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Ergonomic training and fear appeal: impact on behavior and intention

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ERGONOMIC TRAINING AND FEAR APPEAL:

IMPACT ON BEHAVIOR AND INTENTION

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ABSTRACT

ERGONOMIC TRAINING AND FEAR APPEAL:

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by Robert Ulrey

The purpose of this study was to examine the impact a lecture-based ergonomic training presentation incorporating fear appeal had on participants whose jobs involved working on a computer. There were three groups, each designated by the fear appeal material incorporated into an ergonomic training, control (no training), high, and low fear appeal. The effectiveness of the ergonomic training was measured through observations of various postures participants assumed while working at a computer before and after ergonomic training. Questionnaires gathered participants' reactions to training and intentions to follow recommended work habits.

Results did not show significant differences between groups as a result of the high or low fear appeal manipulation. There were limited statistical significant findings with the questionnaire data such that the low fear appeal groups rated injuries resulting from computer use as more serious and professed a greater intention to follow ergonomic recommendations than the high fear appeal group.

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CHAPTER 1

Introduction

Problem Statement

Within the past decade private industry and the government have implemented regulations and standards to help minimize workplace injuries specifically associated with working at a computer. These regulations and standards have been implemented and enforced due to the rise in injuries associated with working at computers, and the subsequent costs to industry and government. Standards, such as the American National Standard for Human Factors Engineering of Visual Display Terminal Workstations (1988), were designed to provide guidelines for the construction of computer workstations. Regulations from both the state and federal governments have been created requiring employers to provide work environments that are safe and free from recognized hazards (Division of Occupational Safety and Health; U. S. Department of Labor: Occupational Safety and Health Administration's General Duty Clause Section 5).

The regulations require training and employee education on exposures to and risk factors associated with jobs. Injuries specifically related to working at a computer have been studied and certain risk factors (i.e., awkward postures, repetition, force, and infrequent rest) have been strongly associated with these injuries (Lewis, Fogleman, Deeb, Crandall, & Agopswicz, 2001). Training for the prevention of workplace injuries associated with computer workstations has been and is currently conducted by employers in an attempt to comply with regulations and reduce injuries associated with working at a computer. Despite these efforts by employers, costs associated with injuries resulting from working at computers continue to rise.

Workplace injuries have cost employers billions of dollars in years past (Liberty Mutual, 2001). As reported by Liberty Mutual (2001), reported that the leading causes of disabling workplace injuries, which resulted in employees missing five or more days of work in 1999, included among others overexertion and repetitive motion injuries. This study also reported overexertion and repetitive motion injuries were the "leading causes of ergonomic related workplace injuries." Overexertion injuries reportedly had an estimated direct cost nationwide of 10.3 billion dollars and repetitive motion injuries had an estimated direct cost nationwide of 2.7 billion dollars.

The National Institute for Occupational Safety and Health (NIOSH) reported in 1994 that 32% of all cases involving days away from work resulted from repetitive motion or overexertion injuries (U.S. Department of Health and Human Services, 1997). A report by the General Accounting Office (GAO) of the United States (1997) reported employers spent nearly $20 billion on workers' compensation costs associated with musculoskeletal disorders. The GAO's report also stated that ergonomic programs have saved companies money in workers' compensation costs, time away from work, and increased productivity, citing programs at AEFA Headquarters, AMP Electronic Connectors Manufacturing Facility, Navistar, Springfield Assembly Facility, SOCHS, and TI Defense Systems and Electronics Group Headquarters. All companies in this study utilized lecture-based training methods as part of their office ergonomics employee education. Lewis, Krawiec, Confer, Agopsowicz, and Crandall (2002) evaluated the cost benefit of an ergonomic training program. Lewis et al. (2002) stated that while the number of worker compensation claims initially increased after their training program began, the average cost of these claims was considerably reduced compared with those of the pre-intervention period. While the cost of musculoskeletal injuries has been shown to be significant, these types of injuries can be prevented and/or their severity minimized through ergonomic interventions.

Lecture-based training has long been a method used by companies to train employees. Companies train employees on a variety of topics ranging from policies, benefits, procedures, and/or safety information. Training methods used by companies have evolved with the advancement of technology. In addition to lecture-based training methods there are other types, for example, computer-based, participatory, and video-based.

The effectiveness of lecture-based training on influencing behaviors has been researched in the past. While positive results have been observed, there has also been evidence that lecture-based training was not always effective at changing behavior (Lewis et al., 2001; King, Fisher, & Garg, 1997). Bohr (2000) looked at the efficacy of office ergonomic education. Bohr compared three groups (control group, lecture-based training with handouts, and participatory training) to see if the training had the desired effect of decreased pain or discomfort, better worker postures, and better workstation configurations. Bohr found that the two treatment groups (lecture-based and participatory) did show a decrease in reported pain, discomfort, and psychosocial stress compared to the control group. Observational data collected revealed that the treatment groups were not more likely to have better working postures or workstation setups than the control group. King (1995) performed a review of ergonomic training and looked at education training literature. King reported that of the current ergonomic training methods those incorporating some form of lecture, demonstration, and participation yielded the best results, while lecture-based training alone was found to be the least effective at changing attitude and behavior.

In an attempt to increase the impact of lecture-based ergonomic training, a technique used in mass health communications will be utilized. This technique employs fear appeal, a persuasive message which uses fear as a motivator to reduce unsafe behaviors, and to increase the effectiveness of their advertisements (Witte, Berkowitz, Cameron, & McKeon, 1998). For example, high or strong fear appeal uses personalized language that explicitly directs the threat towards the intended audience (Janis & Feshbach, 1953). An example of such a statement could be, "This dire consequence could happen to you if you continue to work in this manner." In a low or weak fear appeal statement the language is purely factual and there is limited mention of the unfavorable consequences (Janis & Feshbach), for example, "Injuries can happen to people who work with computers." Fear appeals and their effects have been studied by psychologists for years (Janis & Feshbach, 1953; Janis & Terwilligen, 1962; Witte & Allen, 2000) and proven to be effective. While the theory of fear appeal has been applied to mass health communication, it has not been applied to office ergonomics training.

Given the problem of repetitive motion and overexertion injuries in the workplace and the cost resulting from those injuries there is an obvious need to reduce injuries in the workplace. Ergonomic programs have been developed to help educate and train workers in safe work habits in an effort to reduce injuries in the workplace. Various ergonomic programs have incorporated lecture-based training, and have been shown to be effective in reducing the severity and number of injuries. Lecture-based training continues to be a common way to train workers despite its known shortcomings. This study will incorporate fear appeal into a lecture-based ergonomic training presentation, for the prevention of cumulative trauma disorders in the office work environment, specifically targeting high risk computer users. Fear appeal was incorporated into the training to improve the effectiveness of the lecture-based ergonomic training presentation, based on findings stating health communication ads incorporating fear appeal were more effective than the same ads without fear appeal.

Statement of Purpose

This study examined the impact a lecture-based ergonomic training presentation incorporating fear appeal (high fear appeal material or low fear appeal material) had on participants while they were working at a computer. The study examined various postures participants' assumed during a typical workday while they were working at a computer before and after an ergonomic training presentation. Two ergonomic training presentations were created one incorporating high fear appeal material and the second low fear appeal material. The control group received no training during the study. The purpose of the study was to determine if there was a difference in observed postures within and between groups (control, high fear appeal, and low fear appeal) before and after an ergonomic training presentation. The high fear appeal group attended an ergonomic training incorporating high fear appeal material and the low fear appeal group attended an ergonomic training incorporating low fear appeal material. Subjective data was gathered with questionnaires, which were administered pre-ergonomic training and post-ergonomic training. The questions gathered information on participants' beliefs and knowledge about ergonomic risk factors and injuries related to computer use; about the feelings participants had in reaction to the ergonomic training they went through; participants' beliefs and intentions to follow the ergonomic recommendations; and the severity participants feel and injury resulting from computer use could be.

It was hypothesized that there would be a difference between and within groups (control, high fear appeal, and low fear appeal) in the observed postures while a participant was at a computer before the ergonomic training and after the ergonomic training. It was also hypothesized that there would be a difference between the high fear appeal group and low fear appeal group in their respective responses to the pre-training and post-training questionnaires.

Research Questions

Two questions guided this research: First, how does a lecture-based ergonomic training presentation which incorporated fear appeal material impact the work habits and intentions of participants while working at a computer? Second, when fear appeal material was incorporated into an ergonomic training presentation what level of fear appeal (high or low) material will have the greatest impact on participants' work habits and intentions to adopt recommended safe work habits when working at a computer?

This research specifically looked at lecture-based ergonomic training and the prevention of cumulative trauma disorders in the computer workstation environment.

Definition of Terms

Cumulative trauma disorders.

Cumulative trauma disorders can be described as disorders that are due to the cumulative effects of multiple exposures to a stressor rather than to disease or degeneration. An example of a stressor is, working in an awkward posture for a prolonged time or performing the same task repeatedly. Typically cumulative trauma disorders refer to injuries of the musculoskeletal system (muscles, tendons, ligaments, and nerves). Cumulative trauma occurs when a force or a stress is applied to the same muscle or muscle groups repeatedly, causing an inflammatory response in the tendon, muscle, or nerve (Pedretti, 1996). A neutral posture can be defined as the body position that minimizes stresses on the body (Prevention Services, 2003). Awkward posture is any fixed or constrained body position that overloads muscles and tendons or loads joints in an uneven or asymmetrical manner (Prevention Services, 2003). Deviation of a body part will be defined as any movement of a body part towards the extreme in its range of motion. Radial deviation occurs when the hand moves laterally, or toward the radial bone side, which is the side of the hand the thumb is on (Lippert, 1994). Ulnar deviation occurs when the hand moves medially from the anatomical position toward the ulnar bone side, which is the side of the hand the pinky is on (Lippert, 1994). Static postures can be described as a prolonged state of contraction of the muscles, which usually implies a postural stance (Grandjean, 1988).

Fear.

Fear can be described as a strong negative emotion, accompanied by a high level of arousal, which may be brought on by a threat that is perceived to be significant and personally relevant (Witte, 1992). A threat is an expression of intention to hurt or an indication of imminent danger or harm perceived to be significant and personally relevant. The theory of fear appeal, a persuasive message intended to influence people through a threat of imminent danger or harm, has been studied for years by psychologists. Janis and Feshbach (1953) divided fear appeal into three levels; low, moderate, and high. High fear appeal was defined as emphasizing the painful consequences; the training or education message was personalized, the message explicitly directs threats to the audience, and pictures were realistic and vivid. Moderate fear appeal was defined as describing the threats in a mild and more factual manner; the language was impersonal, and pictures may be lifelike but are more mild examples of the potential negative outcomes. Low fear appeal rarely alludes to the consequences; fear-appeal information was replaced by relatively neutral descriptive information, presented in a purely factual manner, with pictures that were not realistic.

Workstation.

A workstation includes the entire area accessed by a worker while performing their normal job tasks while working at a computer. This will include input devices (keyboard and mouse), chair, and monitor(s). For the purpose of this study a video terminal display will be considered equivalent to computer monitor or laptop screen.

Assumptions

An assumption for this study was that participants worked at least four or more hours during a 12-hour period at a computer. The length of time spent at the computer during a typical workday would not be exactly the same for all participants, but would vary with their work duties. The nature of the observation method, work sampling, assumed that the researcher observed a participant intermittently throughout the workday. Because of the observation method and the assumption that participants would not be in their offices the entire observation period, it was assumed there would not be an equal number of postural observations of participants working at a computer across groups before and after the ergonomic training presentations.

It was assumed that participants would have their own individual knowledge of ergonomics, safe work habits when working at their computers, and history of injuries and illnesses related to computer use. Individual differences were minimized by randomly assigning participants to a group and by examining the participants both pre- and post-manipulation. The assumption was made that each participant could have been impacted by the ergonomic training presentation in a different manner. An individual's prior beliefs and behaviors regarding office ergonomics and risk factors related to computer use could have had a different impact on each participant.

Limitations

This study examined a relatively small worker population at one California computer company. The participants in this study were considered high-risk computer users, working four or more hours a day at the computer during a 12-hour period.

Therefore the results of this study may not be able to be generalized to the general population, but only to similar environments. The observations made of the dependent variable (postures) could not be recorded without the participant knowing when the researcher was observing, and could therefore have led to occasional position adjustments by a participant as a result of noticing the observer, thus introducing bias into the data collection. The researcher attempted to minimize the possible effects by conducting trial observations prior to the onset of the study in an attempt to habituate the participants to his presence.

The natural setting in which the study took place created a limitation. Observing participants in their own offices during a normal workday meant that participants were out of their offices due to meetings and other activities or in their offices, but not working at a computer during the observation period. Observations could fall into one of three categories: out of their office, in their office but not at a computer, or in their office at a computer. There were and equal number of observations taken for all participants, but the total number of postural observations for each participant, taken while participants were in their office at a computer, varied from pre-ergonomic training to post-ergonomic training. The time constraints the researcher was under prevented him from extending the study to gather additional data needed to have an equal number of postural observations of participants, in their office at a computer, across groups before and after the ergonomic training presentation due to the participants being away from their workstation periodically throughout the observation period.

The data collection involved observing specific postures participants assumed while either keying or using the mouse while working at a computer. The researcher after observing a participant matched the observed postures with the graphic icon that most closely represented that posture. The data collection was conducted by the researcher, which may have allowed for observer bias. Observer bias was minimized by the fact that the researcher was not aware to which group a participant had been assigned.

The fear appeal material developed for the ergonomic training incorporated different levels of graphic and vivid pictures and specific language for the high and low fear appeal presentations. The fear appeal material was chosen by the researcher and was limited by his resources and perception of what was considered appropriate. A lecture-based training was chosen as the format in which to present the ergonomic training. Research had indicated that lecture-based training alone may increase knowledge, but it has little carryover effect. While the format of training chosen, lecture-based, was a limitation in itself, it most closely represents the current method this company uses to train their employees in ergonomics. It was the intention of the researcher to keep the training as similar as possible and have the fear appeal material be the only difference.

The purpose of the ergonomic training presentation was to educate participants about the risk factors of working at a computer and provide methods of minimizing those risks. One of the risk factors of working at a computer is awkward postures. The ergonomic training presentations educated participants on what were considered awkward postures through photographs of various people at a computer workstation. This study collected postural observation data for sitting, head and neck, upper extremity, and wrist positions while participants were working at a computer. The ergonomic training presentations created may not have clearly presented what an awkward posture of a sitting position, head and neck, upper extremity, or wrist posture looked liked. It was the job of the presenter of the ergonomic training presentation to point out the awkward postures during the ergonomic training.

Delimitations

The data collection for this study was conducted by the researcher and was limited by time constraints and resources available to him. Due to the time consuming nature of gathering the observational data, the number of participants and observations for this study were limited. The number of experimental groups was limited (control, high fear appeal, and low fear appeal) due to time constraints as well. The ergonomic training presentation was developed by the researcher and was limited by the resources and capability of the researcher to develop a Power Point presentation.

Significance of Project

If the impact of ergonomic training on individuals could be improved, the likelihood of individuals adopting safe work habits may be increased. By practicing safe work habits, injury and illness rates resulting from working at a computer may be reduced, and save companies expenses associated with injured workers.

This ecological study examined how incorporating specific fear appeal material into a lecture-based ergonomic training presentation would influence participants to adopt recommended safe work habits while working at a computer. This was one of the first experimental field studies to incorporate fear appeal material into a lecture-based ergonomic training presentation and gather postural observation data through a work sampling method.

Summary

This study looked at the impact an ergonomic training presentation which incorporated fear appeal had on participants' work habits and intentions to follow recommended safe work habits. Increasing a participant's intention to follow recommended work habits while working on a computer may facilitate prevention of cumulative trauma disorders. One ergonomic training presentation contained high fear appeal material and the other low fear appeal material. Participants' work postures were observed before and after an ergonomic training presentation while they were working at a computer. Reactions to the ergonomic training and intentions to follow recommended work habits from the ergonomic training were gathered with questionnaires. The researcher hoped to find a difference between the control (no training), high fear appeal, and low fear appeal groups in the questionnaire responses and postural observation data gathered before and after the ergonomic training presentation. The threat that was used to instill fear in the ergonomic training presentation was the risk of developing and the possible severity of cumulative trauma disorders and their consequences (aches, pains, numbness, or surgery). The high fear appeal material presented this information with realistic and vivid images and personalized the language of the presentation. It was hypothesized that there would be a difference between groups and within groups in the observed postures before the ergonomic training and the observed postures after the ergonomic training. It was also hypothesized that there would be a difference between the high fear appeal group and low fear appeal group in participants' ratings on the pre-training and post-training questionnaires.

CHAPTER 2

Review of Literature

The literature reviewed for this study included research on cumulative trauma disorders, risk factors related to working at a computer, lecture-based training, and the theory and application of fear appeal.

Cumulative Trauma Disorders

Cumulative trauma disorders are injuries characterized by the cumulative effects of multiple exposures to a stressor rather than to disease or degeneration. Cumulative trauma disorders typically refer to injuries of the musculoskeletal system (muscles, tendons, ligaments, nerves, and circulatory system), and common stressors (risk factors) include awkward postures, force, and repetition. Injuries of this nature occur when a stressor is repeatedly applied to the same muscle or muscle groups, resulting in micro-traumas, which can lead to an inflammatory response in a tendon, muscle, joint, or nerve (Pedretti, 1996). Symptoms of an inflammatory response to a muscle or tendon can include localized pain and swelling when the affected musculoskeletal structure(s) are used (Anderson, 1992). Other terms used to describe injuries of this nature are repetitive strain injury (Anderson, 1992), repetitive motion injury (Anderson, 1992), or musculoskeletal disorder (NIOSHA, 1997).

There are many risk factors strongly associated with cumulative trauma disorders and working at a computer. The National Institute of Occupational Safety and Health (1997) reported that there was strong evidence supporting a relationship between postures and neck and shoulder disorders and strong evidence of elbow musculoskeletal disorders and hand and wrist tendonitis when there was a combination of repetition, force, and/or awkward posture.

Awkward postures can be defined as any constrained body position that overloads muscles and tendons, or loads joints in an asymmetrical manner (Prevention Services, 2003). In relation to computer use awkward postures are commonly observed in the back, neck, shoulders, elbows, and wrists (Bergqvist, Nillsson, &Voss, 1995 a, b; Hedge et al., 1996; Matias, Salvendy, & Kuczek, 1998). For example, typing with the wrists positioned in ulnar deviation and extension can narrow the carpal tunnel and result in an awkward posture for the wrist. The awkward wrist posture can create a mechanical disadvantage for the finger and wrist flexor and extensor muscles leading to increase in muscular effort required to compete the task at hand.

Marcus et al., (2002) reported several neck, shoulder, hand and arm postural risk factors for musculoskeletal symptoms and disorders among computer users. Typing with the "J" key of a keyboard higher than that of the elbow was associated with an increased risk for neck and shoulder symptoms. If the "J" key was higher than the elbows compared to the elbow when the shoulders were relaxed and the elbows were in by the side of the body, it could result in awkward postures for the shoulders. When typing, the body will assume postures to work most efficiently. For example, when typing the shoulders may unconsciously elevate to raise the elbow height level with or higher than the "J" key on a keyboard or we may reach forward with the arms thereby raising the elbow height to minimize stress to the wrists. In each of these resulting postures the muscular effort required by the shoulders increases and the increase in effort required to perform the task can therefore lead to fatigue more quickly. Improper keyboard position was associated with cumulative trauma disorders due to the resulting awkward postures that can result to the hands and wrists as a result of the keyboard placement (Bergqvist, Nillsson, & Voss, 1995 a, b; Hedge et al., 1997; Matias, Salvendy, & Kuczek, 1998). Improper keyboard placement can lead to ulnar deviation, radial deviation, wrist extension, and or flexion when typing.

Improper use of a computer mouse has also been cited as a risk factor for cumulative trauma disorders (Hedge, McCrobie, Morimoto, Rodriguez, & Land, 1996). The use of a computer mouse can lead to awkward postures of the wrist. The computer applications a person uses can affect their frequency of mouse use. The computer work habits of an individual, repetition of work, and insufficient rest breaks are risk factors strongly associated with cumulative trauma disorders (Hedge et al., 1996; McLean, Tingley, & Rickards, 2001). With enough repetition and inadequate recovery time the body's healing ability cannot keep pace with the micro-trauma caused by a stressor, and the beginnings of a cumulative trauma disorder may occur. Marcus et al., (2002) reported radial deviation of the wrist greater than five degrees while using a computer mouse was associated with an increased risk for hand and arm symptoms. For example, when the fingers and wrist work to maneuver a mouse in a radial deviated position greater than five degrees, the muscles and tendons utilized with this activity are at a mechanical disadvantage and therefore can fatigue more quickly; The are tendons functioning at an angle which may result in the tendons gliding with increased friction on surrounding tissues.

Postures associated with a lower risk of neck and shoulder symptoms include keying with an inner elbow angle greater than 121 degrees and the presence of armrests on the participants' chair (Marcus et al., 2002). Postures associated with lower risk of hand and arm symptoms occur when the horizontal location of the "J" key of a keyboard is 12 cm or less from the edge of the work surface on which the keyboard is placed (Marcus et al.).

Through experimental research Ankrum (2002) developed some computer monitor placement guidelines with the aim of minimizing injury while viewing a computer monitor. Specific measures for the monitor placement were recommended in this report: There should be a horizontal distance of at least 25 inches between the user and the computer monitor, the viewing area of the computer monitor should be between 15 and 50 degrees below the user's horizontal eye level, and the monitor should be tilted so the top is slightly farther from the user's eyes than the bottom of the monitor. Improper placement of the monitor can contribute to awkward postures of the head and neck, which has been cited as a risk factor for cumulative trauma disorders (Bergqvist, Nillsson, & Voss, 1995 a, b; Hedge et al., 1997; Horikawa, 2001). According to Ankrum (2002) prolonged (static) postures, even if not awkward postures, may contribute to cumulative trauma disorders of the upper back and neck. Static postures, a prolonged state of muscle contraction, was also cited as a risk factor for cumulative trauma disorders by Grandjean (1987) and McLean, Tingley, and Rickards (2001).

