UNIFORMED SERVICES UNIVERSITY OF THE HEALTH SCIENCES
F. EDWARD HÉBERT SCHOOL OF MEDICINE
4301 JONES BRIDGE ROAD
BETHESDA, MARYLAND 20814-4799

March 6, 2009

APPROVAL SHEET FOR THE DOCTORAL DISSERTATION
IN THE MEDICAL AND CLINICAL PSYCHOLOGY
GRADUATE PROGRAM

Title of Dissertation: " Biomechanical, Mood, and Cortisol Response to Work Demands in Office Workers with High and Low Workstyle "

Name of Candidate: Cherise B. Harrington
Doctor of Philosophy Degree
March 24, 2009

Dissertation and Abstract Approved:

Dr. Neil Grunberg — 3/24/09 Date
Department of Medical and Clinical Psychology
Committee Chairperson

Dr. Michael Feuerstein — 3/24/09 Date
Department of Medical and Clinical Psychology
Major Advisor

Marjan G. Holloway, Ph.D.
Dr. Marjan Holloway — 3/24/09 Date
Department of Medical and Clinical Psychology
Committee Member

Dr. Ann Scher — 3/24/09 Date
Department of Preventive Medicine and Biometrics
Committee Member

Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE **09 MAR 2009**	2. REPORT TYPE	3. DATES COVERED **00-00-2009 to 00-00-2009**

4. TITLE AND SUBTITLE **Biomechanical, Mood, And Cortisol Response To Work Demands In Office Workers With High And Low Workstyle**	5a. CONTRACT NUMBER
	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER
	5e. TASK NUMBER
	5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **Uniformed Services University Of The Health Sciences,4301 Jones Bridge Rd,Bethesda,MD,20814**	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution unlimited

13. SUPPLEMENTARY NOTES

14. ABSTRACT
Workstyle characterizes physiological, cognitive, and behavioral responses to high demand work tasks. Previous research suggests that certain workstyles (i.e. high) may be associated with increased risk of developing job-related upper extremity symptoms and may play a role in the exacerbation or maintenance of symptoms. The current study investigated if physiological and behavioral indicators of stress (i.e., characteristics of workstyle) are measurable in asymptomatic office workers grouped by workstyle score. Recognizing these indicators prior to symptom onset may have implications for the prevention of work-related upper extremity symptoms.

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT **unclassified**	b. ABSTRACT **unclassified**	c. THIS PAGE **unclassified**	**Same as Report (SAR)**	**185**	

Standard Form 298 (Rev. 8-98)
Prescribed by ANSI Std Z39-18

COPYRIGHT STATEMENT

Cherise B Harrington

Cherise B. Harrington, MS, MPH, 2009
Department of Medical and Clinical Psychology
Uniformed Services University of the Health Sciences

Biomechanical, mood, and cortisol response to work demands in office workers with high and low workstyle

Cherise B. Harrington, M.S., M.P.H

Dissertation Manuscript submitted to the faculty of the

Department of Medical and Clinical Psychology

Graduate Program of the Uniformed Services University

of the Health Sciences in partial fulfillment

of the requirements for the degree of

Doctor of Philosophy

2009

Abstract

Title of Dissertation: Biomechanical, mood, and cortisol response to work demands in office workers with high and low workstyle

Author: Cherise B. Harrington, MS, MPH

Thesis directed by: Michael Feuerstein, PhD, MPH
Director of Clinical Training
Department of Medical and Clinical Psychology

Workstyle characterizes physiological, cognitive, and behavioral responses to high demand work tasks. Previous research suggests that certain workstyles (i.e., high) may be associated with increased risk of developing job-related upper extremity symptoms and may play a role in the exacerbation or maintenance of symptoms. The current study investigated if physiological and behavioral indicators of stress (i.e., characteristics of workstyle) are measurable in asymptomatic office workers grouped by workstyle score. Recognizing these indicators prior to symptom onset may have implications for the prevention of work-related upper extremity symptoms.

This laboratory experiment is a mixed-model design. Eighty office workers who were prescreened for workstyle (40 High/40 Low) and spent at least four hours per day on a computer were enrolled in this study. This experiment investigated in a controlled laboratory setting whether workers who score high on a measure of workstyle, indicating potential for higher levels of upper extremity symptoms related

to work on a computer, demonstrate higher levels of keyboard force (biomechanical factor), increased cortisol response, increased heart rate and blood pressure (biochemical factors), and changes in mood (psychological factors) to the increased work demands.

Results indicate that the high workstyle group had increased keyboard force, greater abnormal wrist posture, more negative mood changes, more negative cognitions, and greater output (performance) compared to the low workstyle group. Additionally, the high workstyle group had higher levels of perceived stress and perceived demands during the high demand typing task compared to the low workstyle group. There were no significant differences on the physiological measures of heart rate, blood pressure, and salivary cortisol. Overall the high workstyle group had higher overall levels of stress and higher reactivity to the high demand typing task.

These results provide support for the hypothesis that individuals scoring high on a workstyle measure display an increased response in performance, behavior, and cognitions to perceived increased demands. Future work should focus on long term prospective studies of risk factors in asymptomatic workers to assess if a causal relationship exists.

Dedications

This dissertation project is dedicated to my grandparents the late Mr. & Mrs. William & Margaret V. Whitted. Your influence on my life is immeasurable. And although you are no longer here I feel your love and support always.

Acknowledgements

This dissertation project could not have been completed without the guidance and supervision of Dr. Michael Feuerstein. You have been a substantial resource for encouragement, mentorship, and training. You trained me to be a thoughtful, thorough researcher and critical thinker and have my sincere thanks. My deepest gratitude goes to my committee chair, Neil Grunberg, for your support and encouragement throughout this process. To my committee members, Marjan Holloway and Ann Scher, I thank you for your experience and advice which were invaluable to this project.

Much appreciation to the support staff in the Department of Medical & Clinical Psychology: Tricia Crum, Corinne Simmons, and Natalie Rosen.

To the past and current members of Graduation Education: Janet Anastasi, Tanice Acevedo, and Eleanor Metcalf thank you for your administrative and moral support. And a special thank you to the administrative staff of the Institutional Review Board: Margaret Pickerel and Rachael Wolff.

For financial support of my education and research, I would like to thank the Uniformed Services University of the Health Sciences, the Henry Jackson Foundation, and the American Psychological Association.

To the members of my lab whose support has been instrumental in the completion of my dissertation project: Lisseth Calvio, Gina Luff, Jennifer Hansen, Mark Peugot, Briana Todd, and Michal Moskowitz. To Heather Rogers, whose support and guidance throughout my education has been instrumental.

My class: Michael Perry, Lisseth Calvio, Crescent Seibert, Kristen Hamilton, and Robert Clark - you all have helped to make this experience truly fulfilling. In you all I have found life long friends and colleagues. Love you all!

My deepest affection goes to my family for their continued support and patience. Your love is my foundation. Specifically to my mother Donna Baldwin, and my sister, Chanda Foust, you two women complete the circle of strong Black women in my life. Words cannot express my love for you. Thank you for your undying support. To my nephew, Christopher E. Baldwin, if nothing else I hope that I have instilled in you the drive to make your dreams come true.

To my husband, we have shared sweat, tears, and laughs over the last 11 years. You continue to be my biggest supporter; you are my strength and heart. Thank you for your undying love. You are my best friend and the answer to my prayers. I look forward to continuing in this adventure with you, the sky is the limit.

To GOD, with you anything is possible.

Table of Contents

List of Tables

List of Figures

List of Appendices

Introduction

Musculoskeletal problems of the upper limbs are a major public health problem for industrialized countries (IJzelenberg, Molenaar, & Burdorf, 2004). It is estimated that 85% of the U.S. population will experience musculoskeletal pain including that of the upper extremities in a lifetime (Nachemson & Jonsson, 2000). Estimated costs are more than $50 billion dollars annually for all musculoskeletal problems, mostly attributed to upper extremity and back conditions (Coovert & Thompson, 2003). These estimated costs are directly and indirectly associated with health care and lost of functioning. Upper extremity problems make up one of the largest subgroups of musculoskeletal symptoms (Bureau of Labor Statistics, 2008). Upper extremity (UE) symptoms, disorders, and diseases are most often associated with repetitive movements and physical strain (Grieco, Molteni, De Vito, & Sias, 1998; Hales & Bernard, 1996). Upper extremity symptoms and disorders can negatively impact function related to physical capabilities, including work (Bongers, Ijmker, van den Heuval, & Blatter, 2006). Work-related problems associated with upper extremity symptoms and disorders also can contribute to substantial costs from lost productivity, lost work time, and increases in worker compensation costs (Bergqvist, Wolgast, Nilsson, & Voss, 1995; Van den Heuval, Ijmker, Blatter, & de Korte, 2007). Based on the cost and loss of function, there is a heavy individual and public health burden associated with upper extremity symptoms. Investigating new approaches for prevention is the rationale behind the current research.

There were approximately 270,000 upper limb-related cases in 2007 accounting for 23% of the total number of injuries and illnesses that resulted in missed work days in the U.S. alone (Bureau of Labor Statistics, 2008). Additionally, in the private industry upper extremity problems account for approximately 23% of conditions that result in missed worked days and 20% of the conditions in service-providing industry (Bureau of Labor Statistics, 2005b, 2007). Missed work days is one of the methods used to quantify the costs associated with the impact that certain conditions have at the individual and public health levels (i.e., economic). Musculoskeletal symptoms accounted for a median of nine missed work days in 2007 (Bureau of Labor Statistics, 2008) across job types.

There are multiple measures of disease burden and these measures vary by condition and perspective being considered. As previously described, missed work days is an example of burden from a public health perspective. From the perspective of the individual and treating health care professional, burden is quantified by outcomes related to pain and function (e.g., work status). Decreasing pain and improving function are important factors in the management of upper extremity disorders. Because of the burden of disease on the individual and the work force, the prevention and treatment of upper extremity musculoskeletal symptoms is a source of considerable effort from both a public health and research perspective (Aptel, Aublet-Cuvelier, & Cnockaert, 2002).

Many factors are associated with UE symptoms including biomechanical, functional, and psychological factors. Work factors are especially important to the development of upper extremity problems. Environmental factors related specifically to office work (e.g., keyboarding [Gerr, Monteilh, & Marcus, 2006] and sitting for long periods [Klussman, Gebhardt, Liebers, & Rieger, 2008] have been associated with upper extremity symptoms (NAS, 2001). The number of computer users has increased dramatically in the last 20 years (Ketola, Toivonen, Hakkanen, Luukkonen, Takala, & Vikari-Juntura, 2002), with an estimated 54% of the workforce using a computer (Chengalure, Rodgers, & Bernard, 2004). It also has been found that office workers spend greater than four hours of their work day doing a computer-assisted task (Ketola et al., 2002). In addition to the biomechanical factors associated with work, psychosocial factors also impact the worker in substantial ways.

The environment of the workplace includes exposures to both biomechanical and psychosocial factors (i.e., multi-factorial/dimensional). The etiology of musculoskeletal disorders also are multi-dimensional, which is consistent with the multi-dimensional environment of the workplace (National Institute of Occupational Safety and Health, 1997). The epidemiological literature has identified physical and psychological risk factors for musculoskeletal disorders (MSDs). The integration of these important factors (i.e., biomechanics and psychosocial factors) has shown promise as the best approach to prevent and treat work-related upper extremity symptoms (Feuerstein, Marshall, Shaw, & Burrell, 2000). Efforts to conceptualize the experience of the worker and the influence of this experience on upper extremity symptoms led to the development of the Workstyle measure and construct.

Workstyle is the response pattern of a worker to increased work demands (Feuerstein, 1996; Nicholas, Feuerstein, & Suchday, 2005). Workstyle is believed to influence both performance and function. This pattern of response includes cognitive, physiological, and behavioral components. Research on workstyle suggests that workstyle is associated with the development and exacerbation of UE symptoms (Feuerstein, Huang, & Pransky, 1999; Nicholas et al., 2005). Additionally, recent research suggests that workstyle may be a mediating factor in pain outcomes over time (Meijer, Sluiter, & Frings-Dresen, 2008). These previous studies assessed workstyle and outcomes in workers with upper extremity symptoms. It has not been determined if these patterns of response associated with workstyle score are measurable in healthy office workers who are asymptomatic with regard to upper extremity symptoms. An examination of the response pattern of workers who are asymptomatic and exposed to high work-related demands is an important addition to the workstyle literature because it can provide further validation of the construct of workstyle. Additionally, this research may suggest that workstyle is a tool that can be used to identify asymptomatic workers at risk for developing upper extremity symptoms. It is believed that the information from this and future investigations can be used to potentially prevent UE problems in workers.

The present study sought to determine if patterns in cognitive, physiological, and behavioral reactions to work demands (i.e., workstyle) previously shown to be related to pain and functional outcomes (i.e., psychological and physiological factors) can be identified in asymptomatic workers. This study assessed these patterns in a controlled laboratory environment under both low and high work demand conditions in asymptomatic officer workers.

To understand the rationale for the present study, the following text briefly reviews the pathophysiology of upper extremity symptoms, the epidemiology, stress responses relevant to work, models of occupational stress and health, and the workstyle construct. The pathophysiology section includes a working definition for upper extremity symptoms and some hypothesized causal mechanisms. This section indicates that the upper extremity literature has been unable to identify a single mechanism to explain upper extremity symptoms. The epidemiology of work-related upper extremity symptoms and disorders highlights the literature that supports the role of ergonomic exposure and psychosocial factors. The epidemiology of upper extremity symptoms converges to support a multi-factorial origin and approach to these symptoms. The stress response is a key component of the workstyle construct. The conceptualization of workstyle focuses on the response to high demands; workstyle is described here as a psychological, behavioral, and physiological response that is best described as stress-related reactivity. This section describes the stress response relevant to workstyle, work, and the present experiment. Models of occupational stress and health are briefly covered to reflect current trends of thinking on how ergonomic, behavioral, psychosocial, and other factors (i.e., genetics and individuals factors) integrate to influence health. Finally, the workstyle construct and measure are reviewed.

Public health perspective

Upper extremity symptoms are a significant public health problem. Economically, health care costs associated with upper extremity symptoms can be substantial. Additionally, deficits in work productivity and costs associated with worker's compensation claims also have negative economic influences on the system. A recent study of computer workers found that workers who reported neck/shoulder and hand/arm symptoms reported decreased performance at work attributed to their symptom (Van den Heuval et al., 2007). Because the public health burden associated with UE symptoms is high, it is important to identify risk factors and investigate methods to lower or modify risks. Both social and environmental factors are risk factors for UE symptoms. Specifically, biomechanical or ergonomic stressors are the most established risk factor for UE symptoms, including vibration, repetitive motions, and awkward postures. Public health approaches to UE symptoms and musculoskeletal disorders (MSD) and symptoms consist of regulatory approaches to alter the environment using policy and guidelines. Agencies such as the National Institute for Occupational Safety and Health (NIOSH), part of the Center for Disease Control (CDC), and the Occupational Safety and Health Administration (OSHA) function to make work environments safe for the worker. The public health perspective and approach to UE symptoms and disorders is important to assess the problem and to intervene on a population level. In addition to the public health perspective, the individual or psychological approach to these problems also is an important and useful perspective to consider.

Psychological perspective

Attending to UE symptoms at the individual level is different from the perspective of public health agencies. The research literature has revealed that psychosocial factors are important in the development and progression of UE symptoms (Bongers, de Winter, Kompier, & Hildebrandt, 1993; Bongers, de Winter, & ter Laak, 2002a; Bongers et al., 2006). Interventions that are designed to target the individual perspective, focusing on the physical and emotional components of the work environment, may positively influence the disease process for workers.

The combination of psychological and public health perspectives to prevent and intervene on UE symptoms offer the most promise for positive outcomes. While the public health perspective functions to ensure work environments, tasks, and tools are safe for workers, the psychological arena investigates the ways in which the individual experiences of workers contribute to disease. Together these perspectives can decrease disease, thereby decreasing the public health and individual burden of UE symptoms and disorders.

Background

Pathophysiology of upper extremity (UE) symptoms/disorders

Definition

Multiple factors can cause upper extremity symptoms and if symptoms persist they can develop into disorders, and disorders into disability. Importantly, functional limitations can occur at any stage of the disease process (e.g., development, progression, or outcome). Information on the natural history of upper extremity symptoms and disorders is limited and vague, perhaps because of the variable nature of these conditions. Research does show that one of the biggest predictors of future upper extremity symptoms is a history of symptoms and certain job tasks (i.e., work that consists of awkward wrist postures [Gardner, Dale, VanDillen, Franzblau, & Evanoff, 2008]). Predictors of functional limitations include presence and severity of previous symptoms (Gardner et al., 2008). Also, research shows that individuals reporting symptoms had a 5.1 increased risk of developing an upper extremity disorder three-years later compared to individuals not reporting symptoms at baseline (Descatha, Roquelaure, Evanoff, Chastang, Cyr, & Leclerc, 2008). The link between symptoms, disorders, and functional limitations is clear. However, researching and treating upper extremity problems is challenging because symptoms can be specific or nonspecific (Punnett & Wegman, 2004). Because of the non specificity of upper extremity conditions, this work will discuss factors related to both symptoms and disorders.

Upper extremity symptoms can include fatigue, pain, numbness, and tingling. Upper extremity disorders are characterized by a heterogeneous set of specific and nonspecific symptoms (Visser & van Dieen, 2006). Upper extremity disorders involve the muscles, tendons, ligaments, joints, peripheral nerves, and supporting blood vessels. These disorders are complex and lack a single pathophysiological mechanism (Visser et al., 2006). Often considered the result of exposure to repetitive motions, Higgs and Mackinnon (1995) hypothesized that the underlying etiology of most upper extremity disorders is abnormal or prolonged postures and movements. While the majority of work in the area of upper limb musculoskeletal disorders has focused on biomechanical risk factors, causal mechanisms also include psychosocial work factors (van den Heuval, van der Beek, Blatter, Hoogendoorn, & Bongers, 2005).

Causal explanations for the development of UE symptoms/disorders.

Visser and van Dieen (2006) proposed a simplified conceptual model that assumes a causal relationship between task requirements and upper extremity muscle-related symptoms. Symptoms are related to disorders of the muscle soft tissue as the result of ergonomic exposure (i.e., task requirements) and effect modifiers. Effect modifiers refer to individual and contextual factors that may impact the relationship between factors. This model is consistent with the upper extremity research by proposing that individual factors, work demands (e.g., biomechanical factors), and physiological effects all contribute to UE symptoms. It is an example of how causal models in the literature reconcile the role of individual factors on work and ergonomic exposures. This model is useful because it hypothesizes a logical progression of the symptoms. It is limited because it only accounts for muscle related disorders. Additionally, this model is vague and does not explain how effect modifiers influence the multiple pathways of upper extremity pathophysiology (Visser et al., 2006).

Biomechanical explanations of musculoskeletal disorders concentrate on aspects of the workload including frequency, intensity, and duration of ergonomic exposures. Reactions to biomechanical exposures include altered posture and movements. Specific to the office work environment is the idea of an unremitting workload that is characterized by tasks that restrict some movements (e.g., constant sitting) while demanding the repetition of others (e.g., keyboard use). When the workload is high or demanding the worker may sit for long periods, resulting in extended static postures. The combination of repetitive motions for some body parts and tasks resulting in immobility of other body parts (e.g., awkward postures) results in increased risk of musculoskeletal disorders and specifically, upper extremity problems (Sprigg, Stride, Wall, Holman, & Smith, 2007).

Psychological explanations for musculoskeletal disorders surmise that demanding workloads result in psychological strain which negatively influence musculoskeletal symptoms and disorders (Sprigg et al., 2007). It is believed that high work demands produce exhaustion that decreases the mental and physical functioning of workers and leads to health issues (e.g., musculoskeletal symptoms). The relationship between psychological work-related strain and MSDs has been supported in the epidemiological literature (Bongers, Kremer, & ter Laak, 2002b; Sprigg et al., 2007). It is further hypothesized that psychological strain has negative consequences of a physical nature that result in physical symptoms (Sprigg et al., 2007). An example of the relationship between psychological strain and its physical manifestation is the muscle tension associated with anxiety. Sprigg et al. (2007) recently reported that increased workloads were associated with MSDs in the upper extremities. In addition, psychological strain mediated the relationship between workload and MSDs in the upper body (Sprigg et al., 2007), supporting the hypothesis that stress negatively affects work and health.

An interactive relationship among biomechanical stressors, psychological demands, and psychosocial factors is supported, and it is believed that these factors may have a synergistic effect in their association with MSDs (Macaulay, 2004). The strength of the workstyle measure and the current research is that it accounts for this interactive relationship among the risk factors on the development of UE symptoms (Griffiths, Mackey, & Adamson, 2007).

Epidemiology of upper extremity conditions

Work-related musculoskeletal disorders (WRMDs) are estimated to account for more than 75% of all work-related illnesses (Bureau of Labor Statistics, 2004), with 23.1% accounted for by upper extremity problems. Behaviors associated with work such as postures and repetitive movements of the limbs have been related to upper extremity symptoms and disorders for many types of jobs (Bernard & Fine, 1997). There are multiple terms used to describe these UE symptoms including cumulative trauma disorders (CTD) or repetitive strain injuries (RSI). Each of these terms (i.e., CTD and RSI) focus on an aspect of a work task characterized by repetitive movements that over time result in upper extremity symptoms. These terms are not used here because they imply a single etiology which is not supported by the epidemiological research (Macfarlane, Hunt, & Silman, 2000). Work-related upper extremity symptoms

(WRUE symptoms) earn their special characterization because they are directly associated with work-related factors (NAS, 2001).

WRUEs are influenced by several risk factors including previous medical history, biomechanical exposures, work demands, psychosocial factors, and work organizational factors (Bongers et al., 1993; Huang, Feuerstein, & Sauter, 2002; NAS, 2001). Research has been unable to identify a single causal path among specific exposures, pathologic processes, and upper extremity symptoms. Using epidemiological research, ergonomic, workplace, and individual psychosocial factors have been identified as likely contributors to the etiology and maintenance of WRUE symptoms (Huang, Feuerstein, Kop, Schor, & Arroyo, 2003; NAS, 2001). Evidence also indicates that specific work-task characteristics (e.g., keyboard use), as well as psychosocial factors in the work environment (e.g., job support, autonomy), can negatively influence upper extremity symptoms and disorders (NAS, 2001).

This review of the epidemiology of work-related upper extremity symptoms and disorders includes ergonomic/biomechanical exposures and psychosocial stressors. These sections are further segmented by exposures relevant to the current study. For example, force and posture are reviewed in the biomechanical section because these behavioral measures were assessed in the current study. Also for some of the factors, research from work environments other than of office workers are included; this is necessary because of a lack of substantive research on office workers.

Prospective studies are the gold standard for epidemiological research and are included in this review of the literature. Cross-sectional studies have value in their identification of risk factors and also are reported here. Several reviews of the literature are presented to demonstrate the consistency regarding the epidemiology of WRUE symptoms.

Ergonomic/biomechanical exposures of office workers.

Work tasks, daily functioning, and recreational activities all produce biomechanical loads that, when exceeded, can be associated with the development of MSDs (National Research Council, 1999). Work, particularly, involves a specific group of movements that allows one to accomplish work goals (National Research Council, 1999). In the transition of the workplace, large arm movements (i.e., handling of paper documents) have been replaced by finger movements (i.e., computer work) (Waersted & Westgaard, 1997). While computer work has increased productivity, it also has its own biomechanical problems.

A prospective population study on 1,953 individuals of various work types was conducted to investigate the role of mechanical and psychosocial factors in the onset of upper extremity pain (Macfarlane et al., 2000). This study reported that repetitive movements of the arm (Risk Ratio [*RR*] = 4.1, *CI:* 1.7-10) and wrist (*RR* = 3.4, *CI:* 1.3-8.7) were associated with the onset of symptoms.

Office work (i.e., keyboard use), specifically, has been associated with upper extremity symptoms (NAS, 2001). An integral part of the modern office work environment is the computer. Ergonomic factors related to computer work include exposures related to the chair, monitor, computer tower, keyboard, and computer mouse. Specifically, the keyboard is an important feature of the work environment and has associated ergonomic risk factors that include location, placement, arm position, and force. Work characterized as “computer based” involves working on a computer for more than four hours per day or more than 15 hours per week (Griffiths et al., 2007). Additionally, research suggests a “dose-response” relationship between hours of computer use and development of MSDs, meaning that as the number of hours of computer use increases, the risk of developing a MSD also increases (Faucett & Rempel, 1994; Hanse, 2002). Similarly, a prospective study on almost 7,000 keyboard users reported an increased risk of wrist pain (Odds Ratio [*OR*] = 1.18, *CI:* 1.06-1.32) associated with greater time of keyboard and mouse use (Lassen, Mikkelsen, Kryger, Brandt, Overgaard, Thomsen, Vilstrup, & Andersen, 2004).

A cross-sectional study on 5,033 employees who mostly work on computers reported that the repetitiveness and high volumes of computer work was associated with an increased risk in hand and wrist UE symptoms; Movements: *OR* = 1.35, *CI:* 1.07-1.68; Tasks: *OR* = 1.57, *CI:* 1.24-1.99 (Jensen, Ryholt, Burr, Villadsen, & Christensen, 2002). A case-control cross-sectional study reported that computer work also was related to increased keyboard force in 23 office workers with symptoms compared to 25 workers without symptoms ($F(1,21) = 2.89$, $p < .05$ [Feuerstein, Armstrong, Hickey, & Lincoln, 1997]).

Muscle reactivity related to time pressures and mental demands also is associated with computer work. In a study of 1,007 newspaper employees with upper extremity symptoms and without, more frequent deadlines (*OR* = 4.05, *CI:* 1.61-10.21) and higher psychological demands (*OR* = 1.38, *CI:* 1.05-1.83) were associated with increased risk for symptoms (Polanyi, Cole, Beaton, Chung, Wells, & Abdolell, 1997).

Computer work in other non-office worker samples also has been related to UE symptoms. A cross-sectional epidemiological study that investigated the association between computer work and UE symptoms in college students reported that high rates of computer use were associated with UE symptoms (Hupert, Amick, Fossel, Coley, Robertson, & Katz, 2004).

A review of literature on risk factors associated with computer work summarizes that work involving more than four hours daily computer use has up to a 4-fold increased risk of developing UE pain (Griffiths et al., 2007). This review also found that overtime, hectic work pace, time pressures, minimal breaks, and electronic monitoring were all associated with increased risk for upper extremity symptoms (Griffiths et al., 2007).

The sample of workers targeted in the current study is office workers. Because of the target sample, there is a primary focus on ergonomics and biomechanics of the office work environment. There are specific biomechanical factors associated with office work. Force and posture are two external factors or stressors related to computer-related office work. Additionally, force and posture changes were assessed as behavioral measures of stress in the current study.

Force.

Force refers to the weight and friction that is needed to operate a work object (Armstrong, 1985). An example of the force associated with office work involves the force used to depress keyboard keys. This amount of force used will vary by key stiffness and individuals typing skills (Armstrong, Foulke, Martin, Gerson, & Rempel, 1994). Keyboard use has been associated with the following ergonomic exposures: sustained wrist extension, ulnar deviation, localized pressure at the wrist crease, and keyboard force (Feuerstein et al., 1997). Keyboard force is characterized as the overall force used to key text on a keyboard. Increased keyboard force can be attributed to normal key stroking behavior or in response to increased job stress. Aspects of keyboard force in office workers (i.e., time, speed, force) have been associated with WRUE symptoms (Feuerstein et al., 1997; Pascarelli & Kella, 1993).

The force necessary to depress keyboard keys is low (Bufton, Marklin, Nagurka, & Simoneau, 2006). It is the repetitive nature of keyboarding that has the most ergonomic risk associated with upper extremity disorders (Bufton et al., 2006). Also, it is believed that the cumulative force associated with repetitive keyboard use is a primary factor in the development of musculoskeletal disorders. A case-control study on 48 office workers reported that workers with and without symptoms used four to five times more force than was necessary to depress keyboard keys (Feuerstein et al., 1997). A cross-sectional study on 18 typists found that key strike force was associated with increased time pressure and increased mental workload (Hughes, Babski-Reeves, & Smith-Jackson, 2007). Of interest, the rate at which a keyboardist types has not been found to be related to keyforce (Feuerstein et al., 1997).

Posture.

Posture is also an important biomechanical factor in office work. Posture is influenced by workplace and individual anthropometrics (National Research Council, 1999). While posture variations are most often associated with workstation factors (e.g., unadjustable work stations and obstructions [National Research Council, 1999]), posture also has been associated with psychological factors (e.g., high psychological demands).

The unrelenting working style associated with office work encourages constant work characterized by repetitive movements (i.e., keyboarding), sedentary postures, and minimal breaks from computer stations (Punnett & Bergqvist, 1997). The sedentary postures associated with office work reduce exposure to biomechanical variation. Biomechanical variation is hypothesized to be important to variability of muscle activity. Attending to ergonomics in the design of the computer workstation has reconciled some of the concerns and risk associated with office work by decreasing the ergonomic exposures associated with the office setting (Waersted et al., 1997) by making workstations adjustable (e.g., chairs, desk, monitors). Despite these advances, risk for UE problems remain and are considered to be further compounded by psychosocial factors (Bongers et al., 2002b).

A cross-sectional study of 120 clinical laboratory workers found that certain movements and postures at work were associated (*OR* = 13.5, *CI:* 3.8, 47.9) with the increased reporting of musculoskeletal symptoms (Ramadan & Ferreira, 2006). A prospective cohort study conducted on office workers indicated that self-reported work-related physical factors, including neck rotation (*OR* = 1.43, *CI:* 1.02-2.01) and neck extension (*OR* = 2.42, *CI:* 1.22-4.80), were associated with increased symptoms of the upper limb (van den Heuval, van der Beek, Blatter, & Bongers, 2006). These results were found after controlling for demographics, psychosocial factors, and symptoms at baseline. A prospective study on 632 new computer office workers found that posture, keyboard location, and phone placement were associated with musculoskeletal symptoms and disorders (Marcus, Gerr, Monteilh, Ortiz, Gentry, Cohen, Edwards, Ensor, & Kleinbaum, 2002).

From the ergonomic and biomechanical epidemiological literature it is suggested that ergonomic exposures have a primary role in the development and incidence of work-related symptoms. However, ergonomics do not account completely for the occurrence of symptoms. The other primary factors in the epidemiology of WRUE conditions are psychosocial factors.

Psychosocial stressors

Work-related.

Psychosocial stressors related to work include those aspects of work that are not associated with physical activities including time pressure, workload, feelings of control, and social support (Hughes et al., 2007). Work-related stress is a major influence on psychological and physical health (Maina, Palmas, & Filon, 2007). Job stress has been associated with pain severity, pain exacerbation, and decreased function in individuals with MSDs (Haufler, Feuerstein, & Huang, 2000) and also has been implicated in the cause and exacerbation of WRUEDs (Pransky, Robertson, & Moon, 2002). Job-related stress also has been identified as a contributor to the recognition, manifestation, and persistence of these disorders (Amick, Swanson, & Chang, 1999). Job stress is subjective and can be difficult to characterize and define with respect to health outcomes (Huang et al., 2002). Yet, when job stress is attended to in interventions to decrease occupational stress, its decrease is linked to improved outcomes (Huang et al., 2002).

A prospective population study on approximately 2,000 individuals was conducted to investigate the role of mechanical and psychosocial factors in the onset of upper extremity pain (Macfarlane et al., 2000). This study reported that high levels of psychological distress (*RR* = 2.4, *CI:* 1.5-3.8) and dissatisfaction with support from colleagues or supervisors (*RR* = 4.7, *CI:* 2.2-10) were associated with the onset of symptoms.

A three-year prospective study investigated 787 workers from various occupations (van den Heuval et al., 2005). High job demands (*RR* = 2.1 for neck and shoulder; *RR* = 1.9 for wrist and hand symptoms) and low social support of coworkers (*RR* = 2.2 for wrist and hand symptoms) were identified as risk factors for upper extremity symptoms.

Similarly, a prospective study on almost 7,000 keyboard users reported an increased risk of elbow pain (*OR* = 1.29, *CI:* 1.08-1.54) associated with greater time of keyboard and mouse use. Additionally, increased risk of elbow (*OR* =

1.22, *CI:* 1.05-1.41) and wrist pain (*OR* = 1.23, *CI:* 1.07-1.41) were associated with high time pressures (Lassen et al., 2004).

Another prospective study on over 4,500 employees of a pharmaceutical company assessed risk factors for work absence because of a musculoskeletal complaint. Results indicated that work-related psychosocial stressors were the only predictive factor of work absence because of a musculoskeletal complaint (Bartys, Burton, & Main, 2005). Of these work-related psychosocial risk factors, the following were significant: increased psychological distress (*OR* = 1.6, *CI:* 1.1-2.0), low job satisfaction (*OR* = 3.2, *CI:* 2.0-4.2), low social support (*OR* = 2.3, *CI:* 1.6-3.3), attribution (*OR* = 2.1, *CI:* 1.4-2.8), low control (*OR* = 1.8, *CI:* 1.3-2.9), and negative organizational climate (*OR* = 2.3, *CI:* 1.3-3.9).

A cross-sectional population study on 1,483 workers investigated risk factors associated with upper extremity symptoms (Waters, Dick, Davis-Barkley, & Krieg, 2007). Results indicated that several work-related psychosocial risk factors were significant. Low (*OR* = 2.4, *CI:* 1.6-3.3) and very low job satisfaction (*OR* = 3.7, *CI:* 2.1-6.8), low supervisor support (*OR* = 2.2, *CI:* 1.4-3.4), reporting not enough time to complete work (*OR* = 2.3, *CI:* 1.5-3.6), and work stress (*OR* = 2.5, *CI:* 1.4-4.5) were all significant risk factors for pain in arms. Another large cross-sectional study on 10,000 workers in the United Kingdom found that little job control (*OR* = 1.6) and little supervisor support (*OR* = 1.3) also were associated with the occurrence of neck and upper limb pain (Sim, Lacey, & Lewis, 2006). A cross-sectional study on 216 employees of laundry and dry cleaning establishments reported that low job satisfaction (*OR* = 1.6, *CI:* 1.0–2.6) was associated with pain in the upper extremities (IJzelenberg et al., 2004).

