible 3

VI. Transpositions

______ recieved for received

______ correctly detected from a possible 1

COMPOSITE

Number Correctly Detected	Error Type
________	Extra Letter(s)
________	Incorrect Letter(s)
	______ Shift
	______ Phonetic
	______ Word Choice
	______ Misstroke
________	Incorrect Punctuation
________	Incorrect Spacing
________	Omitted Letter(s)
________	Transpositions
________	Total

APPENDIX Q: FOXCROFT ERROR ANALYSIS SHEET

HC BB

BW GB

BLOCK TWO

____
Name

____
Identification Number

____
Course and Section Number

ERROR ANALYSIS TALLY SHEET
Foxcroft Letter

I. Extra Letter(s)

______ for for Mrs. Foxcroft instead of for Mrs. Foxcroft
______ be be advised for be advised

______ correctly detected from a possible 2

II. Incorrect Letter(s)

<u>Shift</u>
______ Bank for bank

______ correctly detected from a possible 1

<u>Phonetic</u>
______ insure for ensure
______ data for date
______ send for sent

______ correctly detected from a possible 3

<u>Word Choice</u>
______ Treasure for Treasury
______ tough for touch

______ correctly detected from a possible 2

______ correctly detected from a possible 6

III. Incorrect Punctuation

______ " instead of ' in Mrs. Foxcroft's
______ , not needed after 1988
______ , not needed after first

______ correctly detected from a possible 3

IV. Incorrect Spacing

______ mean time for meantime

______ correctly detected from a possible 1

V. Omitted Letter(s)

______ you for your
______ be for been
______ your for yours

______ correctly detected from a possible 3

COMPOSITE

Number Correctly Detected	Error Type
________	Incorrect Letter(s)
	______ Shift
	______ Phonetic
	______ Word Choice
________	Incorrect Punctuation
________	Incorrect Spacing
________	Omitted Letter(s)
________	Total

APPENDIX R: PROVO ERROR ANALYSIS SHEET

HC BB

BW GB

BLOCK ONE

____
Name

____
Identification Number

____
Course and Section Number

ERROR ANALYSIS TALLY SHEET
Provo Letter

I. Extra Letter(s)

______ sirster for sister
______ Mrs. Mrs. Silver for Mrs. Silver

______ correctly detected from a possible 2

II. Incorrect Letter(s)

<u>Shift</u>
______ # for 3 in date
______ october for October
______ Nurse for nurse
______ Nature for nature
______ Sister-In-Law for sister-in-law
______ Physician for physician
______ Payable for payable

______ correctly detected from a possible 7

<u>Phonetic</u>
______ leafe for leave
______ benefisial for beneficial

______ correctly detected from a possible 2

<u>Word Choice</u>
______ become for became
______ states for stated
______ farther for further

______ correctly detected from a possible 3

<u>Misstroke</u>
______ samb for same
______ ot for of
______ durint for during

______ correctly detected from a possible 3

______ correctly detected from a possible 15

III. Incorrect Punctuation

______ ' not needed after reports'
______ sister in law for sister-in-law
______ yours; instead of yours

______ correctly detected from a possible 3

IV. Incorrect Spacing

______ indented incorrectly: street address and inside address

______ correctly detected from a possible 1

V. Omitted Letter(s)

______ car for care
______ considation for consideration
______ policyhoder for policyholder

______ correctly detected from a possible 3

VI. Transpositions

______ Septembre for September
______ October 41 for October 14
______ ot for to

______ correctly detected from a possible 3

COMPOSITE

Number Correctly Detected	Error Type
______	Extra Letter(s)
______	Incorrect Letter(s)
	______ Shift
	______ Phonetic
	______ Word Choice
	______ Misstroke
______	Incorrect Punctuation
______	Incorrect Spacing
______	Omitted Letter(s)
______	Transpositions
______	Total

