STUDENT PREFERENCES IN SCREEN DESIGN FACTORS FOR INTERNET DELIVERED COLLEGE COURSES

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Colleges and universities throughout the world are offering many of their courses via the Internet. Some institutions offer entire degrees online. This has ushered in a renewed interest in the debate on the effectiveness of non-traditional course delivery method. Numerous educational research studies have been conducted in an attempt to quantify that effectiveness. In any form of experimental research, control of variables is paramount. The rich multimedia capabilities of the World Wide Web give educators a wide variety of delivery media. However, with the exception of advice from artisans on design factors of the media, little research has been conducted with regard to the aesthetics of Web page design as viewed by the student. This study was conducted in an effort to establish student preferences with regard to two factors of Web page design as they might be used on those Web pages, background color and typeface used for text. In addition, it contains an analysis of whether or not there is an interaction between the two factors. Use of the results of this study should prove beneficial to both educators and educational researchers in their future endeavors.
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CHAPTER 1

INTRODUCTION

This chapter begins with a statement of fact that the Internet is a means of delivering college courses to students globally. As a media for that delivery, it has come under the same scrutiny as correspondence courses over the past several decades. First impression is quick, but significant. The design factors of Web-based courses are critical to that impression. A lack of previous significant research in this area and a rise in use of the Internet for course delivery at the researcher's teaching institution stimulated interest in the topic, and thus the formulation of this study.

Sosin (1999) commented that changes in multimedia instructional technology, in particular the development of the Internet and the World Wide Web, provide new opportunities for improving teaching and learning. Sosin (1999) further stated, “the challenge for instructors is how to effectively use these new technologies to develop an active-student-learning environment” (p. 288). Dunn (2000) stated, “education is an absolute imperative in the emerging global knowledge society, so new ways of providing access to education for a much higher percentage of the population are now being devised” (p. 35). Dunn (2000) further predicted the impact of multimedia instructional technologies, stating, “all courses in the residential college of the future will be digitally enhanced. Because distance-education methodologies provide some advantages to student learning, those techniques should and will be incorporated into local teaching” (p. 34).

Even now universities are using the Internet to deliver courses to students in different locations around the globe. Dunn (2000) asserted that programs and courses
offered vary from basic literacy courses to the highest graduate-level programming and estimated that 50,000 courses taught at the university level were available through distance-education delivery systems. Distance education programs are being offered today by colleges and universities, major corporations, small businesses, educational agencies, government agencies, branches of the armed services, trade associations, service industries, et cetera (Distance Education and Training Council, 1997). With so many organizations involved in providing distance learning opportunities, it is imperative that participants reap the most benefit from the learning experience.

This study will focus on two variables involved in Web site design, color and typeface. The purpose of this study is to determine whether student preferences for certain background colors and/or typefaces on Web pages exist, and whether there is a possible interaction between the two.

Background of the Study

There is considerable research devoted to comparing classroom-based education and distance education. A few examples of such studies include the following: Barry & Runyan’s (1995) *A Review of Distance-Learning Studies in the U.S. Military*, Goldberg's (1996) *CALOS: An Experiment with Computer-Aided Learning for Operating Systems*, and Moore & Kearsky's (1996) *Research on Effectiveness*. These studies have shown that Internet-delivered courses have been added to the category of distance education and have been under a considerable amount of fire as to their effectiveness. Research credibility depends upon the reasonable control of variables, which if not considered can ultimately confound results of otherwise valid studies.

Clark (1983) asserted, “five decades of research suggest that there are no
learning benefits to be gained from employing different media in instruction” (p.450).
Russell (1998) supported this with an exhaustive list of 248 research reports, summaries, and papers produced between 1928 and 1996, which indicated that no significant differences exist between classroom and correspondence study students. The list has been expanded and is available at http://cuda.teleeducation.nb.ca/nosignificantdifference/.

Kozma (1994) has been a detractor of Clark’s contention since 1983. Kozma capitulated to Clark but asserted that although media do not significantly influence learning, they should. He went on to say that the lack of an identifiable relationship between media and learning does not mean that one does not exist but rather that instructional designers have not been able to exploit it or define it.

Schutte (1996) produced results that marked the difference at 20% in favor of his online students. However, Neal (1998) cited several flaws in the analysis, and claimed that the differences were more a result of teaching methods than delivery systems. Neal (1998) further contended that insufficient control of variables existed in the study.

Clark (1989) asserted that research should be centered in the areas of prescriptive rather than descriptive research meaning the practical application of knowledge by linking that knowledge to problem solving (prescriptive research) versus merely describing how things are and how they work (descriptive research). Clark (1989) stated,

The attention given to the design phase of courses has a greater effect than the delivery mechanism itself and that there are different sets of variable and design considerations that influence design and development. Development research
addresses *local issues* pertaining to the mode of communication, message design, media selection, and other issues related to economics of education. (p. 61)

Moore et al. (1996) similarly concluded that what makes any course good or poor is a consequence of how well it is designed, delivered, and conducted, not whether the students are face-to-face or at a distance.

D’Angelo and Little (1998) stated, “Anyone is capable of publishing Web pages, a fact which is sufficient reason to enumerate parameters for their design.” They went on to say that “there exist so many combinations of colors, typefaces and layouts that it would make even the most novice [*sic*] of graphic artists scream in horror” (p. 71). Clearly, there has to be some optimum combination of those factors.

Gagne (1985) asserted that there are nine distinct steps or events of instruction. The first of these, *Gaining Attention*, is most critical in the sense that it prepares the student for reception of further input. Therefore, the first Web page students find when going to a course Web site is likely to have the greatest effect on their overall impression of the Web site, and ultimately the course in general.

Lohse (1997) established that in the case of advertisements in a typical Yellow Pages directory, the minimum fixation time (to establish recognition) is 100ms (milliseconds). By that point, the viewer has formed an impression of that which is being viewed. The compilation of a set of page-pair, each pair varying one characteristic, such as color or typeface only, when shown to students can produce an instrument which, if used in a random or convenience sample of subjects, will produce data on general preferences of Web page format with reference to those students. Long durations of
exposure to a Web page are unnecessary to the establishment of a first impression (opinion) of the relative aesthetic merits of one page versus another.

In his earlier writings, Clark (1983) concluded that there are far too many variables inherent in a study of evaluating the differences, if any, between classroom-based instruction and distance learning. Clearly, minimizing the impact of seemingly extraneous variables on any study should be of paramount interest to educational researchers.

Statement of the Problem

Changes in instructional technology, in particular the development of the Internet and the World Wide Web, are providing new opportunities for improving teaching and learning (Sosin, 1999). This new avenue of approach to educational media provides current and prospective students an unprecedented flexibility toward the achievement of a university degree. Among the greatest problems faced by those seeking continuing professional education are the time and money costs of participating in educational activities (Queeney, 1996). Companies cannot afford to lose on-the-job time as their employees travel to locations offering courses or conferences. The Internet provides a solution to this problem.

Dunn (2000) stated, “programs available through distance-education delivery systems are estimated at about 50,000 university-level courses” (p. 38). He did not include the number of professional development seminars that are conducted each day. Professionals are finding it necessary to continue to learn throughout their careers. “Distance education has only recently become a key factor in the delivery of continuing professional education and has the potential to revolutionize the ways in which
professional practitioners learn throughout their careers” (Queeney, 1996, p. 703).

Many Web sites are published on a hit-or-miss basis with little thought to the appeal of the design. D’Angelo et al. (1998) contend that the faint of heart graphic artist would scream in horror when faced with the numerous combinations of color, typefaces, and layouts possible. If the aesthetics, or format of the Web site pages are considered as variables which confound the results of educational research, then a need exists to look deeper into methods of reducing their impact. Much has been published on what constitutes good and what constitutes bad Web page design. Logically, if it can be statistically verified that some designs are simply preferable to others, one small variable that currently hinders educational research in this larger area can be either eliminated or reduced to insignificance. This provides insight to the individual variables of instructional delivery rather than the larger aspect of general instructional delivery methods. Identifying some variables in the design of Web sites which are aesthetically appealing will pinpoint aspects of a Web site that encourage participants to focus on the information contained within the site rather than on garish color schemes or hard to read information. Preferences guide first impressions. Thus they must be considered, both in designing Web courses and in researching their effectiveness.

Significance of the Study

Many of today’s opponents of Internet-delivered college courses have chosen to lump them all together under the classification of correspondence courses and make derogatory generalizations based on that classification. Hubbard, Rodgers, Ashton, and Bland (1995) wrote that the roots of pure distance education go back at least 160 years to the beginning of correspondence study in which no actual human connection was
made between student and teacher.

The impetus to develop statistically provable methodologies in educational research is clearly present. It has also been made clear that control of variables is paramount to the validity of such studies. In response to this need during the summer of 2002 this study was developed by the researcher and was conducted to determine whether significant enough preferences exist in color background and typeface choices on Web pages and whether there is an interaction between the two factors. If preferences and possible interactions do exist, they can be considered as variables and therefore be controlled. Preferences and interactions between them establish design factors as variables, which therefore must be controlled. If not, they can effectively be discounted. In either case, this study has the potential to provide future educational researchers another tool in the design and execution of further studies in this area.

The Internet, as a vehicle for delivering college courses has the potential for providing a college education globally to students who would otherwise be deprived of such an opportunity. Hubbard et al. (1995) listed numerous examples of how distance learning allowed access to resource that would have otherwise been denied--students conferencing with authors, staff development courses offered, vocational education certifications requirements met, rural areas with little resources tapping into teachers and materials, and Alaska with large areas and sparsely settled communities accessing educational opportunities.