A systematic review of the literature conducted in 2001, investigated the relationship between psychosocial risk factors and neck pain, an upper extremity subtype (Ariëns, van Mechelen, Bongers, Bouter, & van der Wal, 2001). The review reported that there is evidence that neck pain has several job-related risk factors including high quantitative job demands, poor social support, poor coworker support, low job control, low and high skill discretion, and low job satisfaction (Ariëns et al., 2001). Bongers et al. (2002) reported that high job demands and job stress were related to upper extremity symptoms (Bongers et al., 2002b). This relationship between job demands and job stress also has been shown in laboratory studies. One study revealed that laboratory-induced psychosocial stress (i.e., visual stimuli critical and evaluative in nature) was linked to spinal loading and muscle tension (Marras, Davis, Heaney, Maronitis, & Allread, 2000).

A cross-sectional study that investigated upper extremity symptoms and risk factors in 1,543 white-collar workers reported that psychological demands were significantly associated with neck and shoulder symptoms (Leroux, Brisson, & Montreuil, 2006). The prevalence increased in workers who experienced high job strain (Prevalence Ratio [*PR*] = 1.54, *CI:* 1.00-2.37) defined as psychological demands and low decision latitude (Leroux et al., 2006).

According to the epidemiological literature and other research, ergonomic exposures and psychosocial factors contribute to the development, maintenance, and progression of MSDs and upper extremity symptoms especially. Research also has reported that these risk factors may differ by outcome. Risk factors related to symptoms differ from the risk factors related to lost work time as a result of these symptoms (IJzelenberg et al., 2004). Work-related physical and psychosocial factors were associated with UE pain, whereas individual factors (used in this context as non-work psychological factors) were most associated with those workers who took sick leave as a result of their symptoms (IJzelenberg et al., 2004). This research suggests that individuals who merely report symptoms are exposed to different risk factors than those workers who will ultimately miss work because of their symptoms. This finding regarding the role of psychosocial factors on missed work time is important and highlights the importance of attending to these factors and their public health burden. Additionally, high time pressures reportedly increase speed and force on work tasks (National Research Council, 1999), increasing ergonomic risk and the risk of MSDs.

A review of the literature conducted by the National Institute of Occupation Safety and Health found that upper extremity disorders are associated with the following work-related psychosocial factors: intensified workload, monotonous work, low social support, lack of control, and job dissatisfaction (National Institute of Occupational Safety and Health, 1997). Some of the limitations of a review of this type are the non-standardized methods and diverse operational definitions used across studies. Despite this limitation, the findings are consistent.

Based on the epidemiological literature, work-related psychosocial factors are related to upper extremity symptoms and also may have a synergistic relationship with ergonomic exposures. An example of this relationship is when psychosocial factors (e.g., low supervisor support) increase biomechanical stressors (e.g., keyboard force) resulting in higher risks for developing upper extremity symptoms. When considering this research it is important to consider the established relationship between psychological and physical functioning. The positive association between these factors and pain is important because it supports the consideration of the workstyle construct and the rationale for the current study (see workstyle section). The current experiment assessed this relationship (i.e., integrative) between biomechanical exposures and psychosocial factors in a laboratory setting.

Individual factors.

The epidemiological literature on the role of individuals factors (e.g., age and gender) suggest that these factors have a role in the development of MSDs (National Research Council, 1999). There appears to be a strong relationship between age (i.e., older), past medical history (e.g., previous illnesses), and MSDs (National Research Council, 1999). This relationship between MSDs and factors such as age and medical history has an apparent biological mechanistic plausibility, meaning that older age and significant medical histories are related to increased physical complaints including those of the upper extremities. The literature is mixed on the association between body mass index (BMI) and gender. Some studies report that females and overweight individuals have increased incidence of MSDs. However, other studies report no gender differences. The literature on genetics and physical fitness is also mixed. While the statistical significance of these factors are reported, these factors have proved to be weak predictors of incidence of upper extremity symptoms (National Research Council, 1999). A recent study on the impact of socioeconomic status (i.e., education and income) found no association with work-related MSDs (Gillen, Yen, Trupin, Swig, Rugulies, Mullen, Font, Burian, Ryan, Janowitz, Quinlan, Frank, & Blanc, 2007). In addition, individual factors also include those factors related to individual differences including mood and coping mechanisms (NAS, 2001).

The literature on individual factors and upper extremity symptoms is inconclusive. These individual factors are suggested to mediate the relationship between the psychosocial and biomechanical factors. While individual factors are not a focus of the current experiment, demographic characteristics were assessed in participants for the purpose of describing the sample for generalizability.

In summary, the major factors related to the onset and progression of WRMDs are ergonomic exposures and psychosocial factors (Bongers et al., 2002b; NAS, 2001). Research also has suggested that the highest risk for UE problems is for those workers exposed to both ergonomic and psychosocial stressors (Devereux, Vlachonikolis, & Buckle, 2002). There is some evidence that certain individual factors (i.e., genetic and demographic) may contribute to the occurrence of WRMDs (National Research Council, 1999). It is clear from the epidemiology of work-related upper extremity symptoms that an integrative understanding and approach to prevention, treatment, and intervention is the best course of action.

Biobehavioral stress responses

Individual stress response (i.e., physiological, behavior, and cognitive) can impact health in multiple ways. In the present study, the stress response is important to consider because work demands, both physical and psychosocial, are major stressors with health implications related to the development and maintenance of UE symptoms and disorders. This section reviews physiological, behavioral, and cognitive stress responses relative to the current experiment.

Physiological reactions to stress

The body has numerous indicators of stress response including heart rate, blood pressure, and biochemical response. Physiological reactions to stress are the result of autonomic nervous system activation. The autonomic nervous system is a component of the peripheral nervous system and is most associated with maintaining homeostasis in the body (Vander, Sherman, & Luciano, 2001). The autonomic nervous system is subdivided into the parasympathetic and sympathetic systems. The sympathetic nervous system responds to episodes of physical or psychological stress. Heart rate, blood flow, catecholamine release, and cortisol secretion are all physiological indices that increase during flight-or-fight while gastric activity and blood flow to the extremities are decreased (Baum, Gatchel, & Krantz, 1997; Vander et al., 2001). Parasympathetic response balances sympathetic nervous system responses. The normal reaction to stress or adaptation is the body's method of physiologically responding to stress (McEwen, 1998), although it is important to note that the recovery period is just as important as the initial stress response (i.e., return to homeostasis).

Stress is a process that involves the perception, interpretation, and response to an environmental stimulus. A well-accepted definition for stress is the state under which threat, harm, loss, or excessive demand is perceived and characterized by psychological and biological reactivity (Baum et al., 1997). Stimuli can be psychological or environmental. An organism will respond to a stressor with a heterogeneous set of psychological and physiological responses. Selye (1984) characterized the stress response into three stages: Alarm, Adaptive/Resistance, and Exhaustion (von Onciul, 1996). In the alarm stage the organism recognizes a stressor and the body functions to adapt to the stressor for a finite period of time. The adaptive/resistance stage is characterized by the recovery process and the coping strategies employed to deal with persistent stressors, before resources are depleted. The exhaustion stage results when resources are depleted with negative effects on the body. The exhaustion stage can be considered as a way of conceptualizing the role of job stress and the development of work-related upper extremity disorders.

Heart rate or the rhythmic beating of the heart is influenced by sympathetic nerve activation which increases the heart rate and parasympathetic nerves that decrease heart rate (Guyton & Hall, 1996; Vander et al., 2001). Heart rate is the discharge rate of depolarization, meaning it is the number of times the heart contracts per minute (Guyton et al., 1996; Vander et al., 2001). The average resting heart rate is 70 beats per minute (Vander et al., 2001). The cardiovascular system is able to adapt and meet increased cardiac demand. External demands (i.e., psychological stress or cognitive reactivity) can influence cardiac output. Both stress and emotional distress can affect the central nervous system through the increase of sympathetic nervous system response (Rozanski, Blumenthal, Davidson, Saab, & Kubzansky, 2005). Increased heart rate has also been found in individuals reporting high levels of job stress (Vrijkotte, van Doornen, & de Geus, 2000).

Biochemical stress response consists of the release of catecholamines (e.g., epinephrine), and cortisol, a corticosteroid (Baum, Grunberg, & Singer, 1982). The secretion of cortisol is achieved through the hypothalamic-pituitary-adrenal (HPA) axis (Vander et al., 2001). The nervous system responds to stressful stimuli by secreting corticotrophin releasing hormone (CRH). CRH is carried to the anterior pituitary and stimulates the release of adrenocorticotropic hormone (ACTH), which reaches the adrenal cortex and prompts the release of cortisol (Vander et al., 2001).

Cortisol levels in saliva and plasma are reactive to internal and external stimuli, and appear to be related to negative aspects of stress responses (Mendonca-de-Souza, Souza, Vieira, Fischer, Souza, Rumjanek, Figueira, Mendlowics, & Volchan, 2007). Salivary cortisol has been shown to accurately estimate serum-free cortisol (Maina et al., 2007). Salivary cortisol can be used to assess changes in biochemical stress response to demanding tasks. Salivary cortisol also has been shown to reflect alterations in cortisol secretions following discrete stress exposure episodes (Pawlow & Jones, 2005). In addition, salivary cortisol has been demonstrated to be a good indicator of stress response across multiple stressful tasks in lab settings (Haussmann, Vleck, & Farrar, 2007). Additionally, salivary cortisol has advantages over blood sampling including being less invasive, stable, and not requiring medical personnel for collection (Maina et al., 2007).

Biochemical stress responses also have been related to psychosocial work demands, physical work demands (Lundberg, Dohns, Melin, Sandsjo, Palmerud, Kadefors, Ekstrom, & Parr, 1999), and pain (Evans, Douglas, Bruce, & Drummond). The physiological stress response associated with pain is important because pain is a stressor that produces homeostatic alterations (Melzack, 2001). Cortisol serves an important function in the process by maintaining glucose levels for fast injury response. Chronic activation of the stress response system or allostatic load is influenced by individual differences (e.g., workstyle) and environmental factors, and creates an imbalance in the stress response system (McEwen, 1998). In addition, chronic activation of this process can lead to deleterious effects on muscle and bone (Melzack, 2001).

Blood pressure, heart rate, and salivary cortisol were measured in the current experiment. These physiological measures were used to investigate different response patterns to increased work-simulated demands (i.e., mental demands).

Psychological reactions to stress

Cognitions are influenced by the environment and can be reflected in emotions (Kolb & Whishaw, 1996). Stress is related to negative outcomes (e.g., depression, anxiety, disease, and physical symptoms) and positive outcomes, including the adaptive appraisal of situations (i.e., challenging vs. threatening) (Folkman & Lazarus, 1988). Outcome (i.e., as either positive or negative) can be influenced by stress coping style. Stress coping style is regarded as the overall manner by which stressors are managed. According to Lazarus & Folkman (1988), individuals will employ multiple cognitive and behavioral strategies to cope with a stressful situation. In turn, mood can be the product of perception, coping style (management), and life experiences. Mood can mediate stress coping style and is a fundamental component in the management of stressors in relation to pain (Folkman et al., 1988).

There are multiple psychological variables that can alter the stress response, specifically with regard to work. Selye (1968) highlighted the role of cognitive and behavioral stress reactions. The predictability of a stressor has been shown to influence an organism’s stress response (e.g., low predictability increases stress response). Additionally, the level of perceived control over a stressor also is an important factor. The more control one perceives, the lower the reactivity to that stressor. Stressful or demanding work environments and tasks that are consistently experienced can be construed as an episodic or chronic stressor. A consequence of chronic stress in occupational settings is burnout (Ahola, Honkonen, Kivimaki, Virtanen, Isometsa, Aromaa, & Lonnqvist, 2006). Burnout is characterized as a state of exhaustion that is often accompanied by doubts of value and competence. High job strain has been associated with burnout in a study of 3,270 employees across multiple occupations. The sample of workers most affected by burnout includes full-time, older, and unmarried workers (Ahola et al., 2006). The availability of resources to cope with stressors also can alter the stress response. These resources can be internal or external. Individuals who have high self-efficacy regarding their ability to handle stress have more positive outcomes (Rowe, 2006). Job strain can elicit a stress response, and chronic activation can lead to burnout. Attending to job strain has implications for UE disease processes.

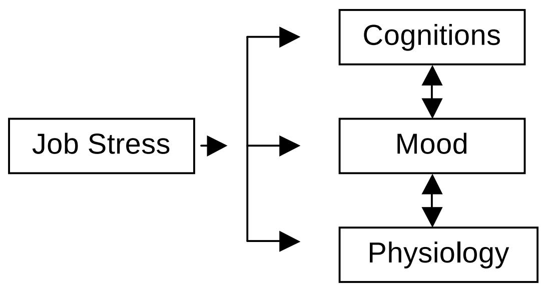
In the workstyle model (see workstyle section), cognitions may be negative and result in psychological distress in high-demanding environments. For example, during a stressful work environment, a worker may experience cognitions involving increased fear of losing one's job, fear of decreasing performance, or frustration/loss of control (Feuerstein, Nicholas, Huang, Haufler, Pransky, & Robertson, 2005). In maladaptive or high-risk workstyles, psychological distress can impact the behavioral response to a stressful task and result in exacerbating ergonomic exposures. In addition to cognitions, mood state (i.e., emotions) can reflect psychological distress (Kolb et al., 1996; Rosenzweig, Reibel, Greeson, Brainard, & Hojat, 2003) and distress associated with work factors (Bono, Foldes, Vinson, & Muros, 2007).

Alterations of mood states as a result of workplace factors (i.e., supervisor interactions) have been studied. One study found that supervisor interaction appears to have a greater impact on mood as compared to interactions with coworkers, clients, and customers (Bono et al., 2007). Emotional regulation (i.e., process by which workers choose to display certain emotions in the workplace) at work also was found to have negative effects on stress and job satisfaction (Bono et al., 2007). In addition to increased psychological distress, emotion suppression also has been linked physical symptoms (Schaubroeck & Jones, 2000).

There is an established link between work stress and mental health (Kopp, Stauder, Purebl, Janszky, & Skrabski, 2007). In addition, there is a direct link between psychosocial stress and WRMSDs. Because work stress and individual psychosocial stress are linked to each other and independently linked to WRMSDs, there appears to be both a direct and indirect relationship between these factors and WRMDS, further demonstrating the role and importance of psychological factors and the disease process of WRMSDs. Additionally, the literature reports some success in attending to psychological factors in secondary prevention techniques. Psychological factors related to WRUE symptoms include pain beliefs, expectations, emotional reactions, and coping mechanisms (Linton, 2002). A review of prospective studies suggest that psychological factors could be used to identify people at risk for chronic pain and disability (Linton, 2002). A meta-analysis reported that interventions attending specifically to occupational stress are valuable in decreasing workers' stress complaints (Shimazu, Umanodan, & Schaufeli, 2006).

In summary, the psychological stress response has implications for upper extremity symptoms. Psychosocial stressors include work factors which can negatively impact mood, ergonomic exposures, and ultimately the development of upper extremity symptoms. In the current study, mood was assessed as well as the presence and change in work-related cognitions in response to increased work demands (i.e., increased work load, task demands and time pressure). See Figure 1.

Figure 1. Relationship between job stress, cognitions, and mood



Biomechanical/ behavioral responses to stress

Keyboard force.

Behavioral responses to stress differ by individual and task, and are a component of psychological reactivity (Baum et al., 1982). From a biomechanical perspective, the manner that an individual works on a keyboard in high-demand environments is a behavioral dimension that can be related to increased force in the upper limbs (Nicholas et al., 2005). Keyboard force is an important ergonomic exposure and most workers use excessive force in normal work condition. From a psychological perspective, the added impact of work-related psychosocial stress suggests that stress may further contribute to increased force used in keyboarding. Keyboard force was measured in the current experiment during low and high demand typing activities. High keyboard force is associated with increased risk of UE symptoms. High keyboard force is also associated with psychosocial stress. Assessing alterations in keyboard force between participants and between the low and high demand task will offer a better understanding of the role of psychosocial and task demand factors on keyboard force in computer office workers.

Posture alterations.

Work-related postural reactivity has been associated with MSDs (Gerr et al., 2006) including wrist placement and deviations, twisting, or overreaching. Factors associated with postural change (e.g., muscle tension) are known to differ between low demand (i.e., typical demands) and high-demand tasks (Waersted & Westgaard, 1996). For example, in response to high-demand or stress-evoking environments, individuals may alter their wrist, arm, back, and foot placements in awkward postures (McAtamney & Corlett, 1993). Postural reactivity may be a common response to certain stimuli (e.g., time pressures); stability of this postural reactivity also may contribute to MSDs and be influenced by psychosocial factors (Macaulay, 2004). Some of these postural alterations include awkward positions that are associated with musculoskeletal symptoms including WRUE symptoms (Gerr, Marcus, & Monteilh, 2004; Gerr et al., 2006; Treaster, Marras, Burr, Sheedy, & Hart, 2006; Waersted et al., 1996).

Proper office ergonomics include appropriate foot placement, lumbar support, wrist placement, and monitor placement. When posture deviates from that which is ergonomically correct there is an increased risk for upper extremity disorders. Alterations in posture may be influenced by increased work demands or psychosocial stressors (Waersted et al., 1996).

Task performance.

In addition to keyboard force, performance on a task, both before and prior to increased demands, is a behavioral measure that can be influenced by environmental factors (i.e., external stimuli) and self control (i.e., internal stimuli) (Baum et al., 1982). Specific to typing or an office work type of task, errors, and time to complete a task may be impacted by stress or demanding situations (Hughes et al., 2007). A laboratory study assessed typists with various demand levels. Results indicated that increased time pressure increased typing speeds, but also increased errors (Hughes et al., 2007).

Stress level also is reportedly associated with work tasks and types of workers including professional and nonprofessional (i.e., semi-skilled) workers (Griffiths et al., 2007). Stressors among “semi-skilled” office workers include job control, social support, and task clarity, while stressors among professional workers include working hours, time pressures, and concentration (Oberlechner & Nimgade, 2005; Wallace, 1999). Overall the literature reports that aspects of work tasks including demand, concentration, and time pressures all have been associated with an increased risk of WRMDs (Bongers et al., 2002b; National Research Council, 1999; Oberlechner et al., 2005).

The multi-factorial nature of the work environment has been previously discussed and corresponds with the multi-factorial epidemiology of work-related upper extremity disorders/symptoms. To further understand the relationship between psychosocial and biomechanical factors and how they influence outcomes associated with work and health, models of occupational stress and health have been developed.

Models of occupational stress and health

Models have been developed to conceptualize the relationship between work factors and health outcomes. These models are presented to highlight the multi-factorial etiology of upper extremity symptoms and disorders. These are integrative models that are all consistent in that they account for job stress and other work organization factors; they differ in their emphasis on various moderating and mediating variables.

The Karasek model of job strain hypothesizes that workers who acknowledge high job strain and both high psychological demands and low decision latitude (i.e., job control) have an increased risk for MSDs (Leroux et al., 2006). This model acknowledges the function of psychosocial work stress (Gimeno, Amick, Habeck, Ossmann, & Katz, 2005). Research on the application of this model also has reported that social support could lessen the negative effect of high job strain (Leroux et al., 2006).

The epidemiological model of MSDs is a useful model that includes aspects of job stress and coping style in the disease process of UE symptoms (Bongers et al., 1993). This model suggests that stress and coping influence muscle reactivity (i.e., tension), by either exacerbating the strain from biomechanical loads or by influencing the burden of symptoms. This model is included because it is related to the workstyle model by acknowledging the relationship between coping with stress and musculoskeletal reactivity.

The biopsychosocial model of job stress posits that psychological strain is the result of both work environments that overload the worker and those that have demands that are too low (Frankenhaeuser, 1991). When applied to models of hormonal and muscle reactivity, there is increased muscle tension, increased cortisol and catecholamine reactivity in response to physical and psychological stress (Melin & Lundberg, 1997). This model is important to consider because it emphasizes cortisol secretion in physiological responses to work. Additionally, this model offers that workload results in psychological stress, which has been suggested to be related to UE symptoms and biochemical reactivity.

Workstyle

The conceptualization of the synergistic effect of ergonomic and psychosocial factors on UE symptoms has proven useful in identifying workers with upper extremity symptoms in cross sectional studies (Huang, Feuerstein, Berkowitz, & Peck, 1998) and providing the basis for additional research and questionnaire development. Based on the association between ergonomic exposure and psychosocial factors on WRUE symptoms, the model and measurement of workstyle was developed (Feuerstein et al., 1999; Feuerstein & Nicholas, 2006).

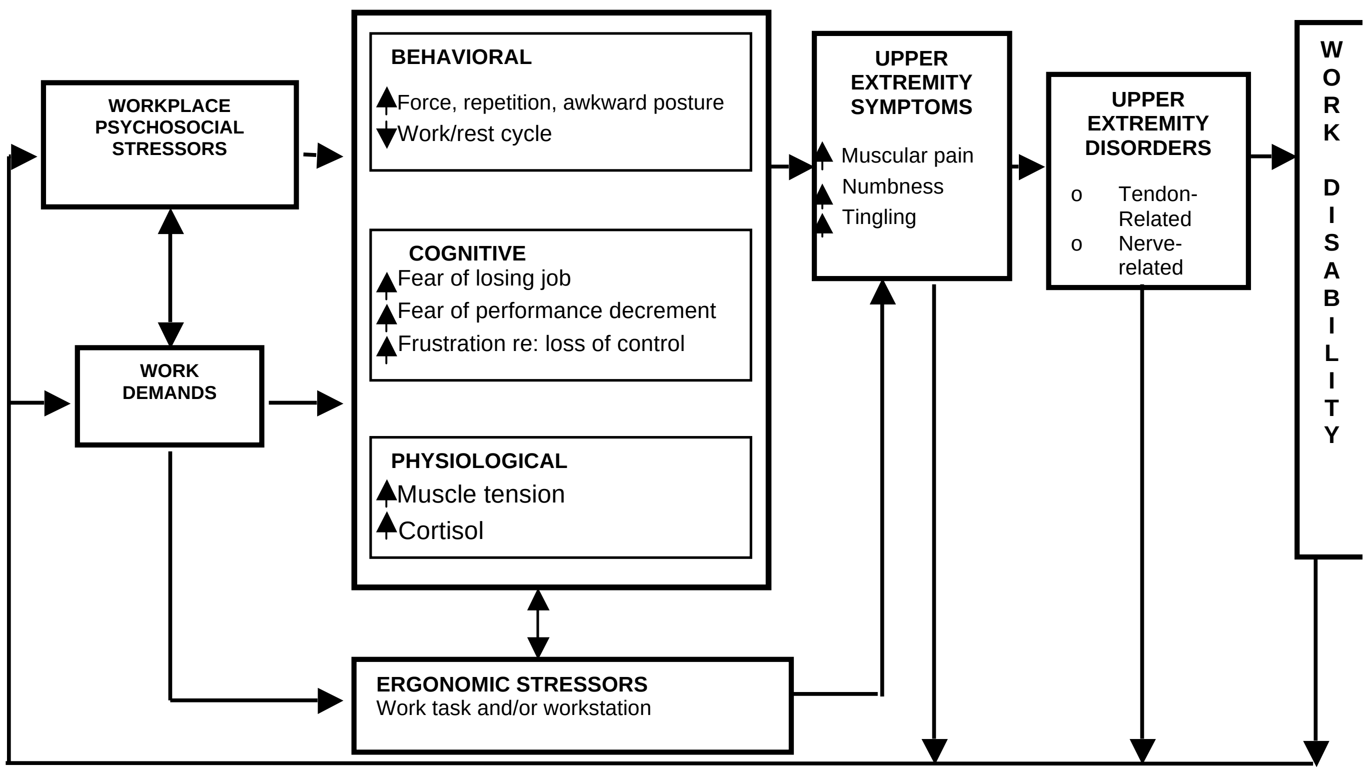
Workstyle is characterized as the response of a worker to high work demands and its impact on performance and function (Feuerstein, 1996; Nicholas et al., 2005). Workstyle includes the cognitive, physiological, and behavioral components (See Workstyle Figure 2 page 39). A worker's approach or response to job-related stressors or challenges is the basis for workstyle. This response is conceptualized as a relatively stable (yet modifiable) aspect of the worker. If this response pattern is adverse, over repeated activation (e.g., consistently demanding work tasks) of the physiological state (i.e., biochemical and musculoskeletal) is believed to contribute to the occurrence and reoccurrence of WRMSDs (Feuerstein, 1996). This model hypothesizes that in response to elevated work demands (perceived or actual), high-risk behaviors (i.e., adverse workstyle) expose the worker to increased ergonomic risk factors of increased force, repetition, and postural stress, thereby increasing the risk of WRUEs or exacerbating present symptoms (Feuerstein et al., 2005). Behavioral or physiological examples of workstyle include awkward postures and prolonged recovery of biomedical markers to baseline level of activity following work-related stressors. In addition, responses to high work demands can be associated with elevated subjective distress and negative cognitions such as "I have too many deadlines and will never be able to get all my work done" (Feuerstein et al., 2005).

The workstyle measure was developed using research emphasizing an integrative approach to UE problems, focus groups, pilot testing, and administration of a pool of items on a sample of office workers (Feuerstein et al., 2005). The scale consists of ten subscales (i.e., working through pain, social reactivity, limited workplace support, deadlines/pressure, self-imposed work pace/load, breaks, mood, pain/tension, autonomic response, numbing/tingling) and had a moderate to high degree of reliability in terms of internal consistency ($r > 0.60$, range 0.62 - 0.91). Test-retest reliability tests comparing scores at baseline and three weeks post baseline ranged from $r = 0.68 – 0.90$ (Feuerstein et al., 2005). Construct validity measures were modest for the total workstyle score and pain ($r = 0.38$), composite symptoms score ($r = 0.30$), upper extremity function limitations ($r = 0.44$), and the Standard Form-12 (SF-12) Mental Component Scale (MCS) ($r = -0.47$). Modest construct validity scores in comparison to these other measures suggests that workstyle assesses characteristics not a accounted for in these other measures

Logistic regression modeling found that high workstyle scores (*OR* = 2.4, 95% *CI* = 1.1-5.3), more ergonomic exposures (*OR* = 2.7, 95% *CI* = 1.3-5.5), and more time at computer (*OR* = 1.9, 95% *CI* = 0.95-3.6) predicted upper extremity pain at three months (Nicholas et al., 2005). Additionally, a recent study on workers with upper extremity disorders seeking treatment found that the total workstyle score was significantly correlated with pain ($r = .53$, $p < .01$) and work status (i.e., restricted work vs. non restricted work [$r = 0.48$, $p < .01$]) at six months (Harrington et al., in press). The short form (32-item SF) of the workstyle measure was used in the present experiment with the “working through pain” subscale removed. Cronbach’s alpha = 0.89 and the test-retest reliability for the total score was $r = 0.88$, $p < .01$ (Feuerstein et al., 2006), see appendix for scale.

Workstyle-related high-risk behaviors may make one more susceptible to the exacerbation or maintenance of WRUE symptoms. In addition to the association between workstyle and symptom risk or exacerbation, workstyle also may result in additional exposures to ergonomic and psychosocial risk factors (See Figure 2). Additional exposures are accounted for in the model by a feedback loop that explains the maintenance of maladaptive workstyles (Feuerstein et al., 2005). For example, an adverse workstyle may result in symptoms and the presence of symptoms impact work productivity and demands. These symptoms also may elicit a response that may further expose the worker to psychosocial and ergonomic factors (Feuerstein et al., 2005).

Figure 2. Workstyle Model (Feuerstein et al., 1999)



Workstyle is predictive of future pain and function limitations in office workers with upper extremity symptoms (Meijer et al., 2008; Nicholas et al., 2005). In the Nicholas et al. study, one hundred and sixty-nine individuals experiencing upper extremity symptoms were assessed for sociodemographic factors, work history, work demands, job stress, ergonomic exposures, and workstyle. The participants were followed for three months and were given a follow-up survey that collected information about general work and heath functional outcomes. Workstyle was predictive of higher levels of pain and greater functional limitations in office workers with upper extremity symptoms at three months post baseline (Nicholas et al., 2005). In another recent study one hundred and twenty office workers reporting upper extremity was assessed using the workstyle measure and followed prospectively for 12 months. Results indicate that 100% of the high risk workstyle workers continued to have upper extremity pain compared to 33% of the low workstyle group (Meijer et al., 2008).

These workstyle and outcome studies contribute to the field of upper extremity by providing support that workstyle is associated with functional and health outcomes. Therefore, assessing workstyle may assist in identifying individuals where prevention techniques to alter these ergonomic and psychosocial correlates could be useful in the secondary prevention of long-term health problems and reductions in productivity. It is suggested that assessing workstyle in workers with WRUE symptoms may assist in intervention efforts based on the observed association between job stress and pain severity, pain exacerbation, and decreased function (Haufler et al., 2000).

Workstyle is a modifiable response style. In contrast to a feature that may be a stable personality trait, research suggests that interventions focused on altering workstyle show promise in decreasing pain-related outcomes (Bernaards, Ariëns, Knol, & Hildebrandt, 2007). Recently, in conjunction with a hand surgeon at the Henry Ford Hospital in Detroit, MI, I collaborated on a study that assessed individuals seeking treatment for hand/arm symptoms and disorders for workstyle and demographic characteristics. Participants with higher workstyle scores were more likely to be on restricted work ($\chi^2 = 4.87$, $p < .05$) and experience higher levels of pain six months following baseline ($F(1,44) = 8.38$, $p < .01$). Multiple regression analyses were conducted that accounted for pain at baseline, baseline grip strength average, treatment type, diagnostic category, and job type. Higher levels of pain were associated with higher scores on the workstyle measure ($R^2 = .57$, $p = .001$) and restricted work status at six months (*OR* = 1.19, *CI* 95%: 1.01-1.40) compared to patients scoring low on the workstyle measure. The workstyle measure predicted pain and work status at six months following both surgical and non-surgical treatments for upper extremity pain (Harrington et al., in press). These results suggest that it was workstyle that predicted outcomes regardless of diagnosis, intervention type, and time. This study is important because it highlights the direct association between workstyle and outcomes associated with upper extremity disorders. These results have clinical preventive implications in light of the fact that workstyle factors are modifiable and are related to outcomes.

Summary

The background information, epidemiology, models of occupational health, stress and its indicators, and the workstyle measure have been reviewed to support the goal of the current research. The background and epidemiology support the consideration of both ergonomic exposures and psychosocial factors in the development and exacerbation of UE problems. Additionally, these sections support the integration of these factors in prevention or intervention techniques. The stress response section was included to describe the various ways that stress may manifest. This section concentrated on physiological reactions that were assessed in the current experiment (i.e., heart rate and salivary cortisol). Additionally, behavioral, biomechanical, and psychological stress responses were focused on those specific to work and work settings. Specifically, behaviors that are influenced by stress or high demands investigated in the present study were explained including posture, keyboard force, and performance. Various models of occupational factors and health were presented and support the role of other important factors including work factors, coping, and biochemical reactions on occupational health (e.g., WRUEs). Finally, the workstyle model and measure were discussed and integrates the epidemiology and stress literature to provide a method of characterizing worker and work styles that may increase risk for developing a WRUE problem.

The present research is a logical progression of the workstyle and UE literature. Upper extremity symptoms are related to both biomechanical and psychosocial stressors. Workstyle is a measure of response to perceived stressors. To date, workstyle has been predictive of upper extremity symptoms, symptom exacerbation, and treatment outcomes. The current research investigated if workstyle can differentiate asymptomatic workers on physiological, psychological, and behavioral indicators of increased demands (i.e., work-related stress).

Specific aims and hypotheses

Workstyle characterizes the physiological and psychological (i.e., cognitive, emotional, and behavioral) response to a high-demand work task. This conceptualization is based upon the hypothesis that heightened job demands evoke a workstyle response that is associated with ergonomic and psychosocial risk factors that exacerbate or maintain job-related upper extremity symptoms. Using the workstyle construct and questionaire to differentiate workers, this study assessed physiological and psychological measures of reactivity including keyboard force, perceptions of stress, task performance (i.e., output), and salivary cortisol response, blood pressure, and heart rate to both a low demand and high-demand work task. These factors were measured in individuals who vary in workstyle (high vs. low risk score) based on a standard questionnaire. This laboratory study adds to the workstyle literature by empirically identifying patterns of physiological, biomechanical, and mood alterations by workstyle score.

It was hypothesized that the workstyle measure would predict how an individual reacts to high work demands in terms of physiological changes (i.e., increased cortisol and heart rate indicating biological strain), cognitive reaction (i.e., presence of negative work-related cognitions), changes in mood, and behavior (i.e., increased force on keyboard, awkward postures-indicating biomechanical strain). Each of these components is part of a complex response to work that can increase the likelihood that upper extremity symptoms are developed and exacerbated. This research suggests that analyzing workstyle in relation to behavioral and biomechanical responses to stress should allow for differentiation of high-risk workers with potential implications for prevention and intervention (e.g., efforts to lower the arousal). If as hypothesized, workers differed in their response to increased job demands by their baseline workstyle score, and workstyle has been linked to the development of upper extremity symptoms, then prevention of WRUE symptoms can target aspects of high workstyle increased arousal to demands.

This mixed-model experimental design included workstyle as the between-subjects measure, and level of task demand, behavioral, physiological, and mood changes as the within-subject measures.

Aim One: Workstyle, Biomechanical, and Behavioral changes

The first aim was to assess whether elevated keyboard force and postural load differ by workstyle score when placed under simulated high job demands. These analyses are important because it may provide evidence that the altered cognitive patterns associated with workstyle also influence behavioral and biomechanical reactivity. Rationale of these analyses include research that show that increased keyboard force and high risk postures have both been independently associated with risk of WRUE symptoms. Determining if these risk factors differentially impact workers with high and low workstyle is the aim of these analyses. Additionally, the impact of workstyle on behavior or performance was assessed. Analyses used output as a proxy for performance

Hypothesis 1A. Office workers with high workstyle scores will have elevated keyboard force and greater changes in keyboard force between the low demand and stress task compared to the low workstyle group.

Hypothesis 1B. Workers with high workstyle scores will have more high risk postures and alterations between the low demand and stress task compared to the low workstyle group.

Hypothesis 1C. High workstyle workers will have greater output (e.g., performance) or perform at a higher rate compared to the low workstyle group.

Aim Two: Workstyle and physiological changes

The second aim was to assess whether individuals differed on physiological reactivity (salivary cortisol, blood pressure, and heart rate) to high and low work demands by workstyle score. It is hypothesized that high workstyle is characterized by increased biobehavioral reactivity, it has not been determined if this pattern of reactivity is evident in asymptomatic workers. Measuring cortisol, blood pressure, and heart rate changes (both within and between subjects) allow investigators to determine how workstyle is associated with physiological changes in response to a work-simulated task.