Force or excess force used in association with typing and using a mouse has also been cited as a risk factor for cumulative trauma disorder (Buckle & Devereux, 2002;

King, Fisher, & Garg, 1997; Lewis, Folgleman, Deeb, Crandall, & Agopswicz, 2001). Using more than the required force to depress a key on a keyboard while typing uses more muscle energy and can facilitate fatigue in the affected body areas. Force, when combined with awkward postures and repetition, results in a greater risk of developing a cumulative trauma disorder than any one of these risk factors alone (NIOSH, 1997).

Ergonomic Training Methods

Studies have been conducted to look at the effectiveness of ergonomic training programs directed at minimizing injuries and work related risk factors, such as awkward postures, static postures, repetition, insufficient rest breaks, force, keyboard position, monitor placement, and computer mouse use (Lewis, Fogleman, Deeb, Crandall, & Agopswicz, 2001; King, Fisher, & Garg, 1997; Buckle & Devereux, 2002). King et al. (1997) examined the effectiveness of three different types of ergonomic training in a large midwestern manufacturing industry: lecture only, lecture with job redesign, and participatory training with job redesign. All three of the intervention groups were given the same lecture but varied by job redesign and participatory measures. Participatory training consisted of a discussion group led by one of the researchers about the ergonomic problems found by the workers in their job area and prospective solutions. Lecture training with job redesign and participatory training with job redesign were said to have the greatest impact on employee attitude and knowledge. The lecture only training without any follow-up intervention had no lasting carryover effects, but did increase the awareness of risk factors for cumulative trauma disorders associated with their jobs. As a result of increase in awareness and no job redesign, the job satisfaction for this group decreased following training. Employees who received lecture with job redesign and participatory training with job redesign also demonstrated an increase in awareness of the risk factors associated with their jobs, as well as an increase in job satisfaction as a result of their training.

Lewis, Fogleman, Deeb, Crandall, and Agopsowicz (2001) conducted lecture-based training to educate workers on correct workstation postures, the need for stretch breaks, risk factors of repetitive strain injuries (RSI), RSI symptoms, and the need for prompt medical care. Another goal of their study was to train computer users to be able to assess and adjust their own workstations. Their population included employees at a petrochemical research and development facility who used a computer for two or more hours a day. The employees were asked to complete a self-administered questionnaire prior to the training and asked to fill out the same questionnaire one year later. The training consisted of a lecture, handout materials, and model workstations in which the participants could practice adjustments. Lewis et al. (2001) found that the instructor-led ergonomic training they provided led to a significant increase in risk factor awareness and a change in some of the observed behaviors, such as improvement in head and mousing postures. Some postures in which no significant changes were observed included wrist, arm, shoulder, and back positions. A significant number of participants reported a decrease in severity of symptoms of the head and neck and hand and wrist on the follow-up questionnaire.

Bohr (2000) conducted a study to look at the efficacy of worker education programs in preventing musculoskeletal injuries associated with working at a computer.

Participants were assigned to a group receiving lecture-based training, participatory training, or to a no-training control group. The lecture–based training group consisted of a one-hour education session and handouts on office ergonomics. The participatory training group received similar information as the lecture-based group, but through an active learning session incorporating problem solving and discussions. The study used surveys to measure worker mental and physical health status and symptomology pre- and post-training. A significant difference was found between the control group and intervention groups, but no significant difference between the two intervention groups for upper body pain and discomfort ratings following training. Both intervention methods resulted in a significant decrease in reported work stress. While the study demonstrated subjective differences between the control group and the two interventions, observational data revealed the intervention groups were not any more likely to have properly arranged workstations or use more neutral working postures than the control group.

Both Lewis, Folgleman, Deeb, Crandall, and Agopsowicz (2001) and King, Fisher, and Garg (1997) were able to show an increase in awareness of cumulative trauma disorder factors associated with the participant's respective jobs through lecture-based training. Lewis et al. demonstrated that lecture-based training affected some behaviors of people working at a computer. Bohr's (2000) findings do not support Lewis et al. and King et al. in that lecture-based and participatory training did not lead to behavioral changes. Bohr, while not demonstrating behavioral change with his study, did show some benefit from training with an increase in perceived comfort by participants following the training.

Rizzo, Pelletier, Serxner, and Chikamoto (1997) conducted a pilot study to examine the effectiveness of educational ergonomic training by measuring participants' immediate and long-term knowledge of ergonomic principles and work practices associated with a computer. The study had three groups: Control, instructor-directed, and self-directed. The control group received no intervention. The instructor-directed group received an instructor-led 60-minute lecture, two 15-minute videos, and a discussion which was held regarding the material covered. The self-directed group watched the same two videos as the instructor-directed group and had a discussion regarding the materials. Results showed both the instructor- and self-directed groups demonstrated significant improvement in their knowledge test following training. It was reported that there was no significant change in intent of participants in the two intervention groups, but results did indicate the intervention groups had a higher level of intent to change than the control group. A significant majority for both intervention groups reported making changes to their workstations as well as in their "use and habits" pertaining to the computer work station.

Lecture-based training combined with a form of demonstration and participation has been shown to be more effective than lecture-based training by itself in affecting behavior and intention (Bohr, 2000; King, 1995; King, Fisher, & Garg, 1997). Lecture-based training by itself has been effective at improving factual knowledge (Liker, Evans, Ulin, & Joseph, 1990). While lecture-based training with or without participation has been effective to an extent at influencing behaviors, there is room for improvement for ergonomic training to affect the behaviors and intentions of employees to adopt safe work habits. In an attempt to add to the impact of current ergonomic training methods and increase the adoption of recommended behaviors, this study will incorporate the theory of fear appeal, a method which has proven effective in mass health communications at affecting the intention and behavior of people, into the lecture-based ergonomic training.

Fear Appeal

Fear appeal messages have been used to motivate or influence individual behaviors (Witte, 1998). Fear appeal has been studied and proven to have a greater effect on the intention of people to adopt the recommended behaviors compared to the use of the same message without fear appeal (Janis & Feshback, 1953; Keller, 1999; Keller & Block, 1996; LaTour, Snipes, & Bliss, 1996; Witte & Allen, 2000). Past research has applied messages using fear appeal to health communication advertisements that were intended to reach a large national population, for example, anti-smoking, prevention of HIV by practicing safe sex, safe sex for the prevention of sexually transmitted diseases, and anti-drinking and driving (Maddux & Rogers, 1983; Montazeri & McEwen, 1997; Sherer & Rogers, 1984; Witte, Berkowitz, Cameron, & McKeon, 1998). Witte (1992) defined fear appeal as "persuasive messages designed to scare people by describing the terrible things that will happen to them if they do not do what the message recommends."

The theory of fear appeal has been studied over the past 50 years. During that time there have been three independent variables (fear, perceived efficacy, and perceived threat) identified as being associated with the theory of fear appeal (Witte and Allen, 2000). A meta analysis by Witte and Allen (2000) categorized the various fear appeal theories that have been proposed over the years into three major groups: drive theories, parallel process models, and subjective expected utility models. The various fear appeal theories tended to reflect the current psychological views of their time period (Witte & Allen). Drive theories on fear appeal assumed the level of fear arousal that was produced from fear appeal acted as a drive to motivate actions. The effectiveness of a fear appeal message was therefore dependant on the arousal of fear. With this theory fear appeal was able to have both a facilitating and interfering effect on motivation (Janis & Terwilliger, 1962). This theory suggested an inverted U-shaped relationship between fear and attitude change, which was ultimately not supported and rejected in the 1970's (Witte & Allen).

Leventhal (1970) proposed the parallel process model of fear appeal. The parallel process models looked to explain the emotional versus cognitive responses to fear appeal. These models suggested that fear appeal produces two separate and potentially interdependent processes: danger control (efforts to control danger or threat) and fear control (efforts to control fear about the threat or danger) Witte and Allen (2000). The parallel process models were ultimately criticized as being untestable and lacking specificity, but they did change the current thinking of the times about fear appeal and separating cognitive from emotional processes.

The Subjective Expected Utility (SEU) models attempted to assess what makes fear appeal effective in a logical manner and tended to have a cognitive focus. Rogers (1975) proposed the protection motivation theory (a SEU model), which assumed that a fear appeal message initiated a cognitive appraisal process regarding the severity of the threat, the probability of the occurrence of the threat event, and the efficacy of a recommended coping response or behavior. This cognitive appraisal process led to protection motivation: an activity to protect ourselves from a threat or danger (Maddux & Rogers, 1983). Cognitive components identified by Maddux and Rogers in fear appeal message acceptance included severity, susceptibility, response efficacy, and self-efficacy. Witte and Allen (2000) disputed Rogers (1983) proposed a four-way interactions between these four components. Witte and Allen claimed the Protection Motivation theory was not able to show support for this four-way interaction. The Protection Motivation Theory was able to explain why fear appeals were effective; it was not able to explain when and how fear appeal fails.

Witte (1992) developed the Extended Parallel Process Model (EPPM) of fear appeal, which integrates the three previous theories on fear appeal into one. The Extended Parallel Process Model expanded on previous research to include a theory on why fear appeal worked and did not work. The Extended Parallel Process Model stated that people go through two appraisal processes when presented with a threat. First a person appraises the threat that is presenting itself. If the perceived threat (perceived susceptibility and severity of the threat) is high then a fear emotion is evoked, and the second appraisal process can begin. If the perceived threat is low then no fear may be elicited, and the person ignores the threat and does not begin the second appraisal process. According to the Extended Parallel Process Model without beginning the second appraisal process, the recommended actions of the message would most likely be ignored.

The second appraisal process involves perceived efficacy, which determines whether people will become motivated to change their behavior to minimize the fear of the threat or deny (discount) a threat to minimize the fear of that threat. According to Witte (1992) efficacy is composed of two parts, response efficacy and self-efficacy. Self-efficacy is a generalized belief in one's ability to perform an action or recommended behavior. An individual with high self-efficacy develops an interest in what he does, sets high goals, sustains strong commitments, and tends to approach difficult tasks as challenges rather than threats. An individual with low self-efficacy tends to avoid difficult tasks that are viewed as threats, has weak commitment to goals, and low aspirations. Response efficacy is a generalized belief that the recommended actions will be effective in preventing the threat. An individual with a high response efficacy believes the recommended actions will work in preventing a threat. An individual with low response efficacy believes the recommended actions will not likely work in preventing the threat and therefore tends not to adopt the recommended behaviors (Witte, 1992; Maddux & Rogers, 1983). Therefore, if an individual perceived a threat as high and the recommendations were believed to be feasible and effective to avert the threat (high self-efficacy and high response efficacy), he would adopt an intention and/or behavior to control the dangerous nature of the threat through the recommended actions. If a threat was perceived as high and the recommendations were believed to be either not adequate to avert the threat (low response efficacy) or the individual believed he was unable to perform the recommended actions (low self-efficacy), the recommended actions have a greater likelihood of being ignored and the fear would be minimized by denying the consequences of the threat or discounting the threat as invalid. While efficacy is an important component to the Extended Parallel Process Model fear and threat also are key components.

Witte's (1992) Extended Parallel Process Model incorporates three basic components of fear appeal: fear, threat, and efficacy. The Extended Parallel Process Model assumed all individuals had their own beliefs and biases, which would affect their personal perceived fear, threat, and efficacy regarding a fear appeal communication. The level of perceived threat and efficacy a message contains can have a direct bearing on the potential for a person to adopt the recommended actions of a message (Maddux & Rogers, 1983; Witte, 1992). Fear, as cited by Witte (1992), may be defined as a negative emotion elicited by a threat that is perceived to be significant and personally relevant and is accompanied by a high level of arousal. A threat can be defined as an expression of intention to hurt or an indication of imminent danger or harm (Merrriam-Webster's Collegiate Dictionary, 2000). A perceived threat is composed of two parts severity and susceptibility (Witte, 1992). The perceived severity of a threat refers to an "individual's beliefs about the seriousness of the threat" and the perceived susceptibility to a threat refers to "an individual's beliefs about his or her chances of experiencing the threat" (Witte, 1992). The greater the perceived severity and susceptibility of a threat, the greater the amount of fear a person may experience. Because people generally do not like being fearful they will try to minimize their fears and therefore minimize the threat by adopting the recommendations of a message. As stated in the Extended Parallel Process Model, people are more likely to adopt recommended actions if those actions are perceived to effectively minimize or eliminate the threat.

The use of fear appeal in health communication has shown varied results, such that in some instances more (fear appeal) was not necessarily better (Janis & Feshbach, 1953; Janis & Terwilliger, 1962). A high or strong level of fear appeal may lead to message discounting or minimizing the perceived threat, because the level of fear instilled was too great (Janis & Terwilliger, 1962; Witte, 1992). The action of discounting a message or minimizing its intent is called defensive avoidance. If the level of fear appeal is too low, people may ignore or discount the message and the true severity of the potential consequences (Witte, 1992). When the fear of resulting consequences is too great and a person feels too susceptible to "some" of the consequences, feeling like whatever he does will not be effective in preventing himself from experiencing the consequences, he may defensively avoid the recommended actions believing they are ineffective. When the threat of a message is presented in a minimally invasive way (low perceived threat) a person may discount the message thinking the threat and resulting consequences are not likely to occur to him. A balance has to be achieved between the level of severity and proposed susceptibility of a threat to best affect peoples' intentions and behaviors. For example, if the consequence of non-compliance is death, a person may be more inclined to adopt the recommended actions compared to a consequence which may merely result in an injury after a prolonged amount of time (e.g., cumulative trauma disorders).

While there is some evidence that high fear appeals do not always have their desired effect (Janis & Feshbach, 1953), a meta-analysis of fear appeals by Witte and Allen (2000) provides evidence that high (strong) fear appeals are effective. Witte and

Allen reported that previous studies suggested that the stronger the fear appeal the greater the change in intention and behavior. The meta-analysis by Witte and Allen found that the greater the fear aroused, the greater the perceived severity and susceptibility of the threat, and the stronger the efficacy of the message, the greater the perceived response efficacy and self-efficacy. For a fear appeal message to be most effective the perceived threat, response efficacy, and self-efficacy need to be high. If any one of these factors is low the likelihood of message acceptance and recommendations being acted upon decreases. For example, when the threat is believed to be serious and relevant to people and the perceived efficacy is high, they become frightened and are motivated to reduce the threat, their fear, by adopting the recommended behaviors. When the threat is high and believed to be relevant, but the perceived efficacy is low, people try to reduce their fear through denial instead of by adopting the recommended behaviors (Witte and Allen, 2000).

Levels of Fear Appeal.

As stated previously, fear appeal is a persuasive message intended to influence people through a threat of imminent danger or harm. Janis and Feshbach (1953) defined three levels of fear appeal: high, moderate, and low. High fear appeal emphasized the painful consequences of a threat, the training message was personalized, threats were explicitly directed toward the audience, and pictures were realistic and vivid. For example:

> If you work on a computer you may develop cumulative trauma disorders if you ignore the risk factors. Cumulative trauma disorders can be very painful, restrict

movement of the joints, cause significant loss of strength in the affected body part, and affect the activities in which you participate.

Moderate fear appeal defines a threat in a mild and more factual manner, the language is impersonal, and pictures may be lifelike but are more mild examples of the potential negative outcomes of a threat (compared to high fear appeal). Low fear appeal rarely alludes to the consequences, fear appeal information is replaced by relatively neutral information describing a threat, information is presented in a purely factual manner, and pictures used are not realistic looking. For example, "People who work at a computer can develop cumulative trauma disorders if risk factors are ignored. Cumulative trauma disorders can be painful and cause decreased flexibility, loss of strength, or limitations on personal activities."

We know that perceived threat and efficacy influence whether or not an individual adopts the recommended behaviors of a message. Another factor that may affect the effectiveness of a fear appeal's message is an individual's prior beliefs regarding a particular threat (Keller, 1999). A person who does not perceive a threat as valid or likely to occur to them may be referred to as "unconverted." A person is "adherent" if he or she already perceives a threat as real and has accepted the message's recommended actions. While individual beliefs (adherent and unconverted) regarding a particular fear appeal message have been shown to be significant (Keller, 1999), a meta-analysis of fear appeals by Witte and Allen (2000) stated that individual characteristics, such as gender, age, ethnicity, or group membership, did not appear to significantly influence the acceptance of fear appeal messages. While individual characteristics did not significantly influence the acceptance of a fear appeal message, their current beliefs (adherent or unconverted) did (Keller).

CHAPTER 3

Methodology

This study examined three levels of fear appeal: control, high, and low. Fear appeal was incorporated into a lecture-based ergonomic training presentation, which educated participants on the prevention of cumulative trauma disorders associated with working at a computer. The control group did not receive any ergonomic training during this study. Two ergonomic training presentations were created, differing by the type of fear appeal material incorporated, either high fear appeal material or low fear appeal material. Participants' postures were observed before and after an ergonomic training presentation while working at a computer.

Participants

The participants were recruited from a California Silicon Valley computer company which company develops desktops, laptops, MP3 players, servers, and software. The participants were employees or contractors at the company and worked eight to 10 hours a day five days a week. Each participant worked a minimum of four hours a day at a computer.

The experiment included 30 adult participants, 14 male and 16 female, ranging from 26- to 60-years-olds. Each participant recruited worked a minimum of four hours a day at a computer. On average the participants estimated they worked at the computer 6.32 hours a day while at work. The participants recruited were considered high-risk computer users according to Rizzo, Pelletier, Serxner, and Chikamoto (1997) who defined high-risk computer users as people who work four or more hours at a computer routinely during a 12-hour period.

All 30 participants underwent five days of postural observation data collection. Of the 30 participants 27 reported never having any ergonomic training and 26 of 30 had never had an ergonomic evaluation of their workstation. Five participants reported they had had a prior injury, 15 participants reported they had not had a prior injury, and 10 participants were not sure if they had had a prior injury resulting from computer use.

Materials

A demographic questionnaire (see Appendix A) was used to gather background information on participants' age, sex, work, office ergonomic, and computer use history. The questions comprising the pre-training questionnaire and post-training questionnaire were adapted from fear arousal, persuasion, perceived susceptibility, and perceived severity measures utilized by Keller (1999). A pre-training questionnaire (see Appendix B) gathered information on participants' beliefs and knowledge about ergonomic risk factors and injuries related to computer use. The post-training questionnaire's (see Appendix C) questions 4 – 11 were identical to the eight questions in the pre-training questionnaire. The purpose of questions one through three of the post-training questionnaire were to examine the differences, if any, between the high fear appeal and low fear appeal ergonomic training presentations' and their impact on participants reaction to the ergonomic training. Question one of the post-training questionnaire asked about the feelings participants had in reaction to the ergonomic training they attended. Question two asked about participants' intentions to follow the ergonomic recommendations covered in the ergonomic training. Question three asked participants about the possible severity of an injury resulting from computer use. An ergonomic quiz (see Appendix D) was given pre-ergonomic training and post-ergonomic training to measure learning. Graphic icons were used to categorize postures (see Figure 1) for the postural observational data. Written definitions of the graphic icons (see Appendix E)

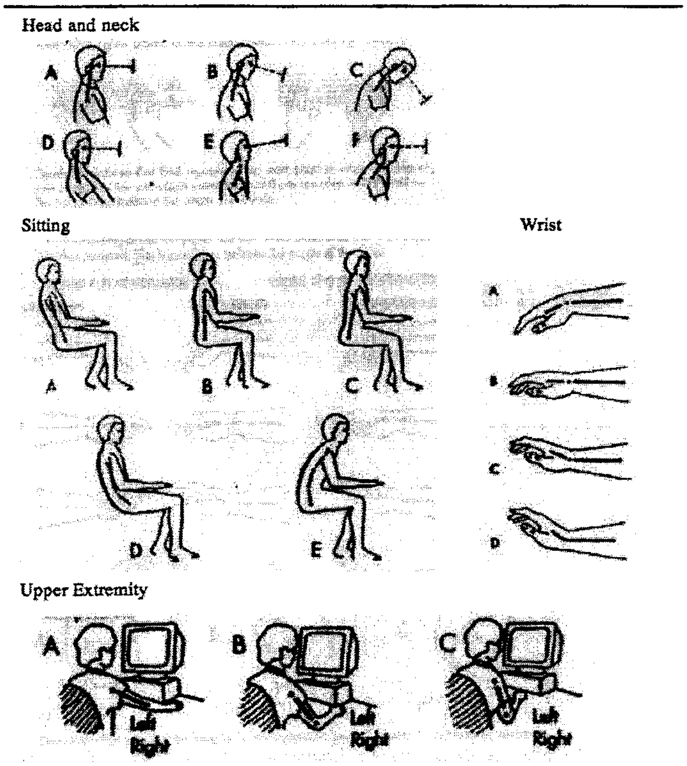


Figure 1. Graphic icons.

were created to provide readers with the definition the researcher used for each graphic. A consent form (see Appendix F) was created to provide details of the study to participants and gain their consent to participate. Notes for the high fear appeal and low fear appeal presentations were developed for the presenter to use during the ergonomic training presentations (see Appendix G and H) and as a way to prepare for the presentations. A data collection sheet (see Figure 2) was developed, which the researcher used to record postural observations during the study. Two Power Point presentations were developed for the ergonomic training, one containing high fear appeal material (see Appendix I) and the second containing low fear appeal material (see Appendix J).

