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Decreasing Bouts of Prolonged Sitting Among Office Workers

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Decreasing Bouts of Prolonged Sitting Among Office Workers

by

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Bachelor of Arts
Psychology
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The undersigned committee, having examined the attached thesis,
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Abstract

Title: Decreasing Bouts of Prolonged Sitting Among Office Workers

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Health care costs of preventable diseases such as cardiovascular disease, type II diabetes, and obesity are higher than ever, and indicate the need for behavioral interventions. Research has shown that individuals who sit for extended periods are at higher risk for these diseases. Moreover, the risks associated with sitting have been found to be independent of an individual's physical activity. That is, longer durations of sitting per day are associated with higher levels of unwanted health risks, regardless of how often an individual exercises. There is a need to address this issue in today's inactive workplace. Research indicates that office workers sit for more than 70% of their workday. The current study assessed how successful antecedent and consequence-based interventions are at motivating compliance with the recommendation that office workers should take a break from prolonged sitting every 30-60 min. Results revealed the information alone was not as effective as a treatment package consisting of feedback and goal setting to reduce bouts of prolonged sitting.

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Keywords

prolonged sitting

sedentary behavior

prompting

feedback

goal setting

bouts

occupational health

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CHAPTER 1

Decreasing Bouts of Prolonged Sitting among Office Workers

The current health status of Americans is daunting. A recent analysis (Ogden, Carroll, Kit & Flegal, 2014) of the 2010 National Health and Nutrition Examination Survey reported that 2/3 of adults in the United States are overweight, 34.9% are obese, and 6.4% are extremely obese. These data are on the rise and do not show any indication of leveling off or decreasing in the near future. Owen, Healy, Matthews, & Dunstan (2011) confirm similar numbers among adults in the United Kingdom and Australia. A number of other health conditions are correlated with obesity including type II diabetes and cardiovascular disease (CVD). Wilmot et al. (2012) documented 18 studies that determined these diseases are correlated with high levels of sedentary behavior. Further, mortality is higher as durations of sedentary behavior increase. That is, the more an individual sits, the higher the risk of premature death (van der Ploeg, Chey, Korda, Banks, & Bauman, 2011).

These statistics are of great concern as obesity is a preventable disease, often described as a result of poor food choices and living an inactive lifestyle. Today's typical work demands are characterized by low energy expenditure (e.g., computer work while seated at a desk) and have increased over recent decades (Church et al., 2011). The modern work environment promotes sedentary behavior. That is, for employees to complete their work, they must be in a seated position for many hours

throughout the day. This type of sedentary work is associated with musculoskeletal disorders (MSDs).

MSDs are work-related injuries that “affect the muscles, nerves and tendons” (BLS, 2015). Common symptoms include neck and shoulder pain (Brandt et al., 2014), and lower back pain (Spyropoulos et al., 2007). The prevalence of these reported symptoms are high in workers that use a computer for greater than 7 hours per shift (Cho, Hwang, & Cherng, 2012). Thorp, Kingwell, Owen & Dunstan (2014) found that these symptoms were alleviated when office workers alternated sitting work with standing work every 30 min. Addressing sedentary behavior in the workplace and how these symptoms can be prevented is important to discover interventions that can lead to improvements in occupational health.

Sedentary Behavior

Definitions

Sedentary behavior is defined in multiple ways. For example, Pate, O’Neill, and Lobelo (2008) define sedentary behavior as “activities that do not increase energy expenditure substantially above the resting level and includes activities such as sleeping, sitting, lying down, and watching television, and other forms of screen-based entertainment” (p.174). The Sedentary Behavior Research Network defines sedentary behavior as “any waking activity characterized by an energy expenditure of less than or equal to 1.5 metabolic equivalents and a sitting or reclining posture” (SRBN, para. 1).

Metabolic equivalents (METs) are common units that measure physical activity levels. METs are units that serve as the basis for the physical activity recommendations made by the Center for Disease Control (2014) and American College of Sports Medicine ([ACSM], 2014). “One MET is the energy cost of resting quietly, often defined in terms of oxygen uptake” (Pate et al., 2008, p.174). Sedentary behavior is defined as 1.0-1.5 METs. Light-to-vigorous physical activity (LVPA) ranges from 1.6-2.9 METs. Moderate-to-vigorous activity (MVPA) ranges from 3.0-6.0 METs. Any activity >6 METs is considered vigorous activity (Ainsworth, 2000). Tudor-Locke and Bassett (2004) suggest an index of physical activity levels using steps counts. Their classification defines a sedentary lifestyle as <5000 steps/day.