Hypothesis 2A. High workstyle workers will have increased elevations in salivary cortisol between the low demand and stress task compared to the low workstyle group.

Hypothesis 2B. High workstyle workers will have increased elevations in heart rate between the low demand and stress task compared to the low workstyle group.

Hypothesis 2C. High workstyle score workers will have increased elevations in blood pressure between the low demand and stress task compared to the low workstyle group.

Aim Three: Workstyle, negative cognitions, and emotional changes

The third aim was to determine whether those workers with higher levels of workstyle experience greater changes in self-reported mood and negative cognitions as a result of the high-demand work-simulated task. Rationale for these analyses was based on the relationship between psychological distress and behavioral activation. These analyses assessed if mood and cognitions were impacted by increased simulated work demands.

Hypothesis 3A. Office workers with high workstyle workers will have greater changes in mood from baseline to post stress task compared to the low workstyle group.

Hypothesis 3B. Office workers with high workstyle scores will be more likely to acknowledge the presence of negative work-related cognitions (as measured by the examples of cognitions derived from the full scale Workstyle measure) from baseline to post stress task compared to the low workstyle group.

Research design and methods

Design

This study was a mixed-model experimental design that includes workstyle as the between-subject measures, and task demand, behavioral, physiological, and mood changes as the within-subject measures. This experiment cross-sectionally investigated reactivity to job-related demands in office workers in a laboratory environment.

Variables

Independent variable

The primary independent variable in this study was the Total Workstyle score. The Workstyle scale measures a workstyle type that consists of the physiological and psychological response to a high work demand. This variable was measured through a self-report questionnaire and was assessed within the baseline measures component of the protocol.

Level of typing demand was also an independent variable. Each participant was asked to engage in a low demand typing task and high demand typing task.

Dependent variable

The dependent variables are grouped by the component of the workstyle construct being operationalized. The biomechanical/behavioral component of workstyle is characterized by keyboard force, typing task performance, and posture alterations. The psychological component was measured using changes in mood state. The physiological element was assessed using salivary cortisol, blood pressure, and heart rate.

Participants

Participants were recruited through fliers, newspaper advertisements, and online advertisements (See Appendix) in the Washington, D.C., metropolitan area and the Raleigh-Durham Triangle area in North Carolina (NC). Eighty individuals were enrolled in this study. According to Bureau of Labor Statistic data as of 2006, workers in office and administrative occupations were 75.4% women (Bureau of Labor Statistics, 2005a). Similarly, 76.3% of the current sample was female. Based on 2006 Bureau of Labor Statistic national data 71.4% of office workers are Caucasian, 13% Black or African American, 3.6% Asian, and 12% Hispanic or Latino. However in the present sample, 34.6% of the sample self-reported as being a Non Minority, which is less than the normal demographic range for this job category. The ratio between minority and nonminorities in this occupational group is notable. According to census data, nationally, approximately 76% of the population is Caucasian and 12.4% African American. Notably, 56% of African Americans (AA) live in the southern regions of the country. This study was conducted in areas with relatively high numbers of minorities which may account for the low number of nonminority office workers in the current sample (According to current census data: Percentage of African Americans: Raleigh, NC 27.8%; Durham, NC 43.8%, and Washington, DC Metropolitan Area 26.3%).

Inclusion criteria included: (1) male and females, (2) aged 18-65, (3) full-time office workers who spend at least 4 hours per work day at a computer/typing task, (4) English-speaking, and (5) eighth grade reading comprehension (minimum reading level for self-report measures). Exclusion criteria included: (1) unemployed, (2) current pregnancy, (3) current use of hormone replacement therapy, (4) medical disorders that may result in variant cortisol levels, (5) current psychiatric disorders/symptoms by self-report, and (6) current tobacco user. Criteria were assessed by self-report. A total of 142 individuals were screened, and for a variety of reasons 43 individuals where ineligible (31 for Workstyle score, 2 for smoking, 2 for diabetes, 2 for thyroid disease, 2 for taking hormone replacement medications, 1 for an eating disorder, 1 for pregnancy, and 1 for depression). There were 19 individuals who met screening criteria but did not complete the study due to no shows. Eighty individuals completed the protocol for this study. Participants received compensation in the amount of $40. Payment was mailed within two weeks of the completion of the study protocol.

Screening

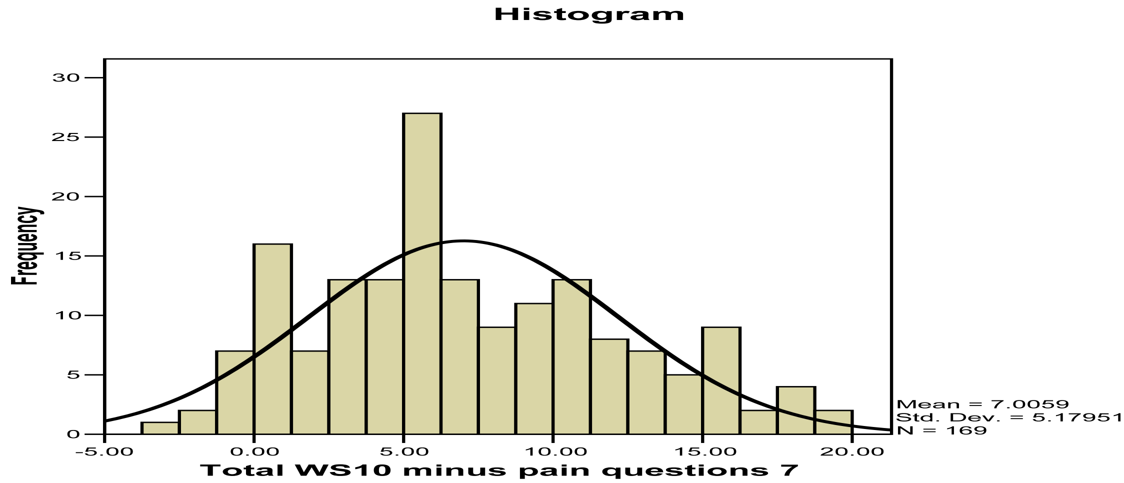
During the telephone screen the potential participants were evaluated for inclusion criteria and workstyle score using self-report (see phone screen Appendix 3). The individuals who scored in both the low and high risk ranges on the workstyle measure were asked to participate in the study (see rationale in data analysis section). The workstyle screen was a 7-item scale derived from the 32-item Workstyle SF (See Appendix 3).

Using the Workstyle SF (i.e., 32-item) a factor analysis was conducted to develop a brief 10 item scale for potential use in the clinical setting. These ten-items were used as the basis for the workstyle screen. For the purpose of the present study all pain related questions were removed from the measures. The pain related questions were removed because this experiment recruited workers who do not have any WRUE symptoms and those items were developed to assess symptoms in symptomatic workers. This 10-item scale became a 7-item scale when the pain related questions were removed. This scale was compared with the 32-item Short Form and the 79-item scale (minus the pain questions) in a sample of 169 workers both with and without upper extremity symptoms. The 7-item scale was highly correlated with the 79-item scale (r = .923, p < .001) and the 32-item scale (r = .932, p < .001).

Cut-off scores.

To determine the cut-off scores for the study inclusion, descriptive statistics were calculated (on the previous sample of 169 workers from the Nicholas et al., study) and the range of scores for the 7-item scale was -3.00 to 19.00 with a mean of 7.00 and standard deviation of 5.17 (see power analysis for sample size). Using the standard deviation as a guide, the sample scores were grouped by thirds (approximately) and it was calculated that scores < 4.00 (34.9%) constitute the low workstyle score and scores > 10.00 (25%) comprise the high workstyle scores. See Figure 4.

Figure 3. Normal distribution of screening questionnaire scores



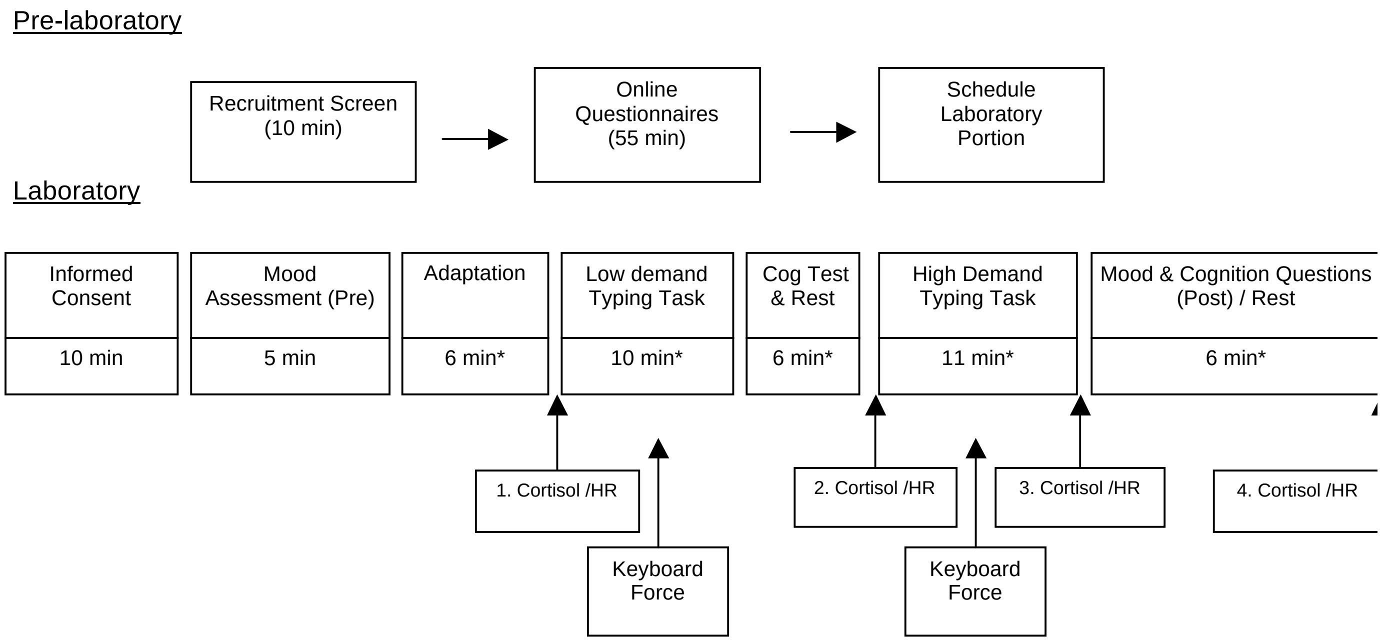
Procedure

The protocol consisted of an online survey (completed prior to laboratory visit) and one laboratory visit. The complete protocol took approximately 125 minutes to complete: 10 min. phone screen, 10 min. informed consent, 55 min. online measures and 50 min. for the laboratory portion. Following the telephone screen, if eligible and interested the participant was given a username and password to access the online survey with instructions to complete the survey prior to their scheduled laboratory visit. The investigator confirmed the completion of online surveys prior to each scheduled visit. The online survey included an informed consent page (see Appendix 1) followed by a self-report battery that included demographic information, occupational status (job title, hours worked per week), medical history/status (Standard Form – 12 Health Survey: Ware, Kosinski, & Keller, 1996), a measure of current mood, a measure of overall stress experience (Perceived Stress Scale: Cohen, Kamarck, &

Memelstein, 1983), ergonomic exposures (Job Requirements and Physical Demands Survey: Marcott, Barker, & Joyce, 1997), and questions regarding job stress (see Appendix 6 through 9 for questionnaires). This study was a dual site study, and the laboratory visits either took place in room B1004 at the Uniformed Services University of the Health Sciences in Bethesda, Maryland or in an office space in Raleigh, North Carolina, depending on the site. Each laboratory room was set up identically. However, the Raleigh laboratory room was approximately double the size of the Bethesda room. Despite the size variation in the room, the investigator set the laboratory measurement tools as they were in the Bethesda room (see laboratory setup Figure 5).

When the participant arrived for the laboratory visit, informed consent procedures were completed. The investigator explained that the study instructions were prerecorded and that the interaction between the participant and investigator would be limited to the completion of physiological, mood, and cognition measures. Each participant was then taken into the laboratory and asked to sit at the desk. First, the participant was familiarized with the computer workstation. The chair was adjustable and the participant was allowed to adjust the height of the chair. Each participant was asked to engage in a grip strength measurement (see grip strength section for procedures). The participant completed a Mood questionnaire. Next, during the adaptation period (5 minutes) the video camera was turned on, and the participant was told they were being video recorded. Then the initial salivary cortisol sample, blood pressure, and heart rate measurement were taken (see methods section for procedures). Once completed, the 10-minute low demand typing task began. Following the low demand task, the participant was asked to complete the cognitive questionnaire and sit quietly for 5 minutes to allow for recovery from any stress that may be associated with the low demand typing task. Magazines were made available to the participant during the three rest periods. Next, the second salivary cortisol sample, blood pressure, and heart rate measurement were taken. Then the high demand typing task was initiated. Following this task, the third salivary cortisol sample, blood pressure, and heart rate measurement were taken. The participant then was asked to rate the level of stress experienced during high-demand task and complete the mood and cognition questions once again. The participant rested again for 5 minutes, after which the final cortisol sample, blood pressure, and heart rate measurement were taken. The recording notified the participant that the study had been completed and that the video camera would be turned off. The participant was then debriefed on the purpose of the study and given a list of mental health resources in their respective geographical area. It was hypothesized that the high demand typing task would result in negative effects on mood and cognitions, while these effects were expected to remit immediately following the recovery period, mental health resources were provided to each participant in the event that they experienced prolonged distress. See Figure 4.

Figure 4. Study components, sequence, and time allotment



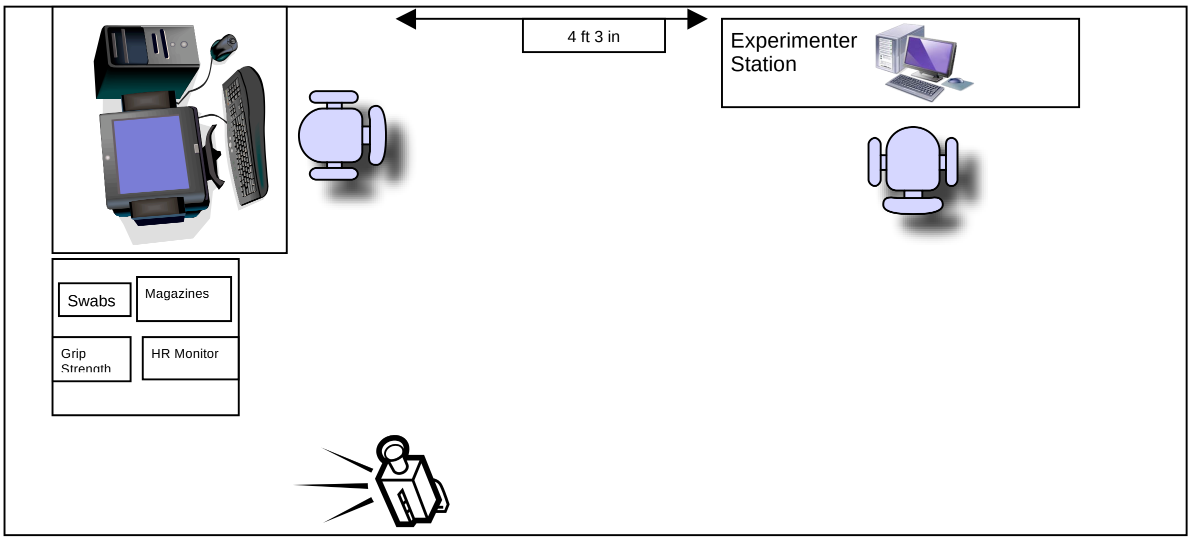
* Task Time + 1 minute for salivary cortisol collection

Laboratory Setting

The laboratory setting consisted of a desk, with desktop computer, monitor, keyboard, and office chair. The desktop computer was located at the far right of the desk area, the monitor at the center of the desk located 19 inches from the front edge of the desk, and the keyboard was located one inch from the front edge of the desk. During each of the tasks, a document holder was placed to the left hand side of the desk approximately 4 inches from the front of the desk.

The investigator was situated (4 feet, 3 inches) behind the participant to monitor and control the study factors. A video camera was also placed in the room and situated to record posture changes in each participant. The video camera was placed four feet and one and half inches from the participant. To the left of the participant desk area, a small folding table was placed that held the heart rate monitor, salivary cortisol collection swabs, magazines, and antibacterial lotion (see Diagram below).

Figure 5. Laboratory Layout



Sample Definition and Task Rationale

Sample Definition

Full-time office workers who spend at least 4 hours per day at a computer/typing task (Feuerstein et al., 1997) were defined as office workers in this experiment. Work status was assessed using self-report.

Task Rationale

The low demand task involved typing text for 10 minutes. The high demand task also involved typing text for 10 minutes, but included instructions to proofread and correct the text (see typing task section for procedures). The high demand task also had additional elements of time pressures and increased demands (i.e., more words to type in the same amount of time). Time pressures and increased demands are both aspects of validated computer tasks linked to increases in behavioral and physiological reactivity (Hughes et al., 2007). Time pressures and increased demands also are associated with mental workload. Mental workload is related to behavioral and physiological reactivity (Gerard, Armstrong, Martin, & Rempel, 2001).

A study that used a computer task with elements of demands for speed and accuracy (Schreinicke, Hinz, Kratzsch, Huber, & Voigt, 1990) in 77 healthy male computer operators reported that serum cortisol concentration was significantly higher after 30 minutes of computer work (*M* = 35.5, *SD* = 20.0) compared to the baseline collection (*M* = 26.7, *SD* = 14.6). Additionally, heart rate also increased following 30 minutes of computer work (*M* = 87.1, *SD* = 16.2) compared to rest (*M* = 77.1, *SD* = 11.3).

A similar typing task to the current study was used in a study of keyboard force and upper extremity symptoms. Participants were asked to enter alphanumeric text from the Federal Register for 15 minutes with instructions that included "…demand characteristics that emphasized speed and accuracy" (Feuerstein et al., 1997). Participants were 48 office workers 23 with high levels of upper extremity symptoms and 25 controls with low levels of symptoms. Both cases and controls perceived that the typing task required a "moderate" or "somewhat strong" exertion with associated behavioral reactivity (i.e., elevated keyboard force) for both groups and greater reactivity in the cases.

This work-simulated high demand typing task was developed for the present study. All aspects of this task (i.e., typing text, time pressures, and increased work demands were evaluated in the present study) have been validated in other similar tasks and found to be related to perceived exertion, behavioral reactivity, and physiological reactivity. Because the components of this task have been validated in other studies, it was anticipated that this task had the necessary components to elicit a behavioral and/or physiological response. The order of the stress manipulation was standardized across all participants; low demand task followed by the high demand task. Counterbalancing was not used because it was anticipated that the high demand task may have carryover effects on the low demand task if the order were reversed.

Measures

Baseline Information

Participant characteristics.

Demographic characteristics (age, race, height, weight, education level, marital status, and ethnicity), occupational factors, health behaviors (tobacco and alcohol consumptions), medical history, and mental health information were obtained by self-report (See Appendices 6 – 9). Measures of self-reported ergonomic exposure, job stress, and psychosocial stressors also were collected. Demographic data were used to characterize the sample for descriptive purposes. Health behaviors and body mass index were assessed due to their status as possible confounders on salivary cortisol variations (Alderling, Theorell, de la Torre, & Lundberg, 2006), and some health behaviors like smoking tobacco are included in the exclusion criteria. These factors were presented in a questionnaire that has been used to assess these dimensions in several studies (Huang et al., 1998; Huang et al., 2003; Nicholas et al., 2005).

Occupation.

Occupational factors including type of office setting (i.e., clerical worker/teller, insurance/real estate sales, management/administration, professional/technical, service worker, or private), duration at current job, and hours per week at job were obtained. The job classifications were derived from the U.S. Bureau of Labor Statistics.

Medical history.

Prior and current medical histories were assessed by a self-report questionnaire. Information regarding health problems (e.g., diabetes, gout, alcoholism, lupus, kidney problems, and hypothyroidism) as well as various health behaviors (e.g., tobacco, alcohol, and prescription medication usage) shown to be related to stress also was included. The literature has validated the self-report assessment of health factors (Chandola & Jenkinson, 2000). Additionally, The Standard Form–12 Health Survey (SF-12) was administered to assess the participants' overall feelings about their health and function. The SF-12 is a 12-item measure that was developed as a population-based measure of general health status and normalized using known clinical and health populations (Ware, Kosinski, & Keller, 1996). Subscales for this measure include a physical and mental component score. Test-retest reliability for this measure ranged from *r* = 0.63 to 0.91(see appendix). Scores closer to zero (0) indicate lower health status, while scores closer to 100 indicate higher scores. This scale was available for public use (see http://www.crufad.com/phc/sf-12.htm).

Mood/affective symptoms and cognitions.

To assess mood state during the baseline questionnaire period questions were developed that asked about general mood over time and during high work stress. To assess mood state during the laboratory experiment, a scale was developed that asked the participant to rate their current level of tension, anxiety, frustration, anger, and happiness, using the scale: none, some, moderate, a lot, and extreme. These questions were presented at baseline and immediately following the stressor task to assess any changes in mood state (psychological distress) as a result of the task. Scoring this measure involved assigning numerical values to each answer choice and then summing the values for tension, anxiety, frustration, and anger, and the numerical value for happiness was subtracted from the total. This method of scoring is consistent with a number of other measures (e.g.,[Curran, Andrykowwki, & Studts, 1995; Feuerstein et al., 2006]) and has historical context wherein number of positive attitudes were subtracted from the number of negative attitudes to assess the likelihood that an individual will conform to a social group (Festinger, Pepitone, & Newcomb, 1952). The higher the score, the greater negative mood. Because this measure was original and constructed by the investigator the internal consistency of the measure was calculated using Cronbach's alpha. A Cronbach alpha $\geq$ .70 is considered acceptable by most social scientists (Nunnelly, 1970).

This scale only had a Cronbach's alpha = .620. When the happiness factor was removed, the Cronbach's alpha = .793.

A work-related cognition questionnaire was given to assess the presence of negative or high risk cognitions associated with work and work demands (Appendix 13). Questions one through seven were derived from the full workstyle scale (Feuerstein et al., 2005). Questions eight through ten were original questions concerning feelings about performance. To score this measure, the participant marked either yes or no if they reported experiencing the thought or feeling following the low and high demand typing tasks. The yes or no answers were assigned numerical values (No = 0, Yes = 1) and summed. Internal consistency was also measured for this original measure and was found to be in the range of an acceptable scale (Cronbach's alpha = .817). The higher the score was indicative of greater negative cognitions.

Workstyle measure.

Workstyle is a construct that is characterized as the response of a worker to high work demands and its impact on performance and function (Nicholas et al., 2005). The 32-item Workstyle scale was used in this experiment (See Appendix 4). Six pain questions (i.e., working through pain subscale) were removed from the scale making it a 26-item scale. The original subscales were designed for individuals experiencing upper extremity symptoms. The "working through pain" subscale was removed for this study because workstyle is being assessed in asymptomatic workers. This scale is highly correlated ($r = .971$, $p < .001$) with the 79-item scale (Nicholas et al., 2005) and the 7-item screen brief questionnaire (r = .932, p < . 001), with the working through pain subscales removed. These correlations were conducted on 169 asymptomatic and symptomatic workers (Nicholas et al., 2005). This scale was administered with the baseline measures. For analytic purposes, a median split was calculated on the continuous measure of the Workstyle measure. The full workstyle measure was a more reliable measure of workstyle and was used to categorize the groups instead of the screener used for recruitment. The dichotomous workstyle categories (High vs. Low) were used in all analysis except the linear regressions. In the linear regression the continuous workstyle score was used.

Measures of job stress and ergonomic exposure

Measures of job stress and ergonomic exposure were administered to allow investigators to determine if the groups differed in baseline ergonomic exposures and job stress.

Workplace ergonomic stressors.

The Job Requirements and Physical Demands Survey (Upper Extremity Index)– 24 (JRPDS-24) was used to evaluate self-report duration of common ergonomic exposures (e.g., awkward postures, repetition, force) associated with a number of job tasks (Marcott, Barker, & Joyce, 1997). This questionnaire measures duration of exposure to common ergonomic factors involved in the respondent's job. This measure is included to allow investigators to account for ergonomic exposures in analyses. This measure has been shown to have an internal consistency of Cronbach's alpha = 0.82 in comparison to an a onsite observational assessment checklist (Dane, Feuerstein, Huang, Dimberg, Ali, & Lincoln, 2002) [see Appendix 6]).

Job stress.

To assess the frequency of job-related stress, participants were asked if they experience stress, anxiety, or tension at work. They were asked to select the term on a Likert scale that best represents the frequency in which they experience stress, anxiety, or tension in the workplace. The answers included never, sometimes, most of the time, and all of the time. The question was scored by assigning a numerical value to each of the answer possibilities. They also were asked a series of questions that asked the participant to acknowledge types of stress that they experience in the workplace and how frequent these stressors occurred.

Perceived stress measure

Stress perception.

The Perceived Stress Scale (PSS) was used to measure the perception of stress during the previous month (Cohen, Kamarck, & Mermelstein, 1983). This scale measures the degree to which a situation is perceived as stressful. The scale assesses how unpredictable, uncontrollable, and overloaded individuals evaluate their lives. Internal consistency is high (r = 0.85) and test-retest correlations are high ($r > .80$, $p < .01$) (see Appendix 7). Permission to use this scale is not necessary when used for research purposes (see: http://www.macses.ucsf.edu/Research/Psychosocial/ notebook/PSS10.html).

Laboratory procedures and measures

Work task (use of keyboard to enter text)

The participants were given a low demand and stress-inducing typing task. The typing task involves instructions to type two word documents (one with 483 words and one with 708 words). The second typing task includes instructions to proofread and correct typographical errors (See Appendix 15). The documents were taken from Federal Register website http://www.archives.gov/federal-register/ or http://www.thefederalregister.com/d.p/2007-11-05-07-5503. The document was titled: "DEPARTMENT OF AGRICULTURE: Agricultural Marketing Service. 7 CFR Part 993 [Docket No. AMS-FV-07-0103; FV07-993-1 FR] Dried Prunes Produced in California; Increased Assessment Rate AGENCY: Agricultural Marketing Service, USDA. ACTION: Final rule." During the low demand task, the participant was asked to type predetermined text for approximately 10 minutes with the instructions that the task is to help the participant become comfortable with the keyboard and to obtain baseline measures. The participant was then given a timed work task with increased demands (i.e., high demand task). The high demand task was similar in content to the low demand typing task but also included instructions to proofread and edit mistakes. In addition, instructions notified the participant that they were being evaluated on speed and accuracy (See Appendix 15). Overall key rate was assessed but it was not expected to impact perceived demand of the task or key force (Feuerstein et al., 1997).

Recorded instructions

Instructions for the typing tasks were prerecorded. Instructions for the low demand task were recorded in a relaxed tone to emphasize that there were no expectations by the experimenter of the participant. Instructions for the high demand task were recorded in a direct and stern tone to emphasize the importance of completing the task in the time allotted and with no errors.

Laboratory measures

Validity of job stressor task.

Task credibility rating of the “How stressful was the second typing task?” and “How demanding…” was measured using a 10-point Likert scale (0=not at all, 5=Somewhat Stressful, 10=Extremely Stressful). This measure allowed investigators to assess feelings about the high demand typing task.

Measure of strength and typing speed.

Grip strength also was assessed at the beginning of the laboratory portion of the experiment using a Jamar hydraulic dynamometer on their dominant hand. Patients were seated in a comfortable position with both feet on the ground and elbows at 90 degree flexion facing the examiner. The participant was asked to squeeze the apparatus three times at their maximum strength. The averages of these scores were used for analysis.

Also, prior to the start to the study protocol, typing speed per minute was assessed with each participant using a one-minute typing test found at http://www.typingtest.com/. The participants were asked to complete the text and were told that accuracy was also being measured. Typing speed was used as a covariate in the biomechanical and behavioral analyses.

Physiological response.

Salivary cortisol, heart rate, and blood pressure were measured and used as a general index of autonomic reactivity to the stressor. A salivary cortisol sample was obtained at four times during the protocol (baseline, prior to stress task, post stress task, recovery). The salivary cortisol was collected using the Salimetrics Oral Swab (SOS) and was then inserted into a swab storage tube. The participant was instructed to place the swab under the tongue for 60 seconds (Kirschbaum & Hellhammer, 1989) and then into the storage tube. Samples were stored in a freezer at a temperature of -20 degrees Celsius. The samples were analyzed using the High Sensitivity Enzyme Immunoassay method at Salimetrics, LLC in State College, PA (Salimetrics, LLC). Participants were instructed not to consume any food for 90 minutes prior to their onsite laboratory protocol (Toda, Morimoto, Nagasawa, & Kitamura, 2004). The baseline and post-stress task salivary cortisol samples (ug/dL) were analyzed for this study.

Heart rate and blood pressure were monitored at baseline, prior to low demand task, prior to high demand task, and at recovery using an automated cuff placed on the left arm (Model: Mabis SmartSpeed Self-Storing Automatic Blood Pressure Monitor with Memory). An automatic inflating cuff was placed on the participants left arm above the elbow. Each measure took approximately 60 seconds.

Keyboard force exertion (behavioral response).

Low force exertions and static and awkward postures are characteristic of physical demands associated with computer work (Treaster et al., 2006). Additionally, time pressure and increased demands are related to increased key force (Hughes et al., 2007).

Keyboard force exertion in Newton's was measured. It was expected that higher levels of keyboard force was likely to occur during the high-demand task in high workstyle group relative to low workstyle. Keyboard force was compared within each individual, comparing low demand task keyboard force and high demand task keyboard force and across groups using the methods developed by Armstrong and colleagues (Armstrong, Foulke, Bernard, Gerson, & Rempel, 1994). This method involves the recording of reaction forces between the keyboard and transducer placed underneath the keyboard. The keyboard force measurement equipment was built by the Ergonomic department at the University of Michigan, Ann Arbor by Charles Woolley. This keyboard force unit was composed of a Dell keyboard 104-key USB Enhanced Multimedia Keyboard. Force cells were attached to the bottom at the left, right, and center of the keyboard. When this unit was calibrated, 1000 grams registered at 46 units of force. This equipment was calibrated daily by the investigator. Analogue force was converted to digital output. Using software that analyzes and converts the digital keyboard force data, the mean, standard deviation, minimum, and maximum force were computed. The measure of rate adjusted keyboard force is expressed in Newton's per minute. The investigator received training on this equipment by Mr. Charles Woolley. Equipment was obtained from National Instruments, LLC, Austin, Texas and Lab View Signal Express was the software used to record and analyze the keyboard force data.

Posture during tasks (behavioral response).

During the low demand and high-demand job tasks posture was assessed using The Rapid Upper Limb Assessment (RULA), a standard observational method that evaluates exposures to postures, forces, and muscle activity (Lueder, 1996). The participants were videotaped, with their knowledge, for the duration of the laboratory protocol. From video recordings, still shots were taken at every minute during each of the typing tasks with a total of 20 observations per participant (10 per typing task). These pictures were then analyzed for posture using RULA guidelines. The RULA measures positions of the upper arm, lower arm, wrist, neck, leg, and trunk. For analysis, posture was numerically scored and then averaged; the averages for each body part were scored individually and also summed for a single low demand task posture score and a high-demand task posture score. Two trained raters were blinded to workstyle score of the participant and rated each videotape using the RULA (See Appendix 7). Inter-rater reliability was assessed following training with a reliability of .802, with >.80 being the minimum allowed.

This method was tested for validity. RULA scores were significantly related to the development of pain or discomfort for the neck and lower arms scores ($p < .01$) but not for trunk, upper arm, and wrist scores (McAtamney et al., 1993). This measure allows the observer to assess changes in general posture between laboratory tasks and is developed for computer work stations. Posture scores also were related to functional unit regions ($p < .01$). To test for reliability the authors reportedly conducted compared responses on the RULA by ergonomic professionals. It was reported that responses were found to be highly consistent although values were not reported (McAtamney et al., 1993). The RULA was available for public use.

Task performance (behavioral response).

Research has shown that performance on typing tasks is influenced by mental demands and time pressure (Hughes et al., 2007). In addition, it is suggested that increased stress load may result in performance deficits during typing tasks (Hughes et al., 2007). For analysis, number of words typed was the variable used as a proxy for performance for both the low demand and high demand tasks, controlling for typing speed.

Power analysis

Using effect sizes (derived from means/standard deviations) from previous published studies based on the measures of interest, the needed sample size was calculated using GPOWER (Erdfelder, Faul, & Buchner, 1996). Three main factors were used for the power analysis: stress changes in salivary cortisol on a computer task, heart rate, and mood changes over a task.

For the salivary cortisol power analysis, a study examining changes in salivary cortisol in 77 health male computer operators was used (Schreinicke et al., 1990). In this study, salivary cortisol was collected in the participants at baseline and post-stressor. The task was a choice reaction task with high demands for speed and accuracy. Results indicated that cortisol concentration was significantly higher after 30 minutes of computer worker compared to the baseline collection. The power analysis using rest cortisol (M = 26.7, SD = 14.6) and after computer work (M = 35.5, SD = 20.0), resulted in an effect size of .60, requiring an n = 70 based on a power = .80 and type I error at <.05 two-tailed.

In the Schreinicke et al., (1990) study heart rate was also found to increase following 30 minutes of computer work. At rest the M = 77.1, SD = 11.3 and after computer work M = 87.1, SD = 16.2, resulted in an effect size of .88 requiring an n = 34 based on a power = .80 and type I error at < .05 two-tailed.

To determine the sample size needed to assess changes in mood following a task, Sarid et al. (2005) conducted a study on 102 individuals that investigated changes in mood by pre-and post- different types of examinations. While, this study did not use a computer task, the evaluative nature of the task is similar to the task in the current experiment. In this study, students were given the Profile of Mood States (POMS) scale before and after an oral presentation and a pencil and paper examination (Sarid, Anson, & Bentov, 2005). The results of the pencil and paper examination were used for the power analysis, because it most closely resembles the task in the current experiment. The power analysis using baseline POMS tension/anxiety score (M = 2.25, SD = .49) and after examination POMS tension/anxiety score (M = 1.19, SD = .39), resulted in an effect size of 2.16, requiring an N = 8 based on a power = .80 and type I error at <.05 two-tailed. The current study did not use the POMS, but a similar mood questionnaire was developed and tested for internal consistency (see Measures section).

A sample size of 75 is what was required based on the maximum number of subjects needed for any one measure (i.e., salivary cortisol, and mood). However, this study recruited 80 individuals, based on the analytical strategy (see below). This sample size was sufficient to examine these data at a power > .80 and type I error at < .05 two-tailed.