Wayland Baptist University, since the mid-seventies, has established 10 off-campus centers at various geographical locations throughout the United States, Alaska and Hawaii included. The thrust of this endeavor is to provide collegiate educational
opportunities to non-traditional students, a significant portion of whom are active duty military personnel often serving in geographically isolated regions. Toward this end, many of the extension campuses are located on or near military bases in such areas as Fairbanks, Alaska; Anchorage, Alaska; Phoenix, Arizona; Honolulu, Hawaii; Albuquerque, New Mexico; Clovis, New Mexico; San Antonio, Texas; and Wichita Falls, Texas.

In the spring of 1998, Wayland Baptist University began an experimental program of offering several courses to students via the Internet in an effort to determine the feasibility of carrying the off-campus program further than the immediate vicinity of the various existing centers. In the fall of 2001, the success of the program prompted the establishment of Wayland’s Virtual Campus and a program coordinator was appointed. The fall 2002 term began with 23 courses offered online. The instructors of said courses have either created their own Web sites in support of their courses, or made use of the Web site design and management programs offered by textbook publishers. As of this writing, plans are in progress to convert course Web sites to a unified course management system with predefined templates, thus increasing the likelihood of further expansion of the virtual campus.

Dunn (2000) predicted that by the year 2025, at least 95% of instruction in the United States would be digitally enhanced. Dunn further stated, “studies have shown that there are 25 college-level courses in a variety of subject areas that get about 50% of the total credit enrollment across U.S. higher education” (p. 34). If development of these courses keeps pace with the demand, it is likely that the number of online college-level courses offered in the future will constitute a significant percentage of the total of
post-secondary offerings. As universities make the transition to this new way of teaching, many instructors will be tasked with developing courseware for their classes.

The results of this study will be useful in two areas. The first is in the area of Web site design for Internet based courses at Wayland Baptist University. Patterns of preferences should be used as a guide to instructors for online course offerings. The second is to provide to future educational researchers a method of taking design factors into consideration when designing studies for evaluation of the effectiveness of Internet-delivered courses.

Businesses need to adapt to the ever-changing environment in which they operate. Employees need to adapt and change also if their business is to remain competitive. Training continues to play an important role in supporting the ongoing development of employee knowledge and skills. Web based courses can offer information when it is needed or serve to support instructional or performance needs (Wagner, 1999). Distance education is especially suited for busy people who wish to increase their knowledge and skills without giving up their jobs, leaving home, or losing income (Distance Education and Training Council, 1997). Courses can offer people opportunities to position themselves for promotion or to completely retrain for a new vocation. Queeney (1996) stated, “recognition of professionals’ need to continue learning throughout their careers is almost universal, with educators, professionals, employers, and the interested public agreeing that continuing professional education has the potential to enhance and ensure practitioners competence” (p.703).

If even one variable in future educational research studies can either be controlled or eliminated by the results of this project, then it will be more than worth the
effort expended.

Purpose of the Study

The purpose of this study was to determine whether there exist clearly preferred background colors and/or typefaces for Web pages and whether there is a possible interaction between the two.

Hypotheses

1. $H_0$: color1 = color2 = color3
2. $H_0$: typeface1 = typeface2 = typeface3
3. $H_0$: there is no relationship between the two variables

Limitations

As will be explained in Chapter 3, communication with the sample selected was done via e-mail. Not every registered student at the university has a listed e-mail address. However, that fact served to eliminate a significant set of potential non-respondents due to their lack of Internet access. By definition, the study itself was concerned only with students who would likely take an Internet-based college course and would therefore have an e-mail address on file.

This study assumed that all respondents had access to either Microsoft Windows®1 or Apple Macintosh®2 based computer systems. There was a possibility that a small number of respondents would be using computers running other operating systems. A caveat on the instrument addressed the issue.

The most significant criticism of the results of this study is the presence of the Hawthorne Effect (Roethlisberger & Dickson, 1939). It is the result of studying human
subjects, and therefore ubiquitous in educational research. There was no known way to control for the effect.

There were also limitations on the control of factors such as the respondents’ Video Display Terminal (VDT), the Web browser used, the visual acuity of the respondents, and their color vision. It was determined that a sufficiently large sample would reduce these factors to insignificance.

With regard to the completion of surveys online for data collection, there was no way to absolutely ensure the identity of the student filling out the survey. Gates (1995) reprinted a cartoon by Peter Steiner in his book *The Road Ahead*, which was originally printed in a 1993 issue of the *New Yorker* magazine that humorously depicted the extent of the anonymity existing on the World Wide Web. A dog is sitting on a stool in front of a computer and talking to another dog sitting on the floor. The caption is, On the Internet nobody knows you’re a dog.

**Delimitations**

This study was designed to provide information on students enrolled or formerly enrolled at Wayland Baptist University. No attempt was made throughout the duration of the study to attribute the results to any other institutions of higher learning.

**Definition of Terms**

For the purpose of this study, the following definitions taken from the *Graphic Communication Dictionary* (Lyons, 2000) were adopted:

1. **College course**: A program of study at the post-secondary level of formal education, commonly under the auspices of an accredited college or university.

2. **Color**: A visual sensation in the brain when the eye views various wavelengths of
the electromagnetic spectrum.

3. **Font**: A complete set of characters (upper and lower case) of one size of one typeface.

4. **Legibility**: The characteristic of copy having sufficient contrast with the paper on which it appears.

5. **Online course**: A program of study in which the delivery platform uses the Internet for a majority of the instruction.

6. **Readability**: One of the major factors in type selection; the perception of the type as easy or hard to read.

7. **Reader fatigue**: The physical tiredness resulting from eyestrain as well as non-optimal mental performance resulting from loss of concentration and deteriorating comprehension.

8. **San serif**: Typeface characterized by vertical letter stress, uniform strokes, and the absence of serifs.

9. **Serif**: Typeface with small strokes found on the ends of letters drawn at right angles across the arm, stem, or tail of a letter.

10. **Typeface**: The unique and distinctive design of a font alphabet; all of the letters, figures and punctuation of a specific font.

11. **Typography**: The art and process of working with and printing from type.

**Summary**

This first chapter showed the ongoing debate between proponents of the effectiveness of online courses versus those who extol the virtues of in-class courses.

Both sides agree that the delivery and design are important in course presentation.
regardless of the delivery method chosen.

Although studies have been conducted on the effect on readability of the factors noted, little data is currently available to instructors on which design format (if any) is most preferable to students. This study of student preferences and affectations would be instrumental in formulating and establishing a common user interface for course Web site design, thus eliminating one potential variable which would currently confound the results of further studies on the overall effectiveness of Internet-delivered college courses at Wayland.

This study provides an asset to any post-secondary educational institution electing to offer its courses via the Internet and also enhance future research in the area of Web-based distance education.
CHAPTER 2
REVIEW OF THE LITERATURE

This chapter begins by reviewing the outcry for research in the area of Web-based media in an educational environment based on the exponential rise of the number of post-secondary Internet-delivered courses and the lack of rules-of-thumb for their development. Two design factors were chosen for analysis, color and typeface. Each of these factors are researched in-turn, first from the aspect of the characteristics of the factor in traditional settings, and then how it applies to the Internet, and specifically Web pages on the World Wide Web.

Technology dramatically affects the educational system. New technologies open possibilities for people who have difficulties attending learning situations in the traditional manner. Edwards and Fritz (1997) found research suggesting that quality learning could be delivered in many ways, including face-to-face and other alternate delivery methods. They see that universities are challenged by the demand fueled by larger percentages of high school graduates attending university, the need for life-long learning and retraining, and the increase in technological skill level demands by information-age employment. They are doubtful that the traditional classroom setting will be able to meet the demands of the student consumer. Web-based courses, as an alternative, challenge instructors and learners to look at new views of the teaching and learning process. Edwards et al. (1997) suggested that it will be the students who will demand delivery of information when it is needed and is most relevant and convenient to them, and educational institutions need to be ready to step up to meet those demands. The authors of the *PBS Distance Degree Handbook* (1996) encouraged
faculty to develop different kinds of instructional material and to be open to new approaches that facilitate instructor/student communication.

In a society full of busy people, Web-based courses offer a method of incorporating education and training into an already active lifestyle. Dunn (2000) stated, “Education is an absolute imperative” (p. 36). Since 1890, more than 100 million Americans have studied by distance education (Distance Education and Training Council, 1997). Dunn (2000) further predicted that by 2025 at least 95% of instruction in the United States would be digitally enhanced because of student demand. It is, therefore, critical to optimize the use of this technology to meet the demands of the learning community.

Well-designed Web pages become a paramount issue in this new system of teaching and learning. In this type of learning environment, video screens are the means of presenting information and creating interactive learning for students. Grabinger (1998) stated, “Because screens are the direct means of communicating with the learner, the design choices determine the success or failure of instruction. Color background and text are two factors that affect Web page design” (p. 42). Edwards et al. stated, “Good presentations are more than the courseware materials. The delivery system, style, and method of presenting the material affect the success of a course” (1997, ¶5). They suggested that the development of good models for others to follow would result in courses that are better designed. Reid (1994) saw the need for models that help developers create good presentation, remarking that after 30 years of courseware development, we still have very few examples that can we can point to as models for future development. Clearly, models of good design would aid future
developers in creating dynamic useful presentations. Two variables that impact on the presentation design and presentation are background color and typeface.