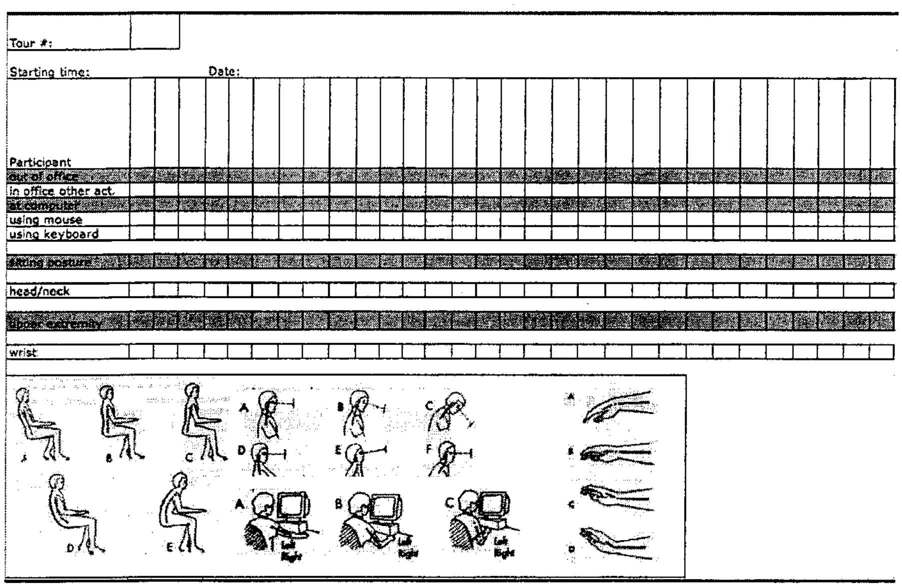


Figure 2. Data collection sheet.

Procedure

Prior to the recruitment of participants the researcher received permission to conduct this study from the San Jose State University Human Subject Institutional Review Board (see Appendix K). Participants were recruited from the company. The researcher received a letter of institutional support (see Appendix L) from the company prior to recruiting participants. To qualify for the study a participant were required to work five days a week (Monday through Friday) and spend four or more hours a day at a computer. The recruiting process began by first sending an email to all potential participants, followed up by the researcher visiting each who had expressed interest in participating. Following the email the researcher approached each potential participant to verify that they met the qualifications of being a participant. When talking with a potential participant the researcher explained that he was part of the company's corporate Environmental Health and Safety department and was presently completing his Master's thesis at San Jose State University in Human Factors and Ergonomics. During the recruiting process the researcher stated that the study would examine the efficacy of current ergonomic training and ways to improve upon it.

The researcher explained to the potential participants that participation in the study would include signing a consent form, completing a demographic questionnaire, completing an ergonomic quiz pre- and post-training, and completing a questionnaire following the ergonomic training. It was also explained that the researcher would be recording postural observation data for two and one half days prior to and after the ergonomic training. During the postural observation data collection period participants were asked to work as they normally would and not act any differently due to their participation in this study. The researcher would not interrupt the participants during his observations of them.

Once an individual agreed to participate he or she was given a consent form to sign. After signing the consent form he or she was given a demographic questionnaire (see Appendix A) to complete. The demographic questionnaire collected information on the participants' work status, type of work, injury and illness history associated with computer use, and current attitudes towards ergonomic techniques for minimizing cumulative trauma disorders associated with computer use.

Once the participants had been recruited an assistant to the researcher randomly divided them into three groups (control, high fear appeal, and low fear appeal) by the following process: the participants were listed in alphabetical order and assigned a number from 1 to 30; a table of random numbers from Keppel, Saufley, and Tokunaga (1992) was used to divide the participants into three groups of 10 using the procedure described in the text. The first group of 10 chosen comprised the control group, the second group of 10 the low fear appeal group, and the third group of 10 the high fear appeal group. The researcher was unaware as to which group each participant had been assigned throughout the study.

Once the three groups had been established, data collection could begin. Each of the 30 participants was observed over the course of five consecutive days. There were two and one half days of pre-training postural observations and two and one half days of post-training postural observations. The training was given on the third day to the high and low fear appeal groups, while the control group received no training during the study. In order to comply with the training requirement of the company and still have a control group, the control group received ergonomic training the week following completion of the study.

The method of work sampling, a time study method, was chosen as the framework for the design of this study. Work sampling is a method of analyzing a job and its related activities, and then determining the amount of time devoted to those activities. The work sampling method requires a large sample of observations of the work activities performed at random time intervals. The results of these observations were used to determine standards for those work activities and ultimately to improve work methods (Nieble & Andris, 1999). The work sampling method could be used to determine the proportion of total time a participant was devoted to a specific or all tasks of their job. According to Barnes (1980) work sampling has three main uses; one to determine the activities and delays between a worker and machine; a second to determine a performance index for a job; and a third to establish a time standard for a task.

The work sampling method is based on the laws of probability (Barnes, 1980; Niebel & Andris, 1999). A sample of instant observations, taken at random, from a large group of people tends to have the same pattern of distribution as the large group. If enough observations were taken to satisfy a given degree of accuracy, the chance that the activities observed from the sample were due to chance falls within an acceptable range (i.e., $\pm$ 5%). One could use the findings from the sample and generalize to the large group within the given accuracy range. The work sampling method did not require observations to be done continuously over a long period of time. The observations could be done in the form of a snapshot. Meaning a worker could be observed at random points spaced at random intervals throughout the day with each observation lasting one instance, to develop a total picture of the workers daily activities and delays (Niebel & Andris, 1999). A snap shot observation records what the person was doing exactly at one point in time.

The work sampling method was appropriate for the design of this study, because the researcher was interested in determining the percent of time participants spent in various postures throughout their workday while working at a computer. By using the work sampling method, the researcher could gather an accurate representation of particular postures participants assumed while working at a computer. This study compared the frequency participants spent in various postures before and after participation in an ergonomic training session. While work sampling has traditionally been used to analyze user machine interaction and improve efficiency, the researcher used this method to determine the frequency of observed postures the participants assumed while working at their computers throughout a workday.

The observations conducted by the researcher were a snapshot of a participant's working posture while at a computer. The postures observed included sitting, head and neck, upper extremity, and wrist. Graphic icons depicting a body region in a particular position were used to categorize the observations (see Figure 1). The graphic icons that were used to categorize postures were adapted from a checklist used in a study by Janowitz, Stern, Wollowitz, Hudes, and Rempel (2002). Janowitz et al. designed a checklist with the goal of assessing the risk factors of working at a computer through worker postures and movements (i.e., postures and movements of the head, trunk, and upper extremity) instead of workstation features (i.e., chair height, keyboard placement, or monitor height). The intent of the checklist developed by Janowitz et al. was for it to be intuitive enough to be used by someone without technical ergonomic expertise, with minimal training, and with eighth grade language skills. Janowitz et al. found that the checklist led to significant improvement of worker posture and movement when used by a trained ergonomics person, but not when used for self-evaluation or for evaluation by a co-worker. The graphic icons used to represent body postures were found to demonstrate high inter-rater reliability.

The researcher who conducted the observations for the study being presented here had three years of work experience in evaluating people working at computer workstations and had completed the course work for the San Jose State University Master of Human Factors and Ergonomics. The work experience and education were the criteria the researcher used to qualify as someone who had trained ergonomic experience and therefore would be competent to use the checklist by Janowitz et al. Only the graphic icons were used from the checklist for this study.

The researcher had a floor plan of the building showing the layout of the offices and cubicles where each of the participants were located (see Figure 3 for an example). The names are blurred to keep the privacy of the individuals. From this map the researcher designed four tours to conduct the random instantaneous observations. A tour was considered complete once it took the researcher past all of the participants' offices. To minimize participants knowing when they would be observed the order in which participants were observed was changed with each tour. The tours differed such that the same tour route did not lead the researcher past the offices in the same manner twice in a row. The starting point for each tour varied as it took the researcher past every participant. The time it took to complete a tour varied depending on how many of the 30 participants were in their office as the researcher walked by to observe them. The time it took to compete a tour was reduced if a participant was not in their office or in their office but not at a computer, because the researcher did not have to observe and record their posture. The researcher observed each participant a total of 55 times over the course of two and one half days both prior to and 55 times following the ergonomic training. Given 10 participants in each group there was a total of 550 observations taken for each group prior to and 550 observations following the ergonomic training. An average of four

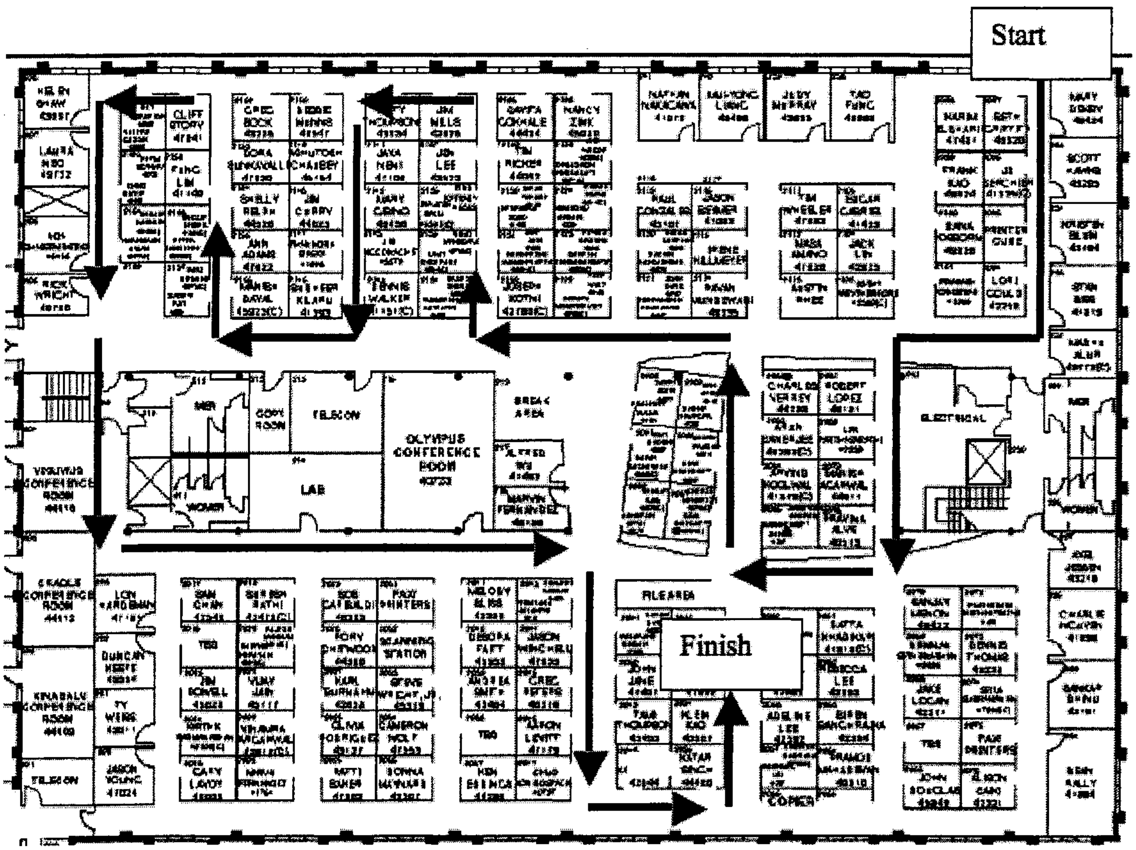


Figure 3. Example of a tour map.

tours were conducted each hour. Observations were conducted as the researcher walked by a participant's office and looked at the posture they assumed at that instant. The observations were like a snapshot, because the researcher did not wait for a participant to perform a particular action, but recorded what he saw at the instant he observed the participant in his or her office.

The participants could have been in one of three scenarios when the observer looked into their office: out of their office, in their office but not working at their computer, or in their office and working at the computer. The postural data was only collected when the participants were in their office working at a computer using the mouse or keying. When participants were working at their computer, whether they were using the mouse or keying was recorded. Observations were recorded on a data collection sheet. One data collection sheet was used per tour. The data collection sheet had all 30 participants listed across the top (see Figure 4). As the researcher observed a participant he then recorded the observation by placing a check mark to signify if the participant was out of the office, in the office but not working at the computer, or in the office and working at the computer. If a participant was in his or her office and working at the computer the researcher would write in the letter of the graphic icon best representing the assumed posture that was observed.

The ergonomic training was conducted on the third day. An assistant conducted the two ergonomic training presentations for the high fear appeal and low fear appeal groups in a training room at the company. Of the 20 participants in the experimental groups (high fear appeal and low fear appeal) 18 attended the ergonomic training presentations, and the control group did not attend an ergonomic training presentation. Both the high fear appeal and low fear appeal groups had one participant not attend their groups' ergonomic training. In addition the high fear appeal group had one participant that had to leave early following the training and did not complete his entire post-training questionnaire. Once all participants were present a pre-training quiz was administered prior to the ergonomic training presentation. The lecture-based training consisted of a Power Point presentation given by the assistant. The training lasted approximately 60 minutes and was followed by an ergonomic quiz and post-training questionnaire. The research assistant collected all of the ergonomic quizzes and post-training questionnaires

Tour #:

Starting time: Date:

Participant	Participant 1	Participant 2	Participant 3	Participant 4	Participant 5	Participant 6	Participant 7	Participant 8	Participant 9	Participant 10	Participant 11	Participant 12	Participant 13	Participant 14	Participant 15
out of office	X				X		X					X			X
in office other act.								X	X						
at computer		X	X	X		X				X	X		X	X	
using mouse		X	X	X						X	X		X	X	
using keyboard						X									
sitting posture		E	C	D		B				A	D		C	D	
head/neck		C	B	B		A				B	C		A	C	
upper extremity		C	B	B		C				A	B		B	B	
wrist		B	B	B		B				C	B		C	B	

Participant	Participant 16	Participant 17	Participant 18	Participant 19	Participant 20	Participant 21	Participant 22	Participant 23	Participant 24	Participant 25	Participant 26	Participant 27	Participant 28	Participant 29	Participant 30
out of office						X	X					X			
in office other act.			X	X				X	X						
at computer	X	X			X					X	X		X	X	X
using mouse	X				X					X	X			X	X
using keyboard		X											X		
sitting posture	C	C			B					E	B		B	D	D
head/neck	A	A			A					C	B		B	B	C
upper extremity	B	A			C					B	B		C	C	C
wrist	C	B			C					B	B		B	C	A

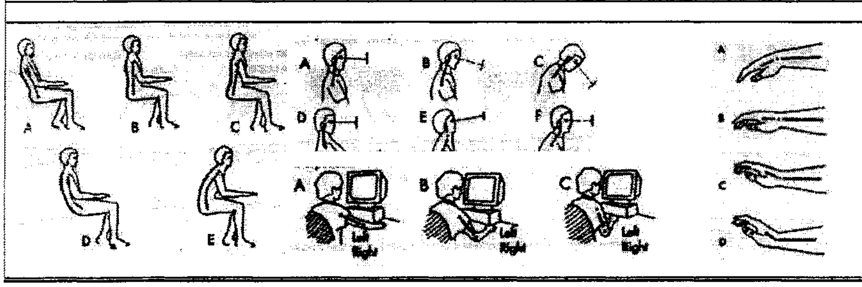


Figure 4. Example of a completed data collection sheet.

following each of the training sessions. The assistant held onto this material until the study was completed, and then handed it over to the researcher. The researcher was not aware of which experimental group each participant was in. Following the training the researcher resumed observations. The observations continued for two and one half days following the training. Upon completion of the observations the participants were debriefed as to the true nature of the study.

Data Analysis

The postural observation data generated in this study was represented in terms of the frequency of occurrence of certain postures. For example, there were three graphic icons which represented the different upper extremity postures; the upper extremity posture could therefore be categorized as most closely representing the graphic icon (a), (b), or (c) (see Figure 1). The postural observation data recorded a total of 110 potential observations of the upper extremity for each participant, 55 pre-ergonomic training observations and 55 post-ergonomic training observations. No postural observation data was recorded when participants were either out of their office or in their office but not working at a computer. The data resulted in a particular number of times a participant had their upper extremity in one of three positions, pre-ergonomic training and post-ergonomic training. A Chi-Square Test of Independence contingency table was used to analyze the postural observation data. The data gathered from the observations consisted of observed frequencies. The Chi-Square statistical test was used to examine the differences in observed posture frequency count within and between groups, before and after an ergonomic training presentation. The absolute error was calculated for each of the observed posture frequencies. The absolute error tells us the possible range of frequencies for the observed postures.

In addition to observational data this research also collected data from the pre-training questionnaire and post-training questionnaire. The questions from the pre-training questionnaire and questions 4 – 11 from the post-training questionnaire were identical. The researcher examined the answers to these eight questions within group for the high fear appeal and low fear appeal groups. The control group did not under go ergonomic training and did not complete a post-training questionnaire. Questions one, two, and three of the post-training questionnaire were examined for the between group (high fear appeal and low fear appeal group) differences. A t-test for independent measures was used to analyze the questionnaire data.

The ergonomic quiz scores from before and after the ergonomic training were examined. The researcher looked at the total scores for the quizzes on a within group basis for the high fear appeal and low fear appeal groups as a measure of learning. A t-test for independent measures was used to determine if a significant difference existed between the quiz scores before and after the ergonomic training.

CHAPTER 4

Results

This section will report the results from the postural observation data and the questionnaire data. The researcher utilized a three (group) by two (pre- and post-ergonomic training) chi-square analysis to evaluate the postural observation data. The data from the questionnaires were analyzed with the t-test for independent measures.

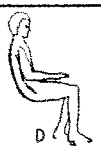
Postural Observation Data

The postural observation data was gathered by the researcher through observing participants while they worked in their office at the computer. Each postural observation included four components: sitting posture, positioning of the head and neck, upper extremity, and wrist (see Figure 1). The researcher recorded the postural observations by walking to a participant's office and recording each of the postures a participant displayed at that moment. Recording postural observations involved matching the observed posture, for example the participant's head and neck position, to the graphic icon for the head and neck position that most closely resembled that head and neck position. Similar matching was done for each of the four postural observation components during each postural observation. A chi-square test for independence was used to determine if there was a difference in participants' observed postures across groups (control, high fear appeal, and low fear appeal) before and after the ergonomic training. There were a total of 550 observations for each group before the ergonomic training and 550 observations for each group after the ergonomic training. However, both the high and low fear appeal groups had one participant that did not attend the assigned ergonomic training presentation; the data for these two participants was not included in the data analysis. As a result, the high fear appeal group and the low fear appeal group each had 495 observations before the ergonomic training and 495 observations after the ergonomic training included in the data analysis. An observation was categorized in one of three ways: out of the office, in the office not at the computer, and in the office working at the computer. Postural observation data was included in the data analysis only when participants were in their office working at the computer (i.e., keying or using a mouse). If participant were sitting in their office and just looking at the computer screen, but not keying or using the mouse no postural observation data was recorded.

The researcher did not control when participants were in their office or the amount of time participants spent working at the computer due to the ecological nature of this study. Also, the researcher was not able to extend the observation period to ensure an equal number of postural observations for each group of participants in their office working at the computer. As a result of postural observations only being recorded when participants were in their office and working at a computer, an unequal number of postural observations were recorded across all three groups both before the ergonomic training and after the ergonomic training. The postural observation frequency data for all groups is summarized in Table 1. The frequency of the raw postural observation data for each group, before and after ergonomic training, were converted to percentages. For example, sitting posture A was observed 35 times in the control group before ergonomic training out of a total of 203 (control group) pre-ergonomic training observations

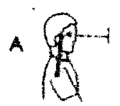
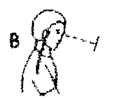
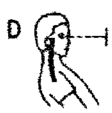
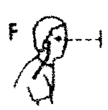
Table 1

Raw Postural Observation Frequency Data

		Pre-Training		Post-Training		
	**Sitting A**	**obs./n**	**%**	**obs./n**	**%**	**Post % - Pre %**
	Control	35/203	17.24	27/223	12.11	-5.13
	High	14/215	7.00	10/208	5.00	-2.00
	Low	23/243	9.00	14/217	6.00	-3.00
	**Sitting B**	**obs./n**	**%**	**obs./n**	**%**	**Post % - Pre %**
	Control	47/203	23.15	48/223	21.52	-1.63
	High	73/215	33.95	71/208	34.13	0.18
	Low	55/243	22.63	72/217	33.18	10.55
	**Sitting C**	**obs./n**	**%**	**obs./n**	**%**	**Post % - Pre %**
	Control	42/203	20.69	41/223	18.39	-2.30
	High	38/215	17.67	60/208	28.85	11.18
	Low	66/243	27.16	80/217	36.87	9.71
	**Sitting D**	**obs./n**	**%**	**obs./n**	**%**	**Post % - Pre %**
	Control	26/203	12.81	79/223	35.43	22.62
	High	12/215	5.58	8/208	3.85	-1.73
	Low	31/243	12.76	19/217	8.76	-4.00
	**Sitting E**	**obs./n**	**%**	**obs./n**	**%**	**Post % - Pre %**
	Control	53/203	26.11	28/223	12.56	-13.55
	High	78/215	36.28	59/208	28.37	-7.91
	Low	68/243	27.98	32/217	14.75	-13.23

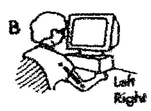
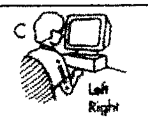
Note. "n" represents the number of observations for a group in each phase of the study (pre- and post-ergonomic training) while the participants were working at a computer. The recorded observations of a participant out of the office or in the office but not at a computer were not used in the data analysis, because they did not involve postural data.