Analytic strategies

All statistical analyses were performed using Statistical Package for the Social Sciences (SPSS v. 12; Chicago, IL). The criterion for significance (alpha level) was set at $p < .05$, two-tailed. For analyses, participant workstyle measure scores was converted to a dichotomous variable (High vs. Low) based on a median split of the full workstyle score (Low = $\leq$ 16, High = $\geq$ 17). The full workstyle measure was a more reliable measure of workstyle and was used to categorize the groups instead of the screener used for recruitment. This categorization method resulted in unequal groups (Low = 41, High = 39). This strategy is appropriate for this research for two primary reasons: (1) comparing individuals with categorically high vs. low workstyle is key to the focus of this study and may speak to a threshold of low and high-risk, and (2) because of the moderate reliability and validity of this scale (Feuerstein et al., 2005), using this categorization allows for a more robust investigation of high and low workstyles. Only the multivariate linear regression used a continuous measure of workstyle.

While the median split is used in behavioral sciences, as a method for determining if a relationship exists between variables, it has two major limitations (Aiken & West, 1991). The first is that analyses are unable to detect differences within each categorical group. The second is a loss of power. A median split would make it more difficult to detect differences if they in fact exist. The analytic strategies for this study included both analyses using a median split (ANOVAs) and continuous variable (Linear Regressions), which indirectly allowed for the evaluation of this method.

Analytic strategies for baseline measures

To assess the characteristics of the sample in this study, several analyses were conducted. To investigate differences in demographic characteristics by workstyle group, Chi-square analyses (χ^2) were conducted on age group, marital status, racial and minority status, educational status, and martial status. Analyses of Variance (ANOVAs) were conducted on baseline psychosocial stress and ergonomic exposures, and laboratory measures.

Primary analytic strategies

AIM 1: Biomechanical and behavioral factors and Workstyle.

Analytic strategy for biomechanical factors (keyboard force & posture):

ANOVAs were conducted to assess whether different levels of workstyle were related to keyboard force (repeated-measures analysis of covariance [ANCOVA]) and postural strain (multiple repeated-measures ANOVAs) in computer users were used. The between-subjects factor was workstyle, and the dependent variables were the within-subject factors. Greenhouse-Geisser corrections will be used as appropriate.

- 1. Workstyle and keyboard force: A repeated-measures ANCOVA was used. The covariate for this analysis was typing speed.
- 2. Workstyle and Posture: A 2 (high/low workstyle) X 2 (Low demand vs. High-demand Task) ANCOVA was used.

Analytic strategy for behavioral factor (output/performance)

The behavioral factor for this study was performance which was assessed using the amount of words typed for each typing task. An ANCOVA was conducted to assess differences by workstyle group.

- Workstyle and Performance: A 2 (high/low workstyle) X 2 (Low demand vs. High-demand Task) ANCOVA was used.

AIM 2: Physiological factors and workstyle.

Analytic strategy for physiological variables

To assess whether workstyle was related to salivary cortisol pre and post high-demand job task a 2 (high/low workstyle) X 2 (Time: pre-high-demands and post-high-demands) repeated-measures ANOVA was used. These analyses allowed the investigator to determine if the workstyle groups differ on baseline cortisol and cortisol reactions to a high-demand job task.

To assess whether workstyle was related to heart rate and blood pressure (both systolic and diastolic), pre and post high-demand job task three 2 (high/low workstyle) X 2 (Time: Initial and post-high-demands) repeated-measures ANOVA was used.

AIM 3: Psychological factors and workstyle.

Analytic strategy for psychological variables (mood and cognitions)

To assess whether workstyle was related to changes in psychological distress (Mood) and changes/presence of negative work-related cognitions, pre and post high-demand job task two 2 (high/low workstyle) X 2 (Pre-task and Post-task) repeated-measures ANOVA was used. These analyses allowed investigators to determine whether the workstyle groups differ on changes in mood in response to a high-demand job task.

Secondary analytic strategy

AIM 4: Identifying factors associated with workstyle characteristics.

Several Linear Regression Analyses were conducted to identify factors associated with the total workstyle score and workstyle constructs. Univariate analyses were conducted on demographic, ergonomic, baseline, and laboratory measures to determine the best model for each regression analysis. Factors significant at $p < .10$ were included in the respective models, based on the research standard. Additionally, a Linear Regression was conducted to identify a profile of workstyle using baseline measures, demographics, and high-demand mood. This analysis allowed investigators to identify a profile of the high/low workstyle worker. The model included scores from the JRPD and PSS entered in the first step, followed by minority status, age, education category, and married vs. not married, and the final step was the total mood score assessed following the high demand typing task. In order to identify a profile of workstyle the factors were included in a specific order. First, it was important to account for any baseline differences in ergonomic stressors and overall perceived stress. Next, demographic factors were included to assess the relationship between these characteristics and workstyle score. Finally, mood following the high demand task was included to determine if baseline ergonomic measures, baseline stress, demographic factors, and emotional reactivity to increased demands could provide a profile of workstyle.

Results

Baseline measures

Demographic characteristics.

Using the dichotomous workstyle score, the low and high workstyle groups were compared on dichotomous demographic characteristics, including age group, race, education, marital status, and job category. Using Chi-square analyses (χ^2), it was determined that the low and high workstyle groups did not significantly differ on any demographic characteristic (see Table 1 page 121).

Preliminary analyses were also conducted to confirm that no differences existed in the sample as an artifact of being conducted in dual sites. Using ANOVAs, the sample was split by location (i.e., Maryland or North Carolina); the groups did not differ on demographic characteristics, baseline measures, mood, cognitions, keyboard force, or salivary cortisol.

Self-reported health status.

Using the dichotomous workstyle score, two ANOVAs were used to analyze group differences on The Standard Form-12 Health Survey (SF-12). Results indicate that the high workstyle group (*M* = 51.37, *SD* = 7.36) did not differ on the Physical Component Summary (PCS) of the scale compared to low workstyle group (*M* = 52.65, *SD* = 5.35 [see Table 4 page 124]). Additionally, the high workstyle group (*M* = 39.56, *SD* = 8.01) did not differ on the Mental Component Summary (MCS) compared to the low workstyle group (*M* = 41.51, *SD* = 8.29 [see Table 5 page 124).

Psychosocial and job stress measures.

Using the dichotomous workstyle score, ANOVAS were conducted on baseline measures including the Perceived Stress Scale (PSS) and the Job Requirements and Physical Demands Survey (JRPD). Results show that the low (M = 19.35, SD = 4.86) and high (M = 22.38, SD = 5.77) workstyle groups differed on the baseline measure of the PSS ($F(1,78) = 6.06$, $p < .05$) . The results show that the high workstyle group had higher baseline scores of perceived stress compared to the low workstyle group (see Table 6 page 124). On the JRPD, the low (M = 87.65, SD = 18.93) and high (M = 83.62, SD = 14.74) workstyle groups did not differ on reported ergonomic exposure in the workplace (see Table 7 page 124).

Laboratory measures of strength and typing speed.

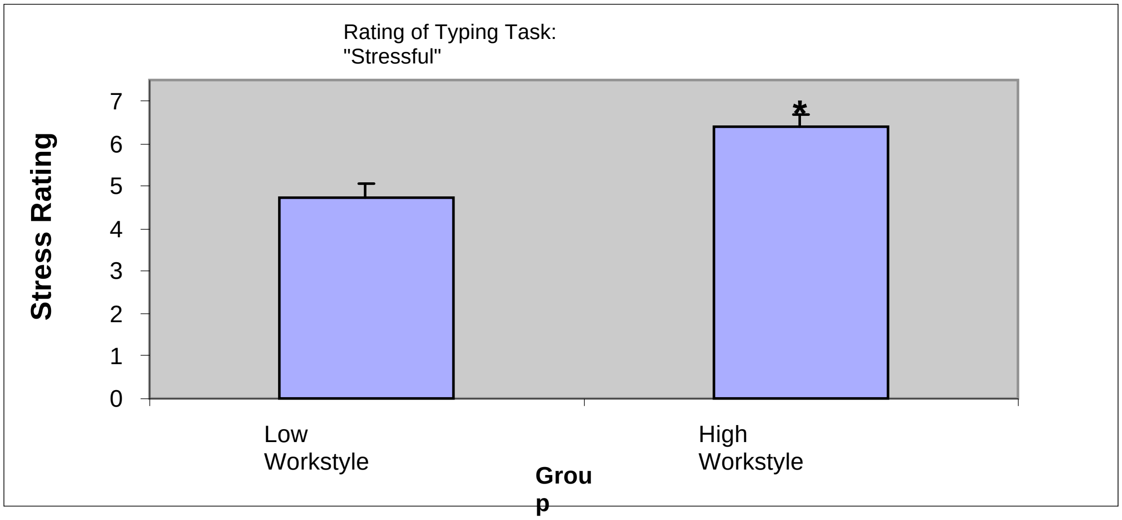
Using the dichotomous workstyle score, ANOVAS were conducted on baseline laboratory measures including grip strength and typing speed. The high (M = 29.12, SD = 10.60) and low workstyle (M = 30.00, SD = 10.76) groups did not differ on average grip strength (see Table 8 page 124). Additionally, the groups did not differ on typing speed (Low: M = 26.62, SD = 9.37; High: M = 28.27, SD = 11.04 [see Table 9 page 124]).

Validation of typing task.

To assess perceived stress and level of demand following the high demand typing task, an ANOVA was performed. The high workstyle group (M = 6.38, SD = 2.36) compared to the low workstyle group (M = 4.74, SD = 2.75) perceived the high demand typing task as more “stressful” ($F(1,67) = 7.02$, p <

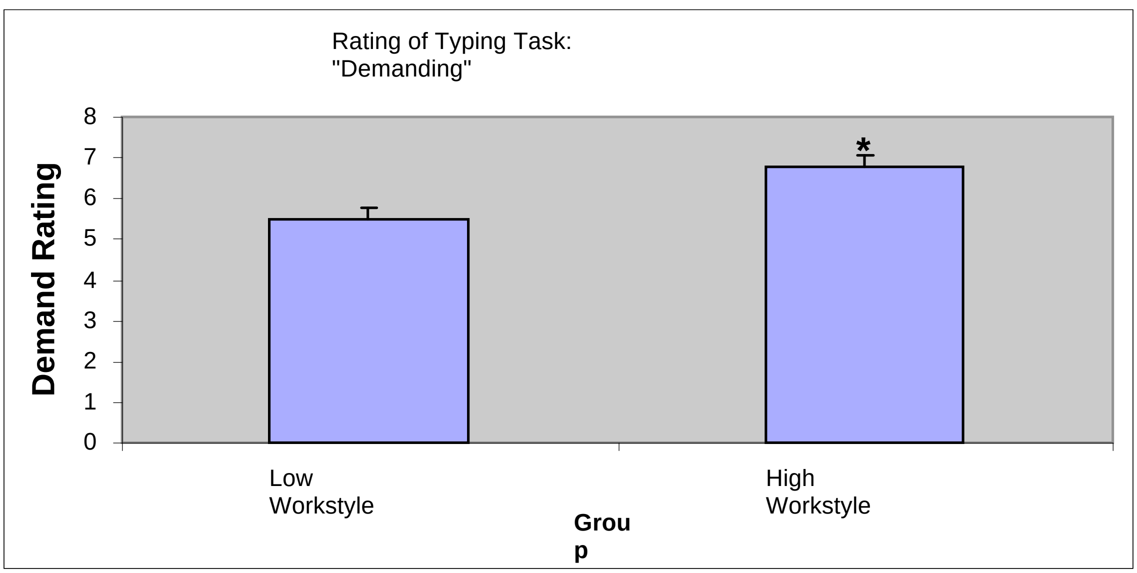
.05: see Figure 6 below and Table 10 page 125). Additionally, the high workstyle group (M = 6.76, SD = 2.06) perceived the high demand typing task as more "demanding" ($F(1,68)$ = 5.23, p < .05) compared to the low workstyle group (M = 5.50, SD = 2.52: see Figure 7 below and Table 11 page 125).

Figure 6. A comparison of the "how stressful" rating question of the high demand typing task between the high and low workstyle group



***p* < *.05* . Bars represent Standard Error of the Mean.**

Figure 7. A comparison of the "how demand" rating question of the high demand typing task between the high and low workstyle group



***p* < *.05* . Bars represent Standard Error of the Mean.**

Mood, cognitions, and workstyle.

Using the dichotomous workstyle score, ANOVAS were conducted on thoughts and feelings acknowledged following each task and presence of mood characteristics. The high workstyle (M = 6.18, SD = 2.23) group acknowledged more negative cognitions and feelings following the low demand typing task ($F(1,77) = 4.73$, $p < .05$) compared to the low workstyle group (M = 4.93, SD = 2.88 [see Table 12 page 125]). Additionally, more negative cognitions and feelings were present in the high workstyle group (M = 6.89, SD = 2.68) following the high demand typing task ($F(1,77) = 4.17$, $p < .05$) compared to the low demand task (M = 5.70, SD = 2.68 [see Table 13 page 125]).

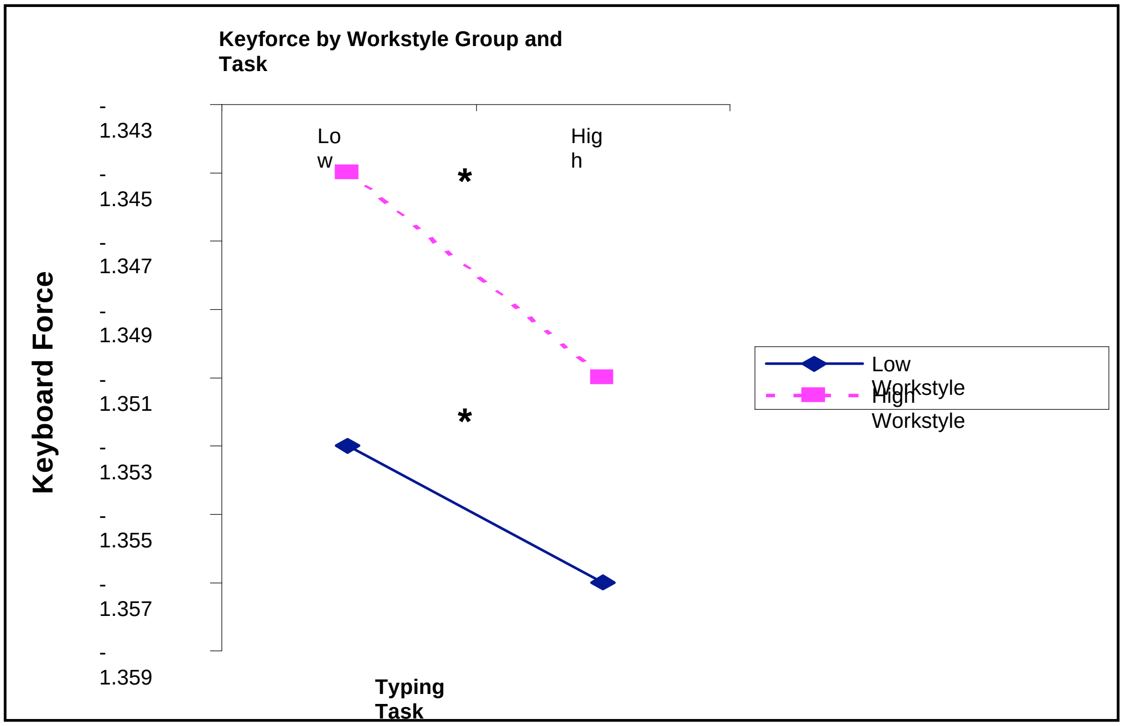
To assess mood at baseline and following the high demand typing task ANOVAs were performed. At baseline, the low and high groups did not differ on level of Tension, Anxiety, Frustration, Anger, or Happiness (see Table 14 page 125). Following the high demand typing task, the high group (M = .21, SD = .522) had significantly higher levels of Anger ($F(1,79) = 4.63$, $p < .05$) compared to the low workstyle group (M = .02, SD = .154). Additionally, the high workstyle group (M = 1.87, SD = .833) had lower levels of happiness ($F(1,79) = 4.35$, $p < .05$) compared to the low workstyle group (M = 2.29, SD = .944 [see Table 15 page 126]).

Results from primary analytic strategies

Biomechanical and behavioral factors and workstyle.

Keyboard force: A repeated-measures ANCOVA was used. The covariate for this analysis was typing speed. Results indicate significant multivariate test (Greenhouse-Geisser) results for Task x Keyboard force (F(7.199, 675) = 3.02, $p < .05$) and Task x Keyboard force x Type speed (F(6.830, 675) = 2.37, $p < .05$). Between-subjects analyses were significant for workstyle (F(1,75) = 4.66, $p < .05$), showing that the high workstyle group had greater levels of keyboard force than the low workstyle group (See Table 16 page 126 and Figure 8).

Figure 8. Keyboard force by workstyle group and task

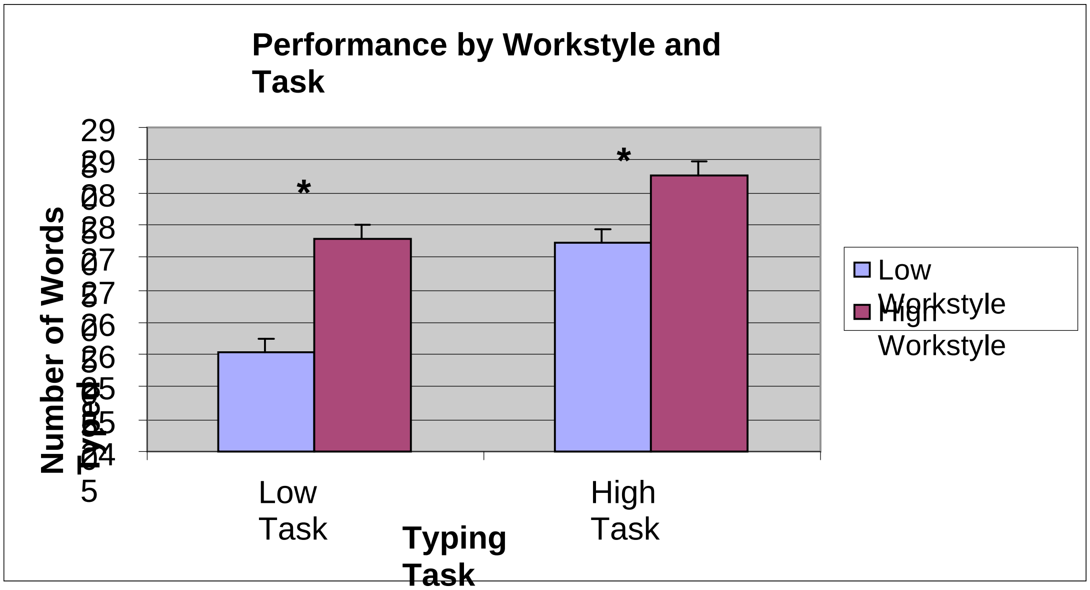


p < .05

Performance: Two ANCOVAs were performed to assess numbers of words typed during the two typing tasks by workstyle group. The covariate for these analyses was typing speed. Results indicate significant results for both the low demand task and the high demand task. For the low demand task, the high workstyle group (M = 277.76, SD = 120.02) typed more words (F(2,78) = 1224.75, $p < .05$) compared to the low workstyle group (M = 260.35, SD = 95.56

[see Table 17 page 127]). Also, for the high demand task, the high workstyle group (*M* = 287.74, *SD* = 105.85) typed more words ($F(2,78) = 1020.20$, $p < .05$) compared to the low workstyle group (*M* = 277.23, *SD* = 92.58: Table 18 page 127 and Figure 9).

Figure 9. Comparison of performance (Output) by task and workstyle



*** *p < .05* . Bars represent Standard Error of the Mean.**

Posture: Repeated-measure ANOVAs were conducted on mean RULA score for each body position (upper arm, lower arm, wrist, neck and trunk) across the two typing tasks. Analyses show that the groups did not differ on changes in upper arm placement, lower arm placement, neck position, and trunk position (See tables 19-22). The groups did differ on wrist placement ($F(1,70) = 4.059$, $p < .05$) where greater ulnar and/or radial deviations were seen in the high workstyle group (Task 1: *M* = 13.90, *SD* = 5.54; Task 2: *M* = 13.66, *SD* = 5.45) compared to the low workstyle group (Task 1: *M* = 11.58, *SD* = 4.06; Task 2: *M* = 11.41, *SD* = 4.41 [see Table 3 for all descriptive values page 123 and Table 21 page 128]).

Results from measures of physiological factors and workstyle

Salivary cortisol.

A 2 (high/low workstyle) X 2 (Time: pre-high-demands and post-high-demands) repeated-measures ANOVA was used to assess changes in salivary cortisol. These analyses allow investigators to determine if the workstyle groups differ on baseline cortisol and cortisol reactions to a high-demand job task (ug/dL). Analyses show that there were no statistically significant between or within-subject differences between the low and high workstyle group (Low: Time 1: *M* = .159, *SD* = .143; Time 3: *M* = .160, *SD* = .141; High: Time 1: *M* = .126, *SD* = .116; Time 3: *M* = .114, *SD* = .009 [see Table 23 page 128]).

Heart rate.

A 2 X 2 repeated-measures ANOVA was used to compare heart rate at baseline and post high-demand task. Analyses found no significant differences between the low (Time 1: *M* = 73.64, *SD* = 12.56; Time 3: *M* = 75.60, *SD* = 13.03) and high (Time 1: *M* = 78.84, *SD* = 15.27; Time 3: *M* = 80.41, *SD* = 18.98) workstyle group (see Table 24 page 128).

Blood pressure.

Repeated Measure ANOVAs were also conducted on both Systolic and Diastolic Blood pressure. The 2 X 2 repeated-measures ANOVA on Systolic Blood pressure (BP) did not detect statistically significant differences between the low (Time 1: *M* = 129.19, *SD* = 15.24; Time 3: *M* = 128.50, *SD* = 14.57) and high (Time 1: *M* = 125.95, *SD* = 12.15; Time 3: *M* = 124.68, *SD* = 11.9) workstyle groups (see Table 25 page 129). The repeated-measures ANOVA on

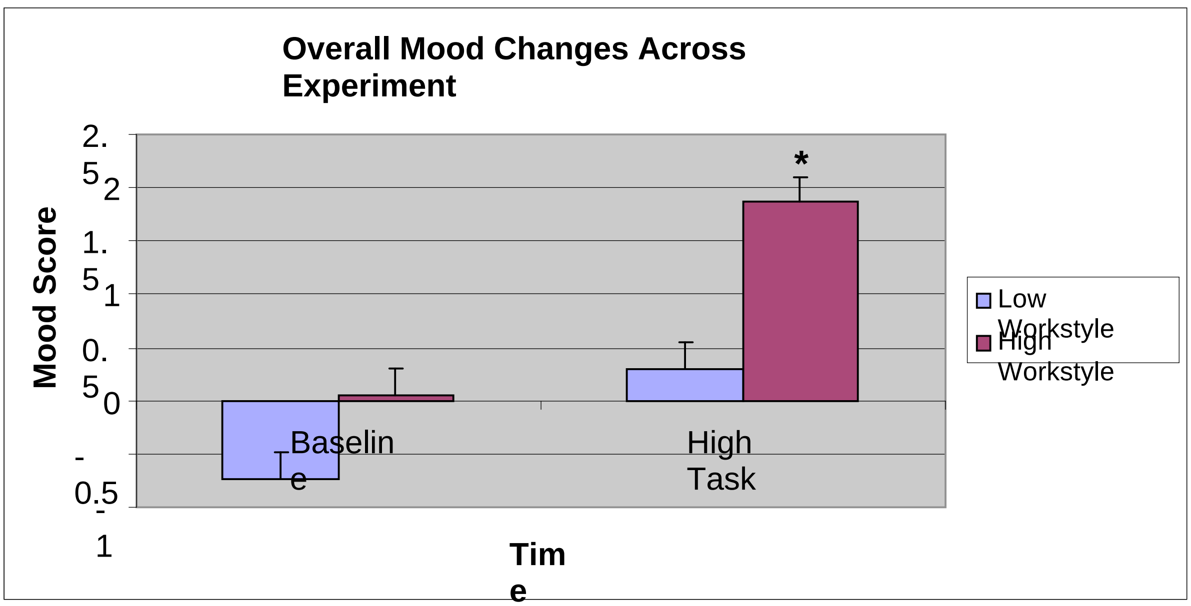
Diastolic BP also were not statistically significant (Low : Time 1: *M* = 80.24, *SD* = 11.01; Time 3: *M* = 80.05, *SD* = 11.80: High: Time 1: *M* = 78.92, *SD* = 9.64; Time 3: *M* = 78.46, *SD* = 8.89) workstyle groups (see Table 26 page 129).

Results from measure of psychological factors and workstyle

Changes in mood.

Analyses on changes in mood measure across the experiment indicate that the high workstyle (Time 1: *M* = 0, *SD* = 2.04; Time 3: *M* = 1.86, *SD* = 2.87) group had greater (i.e., more negative) changes in mood compared to the low workstyle group (Time 1: *M* = -.738, *SD* = 2.40; Time 3: *M* = .309, *SD* = 2.69). Within-subjects analyses show a significant difference for "Time" (Hotelling's Trace $F(1,78) = 25.34$, $p < .05$). Between-subjects analyses show a significant difference by workstyle group ($F(1, 78) = 5.501$, $p < .05$: See Figure 10 and Table 27 page 129).

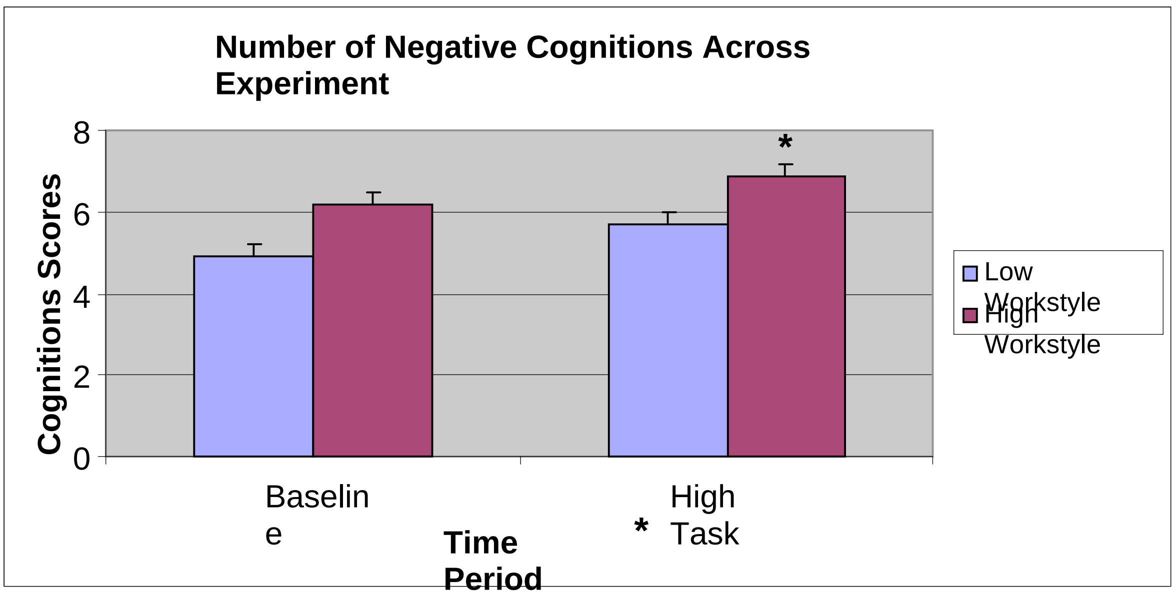
Figure 10. Comparison of overall mood scores across task & workstyle



*** $p < .05$. Bars represent Standard Error of the Mean**

Changes in cognition assessing the number of negative feelings and cognitions across the experiment, results indicate that the high (Time 1: *M* = 6.18, *SD* = 2.23; Time 3: *M* = 6.89, *SD* = 2.91) workstyle group had more negative feelings and cognitions compared to the low workstyle group (Time 1: *M* = 4.90, *SD* = 2.88; Time 3: *M* = 5.70, *SD* = 2.68). Multivariate analyses show a significant difference within the variable "Time" (Hotelling's Trace $F(1,75) = 12.41$, $p < .05$). Between subjects analyses show a significant difference by workstyle group ($F(1.75) = 4.63$, $p < .05$: See Figure 11 and Table 28).

Figure 11. Comparison of number of negative cognitions across experiment and group



*** *p* < *.05* . Bars represent Standard Error of the Mean**

Results from secondary analytic strategies

Identifying factors associated with workstyle.

Several Linear Regression Analyses were conducted to identify factors associated with the main Workstyle constructs including: Biomechanical Factors, Physiological Factors, Psychological Factors, and Behavioral Factors. Univariate analyses were conducted on demographic, ergonomic, baseline, and laboratory measures to determine the best model for each regression analysis. Factors significant at $p < .10$ were included in the respective models.

Keyboard force: To identify factors related to keyboard force, a linear regression model was conducted with demographic characteristics, grip strength average, typing speed, mood score, and workstyle. The workstyle score was the only significant variable in this model and accounted for 18% of the variance ($R^2 = .18$, $p < .05$ [see Table 126]).

Salivary cortisol: To assess the factors related to salivary cortisol a linear regression model that included demographic characteristics, report of task demands and task stress, baseline cortisol, and workstyle score. Only baseline cortisol was related to cortisol following the high demand task ($R^2 = .87$, $p < .05$ [see Table 126]).

Performance: The number of words typed is used in this study as a proxy for performance; a model was analyzed to identify factors related to this measure. Demographic characteristics, overall perceived stress, and ergonomic exposures accounted for 31% of the variance of performance ($R^2 = .310$, $p < .05$ [see Table 126]).

Cognitions: A regression model was developed for negative cognitions and included demographic characteristics, report of task demands and task stress, and workstyle score. Both ratings of task stress and demands, as well as total workstyle score were significant factors in the model, accounting for 33% of the variance of negative cognitions following the high demand typing task (R^2 = .33, $p < .05$ [see Table 127]). A regression also was used to identify factors related to overall mood following the high demand typing task. The model includes demographic characteristics, task stress and demand rating, PSS score, JRPD score, and workstyle status. Task rating and workstyle were the only significant factors in the model accounting for 33% of the variance (R^2 = .33, $p < .05$ [see Table 127]).

Factors related to workstyle: A Linear Regression Analysis was conducted to identify factors related to workstyle using baseline measures (job and psychosocial stressors), demographics, and high-demand tension/anxiety. The model included scores from the JRPD and PSS entered in the first step, followed by minority status, age, education category, and married vs. not married, and the final variable entered was the total mood score assessed following the high demand typing task. The results from the regression showed that this model was able to account for 30% (R^2 = .295, $p < .05$) of the variance in a continuous measure of the Workstyle score (see Table 127).

Discussion

The present laboratory experiment investigated cognitive, behavioral, and psychological differences between individuals scoring in the high and low risk ranges of the workstyle measure. As hypothesized, office workers scoring high on the workstyle scale had increased keyboard force, more awkward wrist posture, more negative mood, more negative cognitions, and greater output (performance) compared to the low workstyle group. The high workstyle group also had higher levels of perceived stress and perceived demands during the high demand typing task. In summary, the high workstyle group had higher overall levels of stress and higher reactivity to the increased demands.

Workstyle appears to be linked to exacerbation of outcomes, predictive of disease, and modifiable (Bernaards et al., 2007; Feuerstein et al., 2006; Nicholas et al., 2005). The next stage in the progression of the workstyle and UE research was to determine if measurable differences exist in asymptomatic individuals with high and low workstyle on physiological and psychological responses in a high-demand work-simulated environment. Assessing differences in demand response in workers who do not have upper extremity symptoms was expected to provide the mechanism to identify high risk workstyle workers and support future research to determine if this tool could be used to prevent future UE symptoms. The purpose of this study was to assess differences in indicators of physiological and psychological stress responses that might exist between groups self-reporting workstyle aspects during increased work demands. Additionally, it was a goal to observe if asymptomatic office workers display these features under varying work demands. Lastly, this experiment was designed to give further support to the workstyle construct by assessing if self-reported workstyle can differentiate reactivity to increased demands in office workers.

The present study investigated the relationship among workstyle score, physiological stress activation (i.e., salivary cortisol and heart rate), behavioral activation, and psychological response to high work demands in a simulated, high-demand work environment (e.g., distress, keyboard force, accuracy, and efficiency of work). The identification of response patterns by workstyle in asymptomatic workers may have major implications in the prevention of work-related upper extremity symptoms. Preventing upper extremity symptoms is important because of the substantial burden of upper extremity symptoms and disorders at the public health economic level as well as the individual functional and psychological level. This study was designed to address one major question: Do individuals who characteristically report a high workstyle (i.e., increased psychological and physiological arousal to high-demand work task) demonstrate altered physiological and behavioral reactivity (keyboard force, posture, heart rate, and cortisol) to work than low workstyle workers (i.e., low risk or no arousal levels) in similar office related occupations?

In this laboratory study when office workers were split in a dichotomous variable (using median split of the workstyle scale), the groups did not differ on any demographic characteristic including age, race, education, marital status, and job category (see Table 3 page 123). Because the groups did not differ on any demographic characteristic, we can assume that any differences detected between the groups can be attributed to the actual factor being assessed.

Preliminary analyses included the analysis of baseline and laboratory measures. Ergonomic exposure (JRPD) and overall perceived stress (PSS) were compared by workstyle group. The groups did not differ on ergonomic exposure experienced in the workplace. These results indicate that the groups had similar biomechanical exposures in the workplace which given the diversity of office settings is a significant detail. The groups did, however, differ on overall perceived stress, where the high risk workstyle group had higher scores on this measure of stress perception (i.e., controllability and predictability). The high workstyle group was hypothesized to perceive and respond to stress in a unique way, the results on the PSS scale are consistent with this hypothesis. Additionally, analyses of grip strength and typing speed were conducted. There were no group differences found in the analysis of grip strength and typing speed.

While the typing task used was comprised of validated components, the task itself had not been previously validated. To assess the task's ability to simulate increased demands, participants were asked to rate how "stressful" and "demanding" they found the task to be. On average, the low workstyle group rated the high demand task as $M = 4.74$, with "5" equaling "somewhat stressful." The high workstyle group on average rated the same task higher at $M = 6.76$. When asked to rate how demanding the task was the low group rated it $M = 5.50$, and the high group $M = 6.76$. These results show that the task was moderately stressful and demanding for both groups, and yet the high workstyle group rated the stress and demands of the high demand task as statistically significantly higher compared to the low workstyle group.