Color

Evers and Kendra (2002) defined color as “a visual sensation produced in the brain when the eye views various wavelengths of light. One of the first impressions a viewer has of a Web page is the color layout” (p.171). An increased emphasis on color technology has raised an awareness of color blindness (Lilliston, 2000). Sewell (1983) estimated that two percent of the female and eight percent of the male population suffer from some form of color blindness. Hoffman’s (1999) estimate ran along the same line with nine to twelve percent of the male population and two percent of the female population experiencing some deficiency in color vision. This fact raised the issue of how best to design computer interface screens to reduce any confusion based on a color deficiency. In a Lighthouse International brochure, Arditi (1997) discussed the importance of effectively using color contrasts to make color choices that work for nearly everyone. He stressed that the understanding of color is based on three perceptual attributes of color-hue, lightness, and saturation. Hoffman (1999) also listed the three attributes of color as important characteristics for designers to understand in order to distinguish how colors differ from each other and how best to use them in design.

Arditi (1997) and Hoffman (1999) defined the three-color characteristics as:

1. Hue: element that distinguishes one color of a rainbow from another; the association made with color names to be able to distinguish the basic colors.
2. Lightness: the amount of light reflected from a surface in relation to nearby surfaces, adding white to achieve pastels or black to create subdued colors.
3. Saturation: the degree of color intensity; the pureness of color.

The effective use of all three attributes adds to the overall design of the presentation that is not only visually pleasing to the viewer but also easy to read. Color and its properties need to be considered when one is creating Web pages.

Color and the Web

Gagne (1985) told instructors the first step is to gain the attention of the audience. If color selection causes emotional responses and associations for the viewer, designers want to ensure it is the desired response. Knowing the symbolism associated with color by various cultures can help the designer create the desired positive emotional response to a Web page design.

Lynch and Horton (1997) in the Yale Style Manual, *Web Style Guide*, supported the concept that graphic design creates visual impact achieved by the combination of visual perceptions of the viewer and the text display. Without this combination of shape, color, and text, Web pages appear boring. The authors claimed background patterns and images are the most controversial graphic elements on Web pages. Evers et al. (2002) proposed that design should first be a process of visualizing the solution on how best to present the design information. Designs that are poorly visualized, poorly planned can have results that range from merely ineffective to catastrophic (p. 5). Lynch and Horton stated that “poor design choices have generated some of the ugliest Web pages, but the proper use of background features can result in Web pages as stunning in graphic impact as anything seen in multimedia CD-ROMs” (1997, ¶5).

Hill (1997) asserted that in a color combination and typeface versus readability study, produced results which indicated that there is a significant enough interaction
between the variables to highlight the fact that there is no one color combination, font type, or word style to use, but rather all conditions affect one another. The challenge is to find the optimum combination of each.

Jeanes, Busby, and Martin (1997) studied the effects of various colored overlays in relation to readability of classroom-presented material. They concluded that overlays of a preferred color, regardless of which color that was, had a positive effect on reading speeds.

Hemphill (1996) conducted a study, which showed that there is a definite link between color and emotional response. A similar study by Terwogt & Hoeksma (1995) indicated that there is indeed a link between color and emotion, but that there are many other variables that are part of an individual’s makeup, such as that person’s cultural background and their previous learning experiences, which can influence what those preferences are.

Evers et al. (2002) stated, “In a visual world, color is the single most powerful symbolic tool” (p. 26). Cultures associate colors with certain attributes. Color has symbolism associated with it. They went on to establish that there is a definite relationship between cultural and psychological significance to the view of graphic designs and color. They listed several Western associations between color and emotions, such as white with purity, black with mourning, green with envy, etc.

Terwogt et al. (1995) wrote that depending on the viewer’s experience with situations associated with particular colors, a pleasant or unpleasant response occurs. Emotional association can result in a heavy negative or a warm comfortable. The authors stated, “color and emotion are tied to each other on the basis of preferences
given to them by the viewer” (p. 11). Ferrett, Preston, & Preston (1998) observed that too often designers use their own preferences for color without giving consideration to their audience. Goto and Cotler (2002) noted, “Problems arise when designers get excited and want to design the coolest thing possible. They cautioned designers to aim to design for your audience, not for any designer’s ego” (p. 28).

In considering the audience, Johanek (2002) advised graphic designers that color carries with it certain messages and can easily set a mood in the reader: Words such as clean and fresh are often associated with blue; Gardening articles and financial advice are enhanced by using green in accompanying illustrations and page layouts. Jacobs (2001) said that “these influences are both psychological and physiological and often they occur beyond our awareness. In addition, understanding of the relationship between color and its influence is often the key to success in a retail environment” (p. 24). Lohse’s (2001) study concluded that advertisements using color were viewed more favorably in his test subjects than those without. However, no mention was made of any particular colors being preferred.

In choosing color backgrounds, Lynch and Horton (1997) suggested that the designer avoid bold, highly saturated primary colors unless using them for emphasis and even then these colors should be used sparingly. Murch (1984) supported this contention when he too recommended avoiding displays of highly saturated colors as fatigue results when the eye has to refocus often. Scharff & Hill (1997) agreed when she advised avoiding mixing colors on the extreme ends of the color spectrum. As the eyes try to focus on the different colors a tug of war ensues that results in eye fatigue. Haubner and Benz (1983) wrote that the improper use of color can impair performance
by distracting a person and interfering with the handling of information. Sokolov (2001) observed that tonal structure is modified by the Law of Contrast between extremes of dark and light. Color structure is similarly modified between the extremes of cold and warm. Possible variations within this basic theme are: dominant cold colors, equal balance, and dominant warm colors.

Typeface in Printed Material

Communication with spoken language allows the receiver to imply certain aspects of the conversation through body language and voice inflections. The way a statement, such as, *I see* is made can express either understanding or sarcasm. Typography is used to convey the author’s meaning through printed material. Typography is the visual treatment of the written language used to enhance communication and encompasses the attributes of written language to convey a message as clearly as possible (de Beaufort Wijnhold, 1997).

People today take printed material for granted. It is everywhere and freely accessible to everyone. At one time, printed material was available only to the very wealthy. Very meticulous, hand printed books were beyond the financial reach of but a few. Gutenberg’s printing press opened the way for mass printing of material made available to almost everyone. Gutenberg created the first typeface used but as the (printing) industry grew, the need for standard type became evident. Mantus (1992) described a typeface as one complete set of characters that bear a single design. Since so many are available, at times it is hard to distinguish one from another. Some are even so outlandish that by design their use is limited. Mantus’ (1992) comment on typefaces was that “some are quite elaborate, others quite simple” (p. 29).
Several factors affected the development of various typefaces that worked their way into use. Widespread distribution of printed material in Europe resulted in the development of typefaces that suited local preferences. Many local areas demanded typefaces that were familiar to them, associating different with bad or foreign. Improvements in the printing process supported new typefaces. Economic conditions dictated the need to conserve, and so thinner typefaces were used to reduce the use of expensive paper. Commercial applications brought a new wave of choices as business organizations looked for a typeface that gave them high visibility and differentiated their product from all the other products available. Commercial use of type in advertising and product packaging at the beginning of the 19th century prompted the design of bolder and more distinctive letters (de Beaufort Wijnhold, 1997).

With so many options available, a designer of written work must choose well. Typography, the design of typeface, is an important aspect of any printed work (Keep, McLaughlin, & Parmar, 2000). de Beaufort Wijnhold (1997) found that not all typefaces are equal. Certain characters/letters evoke emotional responses. Although a B, for example, written in two fonts, B (Kids) and B (Times New Roman), can be recognized as a B, one may be perceived as more professional and seem to readers as being more respectful of them. When we consider the impression letters evoke, not all typefaces are equal. People respond to the particular shape of a character by associating it with a certain intellectual or emotional value.

The challenge is to determine the appropriate typeface to transmit the author’s meaning in the most readable form. Readability is certainly an issue to consider. Johanek (2002) pointed out that readability can be enhanced by using type fonts that
hold up well against busy backgrounds, by going for colors that clarify and separate copy blocks. Typeface is an important element in design as a visual stimulus that conveys mood or meaning. How the letters are shaped and work together on the page is a factor that determines readability. Some businesses have done studies on consumer preferences trying to make associations of a typeface with personalities. The aim was to determine whether there was an association between letterforms and the moods and actions of the consumer. With the exception of early 1900 studies and the study done by Whiteley (1998), who advocated that certain typeface styles on license plates in Great Britain carried a connotation of affluence and were therefore more desirable, little else can be found in scholarly literature on the relationship between typefaces and emotions. Further research into the ways people associate shape with meaning would be valuable in determining the suitability of a typeface chosen for published works.

Typefaces and the Web

Electronic documents have different requirements from those for print-based materials, yet many designers are unaware of the distinction and prepare Web pages as though they were printed pages in a book. Writing Web documents is different from writing for print (Horton, 2000). Sklar (2000) stated, “type creates a strong recurring theme throughout a well-designed Web site” (p. 139). When a person picks up a book to read, it is assumed that he or she will start at the beginning or lose continuity on the information presented. A book is generally read from beginning to end. Information on page ten builds on what was read on previous pages. The reader expects paragraphs of text to fill the page and give detailed information. The contents of a book are accepted
as reliable, at least at the point in time they were published (Mantus, 1992).