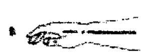
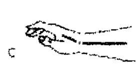
Table 1

		Pre-Training		Post-Training		
	**Head/Neck A**	**obs./n**	**%**	**obs./n**	**%**	**Post% - Pre %**
	Control	68/203	33.50	60/223	26.91	-6.59
	High	29/215	13.49	39/208	18.75	5.26
	Low	78/243	32.10	87/217	40.10	8.00
	**Head/Neck B**	**obs./n**	**%**	**obs./n**	**%**	**Post% - Pre %**
	Control	71/203	34.98	77/223	34.53	-0.45
	High	126/215	58.06	129/208	62.02	3.96
	Low	78/243	32.10	67/217	30.88	-1.22
	**Head/Neck C**	**obs./n**	**%**	**obs./n**	**%**	**Post% - Pre %**
	Control	17/203	8.37	13/223	5.83	-2.54
	High	27/215	12.56	11/208	5.29	-7.27
	Low	13/243	5.35	1/217	0.46	-4.89
	**Head/Neck D**	**obs./n**	**%**	**obs./n**	**%**	**Post% - Pre %**
	Control	15/203	7.39	24/223	10.76	3.37
	High	3/215	1.40	2/208	0.96	-0.44
	Low	4/243	1.65	11/217	5.07	3.42
	**Head/Neck E**	**obs./n**	**%**	**obs./n**	**%**	**Post% - Pre %**
	Control	11/203	5.42	8/223	3.59	-1.83
	High	1/215	0.47	1/208	0.48	0.01
	Low	13/243	5.35	9/217	4.15	-1.20
	**Head/Neck F**	**obs./n**	**%**	**obs./n**	**%**	**Post% - Pre %**
	Control	21/203	10.34	41/223	18.39	8.05
	High	29/215	13.49	26/208	12.50	-0.99
	Low	57/243	23.46	42/217	19.35	-4.11

Note. "n" represents the number of observations for a group in each phase of the study (pre- and post-ergonomic training) while the participants were working at a computer. The recorded observations of a participant out of the office or in the office but not at a computer were not used in the data analysis, because they did not involve postural data.

Table 1

		Pre-Training		Post-Training		
	**Upper Extremity A**	**obs./n**	**%**	**obs./n**	**%**	**Post% - Pre %**
	Control	50/203	24.63	91/223	40.81	16.18
	High	23/215	10.70	41/208	19.71	9.01
	Low	54/243	22.22	66/217	30.41	8.19
	**Upper Extremity B**	**obs./n**	**%**	**obs./n**	**%**	**Post% - Pre %**
	Control	75/203	36.95	48/223	21.52	-15.43
	High	82/215	38.14	84/208	40.38	2.24
	Low	98/243	40.33	95/217	25.81	-14.52
	**Upper Extremity C**	**obs./n**	**%**	**obs./n**	**%**	**Post% - Pre %**
	Control	78/203	38.42	84/223	37.67	-0.75
	High	110/215	51.16	83/208	39.90	-11.26
	Low	91/243	37.45	56/217	25.81	-11.64

		Pre-Training		Post-Training		
	**Wrist A**	**obs./n**	**%**	**obs./n**	**%**	**Post% - Pre %**
	Control	11/203	5.42	23/223	10.31	4.89
	High	14/215	6.51	14/208	6.73	0.22
	Low	22/243	9.05	23/217	10.60	1.55
	**Wrist B**	**obs./n**	**%**	**obs./n**	**%**	**Post% - Pre %**
	Control	129/203	63.55	130/223	58.03	-5.52
	High	134/215	62.33	154/208	74.04	11.71
	Low	159/243	65.43	143/217	65.90	0.47
	**Wrist C**	**obs./n**	**%**	**obs./n**	**%**	**Post% - Pre %**
	Control	59/203	29.06	66/223	29.60	0.54
	High	63/215	29.30	38/203	18.27	-11.03
	Low	54/243	22.22	48/217	22.12	-0.1
	**Wrist D**	**obs./n**	**%**	**obs./n**	**%**	**Post% - Pre %**
	Control	4/203	1.97	4/223	1.79	-0.18
	High	4/215	1.86	2/208	1.38	-0.48
	Low	8/43	3.29	3/217	1.38	-1.91

Note. "n" represents the number of observations for a group in each phase of the study (pre- and post-ergonomic training) while the participants were working at a computer. The recorded observations of a participant out of the office or in the office but not at a computer were not used in the data analysis, because they did not involve postural data.

while the participant was working at a computer. This means that 23.15% (35/203) of the pre-ergonomic training observations for the control group, while the participant was working at a computer, were sitting posture A. Changing the raw frequency data in each cell to a percentage standardizes the cell frequency as if there were 100 observations in each category. The limitation of this method is that the generalization of the actual number of observations in each cell to a hypothetical 100 observations for each cell may slightly affect the data analysis. Summarized in Table 2 are the percentages of postural observation data collected for each group, before and after the ergonomic training session. Summarized in Table 3 are the chi-square tests for independence for the postural observation data. The only statistically significant finding for the postural observation data was for sitting posture D, χ^2 (2, N = 28) = 8.44, $p < .05$, which tells us there was a significant difference in the frequency of this posture before and after the ergonomic training. There were no other statistically significant findings for the other postural observation data. While there were no other significant findings for the postural observation data, there were differences among the groups in the frequency of observed postures before and after the ergonomic training, and those differences will be reviewed in the discussion.

Table 2

Postural Observational Data as a Percentage (absolute error)

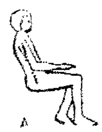
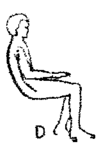
Observed Posture	Group					
	Control		High		Low	
Sitting	Pre	Post	Pre	Post	Pre	Post
 A	17.24% (±3.2%)	12.11% (±2.7%)	7.00% (±2.1%)	5.00% (±1.8%)	9.00% (±2.4%)	6.00% (±2.0%)
 B	23.15% (±3.5%)	21.52% (±3.4%)	33.95% (±4.0%)	34.13% (±4.0%)	22.63% (±3.5%)	33.18% (±3.9%)
 C	20.69% (±3.4%)	18.39% (±3.2%)	17.67% (±3.2%)	28.85% (±3.8%)	27.16% (±3.7%)	36.87% (±4.0%)
 D	12.81% (±2.8%)	35.43% (±4.0%)	5.58% (±1.9%)	3.85% (±1.6%)	12.76% (±2.8%)	8.76% (±2.4%)
 E	26.11% (±3.7%)	12.56% (±2.8%)	36.28% (±4.0%)	28.37% (±3.8%)	27.98% (±3.8%)	14.75% (±3.0%)

Table 2

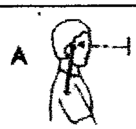
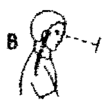
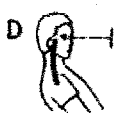
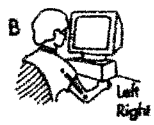
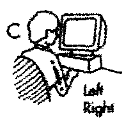
Observed Posture	Group					
	Control		High		Low	
Head and Neck	Pre	Post	Pre	Post	Pre	Post
	33.50%	26.91%	13.49%	18.75%	32.10%	40.10%
A	(±3.9%)	(±3.7%)	(±2.9%)	(±3.3%)	(±3.9%)	(±4.1%)
	34.98%	34.53%	58.06%	62.02%	32.10%	30.88%
B	(±4.0%)	(±4.0%)	(±4.1%)	(±4.1%)	(±3.9%)	(±3.9%)
	8.37%	5.835	12.56%	5.29%	5.35%	0.46%
C	(±2.3%)	(±2.0%)	(±2.8%)	(±1.9%)	(±1.9%)	(±0.6%)
	7.39%	10.76%	1.40%	0.96%	1.65%	5.07%
D	(±2.2%)	(±2.6%)	(±1.0%)	(±0.8%)	(±1.1%)	(±1.8%)
	5.42%	3.59%	0.47%	0.48%	5.35%	4.15%
E	(±1.9%)	(±1.6%)	(±0.6%)	(±0.6%)	(±1.9%)	(±1.7%)
	10.34%	18.39%	13.49%	12.50%	23.46%	19.35%
F	(±2.5%)	(±3.2%)	(±2.9%)	(±2.8%)	(±3.5%)	(±3.3%)

Table 2

Observed Posture	Group					
	Control		High		Low	
Upper Extremity	Pre	Post	Pre	Post	Pre	Post
 A	24.63% (±3.6%)	40.81% (±4.1%)	10.70% (±2.6%)	19.71% (±3.3%)	22.22% (±3.5%)	30.41% (±3.8%)
 B	36.95% (±4.0%)	21.52% (±3.4%)	38.14% (±4.1%)	40.38% (±4.1%)	40.33% (±4.1%)	25.81% (±3.7%)
 C	38.42% (±4.1%)	37.67% (±4.0%)	51.16% (±4.2%)	39.90% (±4.1%)	37.45% (±4.0%)	25.81% (±3.7%)

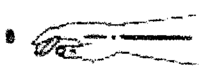
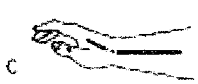
Observed Posture	Group					
	Control		High		Low	
Wrist	Pre	Post	Pre	Post	Pre	Post
 A	5.42% (±1.9%)	10.31% (±2.5%)	6.51% (±2.1%)	6.73% (±2.1%)	9.05% (±2.4%)	10.60% (±2.6%)
 B	63.55% (±4.0%)	58.03% (±4.1%)	62.33% (±4.0%)	74.04% (±3.7%)	65.43% (±4.0%)	65.90% (±4.0%)
 C	29.06% (±3.8%)	29.60% (±3.8%)	29.30% (±3.8%)	18.27% (±3.2%)	22.22% (±3.8%)	22.12% (±3.5%)
 D	1.97% (±1.2%)	1.79% (±1.1%)	1.86% (±1.1%)	1.38% (±1.0%)	3.29% (±1.5%)	1.38% (±1.0%)

Table 3

Postural Observation Data Chi-Square Analysis (Contingency Table)

Observed Posture Sitting	*df*	*N*	χ^2
 A	2	28	0.00
 B	2	28	1.57
 C	2	28	1.36
 D	2	28	8.44*
 E	2	28	1.67

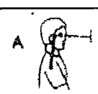
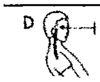
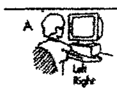
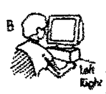
Observed Posture Head and Neck	*df*	*N*	χ^2
 A	2	28	2.19
 B	2	28	0.00
 C	2	28	2.15

Table 3

Observed Posture Head and Neck	df	N	χ^2
 D	2	28	1.04
 E	2	28	0.04
 F	2	28	3.60

Observed Posture Upper Extremity	*df*	*N*	χ^2
 A	2	28	0.46
 B	2	28	3.61
 C	2	28	4.30

Questionnaire Data

All participants completed a pre-training questionnaire (see Appendix B) upon agreeing to participate in the study. A post-training questionnaire (see Appendix C) was completed by participants in the high fear appeal and low fear appeal groups immediately following an ergonomic training presentation. The control group did not participate in training and did not complete a post-training questionnaire.

An ergonomic quiz (see Appendix D) was administered immediately before and after the ergonomic training presentation. The ergonomic training presentations covered the risk factors associated with working at a computer, the signs and symptoms of cumulative trauma disorders, and safe working postures and habits. The ergonomic quiz was incorporated as a measure of learning for the high fear appeal and low fear appeal groups. The low fear appeal group had a significantly higher mean score post-ergonomic training (M = 13.44, SD = 1.40) compared to their pre-ergonomic training score (M = 11.22, SD = 1.56). This difference was significant, $t(16) = -3.42$, $p < .01$. The high fear appeal group's mean ergonomic quiz score did not differ significantly before (M = 11.11, SD = 2.15) and after (M = 13, SD = 6.40) the ergonomic training presentation.

The pre-training questionnaire questions and post-training questionnaire, questions 4 – 11, were identical, and used a 5-point Likert type scale: "strongly disagree" to "strongly agree" (scored 1 – 5 points). Questions one, two, and three of the post-training questionnaire used a 7-point Likert scale, "not at all" to "very much so" (scored 1 – 7 points). Question one of the post-training questionnaire focused on the participants' feeling of general unease they experienced at the end of the ergonomic training session. Question two of the post-training questionnaire focused on participants' beliefs regarding the likelihood of changing their own behavior as a result of the ergonomic training session. Question three of the post-training questionnaire focused on participants' beliefs regarding how severe, dangerous, or serious they perceived an injury resulting from computer use could be. The pre-training questionnaire and questions 4 – 11 of the post-training questionnaire focused on participants' current beliefs regarding work habits, risk factors, and possible injuries related to computer use.

The pre-training questionnaire and questions 4 – 11 of the post-training questionnaire were analyzed by examining the differences for the high fear appeal group before and after the ergonomic training presentation and the differences for the low fear appeal group before and after the ergonomic training presentation. Results of the post-training questionnaire, questions one through three, were analyzed as between group for the high fear appeal and low fear appeal groups. The control group did not attend an ergonomic training presentation during the study and were not given a post-training questionnaire to complete. The results of the control group's pre-training questionnaires were not considered in the data analysis.

The statistical means and standard deviations of the high fear appeal and low fear appeal groups for the pre-training questionnaire are summarized in Table 4. The means and standard deviations of the post-training questionnaire, for the high fear appeal and low fear appeal groups are summarized in Table 5. Table 6 summarizes the results of the t-test analyses for questions one through three of the post-training questionnaire, which examined the differences between the high fear appeal and low fear appeal groups.

Table 4

Pre-Training Questionnaire Means and Standard Deviations

Pre-Training Questionnaire	Group			
	Low		High	
Question	M	SD	M	SD
(1 = strongly disagree, 5 = strongly agree)				
1. An injury sustained from working at a computer can be very painful.	4.00	0.93	4.33	0.67
2. I know what the risk factors associated with computer use are.	3.11	0.88	2.89	0.78
3. I am susceptible to developing an injury from computer use.	3.56	0.88	3.78	0.83
4. Ergonomic techniques (i.e., proper postures and habits) can help reduce the risk of injuries associated with computer use.	4.44	0.53	4.67	0.71
5. An individual's work habits affect the likelihood of developing an injury while working at a computer.	4.33	0.68	4.44	0.52
6. People who have jobs that involve computer work are susceptible to injuries of muscles, tendons, or nerves.	4.00	0.71	3.89	1.05
7. An injury resulting from working at a computer can be debilitating.	3.56	1.24	3.78	0.83
8. I am confident that I can reduce the risk of developing an injury when working at a computer by practicing safe work habits.	4.33	0.71	4.44	0.73

Table 5

Post-Training Questionnaire Means and Standard Deviations

1. Please rate from 1 (Not at all) through 7 (Very much so), how much you are experiencing each of the following feelings listed below as a result of the ergonomic training presentation.

	Group			
	Low		High	
Questions	M	SD	M	SD
1a. Distracted	1.11	0.33	1.77	1.20
1b. Restless	1.33	1.00	2.33	1.41
1c. Worried	2.44	1.74	2.44	1.59
1d. Frightened	1.55	1.67	1.22	0.44
1e. Fearful	1.11	0.33	1.11	0.33
1f. Nervous	1.33	1.00	1.33	0.50
1g. Uncomfortable	1.11	0.33	1.33	0.50
1h. Tense	1.33	0.71	1.44	1.01

2. For each of the following questions please choose a number from 1 (Not at all) through 7 (Very much so), that best matches your current beliefs.

	Low		High	
Questions	M	SD	M	SD
2a. Do you feel you have been persuaded by the ergonomic training presentation to practice the suggested work habits?	6.33	0.87	6.22	0.83
2b. Is it likely that you will follow the ergonomic training recommendations?	6.33	0.87	5.89	0.78
2c. How likely is it that this training will influence the way you work at a computer?	6.33	0.71	5.89	0.93
2d. How likely are you to follow the ergonomic recommendations throughout an entire workday?	5.55	0.88	5.00	0.87

Table 5

For each of the following statements please choose a number from 1 (Strongly Disagree) through 7 (Strongly Agree), that best matches your current beliefs.

	Low		High	
Questions	M	SD	M	SD
3a. An injury resulting from working at the computer can be **severe**.	6.44	1.01	5.25	1.29
3b. An injury resulting from working at the computer can be **dangerous**.	6.11	1.27	4.13	2.43
3c. An injury resulting from working at the computer can be **serious**.	6.33	1.12	4.63	1.53

	Low		High	
Questions (1 = strongly disagree, 5 = strongly agree)	M	SD	M	SD
4. An injury sustained from working at a computer can be very painful.	4.67	0.50	4.29	0.76
5. I know what the risk factors associated with computer use are.	4.22	0.67	4.57	0.79
6. I am susceptible to developing an injury from computer use.	4.22	0.83	3.71	1.11
7. Ergonomic techniques (i.e., proper postures and habits) can help reduce the risk of injuries associated with computer use	4.78	0.44	4.71	0.49
8. An individual's work habits affect the likelihood of developing an injury while working at a computer.	4.67	0.50	4.43	0.53
9. People who have jobs that involve computer work are susceptible to injuries of muscles, tendons, or nerves.	4.67	0.50	4.43	0.79
10. An injury resulting from working at a computer can be debilitating.	3.89	1.27	4.43	0.79
11. I am confident that I can reduce the risk of developing an injury when working at a computer by practicing safe work habits.	4.56	0.53	4.57	0.53

Table 6

Post-Training Questionnaire: High Fear Appeal vs. Low Fear Appeal t-test Analyses

Question	*df*	*t-test*
1a. Distracted	16	-1.59
1b. Restless	16	-1.72
1c. Worried	16	0.00
1d. Frightened	16	0.58
1e. Fearful	16	0.00
1f. Nervous	16	0.00
1g. Uncomfortable	16	-1.10
1h. Tense	16	-0.27

2. For each of the following questions please choose a number from 1 (Not at all) through 7 (Very much so), that best matches your current beliefs	*df*	t-test
2a. Do you feel you have been persuaded by the ergonomic training presentation to practice the suggested work habits?	16	0.28
2b. Is it likely that you will follow the ergonomic training recommendations?	16	1.23
2c. How likely is it that this training will influence the way you work at a computer?	16	1.23
2d. How likely are you to follow the ergonomic recommendations throughout an entire workday?	16	3.24*
3a. An injury resulting from working at the computer can be **severe**.	14	1.78
3b. An injury resulting from working at the computer can be **dangerous**.	14	2.07
3c. An injury resulting from working at the computer can be **serious**.	14	2.19*

Note. All statistical analysis used an alpha = .05. * $p < .05$.

Questions one through three of the post-training questionnaire were designed to assess the impact the ergonomic training presentation had on the participants and the intentions of the participants to change their work habits. Significant difference between the high fear appeal and low fear appeal groups for these questions would show that the high fear appeal ergonomic training and low fear appeal ergonomic training presentation developed for this study each had a different effect on its respective group of participants. A difference in the ratings of these questions between the high fear appeal and low fear appeal groups would provide support that the high fear appeal and low fear appeal ergonomic training presentations each had a different effect on the participants. There were two significant results from the post-training questionnaire when comparing the responses of the two experimental groups. Participants in the low fear appeal group (M = 5.55, SD = 0.88) had a higher mean rating for question 2d, meaning they stated that they were more likely to follow ergonomic recommendations throughout an entire workday, than participants in the high fear appeal group (M = 5.00, SD = 0.87). The difference was statistically significant, $t(16) = 3.24$, $p < .05$. For question 3c, participants in the low fear appeal group (M = 6.33, SD = 1.12) rated they were more likely to believe that an injury resulting from working at the computer can be serious, compared to the high fear appeal group (M = 4.63, SD =1.53). The difference was statistically significant, $t(16) = 2.19$, $p < .05$. The significance of these findings will be reviewed in the discussion.

Table 7 summarizes the results of the t-test for the low fear appeal group's pre-training and post-training (questions 4 – 11) questionnaire data. Table 8 summarizes the results of the t-test analyses for the high fear appeal group's pre- and post-training (questions 4 – 11) questionnaire data. Participants in the high fear appeal group rated, "I know what the risk factors associated with computer use are" (question two on the

Table 7

Low Fear Appeal Pre-Training vs. Post-Training Questionnaire (questions 4 – 11) t-test Analyses

Question	*df*	*t-test*
4. An injury sustained from working at a computer can be very painful.	16	-1.81
5. I know what the risk factors associated with computer use are.	16	0.65
6. I am susceptible to developing an injury from computer use.	16	-1.65
7. Ergonomic techniques (i.e., proper postures and habits) can help reduce the risk of injuries associated with computer use.	16	-1.48
8. An individual's work habits affect the likelihood of developing an injury while working at a computer.	16	-1.5
9. People who have jobs that involve computer work are susceptible to injuries of muscles, tendons, or nerves.	16	-1.93
10. An injury resulting from working at a computer can be debilitating.	16	-0.56
11. I am confident that I can reduce the risk of developing an injury when working at a computer by practicing safe work habits.	16	-0.79

Table 8

High Fear Appeal Pre-Training vs. Post-Training Questionnaire (questions 4 – 11) t-test Analyses

Question	*df*	*t-test*
4. An injury sustained from working at a computer can be very painful.	14	0.11
5. I know what the risk factors associated with computer use are.	14	-4.31*
6. I am susceptible to developing an injury from computer use.	14	0.14
7. Ergonomic techniques (i.e., proper postures and habits) can help reduce the risk of injuries associated with computer use.	14	-0.13
8. An individual's work habits affect the likelihood of developing an injury while working at a computer.	14	0.04
9. People who have jobs that involve computer work are susceptible to injuries of muscles, tendons, or nerves.	14	-1.35
10. An injury resulting from working at a computer can be debilitating.	14	-1.59
11. I am confident that I can reduce the risk of developing an injury when working at a computer by practicing safe work habits.	14	-0.39

Note. All statistical analyses used an alpha = .05. * $p < .05$.

pre-training questionnaire and question five on the post-training questionnaire) higher after training ($M = 4.57$, $SD = 0.79$) than before training ($M = 2.89$, $SD = 0.78$). This within group difference was statistically significant, $t(14) = -4.31$, $p < .05$.