Analyses of baseline measures also included baseline and post-task mood changes and cognitions following each task between the two groups. The participants were asked to rate their level of tension, anxiety, frustration, anger, and happiness. The groups were similar at the beginning of the laboratory experiment, however following the high demand typing task the high workstyle group had higher levels of anger and lower levels of happiness. Additionally, the high workstyle group acknowledged having more negative cognitions on both the low demand task and the high demand task. These results are important and show that during the low demand task where no performance expectations were placed on the participant and during the high demand task where demands were increased, negative cognitions and feelings regarding their performance were present at an increased rate in the high workstyle group. These results suggest that the perception of stress negatively impacted the high workstyle participant both when external demands and expectations were present and when they were not. These results support the adverse nature of a high risk workstyle on cognitions and mood. It is possible that the high workstyle group imposed greater internal demands and expectation on themselves regardless of external factors.

Primary analyses included investigating the factors related to workstyle including biomechanical, behavioral, physiological, and cognitive. To assess the biomechanical factors, keyboard force was compared between the two workstyle groups and typing tasks. Results indicate that the high workstyle group had higher keyboard force compared to the low workstyle group. These analyses accounted for any differences in typing speed. These results indicate that regardless of task expectations and baseline typing speed, the high workstyle group used more force to type. This finding is important because force has been suggested in the literature as a risk factor for developing a work-related upper extremity symptom (Feuerstein et al., 1997).

Additionally, posture was assessed and analyzed. Results indicate that the high workstyle group had more awkward wrist posture compared to the low group. The groups did not differ on upper arm, lower arm, neck, or trunk positions. However, because the workers were not analyzed in there normal work environment, the value of this information is limited and only relevant to the laboratory office setting.

The number of words completed during each of the typing tasks was used in the study as a proxy for performance. In this study, controlling for typing speed, the high workstyle group typed significantly more words in both the low and high demand typing tasks. These results show that despite the external expectations placed on the high workstyle group by the investigator, they produced more force and performed at a higher level compared to the low workstyle group. These results again highlight the importance of perception among this group of workers, when typing speed is accounted for; scoring in the high risk range on the workstyle measure was related to greater biomechanical and behavioral response, to both low and high demands.

This study also investigated physiological reactivity between the two groups. No group differences were detected in the physiological correlates including salivary cortisol, heart rate, and blood pressure. These measures were assessed at four time points during the study; analyses included baseline and post-demand task samples. It is unclear why physiological measures did not reflect self-reported increases in stress. It is possible that while the demands were significant enough to influence performance and cognitions, it was not "stressful" enough to elicit a sympathetic nervous system response. Another possible explanation is that the physiological measures lacked the necessary sensitivity to detect any changes. The lack of findings could also suggest that because the sample was comprised of a group of asymptomatic workers, physiological variations were not as evident as they may be in symptomatic workers. However, despite the lack of significant findings on these physiological measurements, it is the gold standard to use multiple measures and indicators of stress response (Baum et al., 1982). These different markers of stress will not necessarily correlate, which has been suggested to indicate that different aspects of stress reactivity are being measured (Baum et al., 1982). This study measured several biobehavioral markers of stress reactivity with several significant findings.

In analyzing the change in mood and cognitions, results indicated that the high workstyle group had greater changes in mood and more negative cognitions. Overall mood score at baseline compared to the score following the high demand task showed that the mood of the high workstyle group decreased between the two typing tasks more significantly than the low workstyle group. The participants were also asked to acknowledge the presence or absence of cognitions related to performance and feelings of pressure following each task. The high workstyle group had greater self-reported negative cognitions and feelings compared to the low workstyle group.

These results contribute to a better understanding of the process that is occurring when an office worker using a computer is under a high-demand situation (e.g., increased keyboard force and psychological distress). Considered in conjunction with the task stress rating, baseline perceived stress and the lower mood and higher rate of negative cognitions, the high workstyle group appears to be operating with an overall higher level of baseline stress, increased expectations, and increased reactivity to perceived and actual demands (i.e., internal and external).

The burden (i.e., economic and functional) of WRUED/S has resulted in increased efforts to decrease prevalence and incidence. The identification of risk factors has motivated epidemiological research and intervention trials. Ergonomic exposures are the most stable risk factor for WRUEs resulting in efforts to modify ergonomic factors. Ergonomic intervention techniques have been only moderately successful which demonstrates that biomechanics could not completely account for the burden (Gerr et al., 2004). Psychosocial factors also have been shown in the literature to be a risk factor for WRUEs, but like ergonomic interventions, could not account for all occurrences of UE symptoms (Bongers et al., 2002b). Review of the UE literature has lead many to consider an integrative approach to conceptualizing WRUEs. The construct workstyle is an integrative understanding of the factors associated with the development, exacerbation, and maintenance of upper extremity symptoms.

The current study suggests that given the evidence that a multidimensional evaluation of and approach to upper extremity problems are the standard. That stress management techniques targeting perceived and actual work-related stressors, with targeted education on the manifestations of stress (i.e., keyboard force, mood, and negative cognitions) are a logical interventional technique for this population.

There are limitations of this study that should be considered when interpreting results. The first limitation is the way in which the groups were categorized for analyses. A screening tool was developed and used to screen participants. This 7-item screen correlated with the full workstyle score r = .93 in other worker samples. And because the full workstyle measure was a more reliable measure of workstyle it was ultimately used to categorize the groups instead of the screener used for recruitment (Low = $\leq$ 16, High = $\geq$ 17), this method resulted in unequal workstyle groups (Low = 41, High = 39). Approximately 5% of the participants' workstyle categorization on the screener did not correspond with the group assignment using a median split of the full workstyle scale which resulted in a recategorization of their workstyle group. Additionally, using a median split possibly resulted in a loss power. However, the results from the analyses using the median split and the continuous workstyle various were similar, with workstyle being related to keyboard force, mood, and cognitions. These results suggest that this method did not result in significant loss of power and was appropriate for this study.

The ratio of minorities to non-minorities in the sample also should be noted. Sixty-five percent of this sample of office workers belonged to a minority group. According to Bureau of labor statistics data, approximately 73% of office workers are Caucasian. The high number of minorities in this study was attributed to the higher than national averages of minorities in the two recruitment geographic regions in this study (i.e., the South and East). Both the North Carolina Raleigh-Durham area and the Washington D.C. metropolitan areas have over 25% minorities compared to the national average of 12-13%. However, despite the abnormal ratio of minorities to non-minorities in this study, the results are consistent with previous studies which suggest that workstyle was not different by race and that race was not a significant factor in this study or previous studies.

The use of self-report measures in this study also is a potential limitation. Self-reports measures are subject to biases including response biases and social desirability. However despite these limitations self-report measures have been shown to be reliable and practical measures with conceptual advantages (Razavi, 2001) and when used in conjunction with other measurement types there use is further supported (Kazdin, 1995). In the present study, both observational and self-report measures were used to assess the workstyle construct.

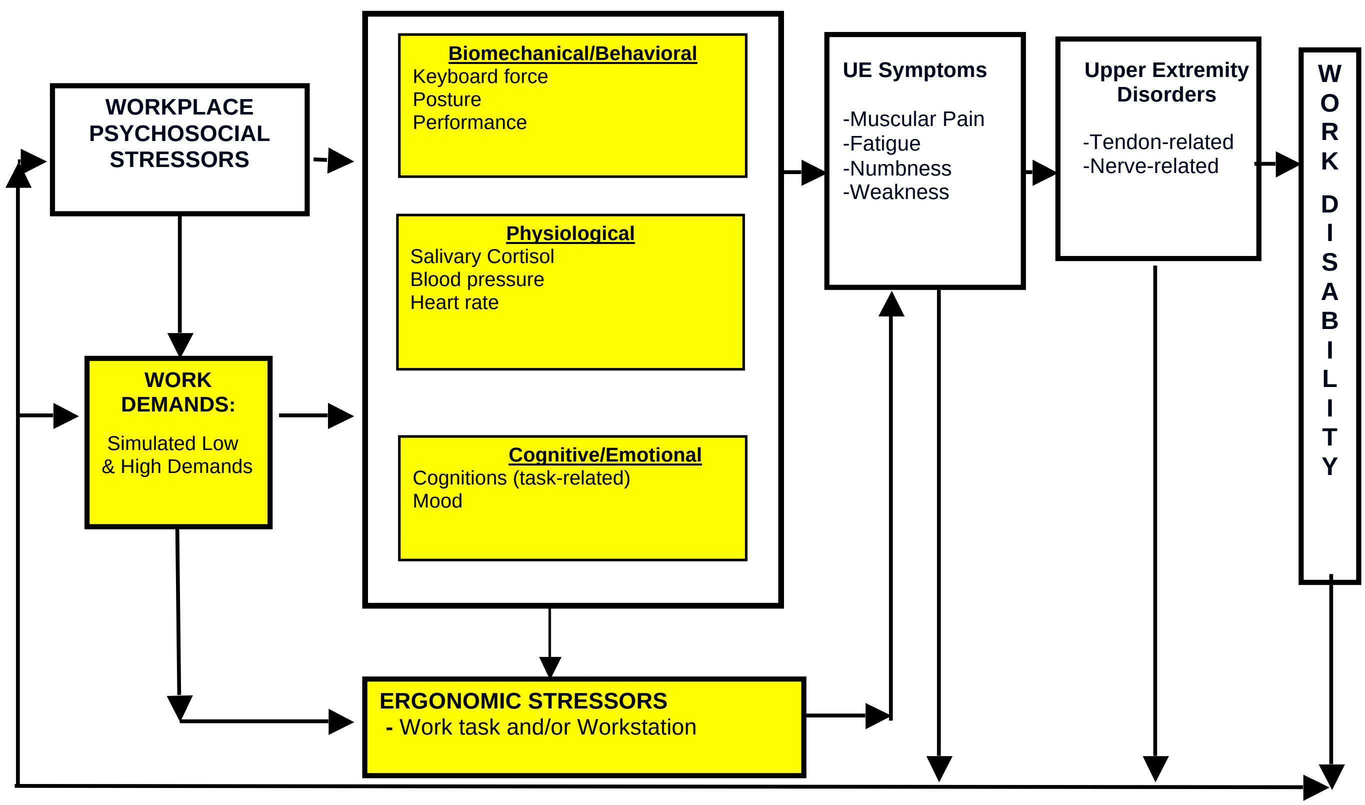
When assessing cognitions, the participants were provided with a list of cognitions and feelings that they were instructed to either acknowledge experiencing or deny. This method is inherent with bias and limits the assessment of other cognitions experienced. The assessment did not include positive cognitions biasing the measure. Because the cognitions were provided and designed to be negative, it is unclear if positive cognitions were experienced including confidence in ability. Additionally, the participant did not have an opportunity to self-report cognitions. Despite these limitations, the alternative method of assessing cognitions (i.e., a write-in answer format) is also riddled with limitations.

Another limitation to this study is that it is not apparent what elements of the task the participant specifically found "stressful" or "demanding." The way the question was framed did not allow for differentiation of the elements of the typing tasks or laboratory environment. When the participant was asked how stressful the task was, the investigator was unable to determine if it was the actual task (i.e., editing a document with time restraints and evaluation) or the circumstances of the experiment including an unfamiliar setup or the investigator that caused the stress. To more completely validate the typing task, a more thorough questionnaire should be provided asking the participant to rate all of the elements of the experience to inform investigators on the relevant stressful variables.

The ability of the typing task to simulate office work given the diversity of occupations in office settings is also a possible limitation. Because of these variations, a limitation of using this task is that it does not replicate the entire office work environment and may not have induced the necessary stress to evoke a typical stress response associated with demanding work. A possible advantage of using this task is that workstyle tends to be stable, such that when presented with a moderately similar work task with high demands, the normal worker response should be induced. The main components of typing tasks have been validated in the literature (i.e., typing text, time pressure, and increased workload). Additionally, only those office workers that scored high and low on the brief screen were asked to participate. While this method allows for analysis on extremes of the Workstyle scale, excluding the middle third from analyses may limit the experiment. By excluding the middle score ranges prior to data collection any secondary analysis on the characteristics on this middle range group is impossible. However, this method was selected so that comparisons between the extreme groups could be made.

Despite these limitations, this experiment was conducted in a controlled laboratory environment. Results indicate that asymptomatic office workers self-reporting high workstyles do experience increased reactivity to both perceived and actual demands. Increased reactivity was seen in comparison to individuals scoring low in the workstyle measure, on performance, mood, cognitions, keyboard force, baseline stress, and task-related stress. In the original Workstyle Model, while mood was implied is was not mentioned as a primary construct in the model. The current research suggests that mood should be a primary factor in the characterization of workstyle patterns of reactivity along with cognitive reactivity. Additionally, since this study was not able to detect differences in physiological reactivity in asymptomatic workers, it may be that this reaction is a related to the onset of symptoms. The negative feedback arrow from symptoms, demonstrating that symptoms may further impact the perception of stressors and demand, and subsequently an altered reactivity, is very important and requires further study. Below is a possible revision to the workstyle model based on these results.

Figure 12. Proposed Revised Workstyle Model



Future directions should focus on two primary elements. First, a prospective study should be designed that assesses office workers with high and low workstyles who are followed and assessed for symptoms over time. A similar study has been conducted on individuals with symptoms who were followed over time to assess outcomes and functional limitations (Nicholas et al., 2005). Secondly, intervention studies to target modifying these workstyle characteristics need to be investigated further. A promising study has been recently published that suggested that characteristics of workstyle are modifiable with improved outcomes (Bernaards et al., 2007). A secondary focus could also be to determine if these findings are consistent within other occupations that have increased risk for upper extremity problems (e.g., manual or production jobs). Other future directions could include additional analyses to further investigate if physiological measures were related to the biomechanical, cognitive, and behavioral response to the simulated increased work demands.

It is clear that workstyle is related to: (1) work tasks, (2) the exacerbation of upper extremity symptoms (Feuerstein et al., 1999; Feuerstein et al., 2005; Nicholas et al., 2005), (3) treatment outcomes in individuals with upper extremity symptoms and disorders (Harrington et al., in press), (4) pain outcomes in individuals with upper extremity symptoms (Meijer et al., 2008), and (5) perception of stress and altered response. This controlled laboratory study directly investigated the physiological and psychological response of asymptomatic workers to a high-demand job-related task with results suggesting that the high risk workstyle group is reactive to both perceived and actual, as well as to internal and external stressors and demands. Given the risk that this increase reactivity can have on the development and progression of upper extremity symptoms, interpreting the occupational and clinical applications of these data are of key importance.

One clinical implication of this study are related to work currently in press in the *Journal of Hand Surgery* (Harrington et al., in press) that showed that workstyle was related to pain and work outcomes. Workers experiencing distress in other areas of function, who seek treatment, could be assessed using the workstyle measure to assess how elements of work could be related or influenced by baseline stress. Additionally, physicians could use this measure to target psychosocial and individual factors for intervention using stress management or behavioral therapies.

The occupational implications are complex. As seen in this study, it appears that output is greater in those high workstyle workers which would make them ideal workers. However, if the behavior and distress experienced by the high workstyle worker potentially is a factor that contributes to the development of or exacerbation of upper extremity symptoms, then the worker may experience discomfort and a decrease in function. Additionally, from a public health standpoint the development of UE symptoms can result in lost work time, lost productivity, and worker's compensation costs. Methods to optimize productivity and lower risk of disease should be a primary goal of the workforce. In cases of individuals scoring high on the workstyle measure it almost certainly would be cost-effective to encourage taking breaks and promote biomechanical variation promote to decrease risk.

One of the concerns with the use of the type of tool in the workplace is hiring or employee discrimination. A measure of this type could be misused in the field if workers were negatively judged based on workstyle scores. This type of use would be prohibited by the Americans with Disabilities act, where prescreening is only allowed if it is screening for ability directly related to completing the job task. Two possible approaches to this problem include first, the employees confidentially assessing themselves and being provided education on the risks associated with high workstyle behavior. A second approach would be to educate all workers (regardless of workstyle) on the signs and risks associate with high workstyle.

The results from the present study support the hypothesis that individuals scoring high on a workstyle measure have an increased response in performance, behavior, and cognitions to perceived increased demands, when strength and typing speed are taken into account. Previously found in symptomatic workers, the present study shows that workstyle was also able to identify possible UE risk in asymptomatic workers. Additionally, previous work conducted in this area suggests that modifying the stress perception and stress reactivity may be a practical future direction.

References

Ahola, K., Honkonen, T., Kivimaki, M., Virtanen, M., Isometsa, E., Aromaa, A., & Lonnqvist, J. (2006). Contribution of burnout to the association between job strain and depression: The health 2000 study. *Journal of Occupational and Environmental Medicine,* 4810: 1023-1030.

Alderling, M., Theorell, T., de la Torre, B., & Lundberg, I. (2006). The demand control model and circadian saliva cortisol variations in a Swedish population based sample (The PART study). *BMC Public Health,* 6: 288-296.

Amick, B., Swanson, N., & Chang, H. (1999). Office technology and musculoskeletal disorders: Building an ecological model. *Occupational Medicine,* 14: 97-112.

Aptel, M., Aublet-Cuvelier, A., & Cnockaert, J. (2002). Work-related musculoskeletal disorders of the upper limb. *Joint Bone Spine,* 69: 546-555.

Ariëns, G.A.M., van Mechelen, W., Bongers, P., Bouter, L., & van der Wal, G. (2001). Psychosocial risk factors for neck pain: A systematic review. *American Journal of Industrial Medicine,* 39: 180-193.

Armstrong, T. (1985). Mechanical considerations of skin in work. *American Journal of Industrial Medicine,* 8: 463-472.

Armstrong, T., Foulke, J., Bernard, J., Gerson, J., & Rempel, D. (1994). Investigation of applied forces in alphanumeric keyboard work. *American Industrial Hygiene Association Journal,* 55: 30-35.

Armstrong, T., Foulke, J., Martin, B., Gerson, J., & Rempel, D. (1994). Investigation of applied forces in alphanumeric keyboard work. *American Industrial Hygiene Association Journal,* 551: 30-35.

Bartys, S., Burton, K., & Main, C. (2005). A prospective study of psychosocial risk factors and absence due to musculoskeletal disorders - implications for occupational screening. *Occupational Medicine,* 55: 375-379.

Baum, A., Gatchel, R., & Krantz, D. (1997). *An introduction to health psychology* (3rd ed.). New York: McGraw-Hill.

Baum, A., Grunberg, N.E., & Singer, J.E. (1982). The use of psychological and neuroendocrinological measurements in the study of stress. *Health Psychology,* 1: 217-236.

Bergqvist, V., Wolgast, E., Nilsson, B., & Voss, M. (1995). Musculoskeletal disorders among visual display terminal workers: Individual, ergonomic, and work organizational factors. *Ergonomics,* 38: 763-776.

Bernaards, C.M., Ariëns, G.A.M., Knol, D.L., & Hildebrandt, V.H. (2007). The effectiveness of a work style intervention and a lifestyle physical activity intervention on the recovery from neck and upper limb symptoms in computer workers. *PAIN* 1321-2: 142-153.

Bernard, B., & Fine, L. (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. Washington, D.C: US Department of Health and Human Services, National Institute for Occupational Safety and Health.

Bongers, P., de Winter, C., Kompier, M., & Hildebrandt, V.H. (1993). Psychosocial factors at work and musculoskeletal disease. *Scandinavian Journal of Work Environmental Health,* 19: 297-312.

Bongers, P., de Winter, C., & ter Laak, J. (2002a). Psychosocial factors at work and musculoskeletal disease. *Scandinavian Journal of Work Environmental Health,* 19: 297-312.

Bongers, P., Ijmker, S., van den Heuval, S., & Blatter, B. (2006). Epidemiology of work-related neck and upper limb problems: Psychosocial and personal risk factors (Part I) and effective interventions from a biobehavioural perspective (Part II). *Journal of Occupational Rehabilitation,* 16: 279-302.

Bongers, P., Kremer, A., & ter Laak, J. (2002b). Are psychosocial factors risk factors for symptoms and signs of the shoulder, elbow, or hand/wrist? A review of the epidemiological literature. *American Journal of Industrial Medicine,* 415: 315-342.

Bono, J., Foldes, H., Vinson, G., & Muros, J. (2007). Workplace emotions: The role of supervisors and leadership. *Journal of Applied Psychology,* 925: 1357-1367.

Bufton, M., Marklin, R., Nagurka, M., & Simoneau, G. (2006). Effect of keyswitch design of desktop and notebook keyboards related to key stiffness and typing force. *Ergonomics,* 4910: 996-1012.

Bureau of Labor Statistics. (2004). Nonfatal occupational injuries and illnesses with days away from work, by the part of body affected, 2004. *http://www.bls.gov/iif/oshwc/osh/os/osbl0033.pdf*.

Bureau of Labor Statistics. (2005a). Bureau of Labor Statistics. U.S. Department of Labor: Current population survey. Available at: http://bls.gov/cps/home.htm#charemp; Internet; accessed November 15, 2007.

Bureau of Labor Statistics. (2005b). Nonfatal occupational injuries and illnesses requiring days away from work, 2005. . Retrieved October 15, 2007, from http://www.bls.gov.iif/home.htm

Bureau of Labor Statistics. (2007). Nonfatal occupational injuries and illnesses requiring days away from work, 2006. *http://www.bls.gov/iif/home.htm*.

Bureau of Labor Statistics. (2008). Nonfatal occupational injuries and illness requiring days away from work, 2007. *http://www.bls.gov/news.release/pdf/osh2.pdf*.

Chandola, T., & Jenkinson, C. (2000). Validating self-rated health in different ethnic groups. *Ethnicity & Health,* 515: 1-9.

Chengalure, S., Rodgers, S., & Bernard, T. (2004). *Kodak's Ergonomic Design for People at Work* (2nd ed.). Hoboken: John Wiley & Sons, Inc.

Cohen, S., Kamarck, T., & Mermelstein, R. (1983). A global measure of perceived stress. *Journal of Health and Social Behavior,* 24: 386-396.

Coovert, M., & Thompson, L. (2003). Technology and workplace health In J. Campbell Quick & L.E. Tetrick (Eds.). *Handbook of occupational health psychology (pp. 221-241). Washington, D.C.: American Psychological Association*.

Curran, S., Andrykowwki, M., & Studts, J. (1995). Short form of the Profile of Mood States (POMS-SF): Psychometric information *Psychological Assessment,* 71: 80-83.

Dane, D., Feuerstein, M., Huang, G., Dimberg, L., Ali, D., & Lincoln, A. (2002). Measurement properties of a self-report index of ergonomic exposures for use in an office work environment. *Journal of Occupational and Environmental Medicine,* 441: 73-81.

Descatha, A., Roquelaure, Y., Evanoff, B., Chastang, J., Cyr, D., & Leclerc, A. (2008). Do workers with self-reported symptoms have an elevated risk of developing upper extremity musculoskeletal disorders three years later? *Occupational Environmental Medicine,* 653: 205-207.

Devereux, J., Vlachonikolis, I., & Buckle, P. (2002). Epidemiological study to investigate potential interaction between physical and psychosocial factors at work that may increase the risk of symptoms of musculoskeletal disorder of the neck and upper limb. *Occupational Environmental Medicine,* 594: 269-277.

Erdfelder, E., Faul, F., & Buchner, A. (1996). GPOWER: A general power analysis program. *Behavior Research Methods, Instruments, & Computers,* 28: 1-11.

Evans, K., Douglas, B., Bruce, N., & Drummond, P. (2007). An exploratory study of changes in salivary cortisol, depression, and pain intensity after treatment for chronic pain. *Pain Medicine (OnlineEarly Articles) doi:10.1111/j.1526-4637.2006.00285.x*

Faucett, J., & Rempel, D. (1994). VDT-related musculoskeletal symptoms: Interactions between work posture and psychosocial work factors. *American Journal of Industrial Medicine,* 265: 597-612.

Festinger, L., Pepitone, A., & Newcomb, T. (1952). Some consequences of de-individuation in a group. *Journal of Abnormal and Social Psychology,* 47: 382-389.

Feuerstein, M. (1996). *Chapter 11: Workstyle: Definition, empirical support, and implications for preventions, evaluation, and rehabilitation of occupational upper-extremity disorders*. London: Taylor & Francis.

Feuerstein, M., Armstrong, T., Hickey, P., & Lincoln, A. (1997). Computer keyboard force and upper extremity symptoms. *Journal of Occupational and Environmental Medicine,* 3912: 1144-1153.

Feuerstein, M., Huang, G.D., & Pransky, G. (1999). Workstyle and work-related upper extremity disorders. In R.J. Gatchel and D.C. Turk (Eds.), Psychosocial Factors in Pain, New York: Guilford.

Feuerstein, M., Marshall, L., Shaw, W., & Burrell, L. (2000). Multicomponent intervention for work-related upper extremity disorders. *Journal of Occupational Rehabilitation,* 101: 71-83.

Feuerstein, M., & Nicholas, R. (2006). Development of a short form of the Workstyle measure. *Occupational Medicine,* 56: 94-99.

Feuerstein, M., Nicholas, R., Huang, G.D., Haufler, A., Pransky, G., & Robertson, M. (2005). Workstyle: Development of a measure of response to work in those with upper extremity pain. *Journal of Occupational Rehabilitation,* 152: 87-106.

Folkman, S., & Lazarus, R. (1988). Coping as a mediator of emotion. *Journal of Personality and Social Psychology,* 543: 466-475.

Frankenhaeuser, M. (1991). The psychophysiology of workload, stress, and health: Comparison between the sexes. *Annals of Behavioral Medicine,* 13: 197-204.

Gardner, B., Dale, A., VanDillen, L., Franzblau, A., & Evanoff, B. (2008). Predictors of upper extremity symptoms and functional impairment among workers employed for 6 months in a new job. *American Journal of Industrial Medicine,* 5112: 932-940.

Gerard, M., Armstrong, T., Martin, B., & Rempel, D. (2001). The effects of work pace on within-participant and between-participant keying force, electromyography, and fatigue. *Human Factors,* 441: 51-61.

Gerr, F., Marcus, M., & Monteilh, C. (2004). Epidemiology of musculoskeletal disorders among computer users: Lessons learned from the role of posture and keyboard use. *Journal of Electromyography and Kinesiology,* 14: 25-31.

Gerr, F., Monteilh, C., & Marcus, M. (2006). Keyboard use and musculoskeletal outcomes among computer users. *Journal of Occupational Rehabilitation,* 163: 265-277.

Gillen, M., Yen, I., Trupin, L., Swig, L., Rugulies, R., Mullen, K., Font, A., Burian, D., Ryan, G., Janowitz, I., Quinlan, P., Frank, J., & Blanc, P. (2007). The association of socioeconomic status and psychosocial and physical workplace factors with musculoskeletal injury in hospital workers. *American Journal of Industrial Medicine,* 50: 245-260.

Gimeno, D., Amick, B., Habeck, R., Ossmann, J., & Katz, J. (2005). The role of job strain on return to work after carpal tunnel surgery. *Occupational Environmental Medicine,* 62: 778-785.

Grieco, A., Molteni, G., De Vito, G., & Sias, N. (1998). Epidemiology of musculoskeletal disorders due to biomechanical overload. *Ergonomics,* 419: 1253-1260.

Griffiths, K., Mackey, M., & Adamson, B. (2007). The impact of a computerized work environment on profession occupational groups and behavioural and physiological risk factors for musculoskeletal symptoms: A literature review. *Journal of Occupational Rehabilitation,* 174: 743-765.

Guyton, A., & Hall, J. (1996). *Textbook of medical physiology* (9th ed.). Philadelphia: W.B. Saunders Company.

Hales, T., & Bernard, B. (1996). Epidemiology of work-related musculosketal disorders. *Orthopedic Clinic of North America,* 274: 679-709.

Hanse, J. (2002). The impact of VDU use and psychosocial factors at work on musculoskeletal shoulder symptoms among white-collar workers. *Work & Stress,* 162: 121-126.

Haufler, A., Feuerstein, M., & Huang, G. (2000). Job stress, upper extremity pain, and functional limitations in symptomatic computer users. *American Journal of Industrial Medicine,* 38: 507-515.

Haussmann, M., Vleck, C., & Farrar, E. (2007). A laboratory exercise to illustrate increased salivary cortisol in response to three stressful conditions using competitive ELISA. *Advanced Physiological Education,* 31: 110-115.

Huang, G., Feuerstein, M., Berkowitz, S., & Peck, C. (1998). Occupational upper extremity related disability: Demographic, physical, and psychosocial factors. *Military Medicine,* 163: 552-558.

Huang, G., Feuerstein, M., Kop, W., Schor, K., & Arroyo, F. (2003). Individual and combined impacts of biomechanical and work organization factors in work-related musculoskeletal symptoms. *American Journal of Industrial Medicine,* 43: 495-506.

Huang, G., Feuerstein, M., & Sauter, S. (2002). Occupational stress and work-related upper extremity disorders: Concepts and models. *American Journal of Industrial Medicine,* 41: 298-314.

Hughes, L., Babski-Reeves, K., & Smith-Jackson, T. (2007). Effects of psychosocial and individual factors on physiological risk factors for upper extremity musculoskeletal disorders while typing. *Ergonomics,* 502: 261-274.

Hupert, N., Amick, B., Fossel, A., Coley, C., Robertson, M., & Katz, J. (2004). Upper extremity musculoskeletal symptoms and functional impairment associated with computer use among college students. *Work,* 23: 85-93.

IJzelenberg, W., Molenaar, D., & Burdorf, A. (2004). Different risk factors for musculoskeletal pain and musculoskeletal sickness absence. *Scandinavian Journal of Work Environmental Health,* 301: 56-63.

Jensen, C., Ryholt, C., Burr, H., Villadsen, E., & Christensen, H. (2002). Work-related psychosocial, physical, and individual factors associated with musculoskeletal symptoms in computer users. *Work & Stress,* 162: 107-120.

Kazdin, A. (1995). Preparing and Evaluating Research Reports. *Psychological Assessment,* 7: 228-237.

Ketola, R., Toivonen, R., Hakkanen, M., Luukkonen, R., Takala, E., & Vikari-Juntura, E. (2002). Effects of ergonomic intervention in work with video display units. *Scandinavian Journal of Work Environmental Health,* 281: 18-24.

Kirschbaum, C., & Hellhammer, D. (1989). Salivary cortisol in psychobiological research: An overview. *Neuropsychobiology,* 22: 150-169.

Klussman, A., Gebhardt, H., Liebers, F., & Rieger, M. (2008). Musculoskeletal symptoms of the upper extremities and the neck: a cross-sectional study on prevalence and symptom-predicting factors at visual display terminal (VDT) workstations. *BMC Musculoskeletal Disorders,* 927.

Kolb, B., & Whishaw, I. (1996). *Fundamentals of Human Neuropsychology*. Lethbridge: Worth Publishers.

Kopp, M., Stauder, A., Purebl, G., Janszky, I., & Skrabski, A. (2007). Work stress and mental health in a changing society. *European Journal of Public Health,* epub ahead of print.

Lassen, C., Mikkelsen, S., Kryger, A., Brandt, L., Overgaard, E., Thomsen, J., Vilstrup, I., & Andersen, J. (2004). Elbow and wrist/hand symptoms among 6,943 computer operators: A 1-year follow-up study. *American Journal of Industrial Medicine,* 46: 521-533.

Leroux, I., Brisson, C., & Montreuil, S. (2006). Job strain and neck-shoulder symptoms: A prevalence study of women and men white-collar workers. *Occupational Medicine,* 56: 102-109.

Linton, S. (2002). Early identification and intervention in the prevention of musculoskeletal pain. *American Journal of Industrial Medicine,* 5: 433-442.

Lueder, R. (1996). A Proposed RULA for Computer Users. . *Proceedings of the Ergonomic Summer Workshop, UC Berkeley Center for Occupational & Environmental Health Continuing Education Program, San Francisco, August 8-9, 1996*.

Lundberg, U., Dohns, I., Melin, B., Sandsjo, L., Palmerud, G., Kadefors, R., Ekstrom, M., & Parr, D. (1999). Psychophysiological stress responses, muscle tension, and neck and shoulder pain among supermarket cashiers. *Journal of Occupational Health Psychology,* 43: 245-255.

Macaulay, M. (2004). The speed of mouse-click as a measure of anxiety during human-computer interaction. *Behavior & Information Technology,* 236: 427-433.

Macfarlane, G., Hunt, I., & Silman, A. (2000). Role of mechanical and psychosocial factors in the onset of forearm pain: Prospective population based study. *British Medical Journal,* 321: 1-5.

Maina, G., Palmas, A., & Filon, F. (2007). Relationship between self-reported mental stressors at the workplace and salivary cortisol. *International Archive of Occupational and Environmental Health,* Available online August 2007.

Marcott, A., Barker, R., & Joyce, M. (1997). Preventing work-related musculoskeletal illness through ergonomics: The Air Force Premier program vol 2: Job requirements and physical demands survey methodology guide. Earth Tech: San Antonio.

Marcus, M., Gerr, F., Monteilh, C., Ortiz, D., 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.

Marras, W., Davis, K., Heaney, C., Maronitis, A., & Allread, W. (2000). The influence of psychosocial stress, gender, and personality on mechanical loading of the lumbar spine. *Spine,* 25: 3045-3054.

McAtamney, L., & Corlett, E. (1993). RULA: A survey method for the investigation of work-related upper limb disorders. *Applied Ergonomics,* 242: 91-99.

McEwen, B. (1998). Stress, adaptation, and disease: Allostasis and allostatic load. *Annals of the New York Academy of Sciences,* 8401: 33-34.

Meijer, E., Sluiter, J., & Frings-Dresen, M. (2008). Is Workstyle a Mediating Factor for Pain in the Upper Extremity Over Time? *Journal of Occupational Rehabilitation,* 18: 262-266.

Melin, B., & Lundberg, U. (1997). A biopsychosocial approach to workstress and musculoskeletal disorders. *Journal of Psychophysiology,* 11: 238-247.

Melzack, R. (2001). Pain and the neuromatrix in the brain. *Journal of Dental Research,* 6512: 1378-1382.

Mendonca-de-Souza, A., Souza, G., Vieira, A., Fischer, N., Souza, W., Rumjanek, V., Figueira, I., Mendlowics, M., & Volchan, E. (2007). Negative affect as a predisposing factor for cortisol released after an acute stress - The impact of unpleasant priming *Stress,* DOI: 10.1080/10253890701379999.