Ennis stated, “designing a Web page is just the opposite of designing a print page because print documents are limited to a few colors with an almost unlimited supply of typefaces, while Web pages have almost unlimited color possibilities with little choice of typefaces. (1996, ¶10), Designers of Web pages must look at the readability of the typeface on the video screen and the availability of a typeface on a viewer’s system. Web postings are a series of pages. One never knows for certain where the reader will enter into the document. Each page of the document must contain all the information needed to understand the concept presented on that page. Horton (2000) advised that designers must be encyclopedic, giving the reader a fairly comprehensive presentation of the topic on every page. Horton (2000) and Nielsen (1997) in separate publications described Web users as scanners. Nielsen’s (1997) study How Users Read the Web gave recommendations on how to control Web site layout to facilitate scanning. Web site visitors are looking for the desired information and do not read paragraphs; instead, they look for lists, highlighted words, typography, or emphasis (Horton, 2000). Web users generally prefer writing that is concise, easy to scan, and objective (rather than promotional) in style (Morkes & Nielson, 1998). References made on Web pages are expected to be current and working. D'Angelo et al. (1998) recommended not posting information resources unless it is reasonably certain that its availability can be maintained.

Grabinger (1998) stated that “designers of computer screens that present information and create interactions for learning make choices in manipulating several attributes which are common to both print and electronic media—text, typography,
layout, and graphics” (p. 29). Somerick and Weir (1998) made a case for the readability of certain typefaces being higher than others, assuming that they improve the effectiveness of communication tools. Hill (1997) discussed the contradictory research conducted to examine which typeface is better, serif or san serif. Hill concluded that much of the difference in opinion came from the generalization of research conducted for legibility of text on paper, to the legibility of text on Video Display Terminals (VDTs). It is the design choices for screens, taking the above mentioned page attributes into consideration, that determine the success or failure of the delivery.

Two factors in the choice of typeface are legibility and readability. Web pages’ readability depends on screen and text density, which is the amount of empty space versus the amount of text displayed on the screen. Too much text crammed on one screen has the reader moving on to another page. Hill (1997) also stressed that legibility, and in turn, readability, of the VDT is important for efficient communication. Designers were told to aim for readability and advised to choose typefaces that facilitate comprehension in a learning situation (de Beaufort Wijnhold, 1997). Sklar (2000) stated, “the type used on pages determines the legibility of text” (p.144). Whiteley (1998) lamented the endless range of typefaces available, many of which are fanciful and inappropriate.

In choosing a typeface, one must give high consideration to ergonomic factors. Ergonomics is designing for human use, the key word being usability (de Beaufort Wijnhold, 1997). In terms of Web pages, usability involves the reduction of eye fatigue and stress while reading screen pages. Hill (1997) also emphasized choosing typefaces for readability and lessening of eye fatigue as key elements in Web page designs.
Lynch and Horton (1997) advised keeping everything conservative, conventional, and simple. They further cautioned designers to beware of graphic embellishments where text is concerned. If the reader has to focus on each letter, the meaning of the text is lost. Ferrett et al. (1998) observed that designers may want to use unusual typefaces to make their presentations more interesting, but the authors warned that overuse of fancy types and enhancements such as shadowing can be distracting, and lessen the impact of a presentation.

Conclusions

More organizations are realizing the importance of creating Web pages that ensure readability. Recognizing the need for uniformity, many public and private institutions have studied typography and established basic guidelines for publishing on the Web. A few examples are North Carolina State University, the University of North Texas, the University of Florida, California State University, and Aquinas Institute of Theology. Many more are easily found on the Internet.

Recognition of the need for clear, concise Web page designs has generated a number of conferences dedicated to educating/training people how to design and write Web pages. The Society for Technical Communications (2001) alone listed seventeen such courses. The list is available at http://www.stc.org/48thconf/pworkshop.html.

Contribution to Field

Throughout this review, in both the case of color and typeface, one recurring issue surfaces, that of readability. A common agreement is that higher contrast between typeface color and background color enhances readability. Indeed, in previous studies such as Jeanes et al. (1997), Hill (1997), and D'Angelo et al. (1998), where it was
concluded in their studies of color preferences for Web pages, the higher contrast combinations were favored. Yet no studies were surfaced that controlled for contrast as a variable. In point of fact, often contrast was intentionally varied. Therefore, such a study was needed. This project addressed the issue through a unique methodology that although available to previous researchers, was neglected. Although it is yet to be determined which typeface is more readable, contrast between text color and background color was held constant, and thus eliminated as a potential confounding element. If nothing else, that fact alone dictates the worth of this study to the field of educational research.

Summary

Companies and educational brokerages are looking for ways to provide just in time rather than in-advance learning (Macknight, 1996). Students are demanding delivery of information when and where it is needed (Edward & Fritz, 1997). Web-based courses have stepped up to fill the demands being made. Educators and training executives recognize the need for clear, concise Web page designs and for the creation of models for others to follow.

This chapter looked at two aspects of Web page design: background color and typefaces. Numerous authors touted the importance of these two factors in a well-designed Web page. The end user must be considered when one chooses background colors and typeface. Clearly, the designer of Web pages must choose well to encourage usability of the Web site.
CHAPTER 3

METHODOLOGY

This chapter describes the research methodology for this study, based on the population, sample, and the variables in question. The instrumentation is described as based on previous research, but more importantly takes into account factors that were previously not considered. The data analysis procedures are then listed as appropriate to the study, albeit simple, yet still effective in providing significant resulting information.

The primary intent of this project was to determine whether there exists a significant preference among students for certain characteristics of Web site design factors. Therefore, survey-based research was in order. Consideration of a paper-based text-only survey was eliminated early since it would introduce an element of ambiguity to the project because of different perceptions of the described characteristics. For example, the word green when read can have a significant number of varied meanings, as well as carrying different connotations and mental images.

Thus, a response derived in the direct context of the area of study was preferable. A Web site accessible through the Internet was the answer. This arrangement allowed survey respondents to view Web page background color and typeface of text as they would appear as characteristics of a course Web site and allowed the researcher to control for several other possible variables such as graphic images, audio, motion-video, and load times which would otherwise affect perceptions.

Research Design

Previous researchers, using Web-based surveys, have resorted to presenting either several samples displayed simultaneously (Hill, 1997) and asked the respondent
to select a single preference from the group, or centered on the readability aspects by also varying the text-to-background contrast as well (Jeanes et al., 1997). The work of Murch (1984) ventured into physiological factors. This project was directed at surfacing individual preferences only, with a deliberate attempt to control for first impression bias because of order of presentation, and also control contrast and readability variations. The review of literature has yielded little in past research which has accomplished these goals.

The research design was a one-shot survey of the selected sample of the population. Trochim (1999) explained this as a Post-test only, non-experiment research design, and gave credibility to the method when used in studies, which are devoid of a treatment phase often found in cause-and-effect research. He went on to say that although the design ranks low in the areas of internal validity and causal assessment, it is probably one of the most common forms of research and, for some research questions, especially descriptive ones, is clearly a strong design.

Control of Variables

It was impossible to control for all possible variations of subjects and equipment in a study of this type. Scharff et al. (1997) indicated that such factors as colorblindness, visual acuity, and quality of the viewer’s video display terminal could influence readability, although they do not mention individual preferences. However, to ensure that the population in question is accurately represented, respondents with less than perfect conditions of these factors were not excluded, and sufficient sample size provided balance.
Population

For convenience and accessibility to the researcher, the population selected for this study was the members of the student body of Wayland Baptist University with e-mail addresses as recorded in the university’s registration system. The system known as WISDOM, has been in place since the fall of 1999 and contains records of both current and former students. At the time of establishing the population as a base, there were 10,729 records in the database. The main campus of the university is located in Plainview, Texas, but has external campuses in Texas (4), Arizona (1), New Mexico (2), Hawaii (1), and Alaska (2). This geographical dispersion diversified the population sufficiently to ensure that a random sample of that population equally distributed by age, gender, racial, cultural, or socio-economic bias. Permission was obtained from Dr. Bobby Hall, Director of University Effectiveness and Mr. Jimmy Fikes of the Information Services Division of Wayland Baptist University (Appendix A) for the researcher to obtain from the Information Systems Division of the university a set of e-mail addresses existing in the main registration system.

Sample

The population as defined was identified in a database at the main campus of Wayland Baptist University and consisted of the aggregate of all students at the main campus and all external campuses. The sample was derived from that list without geographical or campus-related distinction.

According to Krejcie and Morgan (1970), for a population size of 10,000 a sample size of 370 is sufficient to give a researcher reasonable assurance that the sample would reflect the same results as the population. Therefore, a sample size of 1,000 was
chosen. The significantly larger than required number proved later to be prudent due to the larger than expected number of undeliverable messages as a result of incorrect addresses.

The list of 10,729 student e-mail addresses was loaded into a database in single column format. Then, using the services of the Random.org (Haahr, 1999) Web site a list of 1,100 numbers was generated that ranged from 1 to 10,729 and it was loaded into another data file. A computer program was used to select records one by one from the list of random numbers and mark the corresponding record by-number as a selectee.

Random.org generates its lists based upon the argument that true random numbers are generated using atmospheric noise, which for many purposes is better than the pseudo-random numbers typically generated by computer programs. In order to ensure that all population members have equal chances for selection, Random.org states that each number is picked independently of the others (like dice rolls), and a sequence of numbers may therefore contain duplicates (Haahr, 1999). If a duplicate was found, the program moved on to the next entry in the list of random numbers. This process continued until a total of 1,000 addresses were selected and the program terminated.