The purpose of this study was to examine the impact a lecture-based ergonomic training incorporating fear appeal had on participants' work habits and intentions to adopt safe work habits while working at a computer. The postural observation data did not yield statistically significant findings to suggest the incorporation of fear appeal persuaded participants to adopt safe work habits while working at a computer. The limited significant findings with the questionnaire data suggested the low fear appeal ergonomic training presentation had more of an effect than high fear appeal ergonomic training; participants in the low fear appeal group rated cumulative trauma disorders as more serious and that they were more likely to follow ergonomic recommendations throughout the work day. The effect of the ergonomic training presentations will be explored further in the discussion.

CHAPTER 5

Discussion

In this study, the researcher was investigating whether or not there was a difference within group and between groups in observed postures while participants were working at a computer, before and after an ergonomic training presentation. There were three groups of participants: control group which did not under go training, high fear appeal which attended ergonomic training containing high fear appeal material, and low fear appeal which attended ergonomic training containing low fear appeal material. The study's design was a three group (control, high fear appeal, and low fear appeal) by two time of observation (before ergonomic training and after ergonomic training). The results of the pre-training and post-training questionnaires were studied to determine if there was a difference between the high fear appeal and low fear appeal groups' reactions to the ergonomic training and intentions to follow recommended work habits of the ergonomic training presentation. It was hypothesized that there would be a difference between groups and within groups with the observed postures, while participants were at a computer, before and the observed postures after the ergonomic training presentation. It was also hypothesized that there would be a difference between the high fear appeal group and low fear appeal group in the ratings on the pre-training and post-training questionnaires.

Postural Observation Data

There was a lack of statistically significant results for the recorded postural observations before ergonomic training and after ergonomic training within and between groups (control, high fear appeal, and low fear appeal). The one statistically significant finding for the postural observation data was for sitting posture D (see Figure 5). Sitting posture D is defined as a reclined and slouched sitting posture, leaning back in the chair with the participant's back against the chair's back support. The spine is not in a neutral posture, but decreased curve of the lumbar spine and increased curve of the thoracic spine. As shown in Table 2, the observed frequency for sitting posture

Figure 5. Sitting postures A – E.

D increased for the control group post-training. The control group demonstrated an increase in sitting posture D from before ergonomic training (12.81%) to after ergonomic training (35.43%). The high fear appeal and low fear appeal groups demonstrated a decease in sitting posture D from observations conducted pre-ergonomic to post-ergonomic training. The data revealed that sitting posture D was assumed more frequently, by the control group, in the afternoon compared to the morning. This reclined slouched posture may have been assumed more in the afternoon due to fatigue by participants. One possible explanation for the increase in sitting posture D by the control group is that the training had an affect on participants in the experimental groups, which resulted in an increase awareness of sitting positions while the control group did not have that influence. Towards the end of the week the participants in the experimental groups may have felt fatigue as the control group may have, but the increased awareness from the ergonomic training they attended affected their sitting postures.

While there were limited significant findings with the postural observation data, there were interesting trends with the postural observations from pre-ergonomic training to post-ergonomic training. Trends that showed desirable postures (neutral postures) increasing following the ergonomic training are described as "positive trends." Trends that showed a decrease in the desirable postures were described as "negative trends." Since positive trends occurred with both experimental groups and generally not with the control group, any differences could be attributed to the fact that participants underwent ergonomic training, rather than an effect by the fear appeal material. The positive trends could signify an increase in awareness of the risk factors (e.g., awkward postures) associated with working at a computer and an attempt to correct them by the participants. This finding, increase in awareness, was similar to King, Fisher, and Garg, (1997) who reported employees who were in the lecture with job redesign group demonstrated an increase in awareness of the risk factors associated with their jobs.

Sitting posture B (Figure 5) is a neutral sitting posture; the participant sitting upright, and the spine in a neutral position and fully supported by the chair back. The low fear appeal group showed the greatest positive trend for this category, the frequency of sitting posture B increased from pre-ergonomic training (22.63%) to post-ergonomic training (33.18%), while the control and high fear appeal groups' percentage remained essentially the same.

Sitting posture C (Figure 5) is a neutral spine position with a slight forward lean of the trunk. Sitting with a forward lean and the back unsupported may lead to fatigue in the back musculature due to increased muscular effort required to maintain the position.

While this sitting posture is not as desirable as sitting posture B, it is still a position where the spine is in a good posture. The high and low fear appeal groups both showed an increase in percentage for this sitting posture from pre-ergonomic training (high fear appeal = 17.67% and low fear appeal = 27.16%) to post-ergonomic training (high fear appeal = 28.85% and low fear appeal = 36.87%). The positive trends for sitting posture B and sitting posture C occurred for both of the experimental groups and not the control group and may be attributed to the increase in awareness of correct sitting postures as a result of the ergonomic training.

All three groups (control, high fear appeal, and low fear appeal) showed a decrease in sitting posture E, forward lean of the trunk and slouched sitting posture, such that the post-ergonomic training percentage was lower than the pre-ergonomic training percentage. Sitting posture E (Figure 5) is an undesirable sitting posture and the decrease in observed frequency of this sitting posture is considered a positive trend.

The neutral head and neck posture was head and neck posture A (see Figure 6), sitting upright with head and neck in a neutral position, ears aligned with shoulders and hips, and head level. The percentage of time participants assumed the head and neck posture A increased for both the high and low fear appeal groups from pre-ergonomic training (high fear appeal = 13.49% and low fear appeal = 32.10%) to post-ergonomic training (high fear appeal = 18.75% and low fear appeal = 40.10%). The head and neck posture C is described as sitting with a forward lean, neck flexed, downward gaze, and

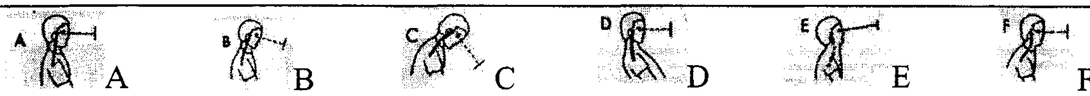


Figure 6. Head and neck postures A – F.

the head and neck in a non-neutral flexed position. The occurrence of the head and neck posture C decreased across all three groups from pre-ergonomic training (control = 8.37%, high fear appeal = 12.56%, and low fear appeal = 5.35%) to post-ergonomic training (control = 5.83%, high fear appeal = 5.29%, and low fear appeal = 0.46%). The increase in head and neck posture A and decrease in head and neck posture C may be correlated to the increase in the neutral spine positions associated with sitting posture B and sitting posture C. Thus, these are positive trends in the head and neck postures.

The high fear appeal group showed the greatest positive trend in the neutral wrist posture B (see Figure 7), such that the occurrence of wrist posture B increased from pre-ergonomic training (62.33%) to post-ergonomic training (74.04%). There was essentially no change in the percentage of wrist posture B for the low fear appeal group.

Figure 7. Wrist postures A – D.

The upper extremity posture C (see Figure 8) represents the neutral posture for the upper extremity position. This posture is described as having the elbows in by the

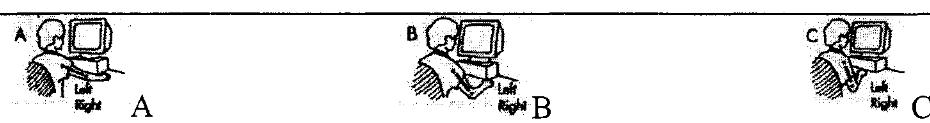


Figure 8. Upper extremity postures A – C.

side and bent approximately 90 degrees. A negative trend was found across all groups, such that the occurrence of upper extremity posture C decreased from pre-ergonomic training to post-ergonomic training, while the occurrence of upper extremity posture A (see Figure 8) increased across all three groups from pre-ergonomic training to post-ergonomic training. The control group demonstrated a greater increase in the occurrence of upper extremity posture A from pre-training (24.63%) to post-training (40.81%) compared to the high and low fear appeal groups. The greater increase in this upper extremity posture by the control group may be correlated with the increase in sitting posture D for the control group. As a participant leaned back to assume a reclined sitting posture, if they failed to move in closer to the desk, this would result in an increase in reach to the keyboard and mouse (upper extremity posture A). There was no clear correlation for the negative trend in the upper extremity posture C with the high and low fear appeal groups who demonstrated a decrease in sitting posture D and an increase in neutral sitting postures.

While there were numerous positive trends in the observed postures, given the lack of statistically significant differences across groups (control, high fear appeal, and low fear appeal) the effectiveness of the ergonomic training presentation and the incorporation of fear appeal material was questionable. The lecture format of the ergonomic training has been shown not to be the most effective method of training to bring about behavioral change (King, Fisher, & Garg, 1997). While the format was specifically chosen for this study because it best matched the current training method used at this company, incorporating participatory techniques may improve the effectiveness of the ergonomic training more so than the incorporation of fear appeal material.

The independent variable in this study was the fear appeal material used in the ergonomic training. The fear appeal material in the ergonomic training consisted of graphic icons and specific language, which were developed based on the definitions by Janis and Feshbach (1953). The threat used to create fear was the threat of developing a cumulative trauma disorder while working at the computer. While the pictures used in the high fear appeal and low fear appeal ergonomic training presentations differed, realistic versus cartoon, vivid versus non-vivid, they did not appear to elicit the desired effect in the participants. Since the efficacy of the fear appeal examples used in this study had not been pre-tested, there was no evidence to demonstrate that they would elicit the desired outcome. As research by Witte and Allen (2000) has shown, if the fear appeal is too low or too high it will be less likely to elicit the desired effect. While this researcher labeled the fear appeal material he incorporated into the ergonomic training presentations as high or low, there was no support for that claim as demonstrated by the results of this study. Hence, the fear appeal material labeled as "high" by this researcher may not have been perceived as "high" by the participants.

Alternatively, the way in which the fear appeal material was incorporated into the Power Point presentations used in the ergonomic trainings may not have been optimal. It is possible that the presentation could have been designed to more effectively convey the intended message. Participants may have discounted the ergonomic training message as a result of the overall presentation and not as a result of inadequacies of the fear appeal material. The researcher's assistant presented the ergonomic training session and had been given instructions on how to address the high and low fear appeal groups during the ergonomic training. However, the ergonomic training presentations were not recorded or observed and the ability of the speaker to deliver the ergonomic training presentations as intended was not evaluated. The assistant did report to the researcher following the training that she did not feel the delivery of the high fear appeal presentation was "natural". The presenter had been asked to speak in the second person (i.e., "you") when addressing the participants, in an attempt to personalize the information being presented. The presenter did feel that the presentation of the low fear appeal information was more natural. The presenter's feelings of comfort or discomfort could have affected the impact of the training on participants negatively or positively. The ergonomic training presentations may not have affected the behavior and intentions of participants as expected, because the fear appeal material was not validated prior to the study and the presenter for the ergonomic training incorporating high fear appeal material was not comfortable with her presentation of the information.

In addition, the measures used to examine the impact of the ergonomic training presentations were limited to postural observations and questionnaire data and may not have accurately captured other positive ergonomic changes by participants as a result of the ergonomic training. Following the ergonomic training, the researcher observed that there were attempts made by participants to modify their workstations, which was not included in the study's data collection, but showed the increase in awareness participants had of their workstations following the ergonomic training. The researcher observed a handful of participants raise their monitors to a better viewing height, likely as a result of the ergonomic training. Because there were participants who attempted to modify their workstations following the ergonomic training, it may be a demonstration of the knowledge participants gained during the ergonomic training session they attended. However, while some participants did take the initiative to modify their workstation following the ergonomic training, it did not lead to significant results for the postural observation or questionnaire data.

The method used to collect the postural observation data, work sampling, was a time sampling method of data collection. A benefit of this method of data collection was being able to obtain a representative sample of the participants' sitting postures while working at a computer. A drawback of this kind of data collection could have been a lack of continuity and quality of completeness of the postural data collected. Since the observations were several snap shot like observations over the course of several days of the participant's postures at the instant the researcher observed them, the data collected may not have been a complete representation of their sitting postures while working at the computer throughout a normal work day.

There was a risk of observer effect due to the data collection method. While trying to remain unobtrusive during the postural data collection, the researcher also attempted to habituate the participants to his presence through practice trials of data collection prior to the study beginning. Given these precautions to minimize observer effect, the possibility remained that participants' behavior were influenced due to the presence of the researcher during the postural data collection period.

The accuracy of the data collection method performed by the researcher could be a potential source of error. Due to the sitting position of a participant or the configuration of an office, the angle of viewing the participant was not always optimal. In these cases where a view of the back, neck, upper extremity, or wrist was not clearly visible, the researcher did enter the participant's workspace to get a better view of the desired posture. Being more obtrusive in obtaining the postural data could have prompted participants to alter their posture and thereby skew the results, although not apparently so based on the results.

While conducting the research in a natural work environment allowed for a more ecological study, there were also drawbacks. For example, the participants' job duties limited the time they spent at their desks, therefore reducing the number of chances to observe them while working at a computer. The researcher followed set routes specified by one of four tours, which determined when he would pass a participant's office, but did not necessarily correlate with the time a participant would be in his or her office working at a computer. The participants' work duties and activities were beyond the control of the researcher, which contributed to participants in all groups (control, high fear appeal, and low fear appeal) being out of the office 39.87% of the observation time pre-ergonomic training and 44.16% of the observation time post-ergonomic training. Participants were in their office, but not on the computer 17.21% of the observation time pre-ergonomic training and 15.39% of the observation time post-ergonomic training. Combining these two statistics, postural data was not able to be collected while the researcher was observing 57.08% of the time during pre-ergonomic training and 59.55% of the time during post-ergonomic training observation periods.

The researcher's bias and human error could also have affected the results of the study. Using the graphic icons to categorize participants' postures left room for subjective interpretation of the participants' postures by the researcher. The concentration of the researcher could also have been a source of inaccuracy in the data collection. The researcher could have inadvertently checked the wrong box on the data collection sheet or interpreted a sitting posture inaccurately. Without the use of video recording there was no way of confirming that what the researcher recorded was in fact the correct categorization of the observed posture. The nature of the observation process involving taking a snap shot like observation of the participant, does not allow for a verification once the observation was recorded and the moment has passed.

Questionnaire Data

The questionnaire data included results from questionnaires and ergonomic quizzes. The majority of the subjective questionnaire data from the analyses between the pre- and post-training questionnaires were not significant. The statistically significant results that were found between the high fear appeal and low fear appeal groups suggested the low fear appeal group was more likely to follow ergonomic recommendations throughout an entire work day. Participants in the low fear appeal group also rated cumulative trauma disorders as more serious than the participants from the high fear appeal group. The participants from the low fear appeal group also demonstrated a significant improvement in their ergonomic quiz scores following the training, which demonstrates a measure of learning that could be attributed to the ergonomic training. Two significant findings from the post-training questionnaire found the low fear appeal group rated question 2d and 3c higher that the high fear appeal group. Question 2d of the post-training questionnaire asked participants to rate, on a 7-point Likert scale ("not at all" to "very much so"), the likelihood they would follow ergonomic recommendations throughout an entire work day. Question 3c of the post-training questionnaire asked participants to rate, on a 7-point Likert scale ("strongly disagree" to "strongly agree"), that an injury resulting from working at the computer could be serious. These results give some support to the statement that the ergonomic training containing low fear appeal was more effective at affecting participants' intentions to adopt safe work habits than the ergonomic training presentation containing high fear appeal.

Witte and Allen (2000) suggested that the stronger the fear appeal the greater the change in intention and/or behavior. According to Witte's (1992) Extended Parallel Process Model on fear appeal, in order for a fear appeal message to be most effective, the perceived threat, response efficacy, and self efficacy of the message recipient need to be high. The examples and language used in the present study for the ergonomic training containing high fear appeal may not have led to a perceived threat that was high or strong, in which case the effectiveness of the ergonomic training would be reduced. According to Witte's (1992) theory on fear appeal, if the high fear appeal material in the ergonomic training was perceived as too high, participants may have felt that nothing they could do would prevent them from developing a cumulative trauma disorder, and they may have discounted the message to ease the threat instead of believing that trying to adhere to the recommended behaviors would reduce the threat. Early research on fear appeal by Janis and Feshbach (1953) and Janis and Terwilliger (1962) both suggested that too high a fear appeal message could lead to message discounting. The limited questionnaire data in the present study suggested the low fear appeal training was more effective, which correlated with the findings from early research by Janis, and went against the suggestions from Witte and Allen (2000) who stated high fear appeal should be more effective.

The beliefs and biases participants held at the onset of this study in all likelihood affected their reactions to the ergonomic training. For example, a participant who had never felt any aches or pains as a result of working at a computer may not have been as motivated to change his or her current computer work habits. A participant who already had experienced discomfort as a result of working at a computer and had tried previous recommendations may have been more likely to have a low response efficacy, which could also reduce the effectiveness of the ergonomic training for that individual.

Another significant finding showed that the high fear appeal group's post-ergonomic training (see Appendix C) rating was higher than the pre-ergonomic training rating for question 5, which asked if the participants knew what the risk factors associated with computer use were. This one question indicates that the participants in the high fear appeal group may have increased their awareness of ergonomic risk factors associated with computer use through their respective ergonomic training. Unfortunately, there was no significant improvement in the high fear appeal group's ergonomic quiz score following the ergonomic training to support this one finding. Also despite the high fear appeal group's apparent increase in awareness of ergonomic risk factors this awareness did not translate to significant improvement in their observed postures.

One interesting statistic noted following the study was that, of the 30 participants, 22 of them responded to the offer to have an individual ergonomic evaluation performed following the study. The high number of participants seeking assistance demonstrates a strong interest in improving their work environment. Receiving an individual ergonomic evaluation could also have been a reason many participants volunteered for the study, because they already thought their workstation could be improved or may have been symptomatic.

While the difference in postural changes before and after ergonomic training were not significant, the questionnaire data did yield some positive results regarding participants' feelings and intentions immediately following the ergonomic training. The findings suggested the low fear appeal group was more likely to follow the recommended safe work habits throughout the entire workday and viewed injuries resulting from computer use as more serious.

Future Research

The fear appeal material used in this study included icons and specific language in which the ergonomic training presentation was delivered. A similar study could first determine whether the high fear appeal and low fear appeal material in the present study, indeed elicits the desired response. For example, a picture of a cartoon muscle being torn may or may not have the same effect as a picture of a real muscle being torn as a result of a cumulative trauma disorder from working at a computer. Testing the fear appeal material would give the researcher foreknowledge of the efficacy of the material he or she has developed.

A follow-up to this study may look at other methods commonly used and know to be effective with lecture-based training, such as participatory methods. By having participants who are attending ergonomic training problem solve workstation examples and determine solutions based on the recommendations offered during training, the impact of the ergonomic training may be greater. Incorporating an exercise to demonstrate each of the desired working postures would help give the participants a first-hand example of what the training message is trying to get across in regards to safe working postures and may be better suited to identify awkward postures.

The type of data gathered for this study involved the researcher taking an observation of a posture and matching the posture with a graphic icon. With the advancement of technology, a method of video recording participants while they are working at a computer would allow a researcher additional time to analyze postures. Video would also allow a desired form to be frozen on screen and viewed by one or multiple raters. In addition, the ability to video record participants could help to minimize observer effect depending on the location of a camera in relation to the participant and a participant's awareness of that camera.

This study was conducted over the course of five days. While the participants in this study met the criteria of working four or more hours a day at a computer, the nature of their work sometimes resulted in them leaving their offices to conduct business. As a result, this study was only able to collect postural observations 42.92% of the time during pre-ergonomic training and 40.45% post-ergonomic training observation periods. A similar study could first determine the number of postural observations desired and allow time to continue the observation period until each participant is observed an equal number of times before and after the ergonomic training. The study could involve employees who would more likely remain in their office throughout an entire workday (e.g., customer services representatives) which may allow for an equal number of observations to be gathered in a shorter time. In addition to observing participants directly prior to and following an ergonomic training a delayed observation period would allow a researcher to study carry-over effects of the training.

Implications

The potential implications of this study include influencing the content and manner in which ergonomic training presentations are given for people working at computers. The potential increase in compliance in the recommended work habits could translate into fewer and less severe cumulative trauma disorders resulting from working at the computer. By decreasing the number or severity of injuries resulting from working at a computer, companies would save money and increase productivity.

Conclusion

Work place injuries resulting from repetitive motion and overexertion are a leading cause of ergonomic related workplace injuries (Liberty Mutual, 2002). Injuries specifically related to working at a computer have been studied and certain risk factors such as awkward postures, repetition, force, and infrequent rest have been strongly associated with these injuries (Lewis, Fogleman, Deeb, Crandall, & Agopswicz, 2001).

Lecture-based training has been one method used by many companies to train employees on the risk factors associated with computer use. This study looked at the impact that a lecture-based ergonomic training incorporating fear appeal had on participants' work habits and intentions in the computer workstation environment. Fear appeal, a persuasive message which uses fear as a motivator to influence unsafe behaviors (Witte, Berkowitz, Cameron, & McKeon, 1998), was incorporated into the ergonomic training presentation in an attempt to increase its effectiveness. One group of participants attended an ergonomic training presentation containing high fear appeal material and a second group attended an ergonomic training presentation with low fear appeal. A third group served as a control group and did not attend an ergonomic training presentation.

All participants were observed while working in their office at the computer over five consecutive days. On the third day of observations, the high fear appeal and low fear appeal groups received ergonomic training on the risk factors of working at computer workstations and ways to prevent and minimize these risk factors. The observational data gathered by the researcher categorized specific postures such as sitting, head and neck, upper extremity, and wrist, that participants assumed while keying or using the mouse. A questionnaire was administered immediately following the ergonomic training presentation to gather subjective data regarding participants' attitudes and intentions towards safe work behaviors while working at a computer.