Nachemson, A., & Jonsson, E. (Eds.). (2000). *Neck and back pain: The scientific evidence of causes, diagnosis, and treatment*. Philadelphia: Lippincott William & Wilkins.

NAS. (2001). National Research Council and the Institute of Medicine. Musculoskeletal disorders and the workplace: Low back and upper extremities. Washington, DC: National Academy Press.

National Institute of Occupational Safety and Health. (1997). NIOSH Publication No. 97-141. Musculoskeletal Disorders and Workplace Factors: A Critical Review of Epidemiologic Evidence for Work-Related Musculoskeletal Disorders of the Neck, Upper Extremity, and Low Back.

National Research Council. (1999). Work-related musculoskeletal disorders: Report, workshop summary, and workshop papers. Steering Committee for the Workshop on Work-related Musculoskeletal Injuries: The Research Base. Washington, DC: National Academy Press.

Nicholas, R., Feuerstein, M., & Suchday, S. (2005). Workstyle and upper-extremity symptoms: A biobehavioral perspective. *Journal of Occupational Environmental Medicine,* 47: 352-361.

Nunnelly, J.C. (1970). *Psychometric Theory* (2nd ed.). New York: McGraw Hill.

Oberlechner, T., & Nimgade, A. (2005). Work stress and performance among financial traders. *Stress and Health,* 21: 285-293.

Pascarelli, E., & Kella, J. (1993). Soft-tissue injuries related to use of the computer keyboard: A clinical study of 53 severely injured persons. *Journal Of Occupational Medicine,* 35: 522-532.

Pawlow, L., & Jones, G. (2005). The impact of abbreviated muscle relaxation on salivary cortisol and salivary immunoglobulin A *Applied Psychophysiology and Biofeedback,* 404: 375-387.

Polanyi, M., Cole, D., Beaton, D., Chung, J., Wells, R., & Abdolell, M. (1997). Upper limb work-related musculoskeletal disorders among newspaper employees: Cross-sectional survey results. *American Journal of Industrial Medicine,* 32: 620-628.

Pransky, G., Robertson, M., & Moon, S. (2002). Stress and work-related upper extremity disorders: Implications for prevention and management. *American Journal of Industrial Medicine,* 415: 443-455.

Punnett, L., & Bergqvist, V. (1997). Visual Display Unit Work and Upper Extremity Musculoskeletal Disorders: A Review of Epidemiological Findings. National Institute for Working Life: Sweden.

Punnett, L., & Wegman, D. (2004). Work-related musculoskeletal disorders: The epidemiologic evidence and the debate. *Journal of Electromyography and Kinesiology,* 14: 13-23.

Ramadan, R., & Ferreira, M. (2006). Risk factors associated with the reporting of musculoskeletal symptoms in workers at a laboratory of clinical pathology. *Annals of Occupational Hygiene,* 503: 297-303.

Razavi, T. (2001). Self-report measures: an overview of concerns and limitations of questionnaire use in occupational stress research. *Southampton, UK, University of Southampton, 23pp. (Discussion Papers in Accounting and Management Science, 01-175)*http://eprints.soton.ac.uk/35712/.

Rosenzweig, S., Reibel, D., Greeson, J., Brainard, G., & Hojat, M. (2003). Mindfullness-based stress reduction lowers psychological distress in medical students. *Teaching & Learning in Medicine,* 152: 88-92.

Rowe, M. (2006). Four-year longitudinal study of behavioral changes in coping with stress. *American Journal of Health Behavior,* 306: 602-612.

Rozanski, A., Blumenthal, J., Davidson, K., Saab, P., & Kubzansky, L. (2005). The epidemiology, pathophysiology, and management of psychosocial risk factors in cardiac practice: The emerging field of behavioral cardiology. *Journal of the American College of Cardiology* 455: 637-651.

Sarid, O., Anson, O., & Bentov, Y. (2005). Students' reactions to three typical examinations in health sciences. *Advances in Health Sciences Education,* 10: 291-302.

Schaubroeck, J., & Jones, J. (2000). Antecedents of workplace emotional labor dimensions and moderators of their effects on physical symptoms. *Journal of Organizational Behavior,* 21: 163-183.

Schreinicke, G., Hinz, A., Kratzsch, J., Huber, B., & Voigt, G. (1990). Stress-related changes in saliva cortisol in VDU operators. *International Archive of Occupational and Environmental Health,* 62: 319-321.

Shimazu, A., Umanodan, R., & Schaufeli, W. (2006). Effects of a brief worksite stress management program on coping skills, psychological distress, and physical complaints: A controlled trial. *International Archive of Occupational and Environmental Health,* 80: 60-69.

Sim, J., Lacey, R., & Lewis, M. (2006). The impact of workplace risk factors on the occurrence of neck and upper limb pain: A general population study. *BMC Public Health,* 6: 234-244.

Sprigg, C., Stride, C., Wall, T., Holman, D., & Smith, P. (2007). Work characteristics, musculoskeletal disorders, and the mediating role of psychological strain: A study of call center employees. *Journal of Applied Psychology,* 925: 1456-1466.

Toda, M., Morimoto, K., Nagasawa, S., & Kitamura, K. (2004). Effect of snack eating on sensitive salivary stress markers cortisol and chromogranin A. *Environmental Health and Preventive Medicine,* 9: 27-29.

Treaster, D., Marras, W., Burr, D., Sheedy, J., & Hart, D. (2006). Myofascial trigger point development from visual and postural stressors during computer work. *Journal of Electromyography and Kinesiology,* 16: 115-124.

Van den Heuval, S., Ijmker, S., Blatter, B., & de Korte, E. (2007). Loss of productivity due to neck/shoulder symptoms and hand/arm symptoms: Results for the PROMO-study. *journal of Occupational Rehabilitation,* 173: 370-382.

van den Heuval, S., van der Beek, A., Blatter, B., & Bongers, P. (2006). Do work-related physical factors predict neck and upper limb symptoms in office workers? *International Archive of Occupational and Environmental Health,* 797: 585-592.

van den Heuval, S., van der Beek, A., Blatter, B., Hoogendoorn, W., & Bongers, P. (2005). Psychosocial work characteristics in relation to neck and limb symptoms. *Pain,* 114: 47-43.

Vander, A., Sherman, J., & Luciano, D. (2001). *Human physiology: The mechanism of body function* (8th ed.). Boston: McGraw Hill.

Visser, B., & van Dieen, J. (2006). Pathophysiology of upper extremity muscle disorders. *Journal of Electromyography and Kinesiology,* 161: 1-16.

von Onciul, J. (1996). ABC of work related disorders: Stress at work. *BMJ,* 313: 745-748.

Vrijkotte, T., van Doornen, L., & de Geus, E. (2000). Effects of work stress on ambulatory blood pressure, heart rate, and heart rate variability. *Hypertension,* 35: 880-886.

Waersted, M., & Westgaard, R. (1996). Attention-related muscle activity in different body regions during VDU work with minimal physical activity. *Ergonomics,* 39: 661-676.

Waersted, M., & Westgaard, R. (1997). An experimental study of shoulder muscle activity and posture in paper version versus a VDU version of a monotonous work task. *International Journal of Industrial Ergonomics,* 19: 175-185.

Wallace, J. (1999). Work-to-nonwork conflict among married male and female lawyers. *Journal of Organizational Behavior,* 266: 797-816.

Ware, J., Kosinski, M., & Keller, S. (1996). A 12-Item Short-Form Health Survey: Construction of scales and preliminary tests of reliability and validity. *Medical Care,* 343: 220-233.

Waters, T., Dick, R., Davis-Barkley, J., & Krieg, E. (2007). A cross-sectional study of risk factors for musculoskeletal symptoms in the workplace using date for the General Social Survey (GSS). *Journal of Occupational and Environmental Medicine,* 492: 172-184.

Tables

Table 1. Demographic characteristics

CATEGORY	LOW WORKSTYLE		HIGH WORKSTYLE	
	N = 41	**%**	**N = 39**	**%**
GENDER				
Male	10	24.6	9	23.1
Female	31	75.6	30	76.9
AGE				
21-30	12	28.6	8	20.5
31-40	16	39.0	17	43.6
41-50	7	16.7	11	28.2
51-60	5	11.9	3	7.7
61-65	1	2.4	0	0
RACE				
Asian	3	7.3	0	0
Black or African American	25	61.0	19	48.7
White or Caucasian	12	29.3	16	41.0
Hispanic or Latino	1	2.4	4	10.3
MINORITY STATUS*				
Non-Minority	12	28.6	16	41.0
Minority	29	70.7	23	59.0
EDUCATION				
Less HS	1	2.4	0	0
High School	2	4.9	3	7.7
Some College	13	31.7	8	20.5
Associates Degree	1	2.4	2	5.1
Bachelors Degree	12	29.3	11	28.2
Some Graduate School	5	12.2	9	23.1
Masters Degree	3	7.3	6	15.4
Doctorate Degree	4	9.8	0	0
EDUCATION CATEGORY*				
Some College or less	17	41.5	13	33.3
Bachelors Degree or more	24	58.5	26	66.7
MARITAL STATUS				
Single	19	46.3	20	23.1
Cohabitating	2	4.9	2	35.9
Divorced	6	14.6	4	0
Married	14	34.1	13	7.7
MARRIED VS NON MARRIED*				
Married	14	33.3	13	33.3
Not Married	27	65.9	26	66.7
JOB CATEGORY				
Clerical	10	25.0	9	23.1
Management/Administration	10	25.0	14	35.9
Data Entry	2	5.0	0	0
Sales	3	7.5	3	7.7
Prof/Tech/Scientist	12	30	9	23.1
Call Center	0	0	2	5.1
Other	3	7.5	2	5.1

*Note. Dichotomous variables for each category were used in the Chi-square analyses. There were no significant differences between the Low and High Workstyle Groups

Table 2. Descriptives for baseline measures

	Low Workstyle		High Workstyle	
Measure	***M (mean)***	***SD***	***M (mean)***	***SD***
Perceived Health (SF-12)				
Physical Component Summary (PCS)	52.65	5.35	51.37	7.36
Mental Component Summary (MCS)	41.51	8.29	39.56	*8.01*
Perceived Stress Scale (PSS)	19.35	4.66	22.38	5.77
Job Requirements & Physical Demands Survey (JRPD)	87.65	18.93	83.62	14.74
Grip Strength	30.01	10.76	29.12	10.60
Typing Speed	26.62	9.37	28.27	11.04
Validation of Typing Task				
Stressful	4.74	2.75	6.38	2.36
Demanding	5.50	2.52	6.76	2.06
Negative Cognitions following Low Task	4.93	2.88	6.18	2.23
Negative Cognitions following High Task	5.70	2.68	6.89	2.91
Baseline Individual Mood Ratings				
Tension	.76	.87	.87	.76
Anxiety	.57	.77	.83	.73
Frustration	.24	.57	.28	.68
Anger	.05	.22	.13	.41
Happiness	2.36	.91	2.15	*.78*
High Demand Task Individual Mood Rating				
Tension	1.17	1.01	1.49	.85
Anxiety	.86	.89	1.23	.87
Frustration	.55	.705	.89	.924
Anger	.02	.154	.21	.522
Happiness	2.29	.944	1.87	.833
Baseline Total Mood	-.738	2.40	0.00	2.04
Total Mood following High Demand Task	.309	2.69	1.86	2.87

Table 3. Descriptives for laboratory measures

	Low Workstyle		High Workstyle	
Measure	***M (mean)***	***SD***	***M (mean)***	***SD***
KEYBOARD FORCE:				
Keyboard Force Task 1-1	-1.34	.032	-1.33	.040
Keyboard Force Task 1-2	-1.35	.028	-1.34	.027
Keyboard Force Task 1-3	-1.34	.032	-1.34	.027
Keyboard Force Task 1-4	-1.34	.032	-1.34	.028
Keyboard Force Task 1-5	-1.35	.021	-1.34	.030
Keyboard Force Task 1-6	-1.36	.020	-1.34	.040
Keyboard Force Task 1-7	-1.36	.023	-1.34	.026
Keyboard Force Task 1-8	-1.35	.024	-1.34	.028
Keyboard Force Task 1-9	-1.35	.037	-1.34	.033
Keyboard Force Task 1-10	-1.35	.024	-1.34	.033
Keyboard Force Task 2-1	-1.35	.025	-1.34	.032
Keyboard Force Task 2-2	-1.35	.018	-1.34	.022
Keyboard Force Task 2-3	-1.35	.022	-1.35	.023
Keyboard Force Task 2-4	-1.35	.024	-1.35	.023
Keyboard Force Task 2-5	-1.36	.020	-1.35	.021
Keyboard Force Task 2-6	-1.35	.023	-1.35	.024
Keyboard Force Task 2-7	-1.35	.024	-1.35	.025
Keyboard Force Task 2-8	-1.35	.035	-1.34	.037
Keyboard Force Task 2-9	-1.35	.026	-1.34	.027
Keyboard Force Task 2-10	-1.35	.026	-1.35	.026
Performance Task 1	260.35	95.56	277.78	120.02
Performance Task 2	277.23	92.58	287.74	105.85
PHYSIOLOGICAL MEASURES:				
Salivary Cortisol Baseline	.159	.14	.126	.12
Salivary Cortisol High Demand Task	.160	.14	.114	.09
Heart Rate Baseline	73.64	12.56	78.84	15.27
Heart Rate High Demand Task	75.60	13.03	80.41	18.98
Systolic Blood Pressure Baseline	129.19	15.24	125.95	12.15
Systolic Blood Pressure High Demand Task	128.50	14.57	124.68	11.19
Diastolic Blood Pressure Baseline	80.24	11.01	78.92	9.64
Diastolic Blood Pressure High Demand Task	80.05	11.80	78.46	8.89
POSTURE: RULA				
Upper Arm Position Task 1	9.76	2.39	10.84	3.60
Upper Arm Position Task 2	9.73	2.30	10.65	3.40
Lower Arm Position Task 1	11.31	3.95	12.89	4.55
Lower Arm Position Task 2	11.02	3.66	12.91	4.52
Wrists Task Position Task 1	11.58	4.06	13.90	5.54
Wrists Task Position Task 2	11.41	4.41	13.66	5.45
Neck Task Position Task 1	11.11	3.63	10.38	3.14
Neck Task Position Task 2	11.07	3.65	10.19	2.82
Trunk Task Position Task 1	9.10	.00	9.10	0
Trunk Task Position Task 2	9.10	.00	9.10	0

Table 4. ANOVA for health status (Physical Component Score [PCS] SF-12)

Tests of Between-Subjects Effects							
Source	Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Observed Power
Workstyle Score	31.577	1	31.577	.774	.382	.010	.14
Error	3099.062	76	40.777				

Table 5. ANOVA for health status (Mental Component Score [MCS] SF-12)

Tests of Between-Subjects Effects							
Source	Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Observed Power
Workstyle Score	74.030	1	74.030	1.11	.295	.014	.180
Error	5066.042	76	66.658				

Table 6. ANOVA for perceived stress (PSS)

Tests of Between-Subjects Effects							
Source	Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Observed Power
Workstyle Score	93.966	1	96.966	4.544	.036	.055	.558
Error	1612.922	78	20.678				

Table 7. ANOVA for ergonomic exposures (JRPD)

Tests of Between-Subjects Effects							
Source	Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Observed Power
Workstyle Score	284.014	1	284.014	.986	.324	.014	.165
Error	19584.057	68	288.001				

Table 8. ANOVA for grip strength average

Tests of Between-Subjects Effects							
Source	Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Observed Power
Workstyle Score	15.651	1	15.651	.137	.712	.002	
Error	9024.245	79	114.231				

Table 9. ANOVA for typing speed

Tests of Between-Subjects Effects							
Source	Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Observed Power
Workstyle Score	54.780	1	54.780	.525	.471	.007	
Error	8240.335	79	104.308				

Table 10. ANOVA for validation of typing task and feelings about task "Stressful"

Tests of Between-Subjects Effects							
Source	Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Observed Power
Workstyle Score	46.357	1	46.357	7.016	.10	.095	.742
Error	442.715	67	6.608				

Table 11. ANOVA for validation of typing task and feelings about task "Demanding"

Tests of Between-Subjects Effects							
Source	Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Observed Power
Workstyle Score	27.968	1	27.968	5.237	.025	.072	.616
Error	363.188	68	27.968				

Table 12. ANOVA for number of negative cognitions following low demand task

Tests of Between-Subjects Effects							
Source	Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Observed Power
Workstyle Score	31.260	1	31.260	4.734	.033	.058	.575
Error	508.461	77	6.603				

Table 13. ANOVA for number of negative cognitions following high demand task

Tests of Between-Subjects Effects							
Source	Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Observed Power
Workstyle Score	32.069	1	32.069	4.176	.044	.051	.523
Error	591.374	77	7.680				

Table 14. ANOVA for individual baseline mood ratings

Tests of Between-Subjects Effects							
Source	Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Observed Power
Tension							
Workstyle Score	.244	1	.244	.357	.552	.005	.091
Error	53.978	79	.683				
Anxiety							
Workstyle Score	1.824	1	1.824	3.228	.076	.039	.427
Error	44.645	79	.565				
Frustration							
Workstyle Score	.039	1	.039	.098	.755	.001	.061
Error	31.516	79	.399				
Anger							
Workstyle Score	.131	1	.131	1.255	.266	.016	.198
Error	8.264	79	.105				
Happiness							
Workstyle Score	.836	1	.836	1.164	.284	.015	.187
Error	56.720	79	.718				

Table 15. ANOVA for high demand task individual mood ratings

Tests of Between-Subjects Effects							
Source	Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Observed Power
Tension							
Workstyle Score	2.077	1	2.077	2.359	.129	.029	.329
Error	69.577	79	.881				
Anxiety							
Workstyle Score	2.823	1	2.823	3.593	.062	.044	.465
Error	62.066	79	.786				
Frustration							
Workstyle Score	2.404	1	2.404	3.607	.061	.044	.467
Error	51.984	78	.667				
Anger							
Workstyle Score	.665	1	.665	4.634	.037	.055	.566
Error	11.335	79	.143				
Happiness							
Workstyle Score	3.465	1	3.465	4.349	.040	.052	.540
Error	62.930	79	.797				

Table 16. Repeated-measures ANOVA for keyboard force

Tests of Within-Subjects Effects							
Source	Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Observed Power
Task	.004	1	.004	2.985	.088	.038	.400
Task X Type speed	.001	1	.001	.621	.433	.008	.122
Task X Workstyle	0	1	0	.177	.675	.002	.070
Error	.094	75	.001				
Keyboard Force	.008	7.199	.001	1.509	.159	.020	.645
Keyboard Force X Type speed	.008	7.199	.001	1.509	.159	.020	.645
Keyboard Force X Workstyle	.005	7.199	.001	.917	.495	.012	.406
Error	.385	539.911	.011				
Task X Keyboard Force	.015	6.830	.002	3.021	.004	.039	.935
Task X Keyboard Force X Type speed	.012	6.830	.001	2.377	.022	.031	.853
Task X Keyboard Force X Workstyle	.003	6.830	.000	.672	.692	.009	.288
Error	.3710	512.231	.001				
Tests of Between-Subject Effects							
Type speed	.014	1	.014	3.195	.078	.041	.423
Workstyle	.020	1	.020	4.658	.034	.058	.568
Error	.319	75	.004				

Values for Greenhouse-Geisser Test of Within-Subjects Effects

Table 17. ANOVA for performance on low demand task (Number of words typed)

Tests of Between-Subjects Effects							
Source	Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Observed Power
Corrected Model	906978.435	2	453489.217	1224.750	.000	.969	1.0
Type speed (Covariate)	900847.445	1	900847.445	2432.942	.000	.2432.942	1.0
Workstyle Score	.830	1	.830	.002	.962	.000	.050
Error	28881.121	78	370.271				

Table 18. ANOVA for performance on high demand task (Number of words typed)

Tests of Between-Subjects Effects							
Source	Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Observed Power
Corrected Model	755503.768	2	377751.887	1020.204	.000	.963	1.0
Type speed (Covariate)	900847.435	1	750641.934	2027.278	.000	.963	1.0
Workstyle Score	.830	1	.830	.002	.962	.000	.050
Error	28881.121	78	370.271				

Table 19. Repeated-measures ANOVA for posture score (Upper Arm) at baseline and high demand task

Tests of Within-Subject Effects							
Source	Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Observed Power
Task	.476	1	.476	1.901	.172	.024	.275
Task X Workstyle	.257	1	.257	1.028	.314	.013	.170
Error	19.016	76	.250				
Tests of Between-Subject Effects							
Workstyle	38.823	1	38.823	2.256	.137	.029	.317
Error	1307.713	76	17.207				

Table 20. Repeated-measures ANOVA for posture score (Lower Arm) at baseline and high demand task

Tests of Within-Subject Effects							
Source	Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Observed Power
Task	.685	1	.685	1.30	.258	.017	.203
Task X Workstyle	.999	1	.999	1.897	.172	.025	.275
Error	39.506	75	.527				
Tests of Between-Subject Effects							
Workstyle	115.219	1	115.219	3.367	.070	.043	.441
Error	2566.838	75	34.225				

Table 21. Repeated-measures ANOVA for posture score (Wrists) at baseline and high demand task

Tests of Within-Subject Effects							
Source	Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Observed Power
Task	1.594	1	1.594	1.498	.225	.021	.227
Task X Workstyle	.042	1	.042	.039	.843	.001	.054
Error	74.516	70	1.065				
Tests of Between-Subject Effects							
Workstyle	187.091	1	187.091	4.059	.048	.055	.511
Error	3226.848	70	46.098				

Table 22. Repeated-measures ANOVA for posture score (Neck) at baseline and high demand task

Tests of Within-Subject Effects							
Source	Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Observed Power
Task	.552	1	.552	6.095	.016	.074	.683
Task X Workstyle	.206	1	.206	2.274	.136	.029	.319
Error	6.885	76	.091				
Tests of Between-Subject Effects							
Workstyle	25.426	1	25.426	1.138	.289	.15	.184
Error	1697.838	76	22.340				

Table 23. Repeated-measures ANOVA for salivary cortisol at baseline and high demand task

Tests of Within-Subject Effects							
Source	Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Observed Power
Task	.001	1	.001	.549	.462	.009	.113
Task X Workstyle	.001	1	.001	.694	.408	.011	.130
Error	.115	60	.002				
Tests of Between-Subject Effects							
Workstyle	.048	1	.048	1.59	.212	.026	.237
Error	1.804	60	.030				

Table 24. ANOVA for heart rate at baseline and high demand task

Tests of Within-Subjects Effects							
Source	Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Observed Power
Task	121.862	1	121.862	.268	.268	.016	.197
Task X Workstyle	1.456	1	1.456	.015	.903	.000	.052
Error	7525.493	77	97.734				
Tests of Between-Subject Factors							
Workstyle	984.557	1	984.557	2.779	.100	.035	.377
Error	27276.215	77	354.237				

Table 25. ANOVA for systolic blood pressure rate at baseline and high demand task

Tests of Within-Subjects Effects							
Source	Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Observed Power
Time	37.813	1	37.813	1.189	.279	.015	.190
Time X Workstyle	3.306	1	3.306	.104	.748	.001	.062
Error	2449.137	77	31.807				
Tests of Between-Subject Factors							
Workstyle	491.464	1	491.464	1.42	.234	.018	.220
Error	26251.839	77	340.933				

Table 26. ANOVA for diastolic blood pressure rate at baseline and high demand task

Tests of Within-Subjects Effects							
Source	Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Observed Power
Time	4.155	1	4.155	.224	.637	.003	.075
Time X Workstyle	.712	1	.712	.038	.845	.000	.054
Error	1428.833	77	18.556				
Tests of Between-Subject Factors							
Workstyle	83.135	1	83.135	.415	.522	.005	.097
Error	15442.637	77	200.554				

Table 27. Repeated-measures ANOVA for changes in total mood from baseline to high demand task

Tests of Within-Subjects Effects							
Source	Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Observed Power
Time	84.820	1	84.820	25.337	.000	.245	.999
Time X Workstyle	6.720	1	6.720	2.007	.161	.025	.288
Error	261.123	78	3.348				
Tests of Between-Subject Factors							
Workstyle	52.630	1	52.630	5.501	.022	.066	.639
Error	746.314	78	9.568				

Table 28. Repeated-measures ANOVA for changes in task-related cognitions from baseline to high demand task

Tests of Within-Subjects Effects							
Source	Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Observed Power
Time	21.701	1	21.701	12.418	.001	.142	.936
Time X Workstyle	.091	1	.091	.052	.820	.001	.056
Error	131.065	75	1.748				
Tests of Between-Subject Factors							
Workstyle	59.159	1	59.159	4.631	.035	.058	.565
Error	959.178	75	12.776				

Table 29. Linear regression to identify factors related to keyboard force

Model	Beta	R	R^2	Std.Error of Estimate	Change Statistics R2 Change	F Change	Sig. F Change
1. Demographics:							
Age	.090						
Minority Status	.267						
Education Category	.127						
Marital Status	.100	.255	.065	.015	.065	1.285	.284
2. Grip Strength Average	.024						
and Typing Speed	.271	.358	.128	.015	.063	2.607	.081
3. Total Mood (Task 2)	-.024	.133	.048	.015	.005	.417	.521
4. Workstyle Score (cont.)	.241	.425	.180	.015	.047	4.042	.048

Table 30. Linear regression to identify factors related to salivary cortisol following stress task

Model	Beta	R	R^2	Std.Error of Estimate	Change Statistics R2 Change	F Change	Sig. F Change
1. Demographics:							
Age	.083						
Minority Status	-.046						
Education Category	.049						
Marital Status	-.057	.254	.065	.133	.065	.760	.557
2. Task Ratings:							
Stress	-.116						
Demand	-.060						
Baseline Measures:							
Ergonomic Exposures	-.236						
& Perceived Stress	-.064	.429	.184	.130	.120	1.468	.230
3. Baseline Cortisol	.881	.934	.872	.052	.687	208.737	.000
4. Workstyle Score (cont.)	-.094	.937	.878	.051	.006	1.842	.183

Table 31. Linear regression to identify factors related to stress task performance

Model	Beta	R	R^2	Std.Error of Estimate	Change Statistics R2 Change	F Change	Sig. F Change
1. Demographics:							
Age	-.433						
Minority Status	-.140						
Education Category	.104						
Marital Status	.020	.444	.197	90.06	.197	3.377	.015
2. Task Ratings:							
Stress	-.079						
Demand	-.079	.451	.204	91.36	.007	.221	.802
3. Baseline Measures:							
Perceived Stress &	.333						
Ergonomic Exposures	-.104	.539	.291	.179	.087	3.123	.053
4. Workstyle Score (cont.)	-.169	.557	.310	87.54	.020	1.428	.238

Table 32. Linear regression to identify factors related to cognitions following stress task

Model	Beta	R	R^2	Std.Error of Estimate	Change Statistics: R2 Change	F Change	Sig. F Change
1. Demographics:							
Age	-.026						
Minority Status	-.057						
Education Category	-.255						
Marital Status	-.041	.068	-.009	2.74	.068	.884	.497
2. Task Ratings:							
Stress	.291						
Demand	.089	.269	.183	2.47	.202	8.143	.001
3. Workstyle Score (cont.)	.281	.577	.333	.241	.063	5.502	.022

Table 33. Linear regression to identify factors related to total mood following stress task

Model	Beta	R	R^2	Std.Error of Estimate	Change Statistics: R2 Change	F Change	Sig. F Change
1. Demographics:							
Age	-.211						
Minority Status	-.019						
Education Category	-.053						
Marital Status	-.093	.256	.065	2.83	.065	.741	.596
2. Task Ratings:							
Stress	.353						
Demand	-.289	.410	.168	2.73	.103	3.146	.051
3. Baseline Measures:							
Perceived Stress &	-.147						
Ergonomic Exposures	-.268	.496	.246	2.65	.078	2.536	.090
4. Workstyle Score (cont.)	.360	.578	.334	2.51	.088	6.327	.015

Table 34. Linear regression to identify factors related to workstyle

Model	Beta	R	R^2	Std.Error of Estimate	Change Statistics: R2 Change	F Change	Sig. F Change
1. Baseline Measures:							
Perceived Stress &	-.020						
Ergonomic Exposures	.295	.405	.164	10.75	.164	6.471	.003
2. Demographics:							
Age	.068						
Minority Status	-.029						
Education Category	.052						
Marital Status	-.082	.426	.181	10.98	.017	.328	.858
3. Total Mood Post Task 2	.370	.543	.295	10.27	.114	9.855	.003

Appendices

1. Informed Consent Form
2. Study Advertisement (Newspapers and online)
3. Phone Screen and Script
4. Laboratory Protocol Script
5. Debriefing Script
6. Work & Health Demographic Survey
7. Perceived Stress Scale
8. SF-12 (Short Form)
9. Workstyle Scale (Short Form)
10. A Brief Mood Questionnaire (Original)
11. Job Requirements & Physical Demands Survey (JRPD-24 Upper Extremity Scale)
12. RULA worksheet
13. Low and High Demand Task Cognition Questionnaire (Original)
14. Neutral and High Demand Typing Task Actual Text
15. High Demand Typing Task with Errors
16. Workstyle Model Permission to use email
17. Institutional Review Board (IRB) Approval Form

Appendix 1. Consent for Participation in a Research Study

<u>Consent for Participation in a Research Study</u>

Title of Project: Workstyle, ergonomic, and cortisol response to work demands during computer work

Principal Investigator: Cherise B. Harrington, MS

TO PERSONS WHO AGREE TO PARTICIPATE IN THIS STUDY:

The following information is provided to inform you about the research project and your participation in it. Please read this form carefully and feel free to ask any questions you may have about this study and/or about the information given below.

It is important that you understand that your participation in this study is totally voluntary. **You may refuse to participate or choose to withdraw from this study at any time**.

If, during the course of the study, you should have any questions about the study or your participation in it, you may contact:

Cherise B. Harrington, M.S. at 301-295-9659
Department of Medical Psychology, USUHS, Bethesda, MD 20814-4799
Michael Feuerstein, Ph.D., MPH at 301-295-9677

Department of Medical & Clinical Psychology, USUHS, Bethesda, MD 20814-4799
Office of Research at (301) 295-9534

1. INDICATED BELOW ARE THE FOLLOWING:
- **a. THE PURPOSE OF THIS STUDY**
- **b. THE PROCEDURES TO BE FOLLOWED**
- **c. THE APPROXIMATE DURATION OF THE STUDY**

1a. THE PURPOSE OF THIS STUDY:

How a worker reacts to high job demands has been related to symptoms such as hand, arm, neck, and shoulder pain. Upper body symptoms affect many types of workers. Also, some parts of office work (i.e., keyboard use) have been shown to be related to upper extremity symptoms. This study will allow researchers to see if office workers who do not have any upper body symptoms respond a certain way to stress during a computer task. We will look at mental and physical responses in a high-demand work-simulated environment. Our purpose is to study differences in mental and physical stress responses that might exist by workstyle. Results of this study could help understand workers and their mental and physical responses to stress.

If you agree to participate in this study, you will be asked to type and proofread information, this activity may be stressful. You also will be video recorded. Your saliva, heart rate, keyforce (how hard you tap keys on the keyboard), number of keystrokes used, and posture will be monitored. You also will be asked to fill out a series of questionnaires as well. The information from these assessments will be measured and the relationship between your attitude about work and work behaviors will be assessed.

1b. THE PROCEDURES TO BE FOLLOWED:

Individuals meeting a certain score range on the workstyle measure and meeting other criteria (see inclusion and exclusion criteria listed below) will be asked to participate in the study.

<u>Inclusion criteria</u>:
1) Male and females
2) Aged 18-65

3) Full-time workers who spend at least 4 hours per day at a computer/typing task
4) English-speaking
5) Eighth grade reading comprehension (minimum reading level for self-report measures.)

Exclusion criteria:
1) Unemployed
2) Current pregnancy
3) Current use of hormone replacement therapy or beta blockers
4) Medical disorders that may result in variant cortisol levels
5) Current psychiatric disorders/symptoms
6) Current Smoker
7) 12-month history of disorders of the fingers, hands, arms, neck, or shoulders

Participation in this study includes completion of online questionnaires (approx 60min) and a single 1hour visit to the Uniformed Services University. The summary of the study can be found below. Each of the sections will be discussed further in the next sections.

Participant Time Allotment

Task	Description	Time
Phone Screen	1. Explanation of study 2. Inclusion/Exclusion Criteria 3. Instructions for online surveys 4. Schedule laboratory appointment	
Online Survey	1. Demographic Information 2. Workstyle Scale 3. Job Stress Survey 4. SF-12 5. JRPD (Job requirement and Physical Demands Survey 6. Perceived Stress Scale 7. Profile of Mood States (Tension dimension)	60 minutes
Visit to University (Laboratory)	1. Informed Consent 2. Laboratory Protocol A. Pre Tension/Anxiety Assessment B. Adaptation C. 1st salivary cortisol & heart rate (HR) collection D. Neutral Typing Task E. 2nd salivary cortisol/HR collection/Rest Period F. High Demand Typing Task G. 3rd salivary cortisol/HR collection H. Recovery/ Post Tension/Anxiety Assessment I. 4th salivary cortisol collection/HR/Task Validation	10 minutes 5 minutes 5 minutes 1 minute 10 minutes 6 minutes 10 minutes 1 minute 10 minutes 2 minutes
		TOTAL 120 MINUTES

Online Questionnaires

Prior to your visit to the university, you were asked to complete a series of questionnaires. Please note all responses are completely confidential and will be in no way linked to your name.

Visit to University

Your on site visit will take approximately 60 minutes. At this visit, we will measure your keyforce, count your key strokes, and video record your posture. You will not feel the measurement and it is in no way harmful to you.

During this visit we will ask you to type two documents (each between 450 and 750 words). During the study, you will be asked to provide a saliva collection to be taken at four periods. Cortisol is a substance that is released in the body when a person experiences stress. We can detect how much cortisol there is in the body by looking at saliva. We measure salivary cortisol to see if there are changes in levels over the typing tasks. This salivary collection involves a cotton swab be inserted inside your mouth and a sample of your saliva being taken and placed in a swab storage tube. These samples will be stored until the study completion, following which the samples will be sent to have the cortisol levels analyzed. Following analysis the samples will be destroyed (within 12 months of study start), no analysis other than that of the cortisol levels will be conducted on these samples. Heart rate and blood pressure also will be measured by placing a sensor unit on your arm for approximately 1 minute.

We also will be asking you to fill out a 9-item questionnaire at the beginning of the study and at the end, which will provide us with information about any tension/anxiety that you feel.

1c. DURATION OF THE STUDY
The total time you will spend participating is approximately 2 hours.