Each selected respondent was sent a message via e-mail requesting his or her participation in the survey (Appendix B). To provide participation incentive to potential respondents, they were informed that upon conclusion of the study, one participant would be selected at random from the list of participants and contacted, requesting name and address for the purpose of receiving a $50.00 check as a reward in the mail. Each message contained a code number from 1 to 1,000 which respondents were
instructed to enter into the Identification (ID) field of the survey form. This was used for the purpose of first to identify which members of the sample actually responded and second to ensure that each one only responded once rather than to stuff the ballot box for the reward.

Instrumentation

The survey consisted of a main Web page with white background and black text in the default typeface of the respondents’ Web browser. This measure was taken to avoid introducing bias due to association. The instrument contained a descriptive introduction and disclaimer at the top and followed by 36 entry areas arranged vertically and centered horizontally on the page. Each set was a rectangular button labeled by set number with two radio buttons beneath each where respondents entered their preferences for the set. Radio buttons were used to limit respondents to one preference only per set.

As each rectangular button was clicked, the respondent was presented with two successive pop-up Web pages, each for a two second duration, and then the pages were removed from view. The interval was chosen to allow sufficient time for download and gave the viewer a short duration look at the page. Each page was approximately two kilobytes in size, which at a nominal download speed of 3.5 kilobytes per second for a standard 56 kilobits per second modem would normally take less than one second, leaving a minimum of one second for viewing. Lohse, (1997) stated, “a short viewing time of approximately 100 milliseconds is optimum for the viewer to form an impression of the object viewed. Much longer and the first impression would have been lost” (p. 62).

Respondents were advised in the introduction that first impressions are the
desired responses, but due to possible differences in Internet and server response, respondents were allowed to view each set again if necessary to form an opinion.

There were two variables under consideration in this study, color and typeface. To keep the survey as short as possible and yet provide sufficient variance in the variables, the three primary colors of the Red Green Blue (RGB) model and the three typefaces common to both Windows-based and Macintosh-based personal computers were selected (Lynch, 1997). The only exception would have been the possibility of the respondent's using a workstation that is Linux or UNIX-based, one which may not have all three of the typefaces available. However, since the overwhelming majority of the computer systems available to students in schools and in their homes are either Windows or Macintosh-based, the likelihood of that exception was deemed insignificant. A caveat in the introduction of the survey warned respondents of this limitation and suggested that the respondent take the survey on either a Windows or Macintosh system.

Referring to the color selection (above), one should remember that computer monitors display colors by varying intensities of three different phosphors on the screen arranged in triads of either small dots or small vertical stripes. Each member of a triad is chosen to emit light in one of the three colors: Red, Green, or Blue. Hence these are referred to as RGB monitors (Webopedia, 2002). When designing Web pages using HyperText Markup Language (HTML), one should note that the page background color is defined as an attribute of the BODY element using a sequence of six hexadecimal characters, two for each of the three primary colors in the order of RRGGBB (Sklar 2000, pp. 196-197). Hexadecimal is a base-16 numbering system developed for use in
computers. Each digit, unlike the common base-10 (Decimal) system we are most familiar with, can range from zero (0) to F rather than from only zero to nine. This provides 16 possible values for each digit (0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, or F). An A digit equates to the decimal value of ten (10), A B digit equals eleven (11), et cetera.

Since there are two digits assigned to each color, the right digit is the ones digit, and the left digit is the sixteens digit. Therefore, the hexadecimal number 3B equates to three sixteens (or 48 in decimal) plus eleven ones for an equivalent of a value of 59 in decimal. The largest two-digit hexadecimal number is FF, which is fifteen sixteens and fifteen ones, for a value of 255 in decimal. Using this, there are 256 possible values of two hexadecimal digits (0-255 inclusive).

Varying the values of each of the three colors, there are $256^3$ (16,777,216) possible colors available for a Web page background. To attempt to survey for all of them would have been an obviously futile effort. As an alternative, the choice of the three primaries was preferable since it delimited the choices to a manageable number. This was also done to consider the possibility of the result indicating a preference which was a combination of colors. For example, if an equal number of respondents favored Blue and Green, it would have been reasonable to conclude that the color produced by equal values of both colors was optimum. This color is known as Cyan. Table 1 lists common color combinations based on their Web page settings:
Table 1

*Color Chart*

<table>
<thead>
<tr>
<th>Color</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red</td>
<td>FF0000</td>
</tr>
<tr>
<td>Green</td>
<td>00FF00</td>
</tr>
<tr>
<td>Blue</td>
<td>0000FF</td>
</tr>
<tr>
<td>Cyan</td>
<td>00FFFF</td>
</tr>
<tr>
<td>Magenta</td>
<td>FF00FF</td>
</tr>
<tr>
<td>Yellow</td>
<td>FFFF00</td>
</tr>
<tr>
<td>White</td>
<td>FFFFFF</td>
</tr>
<tr>
<td>Black</td>
<td>000000</td>
</tr>
</tbody>
</table>

Another characteristic of color referred to earlier is *Lightness*. Displaying full red (FF0000) on a screen and then full green (00FF00) will, besides showing different hues, also display the first page as being quite a bit *darker* than the second page. This contrast was proven in a test on January 7, 2002, by the researcher using a Minolta3 model IVF light meter placed in the center of the screen of a 19" CTX International, Inc.4 computer monitor with each of the above page configurations displayed successively. In the case of the full-red screen, the meter displayed an exposure value (the measure of light intensity for photographic settings) of 8.0. On the full-green screen, a reading of 16.0 was read. Further testing of a full-blue (0000FF) screen produced a reading of 7.1.

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3 © Copyright 2003 Minolta Co., Ltd. All Rights Reserved.
4 © Copyright 2003 CTX International. All Rights Reserved.
Capitalizing on the work of Arditi (1997), the researcher understood that contrast was a factor to consider in color selection. Since this study was to determine color preference, typeface color was held constant and black text was displayed on all screens. With regard to control of contrast variations as stated earlier, a unique method was employed.

As a method of controlling for this variable, rather than using fully saturated colors, it was decided preferable to select those which produce in all three cases a consistent lightness, and thus a constant text-to-background contrast. In order to preserve the main hue of each color, equal values of the other colors are used. Testing various combinations with the light meter, the researcher found that the optimum was: red (FF5050), green (009800), and blue (6868FF). Note that in the case of green, the saturation had to be reduced since there was no combination of the other two, which would produce an equal Exposure Value (EV) without being observed as a pastel version of the color, such as *pink* or *baby blue*.

In an effort to avoid any readability problems on the test pages, and yet let respondents focus on the aesthetics of the typefaces, the text displayed on them used the text set known as the *Lorem Ipsum* paragraph in the public domain, often employed by graphic designers in the layout design phase of their work to keep viewers from being distracted by the content of the text and losing focus on the layout (Walsh, 1996). Respondents were cautioned about this potential problem in the survey instructions.

Referring back to the survey main page design, as respondents completed all of the 36 sets, they clicked on the button at the bottom of the page, which generated an e-mail message sent to the researcher. See example shown below in Figure 1.
An explanation of the data received is as follows:

Colors: R=Red, G=Green, B=Blue; Typeface: T=Times Roman, A=Arial, C=Courier
The sets of three characters on the left of the equals sign denoted, first the variable held constant in each set and then the variable, which is changed and the order of presentation. For example, RTC means that the background color was red and held constant in the set. The first typeface was Times Roman and the second typeface was Courier.

It should be noted at this point that in an effort to reduce or eliminate the possibility that respondents would have been influenced by the first or last impression in each set, the same set was also presented in reverse order elsewhere in the survey.

There were 18 possible combinations in a 3 by 3 matrix when holding one variable constant in a pair and selecting two elements of the other variable. Adding a like total for order of display to be reversed, there were 36 pair wise comparisons, hence 36 survey forms. However, each comparison provides data to potentially indicate interaction between the variables. For example, RAC (and RCA) provided data for preference of a Red-Courier and a Red-Arial potential preference. Therefore, each comparison showed up twice in the matrix above, and thus a total of 72 entries resulted from 36 choices.

Another factor considered was the order in which each of the 36 comparisons appeared in the survey itself. A predictable order of how we are looking at color variances could easily have prepared the respondent for what was coming next and introduce another bias. As a deterrent to that possibility, each of the 36 comparisons was written on a slip of paper, shuffled, and picked from a hat to determine presentation order of comparison sets. The generated e-mail message was then displayed in the order above (with repeats) to facilitate easy summation and recording of the data.
Pilot Study

A group of 20 faculty members of Wayland Baptist University was selected at random and sent a similar message (minus the incentive) prior to finalization of the survey instrument. Their message requested that in addition to taking the survey, they send all possible feedback to the researcher regarding both construct and content validity. After the initial pilot run, another group of 10 was to be selected for a second pilot study, and the results were similar. After the numeric results were tabulated, the assessments were reviewed. The comments that were received are listed here:

I believe you will indeed obtain reliable information on color and typeface preference of participants....at least to the extent of the choices offered in the test.

A psychological factor that also influences one's color and font preferences is the emotional state of the individual. The color red is normally associated with an emotional state of arousal; where the colors blue and green are normally associated with an emotional state of calm. My selection, between the two Websites was based on two criteria, which color was most pleasing and which font within the color was easiest to view. My emotional state beginning the survey was anxious. By the end of the survey I was more focused and less apprehensive.