The frequency of observed postures was converted to percentages and analyzed using chi-square test for independence. While there was a lack of statistically significant findings, there were a number of positive trends. There were positive trends for both the high fear appeal and low fear appeal groups in sitting and head and neck postures from pre-ergonomic training to post-ergonomic training; participants in the high fear appeal and low fear appeal groups demonstrated more neutral postures working at the computer after attending an ergonomic training presentation when compared to participants in the control group (who did not attend ergonomic training). The high fear appeal group showed the greatest positive trend in the neutral wrist posture.

The two significant results from the questionnaires suggested a low fear appeal approach could be more effective than incorporating high fear appeal material into a lecture-based ergonomic training presentation. The statistically significant results that were found in the questionnaire data between the high fear appeal and low fear appeal groups suggested the participants in the low fear appeal group were more likely to follow ergonomic recommendations throughout an entire work day and viewed cumulative trauma disorders as more serious than the participants from the high fear appeal group. The participants from the low fear appeal group also demonstrated a significant improvement in their ergonomic quiz scores following the ergonomic training, suggesting some learning had occurred. However, the number of positive trends by the high fear appeal and low fear appeal groups could be an indicator that it was the ergonomic training, regardless of fear appeal, that had an impact on participants. The limited statistically significant findings of this study may suggest that incorporating fear appeal into an ergonomic training presentation is not the most effective way in which to influence participants to change their intentions to adopt safe work habits while working at the computer.

References

American National Standard for Human Factors of VDT Workstations. (1988). (ANSI / HFS 100-1988). Santa Monica, CA: The Human Factors Society, Inc.

Anderson, V. P., (Eds.). (1992). *Cumulative trauma disorders: A manual for musculoskeletal diseases of the upper limbs*. Cincinnati, Ohio: Taylor & Francis.

Ankrum, D. R. (2002). Visual ergonomics in the office. *Nova Solutions, Inc.*, http://www.office-ergo.com/setting.htm, 1-12.

Barnes, R. M. (1980). Work Sampling. *Motion and times study design and measurement of work.* (pp. 406–437). New York: John Wiley & Sons, Inc.

Bergqvist, U., Nillsson, B., & Voss, M., (1995a). Musculoskeletal disorders among visual display terminal workers; individual, ergonomic, and work organizational factors. *Ergonomics*, 38, 763–776.

Bergqvist, U., Nillsson, B., & Voss, M., (1995b). The influence of VDT work on musculoskeletal disorders. *Ergonomics*, 38, 754–762.

Bohr, P. C., (2000). Efficacy of office ergonomics education. *Journal of occupational rehabilitation*, 10(4), 243-255.

Buckle, P. W., & Devereux, J. J. (2002). The nature of work-related neck and upper limb musculoskeletal disorders. *Applied Ergonomics*, 33(3), 207-217.

Division of Occupational Safety and Health. *1997 subchapter 7. general industry safety orders group 15. occupational noise article 106. ergonomics, 5110 repetitive motion injuries.* Retrieved June 2002, from http://www.dir.ca.gov/title8/5110.html

Grandjean, E. (1987). *Ergonomics In Computerized Offices*. Philidelphia: Taylor & Francis Inc.

Grandjean, E. (1988). *Fitting the task to the man.* (p. 6). Philidelphia: Taylor & Francis Inc.

Hedge, A., McCrobie, D., Morimoto, S., Rodriguez, S., & Land, B. (1996, January). Toward pain-free computing. *Ergonomics In Design*, 4-10.

Horikawa, M. (2001). Effects of visual display terminal height on the trapezius muscle hardness; quantitative evaluation by a newly developed muscle hardness meter. *Applied Ergonomics*, 32(5), 473-478.

Janis, I. L., & Feshbach, S. (1953). Effects of fear-arousing communications. *The Journal of Abnormal and Social Psychology*, 48(1), 78-92.

Janis, I. L., & Tervilliger, R. F. (1962). An experimental study of psychological resistances to fear arousing communications. *The Journal of Abnormal and Social Psychology*, 65(6), 403-410.

Janowitz, I., Stern, D. M., Vollowitz, E., Hudes, M., and Rempel, D., (2002). Validation and field testing of an ergonomic computer use checklist and guidebook. University of California San Francisco/Berkeley Ergonomics Program.

Keller, P. A. (1999). Converting the unconverted: The effect of inclination and opportunity to discount health-related fear appeals. *Journal of Applied Psychology*, 84(3), 403–415.

Keller, P. A., & Block, L. G. (1996). Increasing the persuasiveness of fear appeals: the effect of arousal and elaboration. *Journal of Consumer Research*, 22, 448-458.

Keppel, G., Saufley, W. H., & Tokunaga, H. (1992). *Introduction to design and analysis a student's handbook* (2nd ed.). (pp. 59 – 60, pp. 529 – 530). W. H. Freeman and Company, New York.

King, P. M. (1995). Employee ergonomics training: Current limitations and suggestions for improvement. *Journal of Occupational Rehabilitation*, 5(2), 115-123.

King, P. M., Fisher, J. C., & Garg, A. (1997). Evaluation of the impact of employee ergonomics training in industry. *Applied Ergonomics*, 28(4), 249–256.

LaTour, M. S., Snipes, R. L., & Bliss, S. J. (1996). Don't be afraid to use fear appeals: An experimental study. *Journal of advertising research*, 36(2), 59-67.

Leventhal, H. (1970). Findings and theory in the study of fear communications. In L. Berkowitz (Ed.), *Advances in experimental social psychology*, 5, (pp. 119-186). New York: Academic Press.

Lewis, J. R., Fogleman, M., Deeb, J., Crandall, E., & Agopswicz, D. (2001). Effectiveness of a VDT ergonomics training program. *International Journal of Industrial Ergonomics*, 27, 119–131.

Lewis, J. R., Krawiec, E. C., Agopsowicz, D., Crandall, E. (2002). Musculoskeletal disorder worker compensation costs and injuries before and after an office ergonomics program. *International Journal of Industrial ergonomics*, 29, 95-99.

Liberty Mutual Insurance. (2001, February 26). Liberty mutual reveals first-ever ranking of the leading causes of workplace injuries. Retrieved January, 2004, from http://www.libertymutual.com/about/pressclub/press_workplace.html

Liker, J. K., Evans, S. M., & Ulin, S. S. (1990). The strengths and limitations of lecture-based training in the acquisition of ergonomics knowledge and skill. *International Journal of Industrial Ergonomics*, 5, 147-159.

Lippert, L. (1994). *Clinical kinesiology for physical therapist assistants.* (p. 7). F. A. Davis Company: Philadelphia.

Maddux, J. E., & Rogers, R. W. (1983). Protection motivation and self-efficacy: A revised theory of fear appeals and attitude change. *Journal of Experimental Social Psychology*, 19, 469–479.

Marcus, M., Gerr, F., Monteilh, C., Ortiz, D. J., Gentry, E., Cohen, S., Edwards, A., Ensor, C., & Kleinbaum, D. (2002). A prospective study of computer users: II. Postural risk factors for musculoskeletal symptoms and disorders. *American Journal of Industrial Medicine*, 41, 236-249.

Matias, A. C., Salvendy, G., & Kuczek, T. (1998). Predicive model of carpal tunnel syndrome causation among VDT operators. *Ergonomics*, 41, 213-226.

Mish, F. C., et al. (2000). *Merriam-Webster's collegiate dictionary* (10th ed.). Springfield: Massachusetts.

McLean, L., Tingley, M., Scott, R. N., & Rickards, J. (2001). Computer terminal work and the benefit of microbreaks. *Applied Ergonomics* , 32(3), 225-237.

Montazui, A., & McEwen, J. (1997). Effective communication: perception of two anti-smoking advertisements. *Patient Education and Counseling*, 30, 29-35.

Niebel, B. W. & Andris, F. (1999). *Methods, standards, and work design.* Boston: McGraw-Hill.

Pedretti, L. W., (Ed.). (1996). *Occupational therapy: Practice skills for physical dysfunction.* (pp. 681-682). New York: Mosby.

Prevention Services, Ergonomic Glossary. Retrieved January 2004, from http://www.whscc.nf.ca/ohs/glossary.htm

Rizzo, T. H., Pelletier, K. R., Serxner, S., & Chikamoto, Y. (1997). Reducing risk factors for cumulative trauma disorders (CTDs): The impact of preventive ergonomic training on knowledge, intentions, and practices related to computer use. *American Journal of Health Promotion.* 11(4), 250-253.

Rogers, R. W. (1975). A protection motivation theory of fear appeal and attitude change. *The Journal of Psychology*, 91, 93-114.

Rogers, R. W. (1983). A protection motivation theory of fear appeals and attitude change: A revised theory of protection motivation. In J. Cacioppo & R. Petty (Eds.), *Social psychophysiology*. (pp. 153-176). New York: Guildord Press.

Sherrer, M., & Rogers, R. (1984). The role of vivid information in fear appeals and attitude change. *Journal of Research In Personality*, 18, 321-334.

U.S. Department of Health and Human Services. *1997 Musculoskeletal disorders and workplace factors: A critical review of epidemiologic evidence for work-related musculoskeletal disorders of the neck, upper extremity, and low back*. In B. P. Bernard (Eds.), Retrieved September, 2002, from http://www.cdc.gov/niosh/ergosci1.html

U. S. Department of Labor: Occupational Safety & Health Administration. *1970 General duty clause.* Retrieved June, 2002, from http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=OSHACT&p_id=3359

Witte, K. (1992). Putting the fear back into fear appeals: The extended parallel process model. *Communication Monographs*, 59, 329–347.

Witte, K., & Allen, M. (2000). A meta-analysis of fear appeals: Implications for effective public health campaigns. *Health Education and Behavior*, 27(5), 591-615.

Witte, K., Berkowitz, J. M., Cameron, K. A., & McKeon, J. K. (1998). Preventing the spread of genital warts: Using fear appeals to promote self-protective behaviors. *Health Education and Behavior*, 25(5), 571–585.

United States General Accounting Office. GAO/HEHS-97-163. (1997). *Worker Protection: Private Sector Ergonomics Programs Yield Positive Results.*

Appendix A

Demographic Questionnaire

This questionnaire will be used to gather background information. Please answer the following questions to the best of your ability.

Name: ____________________________________ Date: __________

1. Sex: ___ Male ___ Female

2. Age range: ___18 – 25 years, ___26 – 35 years, ___36 – 50 years, ___51 – 60 years

3. Work status at this company in terms of hours:
   ___ Full time (40 hours/week)
   ___ Part time (between 20 – 40 hours/week)
   ___ Other, please specify ______________________

4. Please estimate how much time you spend doing the following activities each day:

   Computer work _____ hours/day
   Paperwork _____ hours/day
   Phone use _____ hours/day
   Meetings _____ hours/day
   Other _____ hours/day
   ____

5. On average, how many hours a day you do spend at a computer?
   a. At work: _____ hours
   b. At home: _____ hours
   c. At other times: _____ hours

6. Approximately how many days per week do you use a computer? _________

7. On average how many days during the week do you exercise?
   ___ 0, ___1-2, ___3-4, or ___5-7 days per week

8. When was the last time you attended or went through ergonomic training (lecture or web-based)?
   ___ Within the past 6 months
   ___ Within the past year
   ___ Within the past 2 years or more
   ___ Never

9. Have you ever had an ergonomic evaluation of your office or work area at this company or another?
   ___ Yes
   ___ No

10. On average, how many days of work per year do you miss due to illness? ____ Days.

11. Have you ever had an injury that you think may have resulted from or been exacerbated by computer use (i.e., typing or using a mouse)?
    ___ Yes
    ___ No
    ___ Not sure

12. Have you ever had an injury, on or off the job that affected you while working at this company?
    ___ Yes
    ___ No
    ___ Not sure

Appendix B

Pre-Training Questionnaire

Please answer the following questions to the best of your ability.

Name: ____________________________ Date: ______________

For each of the following statements please choose a number from 1 (Strongly Disagree) through 5 (Strongly Agree) that best matches your current beliefs.					
	Strongly Disagree			Strongly Agree	
1. An injury sustained from working at a computer can be very painful.	1	2	3	4	5
2. I know what the risk factors associated with computer use are.	1	2	3	4	5
3. I am susceptible to developing an injury from computer use.	1	2	3	4	5
4. Ergonomic techniques (i.e., proper postures and habits) can help reduce the risk of injuries associated with computer use.	1	2	3	4	5
5. An individual's work habits affect the likelihood of developing an injury while working at a computer.	1	2	3	4	5
6. People who have jobs that involve computer work are susceptible to injuries of muscles, tendons, or nerves.	1	2	3	4	5
7. An injury resulting from working at a computer can be debilitating.	1	2	3	4	5
8. I am confident that I can reduce the risk of developing an injury when working at a computer by practicing safe work habits.	1	2	3	4	5

Appendix C

Post-Training Questionnaire

Please answer the following questions to the best of your ability.

Name: ____ Date: ________________

Please rate from 1 (Not at all) through 7 (Very much so), how much you are experiencing each of the following feelings listed below as a result of the training presentation:							
	Not at all						Very much so
1a. Distracted	1	2	3	4	5	6	7
1b. Restless	1	2	3	4	5	6	7
1c. Worried	1	2	3	4	5	6	7
1d. Frightened	1	2	3	4	5	6	7
1e. Fearful	1	2	3	4	5	6	7
1f. Nervous	1	2	3	4	5	6	7
1g. Uncomfortable	1	2	3	4	5	6	7
1h. Tense	1	2	3	4	5	6	7

For each of the following questions please choose a number from 1 (Not at all) through 7 (Very much so), that best matches your current beliefs.							
	Not at all						Very much so
2a. Do you feel you have been persuaded by the ergonomic training presentation to practice the suggested work habits?	1	2	3	4	5	6	7
2b. Is it likely that you will follow the ergonomic training recommendations?	1	2	3	4	5	6	7
2c. How likely is it that this training will influence the way you work at a computer?	1	2	3	4	5	6	7
2d. How likely are you to follow the ergonomic recommendations throughout an entire workday?	1	2	3	4	5	6	7

For each of the following statements please choose a number from 1 (Strongly Disagree) through 7 (Strongly Agree), that best matches your current beliefs.							
	Strongly Disagree					Strongly Agree	
3a. An injury resulting from working at the computer can be **severe**.	1	2	3	4	5	6	7
3b. An injury resulting from working at the computer can be **dangerous**.	1	2	3	4	5	6	7
3c. An injury resulting from working at the computer can be **serious**.	1	2	3	4	5	6	7

For each of the following questions please circle a number 1 (strongly disagree) through 5 (strongly agree) which bests matches your current beliefs.					
	Strongly disagree			Strongly agree	
4. An injury sustained from working at a computer can be very painful.	1	2	3	4	5
5. I know what the risk factors associated with computer use are.	1	2	3	4	5
6. I am susceptible to developing an injury from computer use.	1	2	3	4	5
7. Ergonomic techniques (i.e., proper postures and habits) can help reduce the risk of injuries associated with computer use.	1	2	3	4	5
8. An individual's work habits affect the likelihood of developing an injury while working at a computer.	1	2	3	4	5
9. People who have jobs that involve computer work are susceptible to injuries of muscles, tendons, or nerves.	1	2	3	4	5
10. An injury resulting from working at a computer can be debilitating.	1	2	3	4	5
11. I am confident that I can reduce the risk of developing an injury when working at a computer by practicing safe work habits.	1	2	3	4	5

Appendix D

Ergonomic Quiz

Name: ____ Date: ____________

Please circle the best answer for each question. There is only one answer for each question.

1. Which of the following is a risk factor for a cumulative trauma disorder (i.e., repetitive strain injury)?

   a) Force
   b) Repetition
   c) Awkward postures
   d) b and c
   e) a, b, and c

2. Which of the following are signs and symptoms of cumulative trauma disorders?

   a) Numbness in your fingers
   b) Muscle stiffness
   c) Increased flexibility
   d) a and b
   e) All of the above

3. When typing you should:

   a) Rest your palms/wrists on the wrist rests to help support the arms.
   b) Keep your elbows in by your side.
   c) Sit back from the keyboard, so you can see the keys better.
   d) Tilt the keyboard tray so it slopes towards you (front edge lower than back edge).

4. Neutral postures help to

   a) reduce muscle energy expenditure
   b) reduce circulation in the muscles
   c) reduce oxygen to the muscles
   d) all of the above

5. Your computer monitor (screen) should be positioned ____ to minimize awkward postures of the head and neck.

a) to the right of the keyboard with the top 1/3 of the screen at or below eye level
b) to the left of the keyboard with the top 1/3 of the screen at or below eye level
c) directly in front of the keyboard and you with the top 1/3 of the screen at or below eye level
d) directly in front of the keyboard

6. The best position for your mouse is:

a) next to the keyboard
b) next to the monitor
c) behind the keyboard
d) wherever there is room on the desk

7. Which of the following items should be within arms reach while sitting at your desk?

a) phone
b) source documents
c) frequently used items
d) all of the above

8. Your chair seat height should be set so your ___ .

a) hips are six inches higher than your knees
b) hips are even or slightly higher than your knees
c) hips are lower than your knees
d) a and b

Please circle the correct answer for **questions 9 - 15**. (True or False)

9. T F It is best to find the most comfortable sitting posture and sit that way all day.

10. T F Your arm should be straight and wrist rested on the desk when using the mouse.

11. T F Your keyboard angle should be adjusted to allow you to type with your your wrists level.

12. T F Other equipment and materials you use should not be placed on your desktop near your computer.

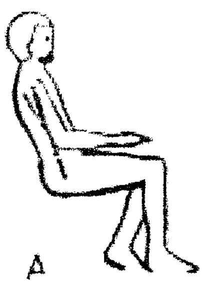
13. T F Neck and shoulder discomfort or pain can be caused by improper positioning of your monitor and work materials (i.e., books or reference documents).

14. T F Static body positions can cause your muscles to tense and lead to discomfort and/or pain.

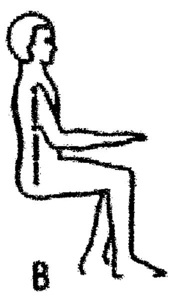
15. T F A cumulative trauma disorder can be caused by using improper typing postures (techniques) over a prolonged period of time.

Appendix E

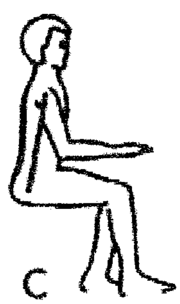
Graphic Icon Definitions



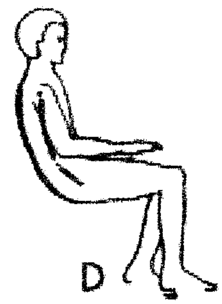
Sitting all the way back in a chair, spine in a neutral posture, with the lower, mid, and upper back against the chair's back support. Reclined from vertical.



Sitting upright and all the way back in the chair, spine in a neutral posture, with the lower and mid back against the chair's back support. The upper back may not be against the backrest depending on the chair.



Sitting with a forward lean from vertical and spine in a neutral posture. The mid to upper back is not against the chair's back support. The lower back may or may not be touching the chair's back support.



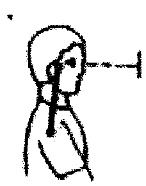
D

Reclined and slouched posture, leaning back in the chair with the back against the chair's back support. The spine is not in a neutral posture. Lumbar spine decreased lordosis and thoracic spine increased kyphosis from neutral.

E

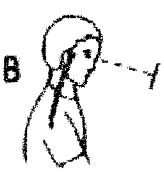
Forward lean and slouched sitting posture. The mid and upper back is not touching the back support of the chair and the lower back may or may not be. The spine is in a flexed non-neutral posture.

A



Sitting upright with head and neck in a neutral posture, ears aligned with shoulders and hips, and head level. Straight ahead gaze.

B

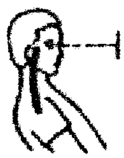


Sitting in a relaxed upright sitting posture with a downward gaze and ears forward in relation to shoulders.

C

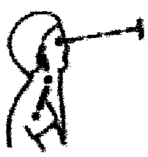
Sitting with a forward lean, neck is flexed, and downward gaze. The head and neck are not in a neutral position.

D



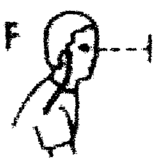
Sitting in a reclined position, forward head (decreased lordodic curve of cervical spine) and straight ahead gaze.

E

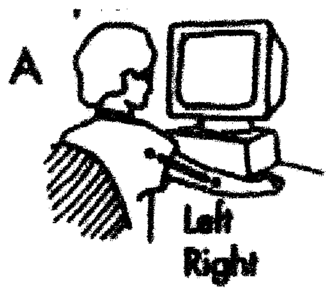


Forward lean, upright, or slouched sitting posture, neck extended (increased lordodic curve of cervical spine), upward gaze.

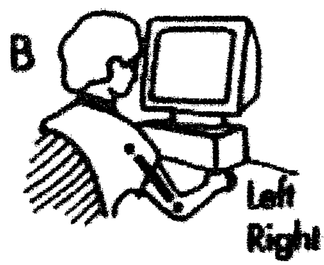
F



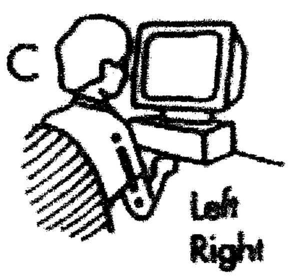
Forward lean or slouched sitting posture, forward head (ears forward in relation to the shoulders) with neck extended, and straight ahead gaze.



Upper extremity extended (left or right) and shoulder abducted when keying or using the mouse.

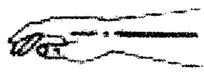


Upper extremity is extended with elbow flexion, shoulder abducted when keying or using the mouse.

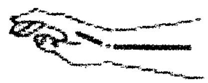


The elbows in by the side and bent approximately 90 degrees

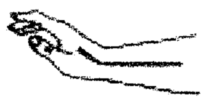
Wrist is flexed when keying or using the mouse.

B 

Wrist is in a neutral posture when keying or using the mouse.