2. THIS STUDY IS BEING DONE SOLELY FOR THE PURPOSES OF RESEARCH.

3. DISCOMFORTS AND/OR RISKS THAT CAN BE REASONABLY EXPECTED ARE:

A. The risks associated with this study are minor. You may find the questionnaires ask questions that may make you uncomfortable. You may feel free to skip questions at any time. Also, you may decline to participate at any time and/or withdraw your participation at any time.
B. You may experience discomfort during the second typing task which is designed to simulate a high job demand task. If this task is too disturbing, you may discontinue participation at ANY time.
C. You will be video recorded. This videotape will only be used to evaluate changes in posture. This video tape will only be identified by a non-identifying study number and will not be associated with your name or any other personal identifying information. Your face will be recorded during this time. However, these videotapes will not be associated with any of your personal information. These tapes will be destroyed within 12months of the recording.
D. Research designs often require that the full intent of the study not be explained prior to participation. Although we have described the general nature of the tasks that you will be asked to perform, the full intent of the study will not be explained to you until after the completion of the study. At that time, we will provide you with a full debriefing which will include an explanation of the hypothesis that was tested and other relevant background information pertaining to the study. You will also be given an opportunity to ask any questions you might have about the hypothesis and the procedures used in the study.

4. POSSIBLE BENEFITS TO YOU THAT MAY BE REASONABLY EXPECTED ARE:

The study is designed for research purposes only and not intended to directly benefit you. You may gain a better understanding of your overall response to high demand work tasks. Through completing this study, you will be providing information that will be helpful in expanding scientific knowledge about workstyle and psychological components of high demand work tasks. The results of this study will help us gain a better understanding of how workers differ in response to high demand work tasks.

5. ALTERNATE PROCEDURES THAT MAY BE ADVANTAGEOUS:

There are many commercial programs available for occupational evaluations. Other commercial methods for assessing your workstyle and patterns include visiting occupational therapists.

6. PRIVACY AND CONFIDENTIALITY:

All information you provide as part of this study will be confidential and will be protected to the fullest extent provided by law. Information that you provide and other records related to this study will be accessible to those persons directly involved in conducting this study and members of the Uniformed Services University of the Health Sciences Institutional Review Board (IRB), which provides oversight for protection of human research volunteers. All questionnaires, forms and charts will be kept in a restricted access, locked cabinet while not in use. Online survey responses will be password protected. To enhance the privacy of the answers you provide data from questionnaires will be entered into a database in which individual responses are not identified. Personal identifying information will only be used for the purpose of compensation. During videotaping of your posture, your face will likely be recorded also. These video recordings will not be associated with any of your personal information. Video tapes will be destroyed within 12 months of time they were recorded. If you are a military member, please be advised that under Federal Law, a military member's confidentiality cannot be strictly guaranteed.

Note: YOU ARE FREE TO WITHDRAW THIS CONSENT AND TO STOP PARTICIPATING IN THIS STUDY OR ANY ACTIVITY AT ANY TIME FOR ANY REASON.

7. COMPENSATION:

You may be paid $40 for completing this study. Completing the study involves completing both the online survey and laboratory portion.

Military: If you are active duty military and wish to be compensated for your participation, you must complete the form “Statement of Approval for Participation in Research” given to you by the study staff. If you do not wish to be compensated, this form does not apply, but you are strongly encouraged to inform your command of your participation.

Federal: If you are a federal employee and wish to be compensated for your participation, you must complete the form “Statement of Approval for Participation in Research” given to you by the study staff. If you do not wish to be compensated, this form does not apply, but are strongly encouraged to inform your supervisor of your participation.

8. COMPENSATION TO YOU IF YOU ARE INJURED AND LIMITS TO YOR MEDICAL CARE:

This study should not entail any physical or mental risk beyond those described above. We do not expect complications to occur. If, for any reason, you feel that continuing this study would constitute a hardship you may withdraw at any time.

If at anytime you believe you have suffered an injury or illness as a result of participating in this research project, contact the Director of Human Subjects Protection Program at the Uniformed Services University of the Health Sciences, Bethesda, Maryland 20814-4799 at (301) 295-9534. This office can review the matter with you. They can provide information about your rights as a research volunteer. They may also be able to identify resources available to you. If you believe the government or one of the government’s employees (such as a military doctor) has injured you, a claim for damages (money) against the federal government (including the military) may be filed under the Federal Torts Claims Act. Information about judicial avenues of compensation is available from the University’s General Counsel at (301) 295-3028.

Should you have any questions at any time about the study you may contact the principal investigator, **Cherise B. Harrington, M.S., Department of Medical & Clinical Psychology, USUHS, Bethesda, MD 20814-4799, at 301-295-9659.**

If you at any time during the study experience distress and would like to discuss it with someone you may contact Michael Feuerstein, Ph.D., MPH, ABPP, Clinical Psychologist, Uniformed Services University of the Health Sciences, 4301 Jones Bridge Rd., Bethesda MD 20814-4799, Ph: 301-295-9677, Fax: 301-295-3034, email: mfeuerstein@usuhs.mil. In addition, you will be provided with a list of mental health resources in area.

STATEMENT BY PERSON AGREEING TO PARTICIPATE IN THIS RESEARCH PROJECT:

I have read this consent form and I understand the procedures to be used in this study and the possible risks, inconveniences, and/or discomforts that may be involved. All of my questions have been answered. I freely and voluntarily choose to participate. I understand I may withdraw at any time. My signature also indicates that I have received a copy of this consent form for my information.

SIGNATURES:

______________________________	________________________________
Signature of Witness	**Signature of Volunteer**
_____________________________	________________________________
Witness Name (Printed)	**Volunteer Name (Printed)**
Date________________________	**Date**___________________________

I certify that I or my research staff has explained the research study to the above individual, and that the individual understands the nature and purpose, the possible risks and benefits associated in taking part in this research study. Any questions that have been raised have been answered.

Investigator's or Designee's Signature ______________________

Printed Name ______________________

ONLINE CONSENT:

Title of Project: Workstyle, ergonomic, and cortisol response to work demands during computer work

Principal Investigator: Cherise B. Harrington, MS

TO PERSONS WHO AGREE TO PARTICIPATE IN THIS STUDY:

The following information is provided to inform you about the research project and your participation in it. Please read this form carefully and feel free to ask any questions you may have about this study and/or about the information given below.

It is important that you understand that your participation in this study is totally voluntary. **You may refuse to participate or choose to withdraw from this study at any time**.

If, during the course of the study, you should have any questions about the study or your participation in it, you may contact:

Cherise B. Harrington, M.S. at 301-295-9659; Department of Medical Psychology, USUHS, Bethesda, MD 20814-4799
Michael Feuerstein, Ph.D., MPH at 301-295-9677; Department of Medical & Clinical Psychology, USUHS, Bethesda, MD 20814-4799

Office of Research at (301) 295-3303 USUHS, Bethesda, Maryland 20814

1. INDICATED BELOW ARE THE FOLLOWING:
- **a. THE PURPOSE OF THIS STUDY**
- **b. THE PROCEDURES TO BE FOLLOWED**
- **c. THE APPROXIMATE DURATION OF THE STUDY**

1a. THE PURPOSE OF THIS STUDY:

How a worker reacts to high job demands has been related to symptoms such as hand, arm, neck, and shoulder pain. Upper body symptoms affect many types of workers. Also, some parts of office work (i.e., keyboard use) have been shown to be related to upper body symptoms. This study will allows researchers to see if worker who do not have any upper body symptoms respond a certain way to stress. We will look at mental and physical responses in a high-demand work-simulated environment. Our purpose is to study differences in mental and physical stress responses that might exist by workstyle. Results of this study could help understand workers and their mental and physical responses to stress.

If you agree to participate in this study, you will be asked to complete an online survey that takes approximately 60 minutes to complete.

2. DISCOMFORTS AND/OR RISKS THAT CAN BE REASONABLY EXPECTED ARE:

A. The risks associated with this study are minor. You may find the questionnaires ask questions that may make you uncomfortable. You will NOT be forced to do anything you do not want to do. You may feel free to skip questions at any time. Also, you may decline to participate at any time and/or withdraw your participation at any time.

3. POSSIBLE BENEFITS TO YOU THAT MAY BE REASONABLY EXPECTED ARE:

The study is designed for research purposes only and not intended to directly benefit you.

4. PRIVACY AND CONFIDENTIALITY:

All information you provide as part of this study will be confidential and will be protected to the fullest extent provided by law. Information that you provide and other records related to this study will be accessible to those persons directly involved in conducting this study and members of the Uniformed Services University of the Health Sciences Institutional Review Board (IRB), which provides oversight for protection of human research volunteers. All questionnaires, forms and charts will be kept in a restricted access, locked cabinet while not in use. To enhance the privacy of the answers you provide data from questionnaires will be entered into a database in which individual responses are not identified. After verification of the database information, paper copies of the questionnaires containing identifiers will be shredded and video tapes will be destroyed. If you are a military member, please be advised that under Federal Law, a military member's confidentiality cannot be strictly guaranteed.

Note: YOU ARE FREE TO WITHDRAW THIS CONSENT AND TO STOP PARTICIPATING IN THIS STUDY OR ANY ACTIVITY AT ANY TIME FOR ANY REASON.

5. COMPENSATION

You may be paid $40 for completing this study. Completing the study involves completing both the online survey and laboratory portion.

Military: If you are active duty military and wish to be compensated for your participation, you must complete the form "Statement of Approval for Participation in Research" given to you by the study staff. If you do not wish to be compensated, this form does not apply, but you are strongly encouraged to inform your command of your participation.

Federal: If you are a federal employee and wish to be compensated for your participation, you must complete the form "Statement of Approval for Participation in Research" given to you by the study staff. If you do not wish to be compensated, this form does not apply, but are strongly encouraged to inform your supervisor of your participation.

6**. RECOURSE IN THE EVENT OF INJURY:**

COMPENSATION TO YOU IF YOU ARE INJURED AND LIMITS TO YOR MEDICAL CARE

This study should not entail any physical or mental risk beyond those described above. We do not expect complications to occur. If, for any reason, you feel that continuing this study would constitute a hardship you may withdraw at any time.

If at anytime you believe you have suffered an injury or illness as a result of participating in this research project, contact the Director, Human Subjects Protection Program at the Uniformed Services University of the Health Sciences, Bethesda, Maryland 20814-4799 at (301) 295-9534. This office can review the matter with you. They can provide information about your rights as a research volunteer. They may also be able to identify resources available to you. If you believe the government or one of the government's employees (such as a military doctor) has injured you, a claim for damages (money) against the federal government (including the military) may be filed under the Federal Torts Claims Act. Information about judicial avenues of compensation is available from the University's General Counsel at (301) 295-3028.

Should you have any questions at any time about the study you may contact the principal investigator, **Cherise B. Harrington, M.S., Department of Medical & Clinical Psychology, USUHS, Bethesda, MD 20814-4799, at 301-295-9659.**

If you at any time during the study experience distress and would like to discuss it with someone you may contact Michael Feuerstein, Ph.D., MPH, ABPP, Clinical Psychologist, Uniformed Services University of the Health Sciences, 4301 Jones Bridge Rd., Bethesda MD 20814-4799, Ph: 301-295-9677, Fax: 301-295-3034, email: mfeuerstein@usuhs.mil. In addition, you will be provided with a list of mental health resources in area.

STATEMENT BY PERSON AGREEING TO PARTICIPATE IN THIS RESEARCH PROJECT:

I have read this consent form and I understand the procedures to be used in this study and the possible risks, inconveniences, and/or discomforts that may be involved. All of my questions have been answered. I freely and voluntarily choose to participate. I understand I may withdraw at any time.

Yes, I consent __________ Date:__________

No, I do not consent__________

Appendix 2. Study Advertisements

Are you an office worker?

We are looking for full-time office workers who spend more than 4 hours per day keyboarding on the computer and are 18 to 65 years old, to participate in a study of office work and stress.

The study requires:

- Completing an online survey for about an hour
- One (1 hour) visit to the Uniformed Services University, Bethesda, MD
- Complete a typing task

Participants may receive compensation

Contact Cherise B. Harrington (301) 295-9659
Or EMAIL officeworkerstudy@gmail.com

Office worker Study 301-295-9659	Office worker study 301-295-9659	Office worker study 301-295-9659	Office worker study 301-295-9659	Office worker study 301-295-9659	Office worker study 301-295-9659	Office worker study 301-295-9659	Office worker study 301-295-9659	Office worker study 301-295-9659

Office Workers Needed

Adult office workers are sought for a study on work tasks and stress. We are looking for office workers who spend more than 4 hours per day on the computer, nonsmokers, who have no major health problems, are 18 to 65, and have not had prolonged hand, wrist, arm or shoulder symptoms. The study requires: completing online survey, one (1 hour) visit to the Uniformed Services University in Bethesda, MD during which you will be typing for approximately 20 minutes. Participants may receive compensation. For more information please call Cherise Harrington at (301) 295-9659.

Seeking Volunteers

Adult office workers are sought for a study on work tasks and stress. We are looking for office workers who spend more than 4 hours per day on the computer, nonsmokers, who have no major health problems, are 18 to 65, and have not had prolonged hand, wrist, arm or shoulder symptoms. The study requires: completing online survey, one (1 hour) visit to the Uniformed Services University in Bethesda, MD during which you will be typing for approximately 20 minutes. Participants may receive compensation. For more information please call Cherise Harrington at (301) 295-9659.

Appendix 3. Phone Screen and Script

Script for Phone Screen

"Hello, my name is ________________. I am calling you back regarding the work and reactivity study. Do you have about 15 minutes to go through the screening process right now?"

If no: "When can I call you back?"
If yes: *go on*

"I'd like to tell you a few things about the study first and then I'll be glad to answer any questions that you might have, OK? This study is designed to compare groups of office workers on several different outcomes. Office workers are defined for this study as individuals working in an office environment. We are interested in how people respond differently to this work related tasks and demands.

If you are eligible and agree to participate, you will be asked to complete a number of questionnaires online and be asked to come in to be observed typing two documents. You will be videotaped during two ten minute portions and we also will take salivary cortisol samples that consist of inserting a cotton swab just in your mouth for several seconds. Cortisol is a substance that is released in the body fluids, like saliva, and it increases when individuals feel pressure or stress. We will also measure your blood pressure and heart rate. All measurements are harmless and painless.

We will only meet once and this meeting should last about 1 hour. You will also be asked to refrain from eating for 90 minutes prior to arriving at the study.

During the study we will ask you to type two documents. However, it is important that you are aware that typing is part of the study and if you feel that you would rather not do the typing tasks, you may choose not to participate. If you do decide to participate and you then decide during the typing task that you would rather discontinue your participation in the study, you may feel free to leave at any time without consequence. Your participation in this study is entirely voluntary.

We are located at the Uniformed Services University, which is near the National Naval Medical Center and across the street from NIH in Bethesda, Maryland. The study is being run by a senior graduate student who has a Master's Degree in Medical Psychology and has had over 5 years of experience in engaging in research studies focused on stress.

If you complete all of this, you will be mailed a check for $40. Since we need all of the information requested in order to use your data, you will have to complete all parts of the study before you will be paid.

Does this sound like something you would be interested in?”

If no: “Thank you for your interest.”

If yes: “Do you have any questions about the study?

Ok, now I will need to ask you some questions to see if you meet criteria for this study.”

COMPLETE PHONE SCREEN.

If the caller does not meet requirements: “I am sorry, but you do not meet the requirements for this study. This doesn’t mean that there is something wrong with you, it simply means that we are looking at very specific things. It is very important for research purposes that our groups look as similar to each other as possible.

Thank you for you interest.”

If caller meets requirement: “Do you have any questions?”

“I am pleased to inform you that you meet the requirements for this study. We can schedule your appointment now and I will give you some instructions to complete the online survey, do you have a pen and piece of paper near by?”

“I am going to give you the website and access information. Here is the website <INSERT WEB ADDRESS>. Here is your identification number and password to access the site. Also, if you would like I will send you an email with these instructions and access information.

“How soon do you think that you will be able to complete the online survey? It will take you approximately an hour to complete.” <Schedule laboratory portion within 14 days of survey completion estimation>

“When you come in for your appointment, we would like you to come to USUHS to participate. The room is located in Building B. You can park in the school’s underground parking garage for free. Due to heightened security, you must bring a picture ID with you in order to get on base. We will also need to add your name to the visitors list. When you arrive, simply show the guard at the gate your ID and state your name. (Collect pertinent contact information.) Thank you in advance for your participation.”

PHONE SCREEN

Interviewer: ____________________________
Date: ___________

1. How did you hear about the study?_______________________________
2. Age_______ → *If younger than 18 or older than 65 exclude from study*
3. Sex ___________
4. Racial/Ethnic group _____________
5. Height_________ inches
6. Weight____________ pounds
7. Are you in the military? YES NO
8. Do you work for the federal government? YES NO
8. Do you smoke tobacco products? → *If yes, exclude from study* YES NO
9. Do you work in an office setting YES NO
10. Do you spend at least 4 hours per working day keyboarding? YES NO
11. Do you work full-time? YES NO
12. What is the highest level of education that you have completed?_______
    → *If less than 8^{th} grade exclude from study*
13. Have you been told by a physician that you had:
    A. Hypertension YES NO
       If yes → is your hypertension controlled? YES NO
          If no → exclude from study
    B. Heart Disease/Problems YES NO
    C. High Blood Sugar/Diabetes YES NO
    D. Thyroid Disease YES NO
    E. Major Medical Problems (such as stroke) YES NO

If yes to B, C, D, or E exclude from study.

14. Have you been told by a psychiatrist or psychologist that you have or had:
    A. Depression YES NO
    B. Eating Disorder YES NO
    C. Anxiety Disorder YES NO
    D. Schizophrenia YES NO
    E. Bipolar Disorder YES NO
    F. Major Psychological/Psychiatric Problem YES NO
       If yes, what was the diagnosis? ___________________________________
    G. Have you sought treatment for any of these problems? YES NO
       If yes, when? ____
    If yes to A, B, C, D, E, or F, exclude from study

15. Are you currently taking any medications? YES NO
    If so, what are you taking? _____________________________________
    → *Exclude if taking hormone replacement medications*
16. Are you currently pregnant or nursing? YES NO
17. Have you ever been diagnosed with a specific disorder in your fingers, hands, arms, neck, or shoulders?
    YES NO →

If yes, exclude.

<u>Continued</u>

<u>Workstyle Screen</u>: Rate the degree to which each of the following items describes you at WORK by selecting the appropriate option, Using: 0=Almost Never, 1=Rarely, 2=Sometimes, 3=Frequently and 4=Almost Always

18. I can't take off from work because other people at work will think less of me.
    0=Almost Never 1=Rarely 2=Sometimes 3=Frequently 4=Almost Always

19. I can't take off from work because I'd be letting down or burdening my boss.
    0=Almost Never 1=Rarely 2=Sometimes 3=Frequently 4=Almost Always

20. I don't really know where I stand despite all the effort I put into my work.
    0=Almost Never 1=Rarely 2=Sometimes 3=Frequently 4=Almost Always

21. The boss doesn't let you forget it if you don't get your work finished.
    0=Almost Never 1=Rarely 2=Sometimes 3=Frequently 4=Almost Always

22. I have too many deadlines and will never be able to get all my work done.
    0=Almost Never 1=Rarely 2=Sometimes 3=Frequently 4=Almost Always

23. I push myself and have higher expectations than my supervisor and others that I have to deal with at work.
    0=Almost Never 1=Rarely 2=Sometimes 3=Frequently 4=Almost Always

24. I take time to pause or stretch during a typical day at work.
    0=Almost Never 1=Rarely 2=Sometimes 3=Frequently 4=Almost Always

Workstyle Screen Score _______ *if score is > 4 and < 10, exclude.*

If still eligible to participate:
Name: _________________________
Address: ____
Home Phone: ________ Work Phone: ______________ Fax: __________________
E-mail: _____________________

Appendix 4. Laboratory Protocol Script

<*Verbalize instructions in a smooth, relaxing tone*>

Thank you for agreeing to participant in this experimental study.

Please sit and make yourself comfortable in the chair. Now I would like to review the informed consent form with you. [Read through entire informed consent and get signature]

Both the chair and keyboard stand are adjustable and you may make any adjustments that you like. First, I would like you to complete the following questionnaire. Now I would like you to sit quietly for five minutes and feel free to look over this reading material while you wait. <AFTER 5 MINUTES> Now I am going to turn on the video camera, remember that you may stop the study at any time if you would like. The video camera is going to record your body position while you type. Now I will take the first salivary cortisol sample. I am going ask you to inserts this cotton swab into your mouth and leave it there for 45 seconds. Now if you will insert it into this tube. I am also going to measure your heart rate.

<<u>PRERECORDED INSTRUCTIONS IN RELAXING TONE</u>>
Now I would like you to spend the next 10 minutes or so typing this document. This is to allow you to become comfortable with the keyboard and desk area. I will stop you in about 10 minutes. <AFTER 10 MINUTES> Now please complete this questionnaire and answers these questions about the typing task you just completed.

Now I would like you to sit quietly again for about 5 minutes. Feel free to look over this reading material. <AFTER 5 MINUTES> Now I will take another salivary cortisol sample, I would like you to do exactly the same as the first collection. Please insert this cotton swab into your mouth and leave it there for 45 seconds. Please insert it into this tube. I am also going to measure your heart rate.

<<u>PRERECORDED INSTRUCTIONS IN DIRECT TONE</u>> *<Experimenter to tighten the facial muscles and maintain eye contact while recording plays.>*

Now the experiment will begin. Type this document. Edit, proofread, and correct each misspelled word. You will have exactly 10 minutes to complete this task. You must complete the entire document and correct all of the errors. Please begin now.

<AFTER 8 MINUTES recording will continue and say, *in stern voice*> Two minutes left

<AFTER 2 MINUTES recording will continue and say, *in stern voice*> Please stop typing

Now I will take another salivary cortisol sample, I would like you to do exactly the same as the first two collections. Please insert this cotton swab into your mouth and leave it there for 45 seconds. Please insert it into this tube. I am also going to measure your heart rate again.

Additionally, please complete this questionnaire and answers these questions about the typing task you just completed.

Now begins the last 5 minute rest period. Again feel free to look over this reading material. <AFTER 5 MINUTES> Now I will take the final salivary cortisol sample. Please insert this cotton swab into your mouth and leave it there for 45 seconds. Please insert it into this tube. I am also going to measure your heart rate for a final time.

Thank you completed the protocol for this laboratory experiment. I will now turn off the video camera.

NOW COMPLETE DEBRIEFING SCRIPT.

Appendix 5. Sample debriefing script

Thank you for your participation in our study. Your participation is important to us and we know that it takes time and energy to be involved. We appreciate your efforts. We recruited you to participate in a study on work and stress, and we are specifically interested in understanding how people differ in their response to work-related demands. This study is designed to look at how different reactions to work affect mood and physiological variables like cortisol. Cortisol is a substance that is released from the body when we experience stress. We also are interested in understanding whether reaction impacts work behaviors like keyboard force and performance. To test the impact of work and reactivity, we asked you to type some text under two different circumstances, one with increased performance demands and one without. The tape recorded instructions were designed to sound relaxed so that you would not be reactive to the task, the second set of instructions were in a non-relaxing tone that may result in a reaction or the suggestion of increased expectations. We think that people may respond differently to these two situations depending on their workstyle. To compare people, we have asked everyone to complete a workstyle measure that asked how you cope with stress and work demands. We believe that a person's workstyle may be associated with certain behaviors and reactions, such as typing keys harder or increased heart rate. We videotaped you to look at how your posture changed between the two typing situations. The reason we did that is because it is believe that changes in posture to work stress may be related to a specific type of workstyle. This study compared your reaction to being asked to complete the low demand typing task to your reaction to the increased demand typing task with time constraints and minimal mistakes. This typing task is designed to elicit a work-related response to high demands. This study is designed to investigate different reactions to a work-simulated task based on your workstyle score.

We are trying to find out if people are different in there response to demands. If in fact, we find that people respond differently based on their workstyles then research could then design ways to help people react to stress in less reactive way. This study is important because it will add to the current knowledge about the association between work stress, postural and hormonal changes, and workstyle.

If you have any questions about the study or want more information, you can contact the primary investigator [or myself] directly at the phone number listed on your copy of the consent form. Again, we appreciate your participation.

The high demand typing task does not produce long term mood changes, however, it is important that you know there are many resources available to you if you do experience such results. The list of resources you will be given is given to all participants, and we hope you will find it useful information.

MORE THAN JUST "THE BLUES"

Mental Health Resources for Montgomery County Residents

Feeling sad a lot of the time? Use this list of mental health facilities and agencies to get help for depression or other mental health concerns. You may call several numbers to determine the place that best meets your needs.

PUBLIC MENTAL HEALTH SERVICES

Montgomery County Mental Health Access Team 240-777-1770
For assistance in obtaining appropriate outpatient mental health services for persons eligible for the public mental health system, APS Healthcare.

Addiction Services Coordination 240-777-4710
255 Rockville Pike, Suite #145 Rockville, MD
Walk-In assessments done Mon – Fri 9AM-11AM and 1PM-3PM

APS Healthcare, Inc 1-800-752-7242
Implements the public mental health system for people eligible for medical assistance and people who receive state subsidization for services.

Mental Health Services for Seniors and Persons With Disabilities 240-777-3990

Montgomery County Crisis Center 240-777-4000
1301 Piccard Drive Rockville, MD 20850
Immediate response to mental health and situational crises through telephone, walk-in and mobile outreach services. Open 24 hours, 7 days a week.

Montgomery County Commission for Women Counseling & Career Center 240-777-8300
Provides personal counseling, career counseling, couples counseling and classes, seminars and workshops among other services.

Childlink 240-777-GROW (4769)
Information & referral service for children, birth to 5 years old, & their families.

Montgomery County Screenings/Assessment Services for Children/Adolescents 240-777-1430

NON-PROFIT PROFESSIONAL MENTAL HEALTH SERVICES

Affiliated Community Counselors	Medical Assistance	Sliding Fee	Private Insurance	301-251-8965
Affiliated Santé Group (Silver Spring, MD)	Medical Assistance			301-589-2303
Andromeda Transcultural Health Center (NW Washington, DC)	Medical Assistance		Private Insurance	202-291-4707
Catholic Community Services	Medicare	Free Services	Private Insurance	301-942-1790
Family Services Agency, Inc. (Gaithersburg, MD)	Medical Assistance	Sliding Fee	Private Insurance	301-840-3200
Interfaith Counseling Services (locations throughout Montgomery County)		Sliding Fee	Private Insurance	301-869-8428
Jewish Social Service Agency (non-denominational) (locations in MD, DC & VA)	Medical Assistance	Sliding Fee	Private Insurance	301-881-3700
North Community Mental Health Center (NW Washington, DC)	Medical Assistance	Sliding Fee	Private Insurance	202-576-6512
Pastoral Counseling and Care Ministries (Silver Spring & Bethesda, MD)		Sliding Fee	Private Insurance	888-626-2273
Pastoral Counseling and Consultation Centers of Greater Washington (locations in MD, DC & VA)		Sliding Fee	Private Insurance	202-234-0202
Reginald S. Lourie Center for Infants and Young Children (Rockville, MD)	Medical Assistance	Sliding Fee		301-984-4444
St. Luke's House (Bethesda, MD)	Medical Assistance		Private Insurance	301-493-4200
Threshold Services, Inc.	Medical Assistance	Sliding Fee	Private Insurance	301-754-1102
Washington Pastoral Counseling Service (over 15 locations in MD, DC & VA)	Medicare	Sliding Fee	Private Insurance	301-681-3201

Mental Health Association • *A United Way Agency (#8151) Serving Montgomery County Residents* • ***301-424-0656***
www.mhamc.org

MORE THAN JUST "THE BLUES"

AREA HOTLINES

These 24-hour Hotlines can provide additional information, referrals and supportive conversation.

Crisis Link Hotline	**703-527-4077**
Montgomery County Hotline	**301-738-2255**
Mental Health Association – Therapist Line	**301-738-7176**
Montgomery County Youth Crisis Line	**301-738-9697**
Maryland Youth Crisis Line	**800-422-0009**
Montgomery County Crisis Center	**240-777-4000**
National Helpline	**1-800-SUICIDE**
Prince George's County Hotline	**301-864-7161**
Relay Service for the Deaf	**800-735-2258**

SELF-HELP & SUPPORT GROUPS

To find a group near you, call these toll-free numbers:

Depression and Bipolar Support Alliance	**1-800-82-NDMDA**
Depression & Related Affective Disorders Association	**1-888-288-1104**
National Alliance for the Mentally Ill	**1-800-950-NAMI**
National Alliance for the Mentally Ill – Mo. Co.	**301-949-5852**
National Mental Health Association	**1-800-969-NMHA**

HOSPITALS

Most have inpatient and/or outpatient treatment, as well as a list of doctors for referral.

Children's National Medical Ctr	Rockville, MD	**301-424-1755**
Doctors Community Hospital	Lanham, MD	**301-552-8544**
G.W. University Hospital	Washington, DC	**202-741-2888**
Georgetown University Hosp.	Washington, DC	**202-687-8609**
Holy Cross Hospital	Silver Spring, MD	**301-754-7860**
INOVA Fairfax Hospital	Falls Church, VA	**703-776-2916**
Laurel Regional Hospital	Laurel, MD	**301-497-7980**
Montgomery General Hospital	Olney, MD	**301-774-8800**
Potomac Ridge Behavioral Health	Rockville, MD	**301-251-4545**
Psychiatric Institute of Washington	Washington, DC	**202-885-5600**
Suburban Hospital	Bethesda, MD	**301-896-3100**
Washington Adventist Hospital	Takoma Park, MD	**301-891-5600**
Washington Hospital Center	Washington, DC	**202-877-5767**

YOUTH SERVICES CENTERS

Each center serves designated communities

YMCA Youth & Family Services (Bethesda-Chevy Chase, Churchill, Walter Johnson, Whitman HS)			Free Services	301-229-1347
GUIDE Gaithersburg Youth Services (Gaithersburg, Watkins Mill HS)	Medical Assistance	Sliding Fee	No Private Insurance	301-590-9864
GUIDE Olney Youth Services (Magruder, Sherwood HS)	Medical Assistance	Sliding Fee	No Private Insurance	301-774-3581
GUIDE Upcounty Youth Services (Damascus, Northwest, Poolesville, Quince Orchard, Seneca Valley HS)	Medical Assistance	Sliding Fee	No Private Insurance	301-972-0307
Kensington Wheaton Youth Services/MHA (Einstein, Kennedy, Wheaton HS)		Sliding Fee	Free Services	301-933-2818
Rockville Youth &Family Services Bureau (Richard Montgomery, Rockville, Wootton HS)			Free Services	240-314-8310
YMCA Youth & Family Services (Blair, Northwood, Paint Branch, Springbrook HS)			Free Services	301-593-1160

Mental Health Association • *A United Way Agency (#8151) Serving Montgomery County Residents* • ***301-424-0656***

www.mhamc.org

Rev. 10/05

Resources for North Carolina Participants

North Carolina Emergency Crisis Hotlines and Help lines	
HopeLine of North Carolina Crisis Hotline: (919) 231-4525 Crisis Hotline: (800) 844-7410 Teen Talkline: (919) 231-3626 Web: HopeLine of North Carolina	North Carolina Care Line Department of Health and Human Services Elder Abuse Hotline: (800) 662-7030 TTY: (877) 452-2514 Phone: (919) 733-7461 Web: North Carolina Care Line
North Carolina Coalition Against Domestic Violence 123 W. Main Street, Suite 700 Durham, NC 27701 Phone: (919) 956-9124 Phone: (888) 232-9124) Fax: (919) 682-1449 Web: Directory of Locations and Crisis Hotlines	Parents Against Teen Suicide P.O. Box 129 Clyde, NC 28721 Hotline: (800) 367-7287 Phone: (828) 627-1001 Web: Parents Agains Teen Suicide
United Family Services 601 E. Fifth Street, Suite 400 Charlotte, NC 28202 Victim Assistance & Rape Crisis Hotline: (704) 375-9900 Phone: (704) 332.9034 Fax: (704) 943-9548 fax Domestic Violence Program Phone: (704) 332-9034 Fax: (704) 373-1604 Web: United Family Services	
Advocacy Organizations	
Local chapters of Mental Health America (formerly the National Mental Health Association) have information about community services and engage in national and State level advocacy. For more information about the association, write or call:	Mental Health Association in North Carolina 3820 Bland Road Raleigh, NC 27609 Phone: 919-981-0740 Toll-Free: 888-881-0740 Information/Referral Line: 800-897-7494 Fax: 919-954-7238 E-mail: sgoff@mha-nc.org Internet: www.mha-nc.org
The National Alliance on Mental Illness maintains a helpline for information on mental illnesses and referrals to local groups. The local self-help groups have support and advocacy components and offer education and information about community services for families and individuals. For information about the Alliance's affiliates and activities in your State, contact:	NAMI North Carolina 309 West Millbrook Road, Suite 121 Raleigh, NC 27609 Phone: 919-788-0801 Toll-free: 800-451-9682 (Statewide) Fax: 919-788-0906 E-mail: mail@naminc.org Internet: www.naminc.org
State Mental Health Agency For more information about admission, care, treatment, release, and patient follow-up in public or private psychiatric residential facilities, contact your State mental health agency:	Division of Mental Health, Developmental Disabilities, and Substance Abuse Services Department of Health & Human Resources 3001 Mail Service Center Raleigh, NC 27699-3001 Phone: 919-733-7011 Fax: 919-733-9455 Internet: www.dhhs.state.nc.us/mhddsas

Advocacy Organizations Continued	
State Protection and Advocacy Agency Each State has a protection and advocacy agency that receives funding from the Federal Center for Mental Health Services. Agencies are mandated to protect and advocate for the rights of people with mental illnesses and to investigate reports of abuse and neglect in facilities that care for or treat individuals with mental illnesses. These facilities, which may be public or private, include hospitals, nursing homes, community facilities, board and care homes, homeless shelters, jails, and prisons. Agencies provide advocacy services or conduct investigations to address issues that arise during transportation or admission to such facilities, during residency in them, or within 90 days after discharge from them. Contact:	Governor's Advocacy Council for Persons with Disabilities 2113 Cameron Street, Suite 218 Raleigh, NC 27605 Phone: 919-733-9250 Fax: 919-733-9173 Toll-free: 877-235-4210 (Statewide) Internet: www.doa.state.nc.us/doa/gacpd/gacpd.htm
The National Mental Health Consumers' Self-Help Clearinghouse, funded partly by the Center for Mental Health Services, promotes and helps to develop consumer-run self-help groups across the country. Technical assistance and materials are available on such topics as organizing groups, fundraising, leadership development, incorporating, public relations, advocacy, and networking. For more information, contact	The National Mental Health Consumers' Self-Help Clearinghouse 1211 Chestnut Street, Suite 1207 Philadelphia, PA 19107 Phone: 215-751-1810 Toll-free: 800-553-4KEY (539) Fax: 215-636-6312 E-mail: info@mhselfhelp.org Internet: www.mhselfhelp.org
The Consumer Organization & Networking Technical Assistance Center (CONTAC), funded by the Center for Mental Health Services, is a resource center for consumers/survivors and consumer-run organizations across the United States. Services and products include informational materials; on-site training and skill-building curricula; electronic and other communication capabilities; networking and customized activities promoting self-help, recovery, leadership, business management, and empowerment. For more information contact:	Consumer Organization & Networking Technical Assistance Center (CONTAC) P.O. Box 11000 Charleston, WV 25339 Phone: 304-345-7312 Toll-free: 888-825-TECH (8324) Fax: 304-345-7303 E-mail: usacontac@contac.org Internet: www.contac.org

Source:
http://mentalhealth.samhsa.gov/publications/allpubs/stateresourceguides/northcarolina01.asp AND http://www.findcounseling.com/help/hotlines/north-carolina.html

Appendix 6. Work & Health Demographic Survey

Please answer the following questions. Please read all directions prior to each section.