The reliability of the data in giving an indication in color and typeface in Web site design may be high or it may be low. Your experimental design will ultimately be the indicator of that. Without the knowledge of your design I do not have a clue as to the reliability. Conditions are as close as possible to being constant, which you cannot control in this type of survey, and then the results should be repeatable.

Yes, Color tends to stimulate basic memory patterns, which form long lasting effects on the future of personal choices consistent with personality patterns. I thought the approach was very objective and should result in some valid data

I think that the survey should produce valid data on color and typeface preference. It is a simple survey, which should lend itself to a high completion rate of reliable data. You did good!

I think it should produce data based on color and type preferences. I did note that as I took the survey I consciously wanted to be consistent in color choice (blue);
however, there were times that another color made the print appear clearer and
easier to read. If that had been included as a factor, it would have made a
difference in some of my responses. I was basing my responses solely upon
color and typeface preferences.

I do think it will produce reliable data on color and typeface preference. The only
outstanding variable I can think of is the quality of color generated by various
monitors on the market today; color variations MIGHT produce different choices
by those surveyed.

All of the comments appeared quite positive. The indication from them was that
in their opinion it would produce both valid and verifiable results. In the last response,
the issue of monitor differences was brought up and needed to be addressed. Besides
individual equipment differences, settings can be different as well. Whereas it could
indeed affect a respondent’s choice, there are three points to consider. First, it is
reasonable to assume that if the respondent owned the equipment, then it is quite likely
that the owner would have previously adjusted it to what he or she considered to be the
optimal settings for their own eyes. Thus it would enhance their decisions. Even if it
were not the property of the individual, it is quite common for people to make minor
adjustments on monitors they are using. Second, It was equally unlikely that from the
beginning to the end of taking the survey they would be making any adjustments.
Therefore, each choice would be made equally. Third, although there are numerous
manufacturers of monitors, and some are considered to be of higher quality than others,
all monitors sold in the U.S. are required to comply with Underwriters Laboratory and
Federal Communications Commission standards. Minor differences in display were
considered just that...minor. Likewise, it was reasonable to assume that display
fluctuations because of faulty equipment could be ignored.

One observation made during the pilot study was that occasionally, a respondent
for reasons unknown would neglect to make a choice in some of the page pairs. Since this data loss could have had an effect on the results of the study, it was decided to add a statement to the main page of the instrument indicating to respondents the importance of making a choice in all elements. Otherwise it would have made their response unusable. Apparently, since in the actual run of the survey, there were no similar instances, the addition was effective. Being satisfied that the pilot study was a success, the comment block was removed from the survey and the data collection procedures began.

Data Collection Procedures

Referring to the sample e-mail response shown earlier, the entries on the right of the respective equal signs indicated the choice made in each case. In a Red-Arial-Red-Courier (RAC) comparison, as shown above, Red-Arial (RA) was the choice. Scoring of each cell of the 3 X 3 matrix was done by counting the number of times a choice was made consistent with the combination appearing in the cell label. Using Figure 1, in the case of the Green-Times Roman cell in the center, there were three cases where that was the preference. The second and the fourth were Green-Times (GT) and the eighth was Times-Green (TG). This gave the cell a score of three. In the Blue-Arial cell at top-right, in all but one given situation, that combination was preferable. Thus, that cell is scored as a seven.

Final tally of the summative results was done using a spreadsheet containing the results of each survey as a row, and the columns indicating the score for each of the color-typeface combinations. Table 2 below shows a hypothetical example after three responses. The actual complete list of responses is in Appendix C.
Table 2

*Example Data Collection Spreadsheet*

<table>
<thead>
<tr>
<th>Resp</th>
<th>R-A</th>
<th>G-A</th>
<th>B-A</th>
<th>R-T</th>
<th>G-T</th>
<th>B-T</th>
<th>R-C</th>
<th>G-C</th>
<th>B-C</th>
</tr>
</thead>
<tbody>
<tr>
<td>385</td>
<td>4</td>
<td>6</td>
<td>8</td>
<td>2</td>
<td>4</td>
<td>6</td>
<td>0</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>112</td>
<td>2</td>
<td>8</td>
<td>6</td>
<td>4</td>
<td>2</td>
<td>8</td>
<td>0</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>202</td>
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<td>8</td>
<td>0</td>
<td>4</td>
<td>6</td>
<td>2</td>
<td>0</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
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<td>22</td>
<td>14</td>
<td>10</td>
<td>12</td>
<td>16</td>
<td>0</td>
<td>10</td>
<td>14</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>R</th>
<th>G</th>
<th>B</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>10</td>
<td>22</td>
<td>14</td>
</tr>
<tr>
<td>T</td>
<td>10</td>
<td>12</td>
<td>16</td>
</tr>
<tr>
<td>C</td>
<td>0</td>
<td>10</td>
<td>14</td>
</tr>
<tr>
<td>Total</td>
<td>20</td>
<td>44</td>
<td>44</td>
</tr>
</tbody>
</table>

Rows were inserted as data were turned in and added to the spreadsheet. The cell matrix entries are reflections of the column totals above. Matrix column and row totals provided the summative data for final analysis. The final results are shown in Chapter 4 and the entire data set is in Appendix C.

Data Analysis Procedures

The totals for each row and column were totaled and appear in Chapter 4. A Chi-Square goodness of fit test was used first on column totals indicating color total scores,
and then on row totals indicating typeface scores. Calculations were made in the spreadsheet using the formula: 

$$\text{Chi Square} = \text{Sum, } \frac{(O-E)^2}{E}$$

This test is used to provide statistics to show whether variances from expected (E) occurring in the observed (O) can be attributed to random error (Hinkle, Wiersma, & Jurs, 1998, pp. 579-580). In the case of the interaction between the two variables, the test of independence is on the entire 3 by 3 matrix (Hinkle, Wiersma, & Jurs, 1998, pp. 583-586).

Summary

On the surface, this study may appear to be designed to perform a relatively simple task. However, it is one that has never been performed in the manner presented here. Past studies have concentrated on aspects of readability, emotions, and even fatigue. With regard to preference, it has been only with color combinations and involved a selection of a favorite from larger groups being offered. No reference could be located in which it was performed on a series of pair wise comparisons. In addition, no study was found which simultaneously studied color and typeface in an attempt to determine whether there is any interaction between the two variables. Finally, to the best of the researcher’s knowledge, no study on color preferences could be found which controlled the variable of contrast. This study was designed to fill in those gaps in research and therefore provide a viable tool for both educators and educational researchers.
CHAPTER 4

FINDINGS

This chapter consists of two parts. The first is a summary of a problem encountered with the sample selected and the actual response rate that resulted. The second is a set of evaluations in turn each of the three hypotheses presented in Chapter One.

Sample

On August 21, 2002 the first set of 100 e-mail messages were sent out. Sets of 100 each were sent separately in an effort to avoid clogging the e-mail server resident on the researcher’s home computer. On September 16, 2002, the final batch was sent. During that period responses mostly arrived within the first two days of being sent, but a few more trickled in over the next few days.

Of particular note, was the fact that in total, of 1,000 messages sent in all, 435 came back as undeliverable. The primary reason was that the address was either invalid or no longer valid. This was especially true in the case of addresses at the large e-mail services such as Yahoo and HotMail. This should be expected for two reasons. The first being that often students obtain e-mail addresses from them for temporary use and then abandon them soon thereafter. The second is that students often forget to update their e-mail addresses in a university registration system on a regular basis.

Table 3 below contains a summary of the response rates considering both the original sample and the resulting reduced numbers based on successful receipt.
Table 3

*Response Rate Summary*

<table>
<thead>
<tr>
<th>Sample Considered</th>
<th>Number in Group</th>
<th>Responses</th>
<th>Response Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Original Selection</td>
<td>1000</td>
<td>94</td>
<td>9.4%</td>
</tr>
<tr>
<td>Eliminating Bad Addresses</td>
<td>565</td>
<td>94</td>
<td>16.6%</td>
</tr>
</tbody>
</table>

All but four respondents entered a valid ID code and were considered for the reward raffle. Three entered numbers not on the list, such as 12345 and 2115 and one left the field blank. It was decided to use the data from the four invalid IDs since that information only pertained to the $50.00 participation drawing. A reprint of the entire data set can be found in Appendix C.

Hypotheses Evaluation

**Hypothesis 1**

\[ H_0: \text{color1} = \text{color2} = \text{color3} \]
Table 4

*Chi Square Goodness of Fit Test for Color*

<table>
<thead>
<tr>
<th></th>
<th>Observed N</th>
<th>Expected N</th>
<th>Residual</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red</td>
<td>977</td>
<td>1128</td>
<td>-151</td>
</tr>
<tr>
<td>Green</td>
<td>1093</td>
<td>1128</td>
<td>-35</td>
</tr>
<tr>
<td>Blue</td>
<td>1314</td>
<td>1128</td>
<td>186</td>
</tr>
<tr>
<td>Total</td>
<td>3384</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Test Statistics

<table>
<thead>
<tr>
<th></th>
<th>Quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chi Square</td>
<td>51.97</td>
</tr>
<tr>
<td>Df</td>
<td>2</td>
</tr>
<tr>
<td>Crit. Val.</td>
<td>5.99</td>
</tr>
</tbody>
</table>

Assuming a conservative alpha of 0.05, and noting that there are two degrees of freedom (df = C -1) in this case, this produced a critical value of 5.99. Since the Chi Square statistic was larger than the critical value, there was sufficient reason to reject the null hypothesis.