C 

Wrist is minimally extended when keying or using the mouse.

D 

Wrist is moderately to maximally extended when keying or using the mouse.

Appendix F

Consent Form

AGREEMENT TO PARTICIPATE IN RESEARCH

Responsible Investigator: Bob Ulrey

Introduction and Background Information:
This research project is being completed by the responsible investigator as partial requirement for a Master degree at San Jose State University. You have been asked to participate in a research study investigating the effects of ergonomic training and high-risk computer users. No risk to you during this study is anticipated. The purpose of this study is to help evaluate the efficacy of a new lecture-based ergonomic training.

You will be observed working at your desk over the course of 5 consecutive days. Specifically, the researcher will pass by your desk approximately 3 times an hour, over a 7-hour period, per day. Each observation will take approximately 30 seconds. You will not be interfered with during the observations, the researcher will only be observing from the office/cubical entrance. You will be asked to work as you normally would for your job. You will not be asked or expected to perform differently than you normally would during the course of the study.

An ergonomic training session will be conducted on the third day of the observation period for many of the participants. If you do not receive ergonomic training at that time, you will receive it the following week. At the time of the training a pre and post-training quiz will be given to help measure learning. Following the training a questionnaire will be administered to gather feedback on the training. The training received during the study will fulfill Apple's ergonomic training requirements. An individual ergonomic evaluation will be offered to each participant following the completion of the study.

Agreement:
I agree that the procedures have been explained to me, and I understand them fully. I understand there are no risks or monetary compensations associated with my participation in this study. I understand that the results may be published, but no information that could identify me in any way will be included. I understand that this consent and data may be withdrawn at any time without penalty. I have been given the right to ask questions, and my questions, if any, have been answered to my satisfaction.

The principal investigator is, Bob Ulrey, (408) 974-6413. I may ask questions at any time during the observation period and training session. Complaints about the research may be presented to Kevin Corker, Ph.D. Director of the Graduate program in Human Factors and Ergonomics, Industrial & Systems Engineering Department, College of Engineering, at (408) 924-3988. Questions about research subjects' rights, or research-related injury may be presented to Pamela Stacks, Ph.D., Acting Associate Vice President, Graduate Studies and Research, at (408) 924-2480.

______
Initials

At the time you sign this consent form, you will receive a copy of it for your records, signed and dated by the investigator.

- **The signature of a participant on this document indicates agreement to participant in the study.**

- **The signature of a researcher on this document indicates agreement to include the above named participant in the research and attestation that the participant has been fully informed of his or her rights.**

____

Participant's Signature Date

____

Investigator's Signature Date

If you would like a summary of the findings, please complete the following information:

Name: ______________________________

Address: ______________________________

____

____

______
Initials

Appendix G

High Fear Appeal Notes

Instructions given to the presenter of the ergonomic training. When giving this presentation speak in the second person tense (i.e., you).

1. (Slide is read aloud.)
2. (Slide is read aloud.)

3. Participate: You are expected to participate in the process and take ownership of your habits and your workstation.

Once you complete your training you are expected to use the information to evaluate your space. If you identify any risk factors you should work to correct them or request assistance.

Once you've evaluated your workstation and corrected any identified risk factors, you should always strive to practice safe work habits. Workstations are relatively easy to change but habits are often a bigger component and harder to change. It takes time and practice.

If you have concerns regarding your workspace, the program or any EHS (Environmental Health and Safety) issue please contact your manager and safety@apple.com.

Report all signs and symptoms of injury to your manager, and remember to report EARLY.

4. (Slide is read aloud.)
5. (Slide is read aloud.)
6. (Slide is read aloud.)

7. Remember injuries are easier to treat and recover from if they are addressed early. If you experience an injury you may initially experience symptoms such as general fatigue. If your injury is not addressed your fatigue can progress to more specific locations of pain or discomfort. You may develop swelling when injured tissues continue to be stressed. You also may have loss of motion and loss of strength once swelling interferes with injured tissue. You may experience stiffness in your hands and fingers or notice you are unable to hold a pen or a coffee cup. If you begin to experience numbness and tingling, this usually indicates that your nerve tissue or blood supply are involved.

If you leave this untreated it can result in permanent nerve damage or surgery.

8. (Use this slide as an opportunity for group to stand and participate. Ask people to

march or swim and volunteer to read the bullets. Once bullets are read, explain in lay terms what each bullet means.)

Your muscles are elastic tissue, the energy required to move them is high, energy and increased heart rate help circulate nutrition where needed and remove waste as necessary.

9. (Use this slide to hold static posture, i.e., "arms out, knee up." Ask volunteers to read bullets. Once completed ask "which is easier?" [Dynamic])

(Explain in lay terms the difference between static vs. dynamic, i.e., "Your energy is still required for static work but circulation is diminished because your muscles are not pumping but holding a position, therefore nutrition is diminished and waste can build up.")

(Let participants know that if they remember nothing else from the training, hope they understand that their static postures (no matter how good/bad) can be difficult to tolerate for long periods of time. Movement, or frequent changes in posture can help prevent fatigue and discomfort.)

10. (Use this slide as a transition to the ergometer.) You should understand that office jobs often encourage more static than dynamic postures.

There are some static positions that are better than others and we call these positions "neutral". These are positions where your joints and muscles are not stressed (i.e., fully flexed, fully extended).

(Use ergometer on right upper trap to demonstrate keyboard too high, too far away, mouse reach to right, pinch of phone between shoulder and ear. Move leads to forearm to demonstrate wrist extended vs. neutral.)

(Turn off slides or turn up lights and move to measurement worksheet in folder. Use white board to demonstrate how to take measurements: adjust chair height first then measure chair (behind knee) elbow and eye heights. These are relative measures and may differ if you are not sitting in the same chair you use in your station.)

11. In order to avoid injury you must be able to recognize the risk factors associated with injury. Risk factors are those things that will put you at risk for an issue. In the case of heart disease, risk factors include smoking, diet, age, hypertension, etc… If you have 8 of the 10 risk factors you are at significant risk for heart disease.

You need to understand and learn how to control risk factors. Identifying these risk factors will not guarantee an injury, but can indicate your level of risk. (Use example of speed limits. Driving at a high rate of speed will not guarantee an accident, but the faster you drive (and the more often you do it) the more likely you are to have a serious accident.)

Risk Factors in the office environment include Posture, Force and Frequency.

Posture: Is the easiest risk for you to identify and change. If you cannot assume a "neutral" posture while at your workstation you may be at risk for injury.

Force: Excessive force is not always obvious in the office environment. Examples include: prolonged sitting in your chair, squeezing your mouse or pen, pounding on your keys, resting your forearms or elbows on hard edges.

Frequency: Should be viewed as two ends of a spectrum. You may be at risk with too little or too much frequency. Use working out in gym as example. We understand the concept of alternating muscle groups in exercise routines, work/rest cycle. This same concept should be applied in office. You need to ensure a "micro" work/rest cycle exists. This is why taking micro-breaks, changing posture, alternating the use of mouse vs. keyboard commands is so important.

12. If posture is so easy to identify and change why don't you do it?

Vision: Is the strongest determinant of your posture. YOUR eyes will always lead and determine your posture when the task requires vision.

Reach: Your hands are the second thing that lead posture. YOUR hands must be able to get to the task. The more you reach, usually = more force!

External support: It is a natural process for your body to continually look for opportunities to off load the weight of your trunk. It is natural to shift constantly or lean when you start to feel fatigue. (Look around the room and help identify ways people are off loading while sitting in class.)
- Chair: Adjust the tension of your chair to support your bodyweight.
- Work surface: The height of your work surface should support neutral positions, not awkward postures like reaching or leaning.
- Floor: Always attempt to set up your workstation with your feet planted firmly on the ground. Avoid using a footrest to substitute for support. Footrests are ok for a change in posture, but should not be your only means of good feet support.

13. (Let class know that these pictures are not to be used as judgments, but as examples of postures that we ALL probably assume at one time or another. The key is identifying them, controlling where we can and altering postures often.)

If you touch type then the generic rule is place your keyboard = elbow height and monitor = eye height.

If YOU do NOT then your neck can be at risk. You may need to "break" the generic rule and opt for a little higher keyboard height with slight slant and a little lower monitor height (The best way to explain is to demonstrate with keyboard. Can get straight wrist and easy distance for eyes from keyboard to monitor, but will need to break from position often and stretch out elbow and forearm.) You should consider learning to touch type if plan on spending much of career on keyboard (at least until voice catches up).

14. (If you are going to fix things where do you start?)

Start with the ground and build up. Always start with your chair, then surface (keyboard, mouse, paper, phone), and finally your monitor position.

15. Example of reaching with your fingers. This happens when you "plant" your wrists on a wristrest and you try to type.

16. You should use wristrests and armrests as a place to rest, not work from.

Make sure your work surface height supports good neutral position, and does not require you to reach to your keyboard or mouse.

"Planting" on a wristrest creates 2 risk factors: awkward posture and force. Tendons of the hand have a difficult time moving through a bent carpal tunnel with force on them. (Like the fraying of a rope across a hard edge.)

(Use physical demo: Ask class to hold their left forearm with right hand with the right fingers on top and thumb on bottom of the left forearm. With left wrist bend fingers toward ceiling: wiggle (should feel extensor muscles on top of forearm moving). Then switch: Bend your left fingers toward floor and wiggle (should feel flexor muscles on bottom of forearm). You need straight wrists with balance between these muscles for a neutral posture.

Right slide also shows common awkward posture of "fly away thumb", which can create force (i.e., pain) in the left forearm.

17. If you are reaching to the mouse this is a problem. You should consider mousing with your left hand, using a mousebridge, or using smaller keyboard to minimize your reach.

If a mousebridge is a good solution make sure it does not cause "hiking" of the shoulder.

18. (Left slide: Left hand tense, with fingers hanging over the keyboard.)

(Right slide: "Rolling" your hand when not using it helps to relax your muscles and avoid muscle tension.)

19. Summary slide. Stress increases the likelihood of RSI when the risk factors are combined.
When YOU use excess force and awkward postures YOU are more likely to develop symptoms.

Appendix H

Low Fear Appeal Notes

Instructions for the presenter of the ergonomic training. When giving this presentation present information in a factual manner.

1. (Slide is read aloud.)
2. (Slide is read aloud.)

3. Participate: Employees are expected to participate in the process and take ownership of habits and the workstation set up.

Once training has been completed use the information to evaluate the workstation. If any risk factors have been identified, work to correct them or request assistance.

Once the workstation has been evaluated and identified risk factors corrected, remember safe work habits should always be practiced. Workstations are relatively easy to change, but habits are often a bigger component and harder to change. It takes time and practice.

For concerns regarding the workspace, the program, or any EHS (Environmental Health and Safety) issue please contact your manager and safety@apple.com.

Report all signs and symptoms of injury to your manager and remember to report EARLY.

4. (Slide is read aloud.)
5. (Slide is read aloud.)
6. (Slide is read aloud.)

7. Injuries are easier to treat and recover from if they are addressed early. Symptoms can begin as general fatigue. If the stressors are not addressed fatigue can progress to more specific locations of pain or discomfort. Swelling begins when injured tissues continue to be stressed. Loss of motion and loss of strength can develop once swelling interferes with injured tissues. Symptoms of numbness and tingling usually indicate that nerve tissue or blood supply are involved.

8. (Use this slide as an opportunity for group to stand and participate. Ask people to march or swim and ask for a volunteer to read the bullets from the slide. Once bullets are read explain in lay terms what each bullet means.)

Muscles are elastic tissue, the energy required to move them is high, energy and increased heart rate help circulate nutrition where needed and remove waste as necessary.

9. (Use this slide to hold static posture (i.e., Arms out, knee up). Ask for volunteers to read bullets from the slide.)

Once complete holding a static posture ask which is easier (dynamic or static)? Explain in lay terms the difference between static vs. dynamic (i.e., energy is still required for static work, but circulation is diminished because the muscles are not "pumping" but "holding" a position, therefore nutrition is diminished and waste can build up).

Let participants know that if they remember nothing else from the training, they understand that static postures (no matter how good or bad) can be difficult to tolerate for long periods of time. Movement or frequent changes in posture can help prevent fatigue and discomfort from static positions.

10. (Use this slide as a transition to the ergometer.) We understand that office jobs often encourage more static than dynamic postures.

Explain that there are some static positions that are better than others and we call these positions "neutral". These are positions where the joints and muscles are not stressed (i.e., Fully flexed or fully extended)

Use the ergometer on right upper trapezius to demonstrate muscle activity in various postures; keyboard position that is too high and too far away; reach to the right past the numeric pad of a keyboard to use the mouse; and pinch the phone between shoulder and ear. Move the leads of the ergometer from upper trapezius to a forearm to demonstrate wrist extended versus a neutral wrist posture.

Turn off slides or turn up lights. Use white board to demonstrate how to take measurements of seated elbow and eye heights: Adjust chair height first then measure chair height (behind knee), seated elbow height from floor to bottom of elbow, and seated eye height (floor to eye level when head level and looking straight ahead). Explain that these are relative measures and may differ if they are not sitting in the same chair they use in their office.

11. (Describe in factual manner) In order to avoid injury we need to understand and learn how to control risk factors.

Risk factors are those things that will put you at risk for an injury. In the case of heart disease, risk factors include smoking, diet, age, and hypertension. If you have 8 of the 10 risk factors for heart disease you are at significant risk.

There are three primary risk factors associated with injury in the office environment: Posture, force, and Frequency. Identifying these risk factors can indicate your level of risk. Use example of speed limits. Driving at a high rate of speed will not guarantee an accident, but the faster you drive (and the more often you do it) the more likely you are to have a serious accident.

Posture: Is the easiest risk factor to identify and change. "Neutral" postures are recommended to avoid injury.

Force: Excessive force is not always obvious in the office environment. Examples include: prolonged sitting, squeezing of a mouse or pen, pounding on keys while typing, or resting forearms or elbows on hard edges of a work surface.

Frequency: Should be viewed as two ends of a spectrum. Risk is associated with too little and too much frequency. (Use working out in gym as example.) We understand the concept of alternating muscle groups in exercise routines, work/rest cycles. The same concept should be applied in the office environment. "Micro" work/rest cycles are important. This is why taking micro-breaks, changing posture, alternating the use of mouse versus keyboard commands is so important to minimize the effects of frequency.

12. If posture is so easy to identify and change why do we have issues with it?

Vision: Is the strongest determinant of posture. Our eyes will always lead and determine posture when the task requires vision.

Reach: Hands are the second thing to lead posture. Hands must be able to get to the task. More reaching of the arms usually equals more force!

External support: It is a natural process for our bodies to continually look for opportunities to off load the weight of our trunks. It is natural to shift constantly or lean when we start to feel fatigue. (Look around the room and help identify ways people are off loading while sitting in class)

- Chair - adjust the tension of the chair should support your bodyweight
- Work - surface- height should support neutral positions, not awkward reach/lean
- Floor - always attempt to set up workstation with feet planted firmly on the ground. Avoid using a footrest to substitute for support. They are ok for a change in posture but should not be your only means of good support.

13. (Let class know that these pictures are not to be used as judgments, but as examples of postures that we ALL probably assume at one time or another. The key is identifying them, controlling where we can and altering postures often.)

If you touch type then the generic rule of keyboard = elbow height and monitor = eye height will apply.

If you do not then placing the keyboard at elbow height can be at risk of awkward posture for the neck. The generic rule may need to be broken and opt for a little higher keyboard height with slight slant and a little lower monitor height (best way to explain is to demonstrate with keyboard, can get straight wrist and easy distance for eyes from keyboard to monitor, but will need to break from position often and stretch out elbow/forearm). Should consider learning to touch type if plan on spending much of your career on a keyboard (at least until voice catches up).

14. Where do you start if you are going to fix things? Start from the ground and build up. Always start with the chair, then work surface (keyboard, mouse, paper, phone), and finally monitor position.

15. Example of reaching with fingers to type. This happens when the wrists are "planted" on a wristrest and trying to type.

16. Should use the wristrest (and armrests) as a place to rest, not to work from. Make sure surface height supports good neutral position, and does not promote reaching to the keyboard or mouse.

"Planting" on a wrist rest creates 2 risk factors: awkward posture and force. Tendons of the hand have a difficult time moving through a bent carpal tunnel with force on them. (Like the fraying of a rope across a hard edge.)

(Use physical demonstration: Ask the class to hold their left forearm with right hand, with right fingers on top and thumb on bottom of left forearm. With left wrist bent fingers toward the ceiling: wiggle fingers (should feel extensors muscles on top of forearm), then switch left wrist bend fingers toward floor and wiggle (should feel flexor muscles on bottom of forearm). Need straight wrist with balance between these muscles for a neutral posture.)

Right slide also shows a common awkward posture of "fly away thumb", which can create force (i.e., pain) in left forearm when held in a static posture.

17. If reaching to the mouse is a problem consider mousing with the left hand, using a mousebridge, or a smaller keyboard to minimize reaching. If a mousebridge is a proper solution make sure it does not cause "hiking" of the shoulder.

18. Left slide: Left hand tense, with fingers hanging over the keyboard. Right slide: "Rolling" the hand when not using it helps to relax muscles and avoid muscle tension.

19. Summary slide. Stress can increase the likelihood of RSI when the risk factors are combined. Using excess force while in an awkward posture will increase the likelihood of developing symptoms.

Appendix I

High Fear Appeal Training Presentation

Office Ergonomic Training

2/7/05

What Do I Need to Know ?

- Your role in the program
- Signs and symptoms of injury
- How to report injuries
- How to identify risk factors:
  - Posture
  - Force
  - Frequency
- Work habit and workstation design control risk

2/7/05

Your Role in the Program

- Participate and take ownership in the ergonomics process
- Evaluate your workstation and work habit(s)
- Correct any identified risk factors:
  - Posture
  - Force
  - Frequency
- Practice safe work habits
- Communicate ergonomic concerns
- Report signs and symptoms of injury

2/7/05

Reporting Injuries

- Tell your Manager/Supervisor
- If medical attention is necessary, see a doctor immediately.
- Manager completes Work Injury/Illness Report
- Addressing is automatic

If left untreated it can lead to surgery.

Ergonomics

"ergo" = work
"nomas" = natural laws

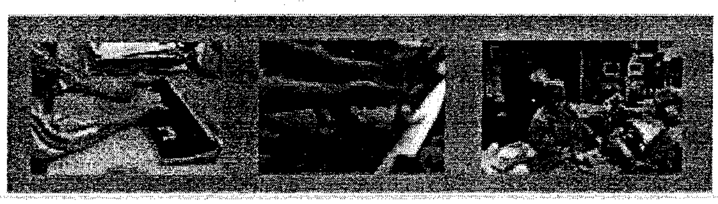
The study of how to design tools and tasks to fit the natural design of the body

"Design with people in mind"

2/7/05

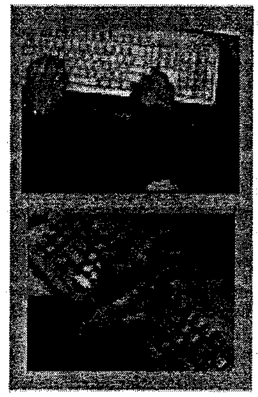
Characteristics of Repetitive Motion Injuries

- Occurs from a build up of micro-trauma
- Takes weeks, months, or years to develop
- May produce no symptoms in early stages
- Work, home and recreation all contribute
- Differs from individual to individual



Signs and Symptoms of Injury

- Fatigue
- Discomfort/Pain
- Swelling
- Loss of motion
- Loss of strength
- Numbness and Tingling

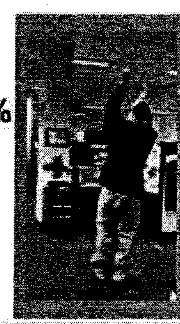


2/7/05

Dynamic Muscular Work

(Movement)

- Muscles contract and relax
- Metabolic needs are high
- Circulation is increased by 10-20%
- Nutrients are increased
- Waste is removed

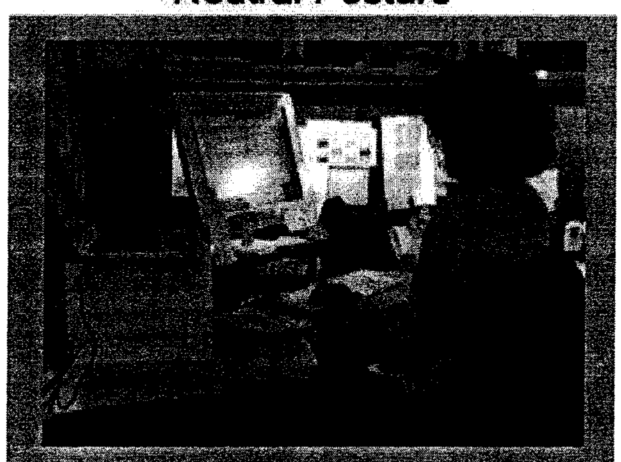


Static Muscular Work

(Maintain Posture)

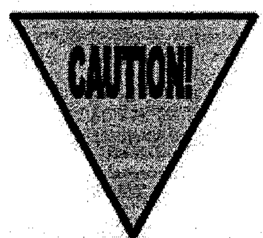
- Prolonged contraction of muscles
- Glucose and oxygen- decreased
- Metabolic needs are high
- Circulation is diminished
- Lactic acid build up

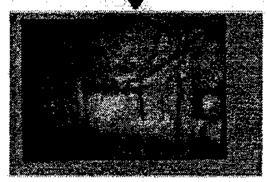
Neutral Posture



Risk Factors

- Posture
- Force
- Frequency





2/7/05

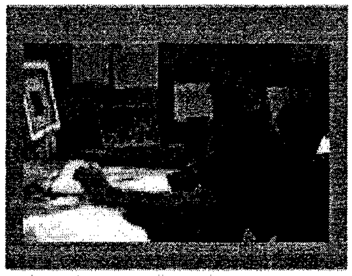
What Influences Posture?