1. Year of Birth ___________

2. Height _____in.

3. Weight ______lbs

4. Education: What is the highest level of education that you have completed? (Place an "x" next to level)

__Less than High School __Bachelors Degree

__High School Diploma __Some Graduate School

__Some College __Master's Degree

__2-year Degree/A.A. __Ph.D./M.D./Terminal Degree

5. Marital Status: (Place an "x" next to status)

__Single __Separated

__Single but Cohabitating __Widowed

__Divorced __Married

6. Handedness: (Place an "x")

__Right-handed

__Left-handed

__Both

7. Race: (Place an "x" next to race)

__American Indian or Alaska Native __White

__Asian __Hispanic or Latino

__Black or African American __Native Hawaiian/Pacific Islander

8. What is your current job title?

____

9. How many hours a week do you work?

__Less than 10hours __10 to 15 hours

__15 to 20 hours __20 to 30 hours __30 or more

10. How long have you held your current job? _____Years ____Months

11. How many jobs do you current hold? _____#

12. How many hours a day do you spend doing typing/computer work?

____4 hours or less

____Between 4 hours and 6 hours

____More than 6 hours

13. Which category best describes your primary occupation?

___Clerical ___Sales (Insurance/Real Estate)

___Management/Administration ___Professional/Technical/Scientist

___Data Entry ___Call Center Worker

___Other ________________________

14. Which category best describes your yearly household income?

___Less than 10,000 ___41,000 to 50,000 ___81,000 to 100,000

___11,000 to 19,000 ___51,000 to 60, 000 ___100,000 or more

___20,000 to 30,000 ___61,000 to 70,000

___31,000 to 40,000 ___71,000 to 80,000

13. List any prescription medications that you are currently taking?

1. ____ Dosage______________________________

2. ____Dosage______________________________

3. ____Dosage______________________________

4. ____Dosage______________________________

5. ____Dosage______________________________

14. List any non-prescription medications that you are currently taking?

1. ____Dosage______________________________

2. ____Dosage_____________________________

18. **How many times a week do you drink any alcoholic beverage?**

___I don't drink

___0-1 times

___1-2 times

___3-4 times

___5 or more times

19. How many times a week do you consume any illegal substance (e.g., marijuana, cocaine)

___I don't drink

___0-1 times

___1-2 times

___3-4 times

___5 or more times

Mark the statements that apply to you regarding your feelings about your primary job?

___I enjoy my job and work hard to do well ___I don't like my job, and just do what I have to do to earn a paycheck

___I enjoy my job, but don't have to work hard ___If my pay depended on my productivity I would work harder

___I don't like my job, but work hard to do well

Appendix 7. Perceived Stress Scale- 10 Item

The questions in this scale ask you about your feelings and thoughts during the last month. In each case, please indicate with a check how often you felt or thought a certain way.

1. In the last month, how often have you been upset because of something that happened unexpectedly?

___0=never ___1=almost never ___2=sometimes ___3=fairly often ___4=very often

2. In the last month, how often have you felt that you were unable to control the important things in your life?

___0=never ___1=almost never ___2=sometimes ___3=fairly often ___4=very often

3. In the last month, how often have you felt nervous and "stressed"?

___0=never ___1=almost never ___2=sometimes ___3=fairly often ___4=very often

4. In the last month, how often have you felt confident about your ability to handle your personal problems?

___0=never ___1=almost never ___2=sometimes ___3=fairly often ___4=very often

5. In the last month, how often have you felt that things were going your way?

___0=never ___1=almost never ___2=sometimes ___3=fairly often ___4=very often

6. In the last month, how often have you found that you could not cope with all the things that you had to do?

___0=never ___1=almost never ___2=sometimes ___3=fairly often ___4=very often

7. In the last month, how often have you been able to control irritations in your life?

___0=never ___1=almost never ___2=sometimes ___3=fairly often ___4=very often

8. In the last month, how often have you felt that you were on top of things?

___0=never ___1=almost never ___2=sometimes ___3=fairly often ___4=very often

9. In the last month, how often have you been angered because of things that were outside of your control?

___0=never ___1=almost never ___2=sometimes ___3=fairly often ___4=very often

10. In the last month, how often have you felt difficulties were piling up so high that you could not overcome them?

___0=never ___1=almost never ___2=sometimes ___3=fairly often ___4=very often

Appendix 8. SF-12 (Short Form)

SF-12 (Short Form)

Question 1	In general, would you say that your health is excellent, very good, good, fair, or poor?	Excellent ○ Very good ○ Good ○ Fair ○ Poor ○
	The following items are about activities you might do during a typical day. Does you health now limit you in these activities? If so, how much?	
Question 2	First, moderate activities such as moving a table, pushing a vacuum cleaner, bowling, or playing golf. Does your health now limit you a lot, a little, or not limit you all?	Limited at lot ○ Limited a little ○ Not limited at all ○
Question 3	Climbing several flights of stairs. Does your health now limit you a lot, a little, or not limit you all?	Limited at lot ○ Limited a little ○ Not limited at all ○
Question 4	During the past four weeks, have you accomplished less than you would like as a result of your physical health?	No ○ Yes ○
Question 5	During the past four weeks, were you limited in the kind of work or other regular activities you do as a result of your physical health?	No ○ Yes ○
Question 6	During the past four weeks, have you accomplished less than you would like to as a result of any emotional problems, such as feeling depressed or anxious?	No ○ Yes ○
Question 7	During the past four weeks, did you not do work or regular activities as carefully as usual as a result of any emotional problems such as feeling depressed or anxious?	No ○ Yes ○
Question 8	During the past four weeks, how much did pain interfere with your normal work, including work both outside the home and housework? Did it interfere not at all, slightly, moderately, quite a bit, or extremely?	Not at all ○ Slightly ○ Moderately ○ Quite a bit ○ Extremely ○
	These questions are about how you feel and how things have been with you during the past 4 weeks. For each question, please give the one answer than comes closest to the way you have been feeling.	
Question 9	How much time during the past 4 weeks have you felt calm and peaceful?	All of the time ○ Most of the time ○ A good bit of the time ○ Some of the time ○ A little of the time ○ None of the time ○

Question 10	How much time during the past 4 weeks did you have a lot of energy?	All of the time Most of the time A good bit of the time Some of the time A little of the time None of the time	○ ○ ○ ○ ○ ○
Question 11	How much time during the past 4 weeks have you felt down?	All of the time Most of the time A good bit of the time Some of the time A little of the time None of the time	○ ○ ○ ○ ○ ○
Question 12	How much time during the past 4 weeks, how much of the time has your physical health or emotional problems interfered with your social activities like visiting with friends, relatives, etc?	All of the time Most of the time Some of the time A little of the time None of the time	○ ○ ○ ○ ○

Appendix 9. Workstyle Scale (Short Form)

Please complete the following survey by checking the boxes that describe your experience at work.

Part 1: Rate the degree to which each of the following items describes you at WORK by selecting the appropriate option

	Almost Never	Rarely	Sometimes	Frequently	Almost Always
1. I can't take off from work because other people at work will think less of me.	[ ]	[ ]	[ ]	[ ]	[ ]
2. I can't take off from work because I'd be letting down or burdening my boss.	[ ]	[ ]	[ ]	[ ]	[ ]
3. I can't take off from work because I'd be letting down or burdening my coworkers.	[ ]	[ ]	[ ]	[ ]	[ ]
4. I can't take off from work because it will negatively affect my evaluations, promotions, and/or job security.	[ ]	[ ]	[ ]	[ ]	[ ]
5. If I take time off to take care of my health or to exercise, my coworkers/boss with think less of me.	[ ]	[ ]	[ ]	[ ]	[ ]
6. I don't really know where I stand despite all the effort I put into my work.	[ ]	[ ]	[ ]	[ ]	[ ]

Rate the degree to which each of the following items describes you at WORK by selecting the appropriate option

	Almost Never	Rarely	Sometimes	Frequently	Almost Always
7. The boss doesn't let you forget it if you don't get your work finished.	[ ]	[ ]	[ ]	[ ]	[ ]
8. If I bring up problem(s) to my supervisor, like a coworker not pulling his/her weight, it won't make any difference anyway, so I just go ahead and do the work myself.	[ ]	[ ]	[ ]	[ ]	[ ]
9. It is frustrating to work for those who don't have the same sense of quality that I do.	[ ]	[ ]	[ ]	[ ]	[ ]
10. I have too many deadlines and will never be able to get all my work done.	[ ]	[ ]	[ ]	[ ]	[ ]

11. Even if I organize my work so that I can meet deadlines, things change and then I have to work even harder to get my work done on time.	[ ]	[ ]	[ ]	[ ]	[ ]
12. My schedule at work is very uncontrollable.	[ ]	[ ]	[ ]	[ ]	[ ]
13. I feel pressured when I'm working at my workstation.	[ ]	[ ]	[ ]	[ ]	[ ]
14. I push myself and have higher expectations than my supervisor and others that I have to deal with at work.	[ ]	[ ]	[ ]	[ ]	[ ]
15. My coworkers don't pull their weight and I have to take up the slack.	[ ]	[ ]	[ ]	[ ]	[ ]
16. Others tell me I should slow down and not work so hard.	[ ]	[ ]	[ ]	[ ]	[ ]
17. I take time to pause or stretch during a typical day at work.	[ ]	[ ]	[ ]	[ ]	[ ]
18. I take breaks when I am involved in a project at my workstation.	[ ]	[ ]	[ ]	[ ]	[ ]

Part 2:

Check all the behaviors/emotions/symptoms that you experience only during periods of high work demands/work load.

19. Anger	[ ]
20. Out of Control	[ ]
21. Have Trouble Concentrating/Focusing on Work	[ ]
22. Depleted/Worn Out	[ ]
23. Overwhelmed	[ ]
24. Short Fuse/Irritable	[ ]
25. Cold feet	[ ]
26. Cold hands	[ ]

Appendix 10. Brief Mood Questionnaire (Original)

		None	Some	Moderate	A lot	Extreme
1.	Please rate your current level of tension?	O	O	O	O	O
2.	Please rate your current level of anxiety?	O	O	O	O	O
3.	Please rate your current level of frustration?	O	O	O	O	O
4.	Please rate your current level of anger?	O	O	O	O	O
5.	Please rate your current level of happiness?	O	O	O	O	O

Appendix 11. Job Requirements & Physical Demands Survey JRPD-24 UE Index

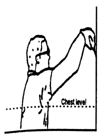


Figure A.

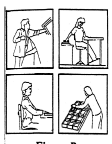


Figure B.

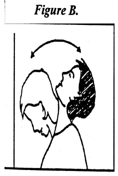


Figure C.

Figure D.

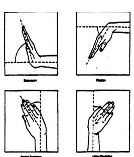


Figure E.

Figure F.

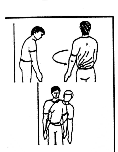


Figure H.

Figure I.

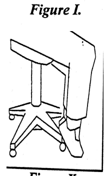
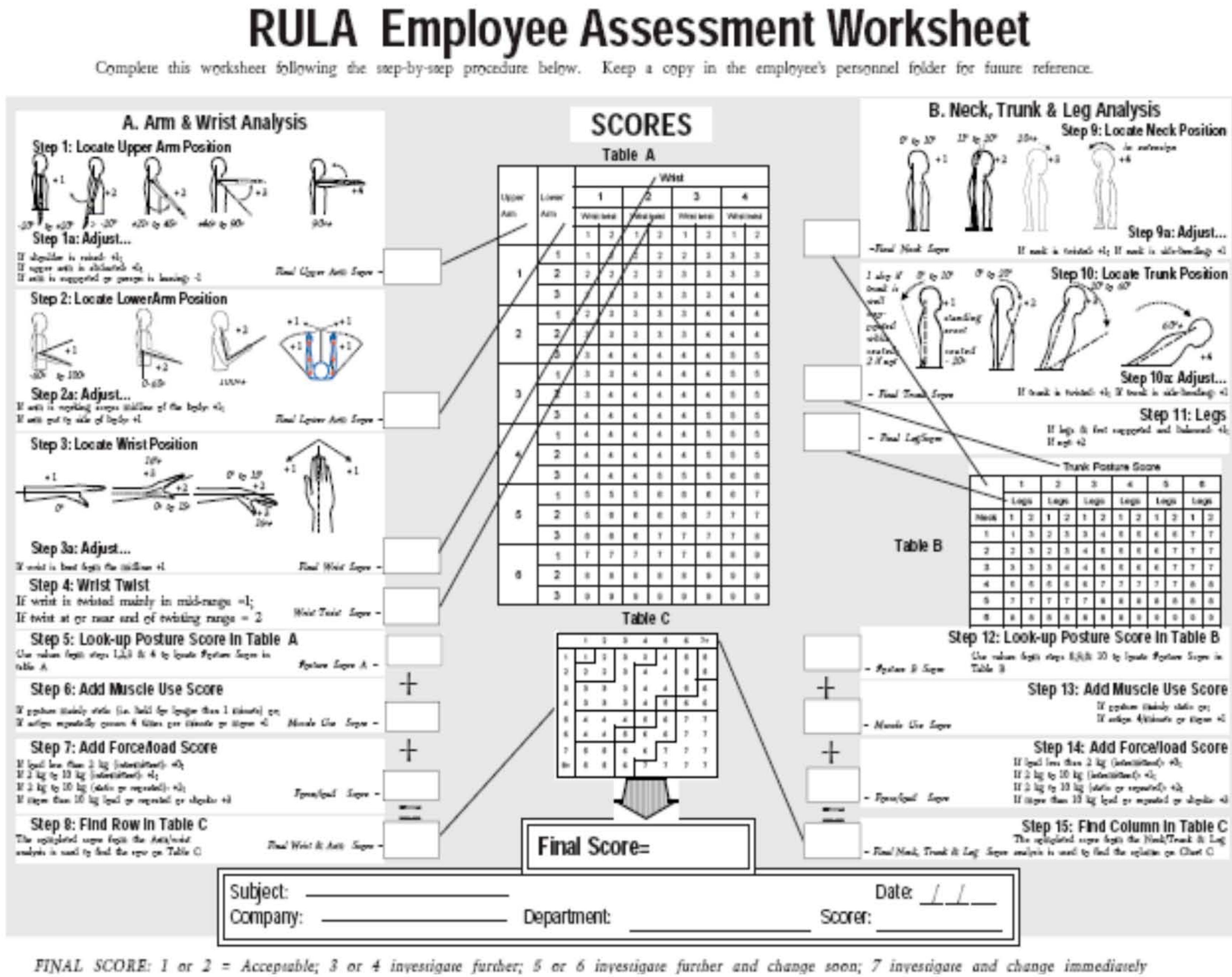


Figure K

Instructions: Instructions: Indicate on average, how long you do this work on a daily (every day or weekly) basis.

Task	More than 4hrs per day	2-4 hrs per day	Less than 2 hrs per day	Less than 5 hrs/Week	Never
1. I work with my hands at or above chest level. (Figure A)	○	○	○	○	○
2. I reach/hold my arms in front of or behind my body (e.g., using Keyboard, filing, handling parts, perform inspection tasks, pushing/ pulling carts, etc). (Figure B)	○	○	○	○	○
3. My neck is tipped forward or backward when I work. (Figure C)	○	○	○	○	○
4. I cradle a phone or other device between my neck and shoulder. (Figure D)	○	○	○	○	○
5. My wrists are bent (up, down, to the thumb, or little finger side) while I work. (Figure E)	○	○	○	○	○
6. I apply pressure or hold an item/material/tool (e.g., screwdriver, spray gun, mouse, etc. in my hand for longer than 10 seconds at a time).	○	○	○	○	○
7. My work requires me to use my hands in a way that is similar to wringing out clothes. (Figure F)	○	○	○	○	○
8. I perform a series of repetitive tasks/movements during the normal course of my work (e.g. using keyboard, tightening fasteners, cutting meat, etc).	○	○	○	○	○
9. The work surface (e.g., desk, bench, etc.) or tool(s) that I use presses into my palm(s), wrist(s), or against the sides of my fingers leaving red marks on or beneath the skin.	○	○	○	○	○
10. My hands and fingers are cold when I work.	○	○	○	○	○
11. I work at a fast pace to keep up with the machine production quota or performance incentive.	○	○	○	○	○
12. I squeeze or pinch work objects with a force similar to that which is required to open a lid on a new jar.	○	○	○	○	○
13. I lean forward continually when I work (e.g., when sitting, when standing, when pushing carts, etc.)	○	○	○	○	○
14. I repeatedly bend my back (e.g., forward, backward, to the side, or twist) in the course of my work.	○	○	○	○	○
15. When I lift, my body is twisted and/or I lift quickly. (Figure H)	○	○	○	○	○
16. I lift and/or carry items with one hand. (Figure I)	○	○	○	○	○
17. I lift or handle bulky items.	○	○	○	○	○
18. I lift materials that weigh more than 25 pounds.	○	○	○	○	○
19. I must constantly move or apply pressure with one or both feet (e.g. using foot pedals, driving, etc).	○	○	○	○	○
20. When I'm sitting, I cannot rest both feet flat on the floor. (Figure K)	○	○	○	○	○
21. I stand on hard surfaces.	○	○	○	○	○
22. I can see glare on my computer screen or work surface.	○	○	○	○	○
23. It is difficult to hear a person on the phone or to concentrate because other activity, voices, or noise in/near my work area.	○	○	○	○	○
24. It is difficult to see what I am working with (monitor, paper, parts, etc).	○	○	○	○	○


RULA Employee Assessment Worksheet
Complete this worksheet following the step-by-step procedure below. Keep a copy in the employee's personnel folder for future reference.
A. Arm & Wrist Analysis
Step 1: Locate Upper Arm Position
Step 1a: Adjust...
Step 2: Locate Lower Arm Position
Step 2a: Adjust...
Step 3: Locate Wrist Position
Step 3a: Adjust...
Step 4: Wrist Twist
If wrist is twisted mainly in mid-range =1;
If twist at or near end of twisting range = 2
Wrist Twist Score
Step 5: Look-up Posture Score in Table A
Step 6: Add Muscle Use Score
Step 7: Add Force/load Score
Step 8: Find Row in Table C
SCORES
Table A
Table B
Table C
Final Score=
B. Neck, Trunk & Leg Analysis
Step 9: Locate Neck Position
Step 9a: Adjust...
Step 10: Locate Trunk Position
Step 10a: Adjust...
Step 11: Legs
Trunk Posture Score
Step 12: Look-up Posture Score in Table B
Step 13: Add Muscle Use Score
Step 14: Add Force/load Score
Step 15: Find Column in Table C
Subject:
Company:
Department:
Date: / /
Scorer:
FINAL SCORE: 1 or 2 = Acceptable; 3 or 4 investigate further; 5 or 6 investigate further and change soon; 7 investigate and change immediately

Appendix 13. Low and High Demand Task Cognition Questionnaire

	Check the box, if you had any of the following thoughts or feelings during the previous task	Mark Here
THOUGHTS		
1.	During the previous task, I was afraid of making mistakes	O
2.	During the previous task, I had thoughts that I am my own worst critic	O
3.	During the previous task, I felt pressured	O
4.	During the previous task, I tried to do my best because that's what I owe to myself	O
5.	During the previous task, I put a lot of pressure on myself	O
6.	During the previous task, I couldn't slow my work pace. It is just not possible	O
7.	During the previous task, I felt that I must work as fast as possible.	O
FEELINGS: During the previous, did you…		
8.	Worry about performance?	O
9.	Worry about being evaluated?	O
10.	Worry about not doing well?	O

Appendix 14. Neutral & High Demand typing task actual text (WORDS 483)

<u>Part I: BEGIN TYPING HERE:</u>

DEPARTMENT OF AGRICULTURE: Agricultural Marketing Service
7 CFR Part 993 [Docket No. AMS-FV-07-0103; FV07-993-1 FR]
Dried Prunes Produced in California; Increased Assessment Rate
AGENCY: Agricultural Marketing Service, USDA. ACTION: Final rule.

SUMMARY: This rule increases the assessment rate established for the Prune Marketing Committee (Committee) for the 2007-08 and subsequent crop years from $0.40 to $0.60 per ton of salable dried prunes.

The Committee locally administers the marketing order that regulates the handling of dried prunes in California. Assessments upon dried prune handlers are used by the Committee to fund reasonable and necessary expenses of the program. The higher assessment rate is needed to offset an anticipated decrease in dried prune production this year. The crop year began August 1 and ends July 31. The assessment rate will remain in effect indefinitely unless modified, suspended, or terminated.

SUPPLEMENTARY INFORMATION: This rule is issued under Marketing Agreement No. 110 and Marketing Order No. 993, both as amended (7 CFR part 993), regulating the handling of dried prunes grown in California, hereinafter referred to as the ``order.'' The marketing agreement and order are effective under the Agricultural Marketing Agreement Act of 1937, as amended (7 U.S.C. 601-674), hereinafter referred to as the ``Act.''

The Department of Agriculture (USDA) is issuing this rule in conformance with Executive Order 12866. This rule has been reviewed under Executive Order 12988, Civil Justice Reform. Under the marketing order now in effect, California dried prune handlers are subject to assessments. Funds to administer the order are derived from such assessments. It is intended that the assessment rate as issued herein was applicable to all assessable dried prunes beginning on August 1, 2007, and continue until amended, suspended, or terminated. This rule will not preempt any State or local laws, regulations, or policies, unless they present an irreconcilable conflict with this rule.

The Act provides that administrative proceedings must be exhausted before parties may file suit in court. Under section 608c(15)(A) of the Act, any handler subject to an order may file with USDA a petition stating that the order, any provision of the order, or any obligation imposed in connection with the order is not in accordance with law and request a modification of the order or to be exempted there from. Such handler is afforded the opportunity for a hearing on the petition. After the hearing, USDA would rule on the petition. The Act provides that the district court of the United States in any district in which the handler is an inhabitant, or has his or her principal place of business, has jurisdiction to review USDA's ruling on the petition, provided an action is filed not later than 20 days after the date of the entry of the ruling.

This rule increases the assessment rate established for the Committee for the 2007-08 and subsequent crop years from $0.40 to $0.60 per ton of salable dried prunes handled.

END TYPING HERE

High Demand typing task actual text (WORDS 708)

Part II: BEGIN TYPING HERE

The California dried prune marketing order provides authority for the Committee, with the approval of USDA, to formulate an annual budget of expenses and collect assessments from handlers to administer the program. The members of the Committee are producers of California dried prunes. They are familiar with the Committee's needs and with the costs for goods and services in their local area and are thus in a position to formulate an appropriate budget and assessment rate. The assessment rate is formulated and discussed at a public meeting. Thus, all
directly affected persons have an opportunity to participate and provide input.

For the 2006-07 and subsequent crop years, the Committee recommended, and USDA approved, an assessment rate that would continue in effect from crop year to crop year unless modified, suspended, or terminated by USDA upon recommendation and information submitted by the Committee or other information available to USDA.

The Committee met on June 28, 2007, and unanimously recommended an assessment rate of $0.60 per ton of salable dried prunes and expenditures totaling $102,523 for the 2007-08 crop years. In comparison, last year's approved expenses as amended in April 2007 were $77,722. The assessment rate of $0.60 per ton of salable dried prunes is $0.20 higher than the rate currently in effect.

The Committee recommended a higher assessment rate based on a production estimate of 95,000 tons of salable dried prunes for this year, which is substantially less than the 187,737 tons produced last year. At this assessment rate the assessment income for the 2007-08 crop years is $57,000. The Committee's budget of expenses of $102,523 includes a slight increase in personnel expenses, and a slight decrease in operating expenses. Combined salaries and expenses are almost two percent higher than last year, or about $65,580. The Committee also included $36,943 for contingencies. Most of the Committee's expenses reflect its portion of the joint administrative costs of the Committee and the California Dried Plum Board. Based on the Committee's reduced activities in recent years, it is funding only ten percent of the shared expenses of the two programs. This funding level is similar to that of last year. The Committee believes carryover funds, plus assessment and interest income, is adequate to cover its estimated expenses of $102,523.

The major expenditures recommended by the Committee for the 2007-08 crop year include $50,505 for salaries and benefits, $15,075 for operating expenses, and $36,943 for contingencies. For the 2006-07 crop year, the Committee's budgeted expenses were $48,662 for salaries and benefits, $15,895 for operating expenses, and $13,165 for contingencies.

The assessment rate recommended by the Committee was derived by dividing the handler assessment revenue needed to meet anticipated expenses by the estimated salable tons of California dried prunes. Dried prune production for the year is estimated to be 95,000 salable tons, which should provide $57,000 in assessment income at $0.60 per ton of salable dried prunes. Income derived from handler assessments, plus excess funds from the 2006-07 crop years should be adequate to cover budgeted expenses.

The Committee is authorized under Sec. 993.81(c) of the order to use excess assessment funds from the 2006-07 crop year (currently estimated at $45,423) for up to 5 months beyond the end of the crop year to meet 2007-08 crop year expenses. At the end of the 5 months, the Committee either refunds or credits excess funds to handlers.

The assessment rate established in this rule will continue in effect indefinitely unless modified, suspended, or terminated by USDA upon recommendation and information submitted by the Committee or other available information.

Although this assessment rate was in effect for an indefinite period, the Committee will continue to meet prior to or during each crop year to recommend a budget of expenses and consider recommendations for modification of the assessment rate. The dates and times of Committee meetings are available from the Committee or USDA. Committee meetings are open to the public and interested persons may express their views at these meetings. USDA will evaluate the Committee's recommendations and other available information to determine whether modification of the assessment rate is needed. Further rulemaking was undertaken as necessary. The Committees' 2007-08 budget and those for subsequent crop years was reviewed and, as appropriate, approved by USDA.

END TYPING HERE

Appendix 15. High demand typing task with errors highlighted (WORDS 708)

Part II: BEGIN TYPING HERE

The California dried prune marketing order provides authority foor the Committee, with the approval of USDA, to formulate an annual budget of expenses and collect assessments frm handlers to administer tehe program. The members of the Committee are producers of California dried prunes. They aere familiar with the Committee's needst and with thie costs for goods ansd services in their local area and are thus in a position to formulate an appropriate budget and assessment rate. The assessment rate is formulated and discussed at a pubblic meetting. Thus, all directly affected prsons have an opportunity to participate and prvide input.

For the 2006-07 and subsequent crop years, the Committee recommended, and USDA approved, an #assessment rate that wold continue in efect from crop year to crop year unless modified, suspended, or terminated by USDA upon recommendation and infrormatoin submitted by the Committee or other information available to USDA.

The Committee met on June 28, 2007, and unanimously reconmended an assessment rateq of $0.60 per ton off salable dried prunes and expenditures totaling $102,523 for the 2007-08 crop years. In comparison, last year's apprved expenses as amended in April 2007 were $77,722. The assessment rate of $0.60 per ton of salable dried prunes is $0.20 higher than thre rate currently in efect.

Teh Committee recommended a higher assessment rate basd on a production estimate of 95,000 tons of salable dried prunes fro this year, which is substantially less than the 187,737 tons produced last year. At this assessment rate the assessment income for the 2007-08 crop years is $57,000.^ The Committee's budget of expenses of $102,523 includes a slght increase in personnel expenses, and a slihgt decrease in operating expenses. Combined salaries and expenses are almst two percent higher thna last year, or about $$$65,580. The Committee also included $36,943 for contingencies. Most of the Committee's expenses reflect its portion fo tehe joint administrative coststs of the Committee and !the California Dried Plum Board. Base’d on the Committee's reduced activities in recnt years, it is funding onyl ten percent of the shared expenses of the tow programs. This funding level is similar to that of last yera. The Committee believves carryover funds, plust assessment and interest income, is adequate to covver its estimated expenses of $102,523.:]

The major expenditures recommended by the Committee for the 2007-08 crop year includde $50,505 for salariesy and benefits, $15,075 for operating expenses, and $36,943 for contingencies. Fro the 2006-07 crop year, the Committee's budgeted expenses wree $48,662 for salaries ansd benefits, $15,895 for operating expenses, and $13,,165 for contingencies.

The assessment rate recommended by the Committee wsa derived by dividing the handler assessment revenue needd to meet anticipated expenses by teh estimated salable tons of Callifonrnia dried prunes. Dried prune production foor the year isd estimated to be 95,000 salable tons, which should provide

$57,000 in assessment income at $0.60 per ton of salable dried prunes. Income derived fromm handler assessments, pluss excess funds from the 2006-07 crop years should be adequate to cover budgeted expenses..

The Committee is authorized under Sec. 993.81(c) of the order to usse excess assessment funds from the 2006-07 crop year (currently estimated at $45,423) for up to 5 months beyond,dd the end of the crop yeaer to meet 2007-08 crop year expenses. At the end of the 5 months, the Committee either refunds or credits excess funds to handlers.,

The assessment rate estab:lished in this rule willl continue ins effect indefinitely unless modified, suspended, or terminated by USDA upon recommendation and information submitted by the Committee orr ohther available information..

Although this assessment rate willh be in effect fro an indefinite period, the Committee will continuez to meet prior to or during each crop year to recommend a budget of expenses and consider recommendations forg modification of the assessment rate. The dates and timez of Committee meetings are available from the Committee or USDA. Committee meetings arex open to the pubulic and interested persons mya express their views at these meetings. USDA will evaluate the Committee's recommzendations and other available information to detremine whether modification of the assessment rate is needed. Further rulemaking was undertaken as nezessary. The Committees' 2007-08 budget and those for subsequent crop years was reviewed and, as appropriate, approved byUSDA.

<u>END TYPING HERE</u>

Appendix 16. Permission to reprint Workstyle model.

Mail From: Michael Feuerstein

File Edit View Actions Tools Window Help

Close Reply Forward

Mail Properties Personalize

From: Michael Feuerstein 12/17/2007 7:11 PM

To: Harrington, Cherise

Subject: Re: Permission to reprint Workstyle Model

Cherise

You have my permission to use the figure for this purpose. You also need to obtain approval from the publisher.

Dr Feuerstein

Michael Feuerstein, Ph.D., MPH, ABPP
Professor
Departments of Medical and Clinical Psychology
and Preventive Medicine and Biometrics
Uniformed Services University of the Health Sciences
4301 Jones Bridge Rd.
Bethesda MD 20814-4799
Ph: 301-295-9677
Fax: 301-295-3034
e mail: mfeuerstein@usuhs.mil

>>> Cherise Harrington 12/17/07 6:18 PM >>>
Dr. Michael Feuerstein

In my dissertation titled "Biomechanical, mood, and cortisol response to work demands in office workers with high and low workstyle," your workstyle model from your 1996 article is being used. This is a request to reprint your model in its entirety. Following completion of my dissertation project, this document will be available for public view.

Thank you for your consideration in this matter

Cherise B. Harrington

Cherise B. Harrington, MS
Ph.D. Candidate
Medical Psychology
Uniformed Services University of Health Sciences
4301 Jones Bridge Road
Bethesda, MD
(301) 295-9659
charrington@usuhs.mil

start 2 Novell Gr... 2 Windows... 2 Microsoft... EndNote X (... Google 7:46 PM

Appendix 17. Institutional Review Board Approval Form

UNIFORMED SERVICES UNIVERSITY OF THE HEALTH SCIENCES
4301 JONES BRIDGE ROAD
BETHESDA, MARYLAND 20814-4712
www.usuhs.mil

April 17, 2008

MEMORANDUM FOR MS. CHERISE B HARRINGTON, , MEDICAL AND CLINICAL PSYCHOLOGY

SUBJECT: Final Institutional Review Board (IRB) Approval (DoD Assurance No. P60001 and FWA # 00001628) of T072JQ for Human Subject Participation

Congratulations! Your no more than minimal risk research protocol T072JQ entitled, "***Workstyle, Ergonomic, and Cortisol Response to Work Demands During Computer Work*** ," was given full review by the Uniformed Services University Institutional Review Board (IRB) on March 13, 2008 and was approved pending revisions stipulated by the IRB. These revisions have been received and reviewed and are approved. **Your approval expires on March 12, 2009.**

The purpose of this study is to identify differences in indicators of physiological and psychological stress responses that might exist by workstyle. This study will investigate the relationship among workstyle score, physiological stress activation (i.e. salivary cortisol), and psychological response to high work demands in a simulated, high-demand work environment (i.e. distress, keyboard force, accuracy, and efficiency of work).

The PI has completed the stipulations for this study from the 13 March 2008 convened IRB.

Authorization to conduct this protocol will automatically terminate on March 12, 2009. If you plan to continue with data collection or analysis beyond this date, please submit a USU form 3204A/B (continuing review) to the Office of Research by **January 11, 2009**. Though we will attempt to assist you by sending you a reminder, this reporting requirement is your responsibility.

You are required to submit amendments to this protocol, changes to the informed consent document (if applicable), adverse event reports, and other information pertinent to human participation in this protocol to this office for review. No changes to this protocol may be implemented prior to IRB approval.

If you have questions regarding specific issues on your protocol, or questions of a more general nature concerning human participation in research, please contact me at 301-295-0819/9534 or mpickerel@usuhs.mil.

Margaret Pickerel

Margaret Pickerel
Institutional Review Board Coordinator

cc: REA
Chair, MPS
File

Learning to Care for Those in Harm's Way