**Hypothesis 2**

\[ H_0: \text{typeface1} = \text{typeface2} = \text{typeface3} \]
Table 5

*Chi Square Goodness of Fit Test for Typeface*

<table>
<thead>
<tr>
<th></th>
<th>Observed N</th>
<th>Expected N</th>
<th>Residual</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arial</td>
<td>1251</td>
<td>1128</td>
<td>123</td>
</tr>
<tr>
<td>Times Roman</td>
<td>1145</td>
<td>1128</td>
<td>17</td>
</tr>
<tr>
<td>Courier</td>
<td>988</td>
<td>1128</td>
<td>-140</td>
</tr>
<tr>
<td>Total</td>
<td>3384</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Test Statistics

<table>
<thead>
<tr>
<th>Quality</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Chi Square</td>
<td>31.04</td>
</tr>
<tr>
<td>df</td>
<td>2</td>
</tr>
<tr>
<td>Crit. Val.</td>
<td>5.99</td>
</tr>
</tbody>
</table>

Again assuming a conservative alpha of .05, and noting that there are two degrees of freedom (df = C -1) in this case, this produced a critical value of 5.99. Since the Chi Square statistic was larger than the critical value, there was sufficient reason to reject the null hypothesis.

**Hypothesis 3**

$H_0$: there is no relationship between the two variables.
Table 6

*Chi Square Test of Independence*

<table>
<thead>
<tr>
<th>OBSERVED</th>
<th>Red</th>
<th>Green</th>
<th>Blue</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arial</td>
<td>359</td>
<td>419</td>
<td>473</td>
<td>1251</td>
</tr>
<tr>
<td>Times Roman</td>
<td>344</td>
<td>360</td>
<td>441</td>
<td>1145</td>
</tr>
<tr>
<td>Courier</td>
<td>274</td>
<td>314</td>
<td>400</td>
<td>988</td>
</tr>
<tr>
<td>Total</td>
<td>977</td>
<td>1193</td>
<td>1314</td>
<td>3384</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>EXPECTED</th>
<th>Red</th>
<th>Green</th>
<th>Blue</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arial</td>
<td>361.1782</td>
<td>404.0612</td>
<td>485.7606</td>
<td>1251</td>
</tr>
<tr>
<td>Times Roman</td>
<td>330.5748</td>
<td>369.8242</td>
<td>444.6011</td>
<td>1145</td>
</tr>
<tr>
<td>Courier</td>
<td>285.2470</td>
<td>319.1147</td>
<td>383.6383</td>
<td>988</td>
</tr>
<tr>
<td>Total</td>
<td>977</td>
<td>1093</td>
<td>1314</td>
<td>3384</td>
</tr>
</tbody>
</table>

Test Statistics

<table>
<thead>
<tr>
<th>Quality</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Chi Square</td>
<td>2.959272</td>
</tr>
<tr>
<td>Df</td>
<td>4</td>
</tr>
<tr>
<td>Crit. Val.</td>
<td>9.49</td>
</tr>
</tbody>
</table>

Regarding the test for independence on the 3 by 3 matrix, the statistic calculated
was 2.96. Here there are four degrees of freedom using the formula $df = (R - 1)(C - 1)$. The critical value for an alpha of .05 is 9.49, which is greater than the test statistic. In this case, therefore, there is insufficient reason to reject the null hypothesis.

**Summary**

Maintaining the data collection and analysis procedures outlined in Chapter 3 the results of the experiment are clear. Data for color preferences showed that blue at 39.4% received the plurality with green (32.3%) second, and red (29.4%) third. Using the Chi Square Goodness of Fit procedure the statistic indicated that the color preference should not be attributed to random error.

Similar conclusions were made in the case of typeface. The rank there was Arial (36.7%), Times Roman (33.8%), and Courier (29.2%) and indicated a preference. The statistic calculated was again significantly large enough to deduce that it was unlikely due to random error. Regarding the test for independence the statistic calculated was insufficient to conclude that an interaction between the variables exists or that any minor differences could be attributed to any factor other than random error.
CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

In spite of the fact that this study may appear to be limited in scope, it did produce some useful results to both educators and educational researchers. It is unique in several areas, and that characteristic is what makes it useful. There are indeed color and typeface preferences. However, it does also surface questions in other areas, each of which warrants investigation.

Conclusions

Hypothesis 1: The plurality of choice for Blue as a background color preference (39.4% versus an expected 33.3%) indicates that although a preference exists, it is insufficient to conclude that in all cases blue should be used as a background color for Web pages for Internet delivered college courses. Rather, it should be considered as a preferred option if there is no valid reason to use any other possible color. Such reasons could include using school colors as a standard for Web course design.

Hypothesis 2: Here again, a plurality of choice for the Arial typeface, (36.7% versus an expected 33.3%) was recognized and verified as statistically significant. However, more so than in the case of background color the variance is not great enough to suggest that the typeface should always be used.

Hypothesis 3: The statistic produced in this analysis indicates that there is insufficient reason to believe that there is an interaction between the two variables and they can be considered to be independent.

This study produced results which indicate that a preference does exist in the Web page design factors of color and typeface, although in both cases, that preference
is not an overwhelming one. There is also statistical evidence sufficient to conclude that those results are not due to random error. Therefore, it is reasonable to assume that the conclusions derived can be inferred to the population in question, the student body of Wayland Baptist University.

The results show that the color blue was favored at a rate of 39.4% and the Arial typeface was favored at 36.7%. With regard to future Web course designers, there is not a significant enough difference in the totals to say that they should always pick blue and Arial. However, it is reasonable to advise that choice if there is no other reason of any kind to pick any other color or typeface. In that sense, this study is useful to them.

However, on a more far-reaching tone, consider the effect of this information on educational research. Although this study made no attempt to prove the correlation between affectations and learning, it is reasonable to consider that the relationship exists. Further, in referring to the Clark (1983 & 1989) and Kosma (1994) debate, there was an agreement that research is needed wherein the design was flawed due to lack of control of variables which could affect the outcome.

On an even greater scale, this study shows that in future studies comparing one form of instructional delivery to another, if one is an online course, the design of the Web site could indeed have a significant effect on the outcome. In some cases it could make the difference.

Strengths

This study is unique in educational research in the fact that it is the first study of color preferences known to the researcher to control in an effective manner the variable of contrast between background and text. Previous research appears to have been
conceived as a study of color preference, but the results showed that contrast differences overwhelmed the original hypothesis, and thus often invalidated the results.

Picking from a group is difficult. However, breaking it down into pair wise comparisons and then summing up the data makes it easier for both test subjects and researchers, thus producing more verifiable results.

Experts in the graphic arts echoed in Chapter 2 have touted readability as a prime goal in any graphic design intended for informational or instructional purposes. Readability has been shown to be primarily dependent on contrast rather than color. The conclusions of this study show that when contrast is held constant, other factors such as color and typeface can enhance an educational experience as well.

Limitations

This study was based on a limited number of categories of each of the variables actually in question. This was done to keep the survey as short as possible while still producing some results. However, this limitation can easily be ascribed to each variable individually and not to the interaction between them.

The design and delivery of the instrument used was such that it allowed for a large sample size, yet didn’t anticipate the invalidity of almost half of the potential respondents due to bad e-mail addresses. The manual nature of sending out 1,000 individual messages also limited the scope of the study.

Recommendations

Further research is definitely needed in this arena. Color should be studied in greater depth by, as suggested above, expanding to a larger array of hues. Typeface preference would be difficult to expand much further due to inconsistencies in fonts
installed on different computer systems. In that case, it should be done in a lab environment where configurations of the testing computers can be controlled easily.

Considering the research questions in general, perhaps the most significant finding is the lack of interaction between the two variables. Beginning with that fact, it is suggested that further research consider each individually rather than in combination. This does not suggest that other variables such as page format and imbedded graphics do not themselves interact with the two variables studied. Those should be examined similarly in their own right.

With that in mind, the next logical step is to take each of the variables individually and expand the array of choices to provide greater variance. In the case of color, the list should be expanded to include at minimum the secondary colors and perhaps if possible the tertiary colors as well. However, caution should be taken to maintain a constant contrast in the colors displayed. The methodology used in this study should provide the basis for that action. In addition, every effort should be taken to ensure that other potentially confounding variables be eliminated in such a study.

To expand on color choices by adding the secondary colors of cyan, magenta and yellow gives six categories of the color variable. This means that there would be 15 possible pairs if order is not considered, and 30 if it were. This would be a manageable size survey given the presentation methods used in this survey. Adding also the tertiary colors, those halfway between each primary and secondary gives a total of 12 choices. Whereas this would allow researchers a greater refinement of the variable, it would be detrimental in the size of the survey. There would be 66 possible combinations (132 if order is considered.) Thus the survey instrument would likely become too long for even
the most persistent of respondents.

Using that large of a category set would necessitate a major change in instrument design. One possibility is displaying more than two on the same screen rather than in sequential pair combinations. The second option is to display all of the colors on the screen at the same time and make respondents click on their choice. This would relegate the study to fit into the more traditional design as used by previous researchers. The caution here is to avoid the trap of using saturated colors, and to avoid placing text or graphics on the color patches. In the case of text, it would be virtually impossible to avert the respondent from making a choice based on readability. In any case, unless the researcher is intending to study for interaction between two variables, or to continue previous research on readability, there is simply no good reason to display text or graphics on top of a color background.