APPENDIX R: PROVO ANALYSIS SHEET

HC BB

BW GB

BLOCK TWO

____
Name

____
Identification Number

____
Course and Section Number

ERROR ANALYSIS TALLY SHEET
Provo Letter

I. Extra Letter(s)

______ Mrs. Mrs. Silver for Mrs. Silver

______ correctly detected from a possible 1

II. Incorrect Letter(s)

<u>Shift</u>

______ Nurse for nurse
______ Nature for nature
______ Sister-In-Law for sister-in-law
______ Physician for physician
______ Payable for payable

______ correctly detected from a possible 5

<u>Word Choice</u>

______ become for became
______ states for stated
______ farther for further

______ correctly detected from a possible 3

______ correctly detected from a possible 8

III. Incorrect Punctuation

______ ' not needed after reports'
______ sister in law for sister-in-law
______ yours; instead of yours

______ correctly detected from a possible 3

IV. Incorrect Spacing

______ indented incorrectly: street address and inside address

______ correctly detected from a possible 1

V. Omitted Letter(s)

______ car for care

COMPOSITE

Number Correctly Detected	Error Type
________	Incorrect Letter(s)
	______ Shift
	______ Phonetic
	______ Word Choice
________	Incorrect Punctuation
________	Incorrect Spacing
________	Omitted Letter(s)
________	Total

APPENDIX S: FITSCHEN ERROR ANALYSIS SHEET

HC BB

BW GB ______________________________ Name

BLOCK ONE ______________________________ Identification Number

______________________________ Course and Section Number

ERROR ANALYSIS TALLY SHEET
Fitschen Letter

I. Extra Letters

______ acccident for accident

______ correctly detected from a possible 1

II. Incorrect Letter(s)

<u>Shift</u>

______ fitschen for Fitschen
______ Accident for accident
______ Claim for claim

______ correctly detected from a possible 3

<u>Phonetic</u>

______ benifits for benefits
______ Miscellanious for Miscellaneous
______ endicates for indicates

______ correctly detected from a possible 3

<u>Word Choice</u>

______ covert for covers
______ receives for received

______ correctly detected from a possible 2

<u>Misstroke</u>

______ bu for by

______ correctly detected from a possible 1

______ correctly detected from a possible 9

III. Incorrect Punctuation

______ , should not be after Fitschen
______ - not needed between Scheduled-Accident
______ , not needed after Benefit
______ ' omitted from can't (should be cannot)

______ correctly detected from a possible 4

IV. Incorrect Spacing

______ excess spacing after RE:

______ correctly detected from a possible 1

V. Omitted Letter(s)

______ Individal for Individual

______ correctly detected from a possible 1

VI. Transpositions

______ Acciednt for Accident
______ provieds for provides

______ correctly detected from a possible 2

COMPOSITE

Number Correctly Detected	Error Type
________	Extra Letter(s)
________	Incorrect Letter(s)
	______ Shift
	______ Phonetic
	______ Word Choice
	______ Misstroke
________	Incorrect Punctuation
________	Incorrect Spacing
________	Omitted Letter(s)
________	Transpositions
________	Total

APPENDIX S: FITSCHEN ERROR ANALYSIS SHEET

HC BB

BW GB

BLOCK TWO

____
Name

____
Identification Number

____
Course and Section Number

ERROR ANALYSIS TALLY SHEET
Fitschen Letter

I. Incorrect Letter(s)

<u>Shift</u>

______ Accident for accident
______ Claim for claim

______ correctly detected from a possible 2

<u>Phonetic</u>

______ endicates for indicates

______ correctly detected from a possible 1

<u>Word Choice</u>

______ covert for covers
______ receives for received

______ correctly detected from a possible 2

______ correctly detected from a possible 5

II. Incorrect Punctuation

______ , should not be after Fitschen
______ - not needed between Scheduled-Accident
______ , not needed after Benefit

______ correctly detected from a possible 3

III. Incorrect Spacing

______ excess spacing after RE:

______ correctly detected from a possible 1

COMPOSITE

Number Correctly Detected	Error Type
________	Incorrect Letter(s)
	______ Shift
	______ Phonetic
	______ Word Choice
________	Incorrect Punctuation
________	Incorrect Spacing
________	Omitted Letter(s)
________	Total

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