- Vision
- Reach
- External Support
  - Chair
  - Work-surface
  - Floor

Vision

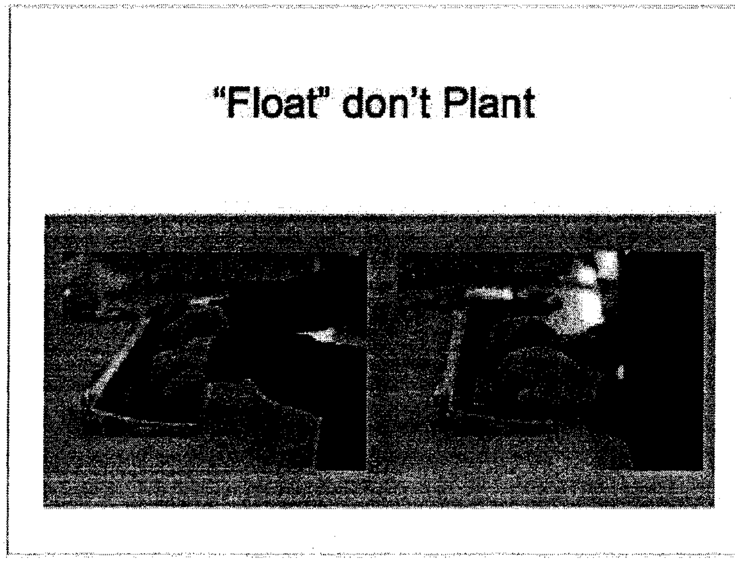
Eyes lead the body.

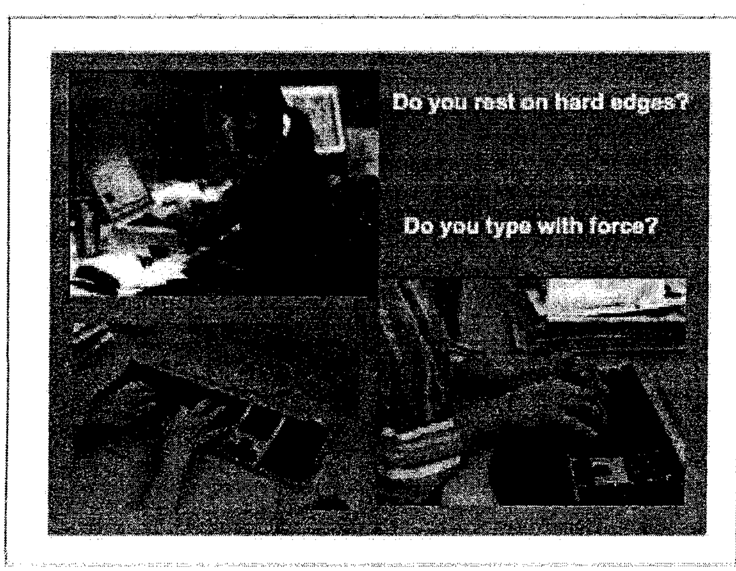
Do you Touch Type?

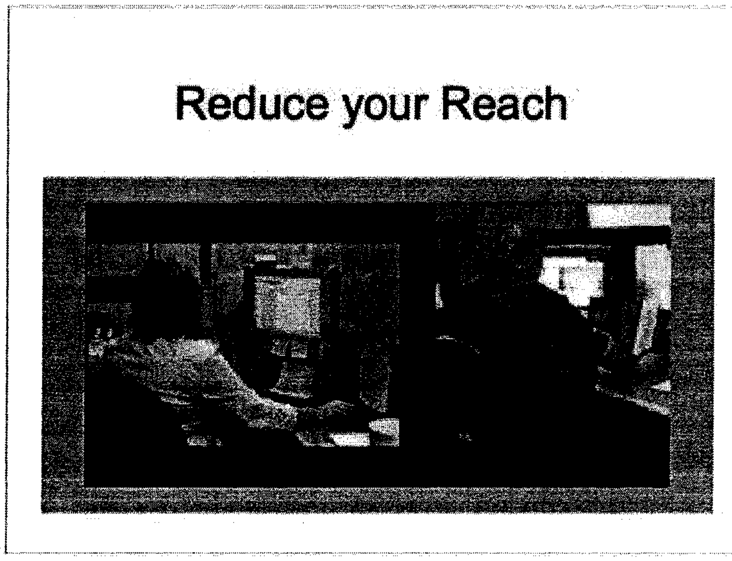


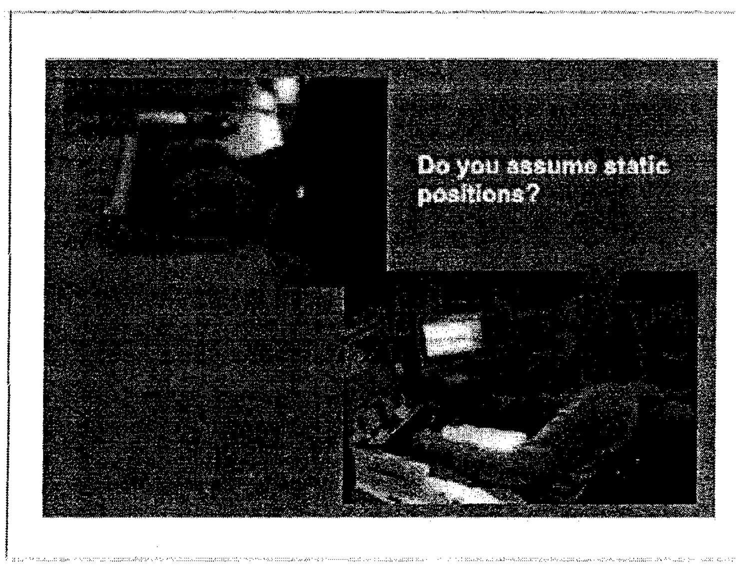
What about...

- Chair height?
- Surface height?
- Monitor height?


"Float" don't Plant

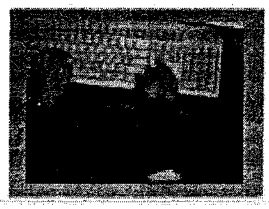

Do you rest on hard edges?
Do you type with force?


Reduce your Reach


Do you assume static positions?

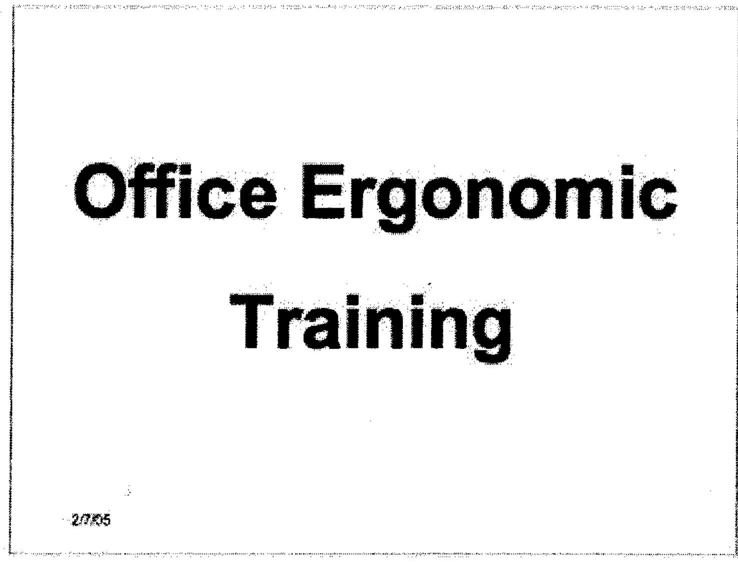
Summary

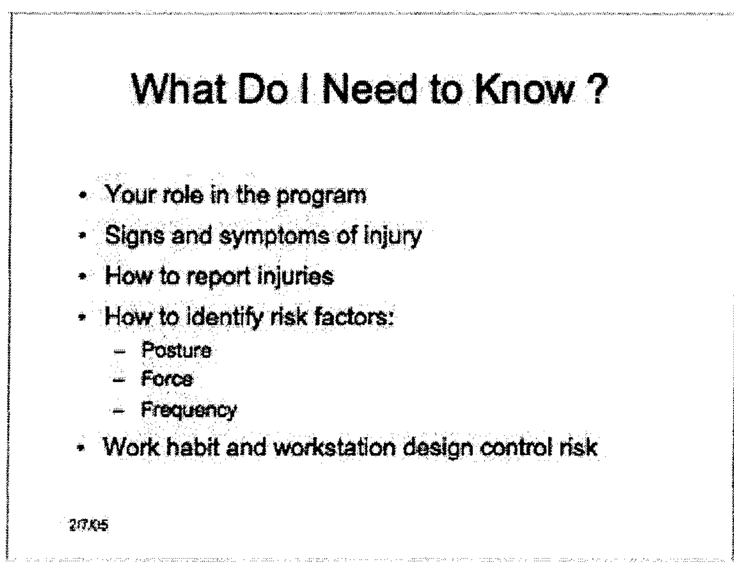
- Your work habits and workstation design control risk
- Evaluate risk factors
- Eliminate or control risk factors
- Move often
- Report symptoms early



Appendix J

Low Fear Appeal Training Presentation





Employee Role in the Program

- Participate and take ownership in the ergonomics process
- Evaluate the workstation and work habit(s)
- Correct any identified risk factors:
  - Posture
  - Force
  - Frequency
- Practice safe work habits
- Communicate ergonomic concerns
- Report signs and symptoms of injury

2/7/05

Reporting Injuries

- Tell your Manager/Supervisor
- If medical attention is necessary, see a doctor immediately.
- Manager completes Work Injury/Illness Report
- Addressing is automatic

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2/7/05

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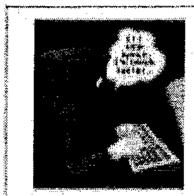
- Takes weeks, months, or years to develop
- May produce no symptoms in early stages
- Work, home and recreation all contribute
- Differs from individual to individual



Signs and Symptoms of Injury

- Fatigue
- Discomfort/Pain
- Swelling
- Loss of motion
- Loss of strength
- Numbness and Tingling

If left untreated it can lead to surgery.

Dynamic Muscular Work

(Movement)

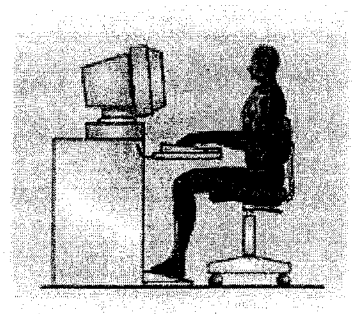
- Muscles contract and relax
- Metabolic needs are high
- Circulation is increased by 10-20%
- Nutrients are increased
- Waste is removed

Static Muscular Work

(Maintain Posture)

- Prolonged contraction of muscles
- Metabolic needs are high
- Circulation is diminished
- Glucose and oxygen- decreased
- Lactic acid build up

Neutral Posture



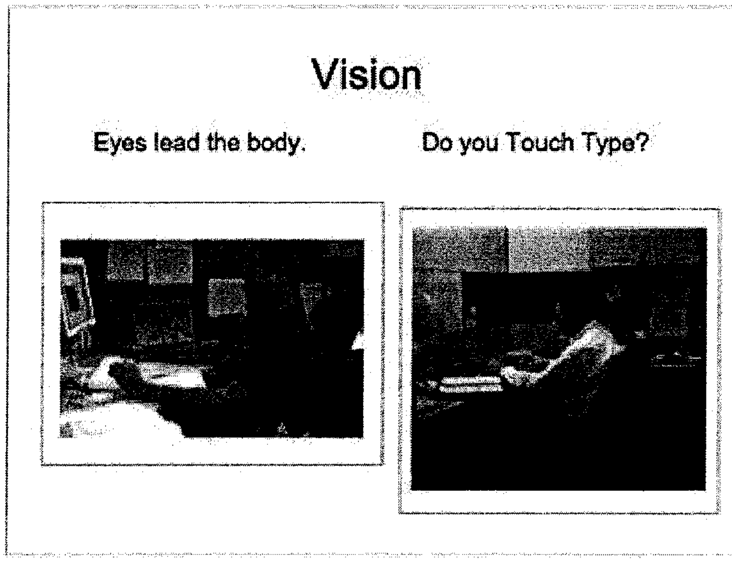
Risk Factors

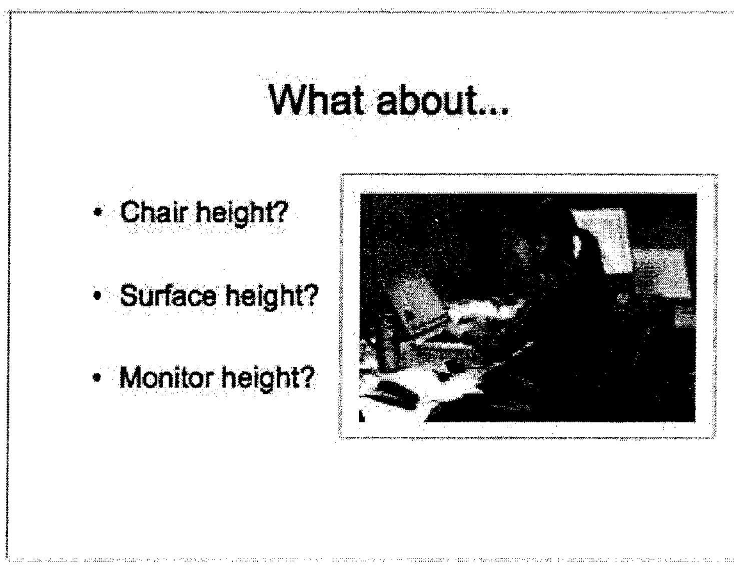
- Posture
- Force
- Frequency

2/7/05

What Influences Posture?

- Vision
- Reach
- External Support
  - Chair
  - Work-surface
  - Floor


Vision
Eyes lead the body.
Do you Touch Type?


What about...
• Chair height?
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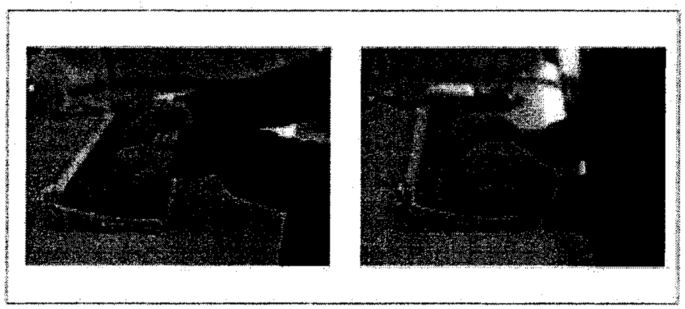
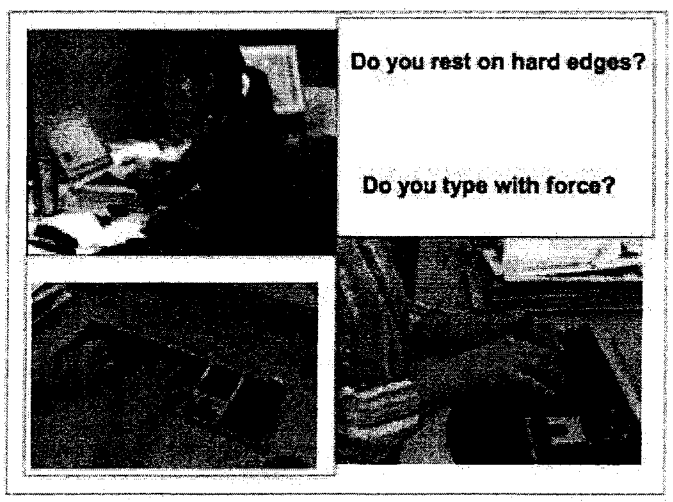
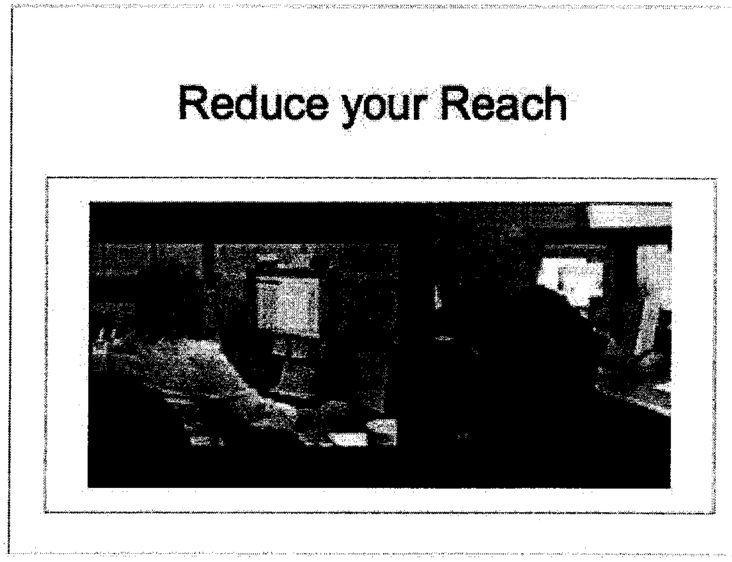
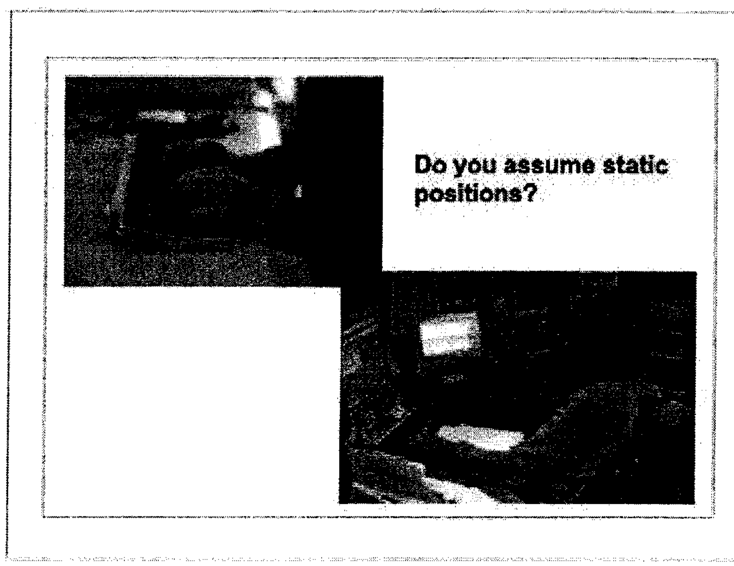





Reduce your Reach


Do you assume static positions?

Summary

- Work habit(s) and workstation design control risk
- Evaluate Posture, Force and Frequency
- Eliminate or control contributing risk factors
- Move often
- Report symptoms early

San José State
UNIVERSITY

Appendix K

SJSU Human Subjects Institutional Review Board Permission

Office of the Academic Vice President
Academic Vice President Graduate Studies and Research
One Washington Square
San José, CA 95192-0025
Voice: 408-283-7500
Fax: 408-924-2477
E-mail: gradstudies@sjsu.edu
http://www.sjsu.edu

To: Robert Ulrey
7100 Rainbow Dr., #7
San Jose, CA 95129

From: Pam Stacks, Pam Stacks
Interim AVP, Graduate Studies & Research

Date: July 6, 2004

The Human Subjects-Institutional Review Board has approved your request to use human subjects in the study entitled:

"Ergonomic Training and Fear Appeal: Impact on Behavior and Intention."

This approval is contingent upon the subjects participating in your research project being appropriately protected from risk. This includes the protection of the anonymity of the subjects' identity when they participate in your research project, and with regard to all data that may be collected from the subjects. The approval includes continued monitoring of your research by the Board to assure that the subjects are being adequately and properly protected from such risks. If at any time a subject becomes injured or complains of injury, you must notify Pam Stacks, Ph.D. immediately. Injury includes but is not limited to bodily harm, psychological trauma, and release of potentially damaging personal information. This approval for the human subjects portion of your project is in effect for one year, and data collection beyond July 6, 2005 requires an extension request.

Please also be advised that all subjects need to be fully informed and aware that their participation in your research project is voluntary, and that he or she may withdraw from the project at any time. Further, a subject's participation, refusal to participate, or withdrawal will not affect any services that the subject is receiving or will receive at the institution in which the research is being conducted.

If you have any questions, please contact me at (408) 924-2480.

cc: Dr. Kevin Corker

Appendix L

Letter of Institutional Support for Study

April 26, 2004

San Jose State University
Human Subjects-Institutional Review Board
Student Service Center, Room 424
San Jose, CA 95192-0025

To Whom It May Concern:

This letter grants permission to Robert Ulrey, Master's student at San Jose State University in Human Factors and Ergonomics, to conduct research with employees of Apple Computer, Inc. The company has been made aware that the purpose of this study is to examine how an ergonomic lecture-based training incorporating fear appeal impacts individuals' behavioral intentions and actual work habits while working at a computer.

Apple Computer, Inc. has been informed of the exact nature of the research study and understands that the researcher will conduct 5 days of observations while participants are working at a computer in their office or cubical. The participants will not be asked to work differently than they normally would. The participants will be administered two questionnaires, to gather demographic data and information regarding their current attitudes and beliefs about ergonomics and computer workstations. A quiz on ergonomic knowledge will be administered prior to and following an ergonomic training presentation to measure learning. An ergonomic lecture-based training presentation will be administered to the two experimental groups while the control group will not undergo training during this study. The control group will receive training one week following the completion of the observations. Mr. Ulrey has received permission to use Apple's ergonomic training material as a basis for the training presentation to be used for his study. The training given to all study participants will fulfill the ergonomic training requirements of Apple. Each participant will be offered the opportunity to schedule an individual ergonomic evaluation following this study.

Sincerely,

Kim Garner
Ergonomic Program Manager