Another suggestion is to run two independent studies of color, controlling for contrast as this one has done and expand the number of choices to include the secondary colors as well. One study should present choices in a pair wise manner, and the other in a pick from a group fashion. The results of which would be interesting.

Studying color preferences is impossible without at least considering the effects of cultural, ethnic, gender, and other possibly influential factors too numerous to mention. This study used a population that by definition contained a satisfactory blend of these factors in an effort to smooth out their effects on the results. If further research were intended to examine those effects, then considerably more data on respondents would be required. Under the circumstances of this study, that data was unavailable at the onset. This would likely be the case in any similar study. Therefore, it is
recommended that the survey instrument contain elements to establish categorization of respondents when taking the survey. Thus during analysis, grouping can be accomplished as well as protection of the privacy of respondents.

With regard to the typeface variable, this study intentionally held constant the point size of the typeface. Typefaces, although defined by a point size, are observed to actually take up different amounts of space on a page. This study controlled the amount of text in the displayed paragraph to a predetermined physical dimension. In the case of Arial, the slightly wider typeface, the paragraph was shortened to accommodate the dimension. Further studies should make an attempt to control more for physical dimensions of the characters than merely point size.

Researchers using varied typefaces to determine aesthetic preferences should also consider further control of the readability factor. In order to accomplish this it is suggested that rather than using the *Lorem Ipsum* set it would be possible to design a set of nonsensical characters of the look and feel used of a typeface and grouped in sets to simulate words. Respondents would then be relegated to making a choice on aesthetic preferences only.

There are other design factors for Web sites that have not been addressed in this study; Page layout being principle among them. Is the vertical, or columnar arrangement preferable to the horizontal, or paragraph style? Graphics are another issue to consider in further research. Are animated graphics, something often overused on Web pages helpful in conveying a message, or are they in fact more distracting than anything else?

In addition, selecting sets of two of the above names variables, studies should be
conducted to see if any two interact. The fact that background color and typeface do not interact does not negate the possibility that other factors do.

Finally, mechanics of conducting the survey could have been done considerably easier. If a program were written on the Web server which could generate e-mail messages automatically to a predetermined set of addresses in electronic form while incrementing the respondent ID number, a considerably larger sample could have been selected, although it is doubtful that it would have affected the results to any appreciable degree. However, it would facilitate more future studies. Also, automation of tally procedures from responses received should be considered to reduce the time overhead of studies.

Summary

This study was an exercise in perseverance and resourcefulness. The results surfaced preferences for certain colors over others and the same for typefaces. Although the preferences were not overwhelming, statistical analysis did indicate that the results are repeatable and not due to random error. The fact that no significant interaction between the two study variables existed in this study is also important. That fact allows future researchers to discount the potential of interaction in their research design. Finally, it demonstrated that it is possible to create a survey instrument in the form of a Web site on the World Wide Web, which can be administered to a geographically dispersed sample, and yet produce significant results useful to the field of educational research. In some sense, the answers this study has produced may seem small. However, it is the aggregate of small answers that when viewed as a whole pave the way for major breakthroughs.
APPENDIX A

PERMISSION LETTERS
July 8, 2002

Joseph R. Pineau  
4325 Berwick Dr.  
Wichita Falls, TX 76309-4811

RE: Human Subjects Application No. 02-172

Dear Mr. Pineau,

Your proposal titled “Student Preferences in Web Site Design Factors” has been approved by the Institutional Review Board and is exempt from further review under 45 CFR 46.101. Federal policy 45 CFR 46.109(c) stipulates that IRB approval is for one year only.

U.S. Department of Health and Human Services regulations require that you submit annual and terminal progress reports to the UNT Institutional Review Board. Further, the UNT IRB must re-review this project annually and/or prior to any modifications you make in the approved project. Please contact me if you wish to make such changes or need additional information.

Sincerely,

Peter L. Shillingsburg  
Chair  
Institutional Review Board

PS:sb
Hi Jimmy,

As per our previous conversations, I am requesting data from the school's registration system (WISDOM) for the purpose of conducting research, which will be used in my Doctoral dissertation at the University of North Texas at Denton. I need to have an electronic copy of all the e-mail addresses contained in the system. There should be no filtering out of any addresses for any reason other than deceased students. This should include all external campuses as well as Plainview. The resulting list should not contain any references to identity except that which may result from the address itself. Entries will be selected randomly from the list and sent a message requesting participation in a survey which is hosted at http://pineau.net/survey and is intended to determine preferences in typeface and background color used on Web sites. Participation in this survey will cause no harm to the participant or the computer used in the process. The list should be in carriage-return line-feed (CRLF) delimited format for ease of use. It can be added as an attachment to the reply to this message for your convenience. A copy of this message will be included in the request for use of human subjects package to the University of North Texas.

Many thanks again for your assistance in this effort.

Roy
Hi Roy,

The attachment here is from Amanda Ward. She prepared this file last January when we were discussing this. If you need modifications to what Amanda has prepared just contact her directly at award@wbu.edu.

Good luck on your research.

Jimmy Fikes
Director of Information Services
Wayland Baptist University
APPENDIX B

SURVEY INSTRUMENT
Greetings!
And thank you for your participation in this survey!
The results gathered here will be instrumental in forming the conclusions for my dissertation.

INSTRUCTIONS

This entire survey consists of thirty-six elements. It should take you no more than 5 minutes to complete at most. You will be shown throughout the survey sets of web pages, two at a time. You view each set by clicking on the gray buttons with the set numbers on them. Each of the two pages per set will display automatically for approximately 2 seconds or more depending on the speed of your Internet connection. When the second page closes, you should select either 1 or 2 (by clicking on the appropriate button) to indicate which page of each set is more pleasing to you of the two presented. Evaluate each set individually without regard to any other pages presented. In some cases, both may appear either bad or good (or even hideous). Still, I encourage you to make a choice between the two. If you leave any set unanswered, you will invalidate your response to the entire survey. You should only need repeat the display of a set if there was a significant delay due to web connections and an entire page was not shown.

Please don't attempt to actually read the text on the page since it is intentionally nonsensical. I am seeking your first-impression preferences on page design rather than content.

With the exception of the ID which you have been given and are asked to enter in the box below, there is no record of your identity whatsoever. The ID is to ensure that each participant is one that has been selected and that each completes the survey only once. When you have reviewed all the page-sets, please click on the "Submit" button at the bottom. This will complete the survey for you and generate a message to me containing your choices.

This web site will do nothing intentionally in any way to harm your system, and leaves no permanent record with you of your visit to it. If you have reservations about taking this survey, then you may terminate it by leaving this web site at any time. If you have any questions or concerns about this survey or on the subsequent uses of the data obtained through it, please contact me at roy@pineau.net and I will be more than happy to answer them.

In some cases, specifically using certain releases of Internet Explorer, I have noted that when closing a test set and returning to this page, the application will produce an "illegal operation" error and close down the web browser. If you experience this, you should probably update your version of Internet Explorer from the Microsoft Web site. If you do not wish to do this (and it does take a while to do), you can avoid the error by moving your mouse cursor off of the gray button immediately after you've clicked on it. No application errors have been noted when using Netscape Navigator or America Online.

This study has been reviewed and approved by the UNT Committee for the Protection of Human Subjects (940/565-3940).

Again, let me take the opportunity to thank you for your participation.

Roy Pineau
Assistant Professor of Management Information Systems
Wayland Baptist University
Doctoral Candidate
University of North Texas
Please enter your ID number (from the e-mail) here: 

Please make a choice on every set.
Leaving a set unanswered invalidates your entire response.

Set #1
Preference?  ○ First Page  ○ Second Page

Set #2
Preference?  ○ First Page  ○ Second Page

Set #3
Preference?  ○ First Page  ○ Second Page

(Sets 4 through 33 were present here)

Set #34
Preference?  ○ First Page  ○ Second Page

Set #35
Preference?  ○ First Page  ○ Second Page

Set #36
Preference?  ○ First Page  ○ Second Page

Click Here To Send Completed Survey

Sample of set selection portion
Lorem ipsum dolor

Sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat. Duis aute irure dolor in reprehenderit in voluptate velit esse cillum dolore eu fugiat nulla pariatur. Excepteur sint occaecat cupidatat non proident, sunt in culpa qui officia deserunt mollit anim id est laborum. Et harum und lookum like Greek to me, dereud facilis est er expedit distinct. Nam liber te conscient to factor tum poen legum.
Lorem ipsum dolor

Sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat. Duis aute irure dolor in reprehenderit in voluptate velit esse cillum dolore eu fugiat nulla pariatur. Excepteur sint occaecat cupidatat non proident, sunt in culpa qui officia deserunt mollit anim id est laborum. Et harum und lookum like Greek to me, dereud facilis est er expedit distinct. Nam liber te conscient to factor tum poen legum odioque civiuda labore et dolore magna aliqua.
Lorem ipsum dolor

Sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat. Duis aute irure dolor in reprehenderit in voluptate velit esse cillum dolore eu fugiat nulla pariatur. Excepteur sint occaecat cupidatat non proident, sunt in culpa qui officia deserunt mollit anim id est laborum.
APPENDIX C

DATA SET RECEIVED
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<th>G-A</th>
<th>B-A</th>
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<th>G-T</th>
<th>B-T</th>
<th>R-C</th>
<th>G-C</th>
<th>B-C</th>
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