Prevalence

Regardless of the measurement unit, of greater importance is how much sedentary behavior occurs on a daily basis at work or at home. Parry and Straker (2013) found that in a group of 50 office workers, 81.8% of work hours were considered sedentary. The authors also found that the number of sedentary bouts (>30 min) were significantly higher during the workdays when compared to non-workdays. Matthews et al. (2008) found that participants (n = 6,329) spent 7.7 hours per day in sedentary behavior, with 60% of waking time spent sedentary. Thorpe et al. (2010) noted that office workers spend 77% of the working day sitting. The study also found varying levels of physical activity between groups of workers, along with differing amounts of breaks in sitting. Of the three groups surveyed, participants often reported

that they were meeting minimum physical activity recommendations when they in fact were not.

These recent findings are characteristic of the workforce in developed nations. Church et al. (2011) analyzed trends in the types of jobs over the past 50 years. The authors found that the proportion of both sedentary (<2 METs) and light-activity (2.0 – 2.9 METs) jobs have increased in the United States' private sector. The number of moderate-activity jobs (≥ 3.0 METs) has decreased by over 20% in the same period. The authors also found that daily energy expenditure has decreased on average by over 100 calories. With this finding, the authors suggest a portion of the increase in obesity is accounted for by these data.

In a review paper on sedentary behavior, Owen et al. (2011) suggest that understanding the environmental determinants of sedentary behavior is important in future research, as much physiological research has well-documented the effects of prolonged sitting. Many group design studies have aimed to uncover these environmental variables. Chastin, Dall, Tigbe, Grant, and Ryan (2009) assessed how well postal workers in the UK were adhering to current physical activity recommendations. Not surprisingly, results showed that 77% of “active” postal workers (those delivering mail) and 28% of “inactive” (office) postal workers met the 10,000 steps per day recommendation (Tudor-Locke & Bassett 2004). In addition, 15% of active postal workers met the MVPA guidelines (30 min of moderate activity/5x week, ACSM 2014). Only 5% of office postal workers met these criteria.

Only one active postal worker, and zero inactive postal workers, met ACSM guidelines.

Risks

The effects of sedentary behavior and prolonged sitting are noted in a landmark study by van der Ploeg et al. (2012). With a survey given to 222,497 participants, the investigators sought to determine the relationships between sitting and all-cause mortality (i.e., all known reasons for an individual's cause of death). Findings indicated that as prolonged sitting increased, an individual's chance of mortality increased as well, independent of one's own physical activity levels. That is, being moderately physically active according to MVPA guidelines (30 min of exercise per day, 5 times per week), does not reduce the risk for early death.

For example, an individual may exceed MVPA guidelines each week. However, if this individual sits for over 11 hours/day, the risk of death for this person is greater when compared to another individual who meets minimum MVPA guidelines but engages in less sedentary activity (e.g., 0 – 4 hours) throughout the day. The work by van der Ploeg et al. (2012) was important as it documented the effects of prolonged sitting independent of recommended MVPA guidelines. Not surprisingly, as individuals engaged in more physical activity/week, the risk for death decreased. The key finding that set this study apart from others is that, for all MVPA activity levels (i.e., 0, 1-149, 150-299, ≥ 300 minutes/week) the risk of death increased with increasing levels (i.e., 0 – ≤ 4 , 4 – < 8 , 8 < 11 , ≥ 11 hours/day) of sitting. These results were further strengthened by the fact that this study controlled for sex, age, education,

body-mass index (BMI), smoking, location of residence, self-related health status and disability.

Katzmarzyk (2009) found that the more time spent sitting, the higher the risk of premature mortality. Similar to van der Ploeg et al. (2012), variables such as body mass index (BMI), smoking, and physical activity levels were controlled. In a cohort of American adults, Patel et al. (2010) found similar results. On the effects of standing, Katzmarzyk (2013) found in a cohort of approximately 17,000 Canadian adults that greater amounts of standing were associated with lower mortality. The findings were similar when comparing inactive adults with physically active adults. In turn, Katzmarzyk suggests that standing more may be a healthier alternative for inactive adults. While the research has yet to document any health risks associated with standing as a replacement for prolonged sitting, the current health risk associated with engaging in predominantly sedentary behavior appears more than the risks associated with predominantly standing.

While health recommendations of sitting time are yet to be standardized, Chau et al. (2013) found in a meta-analysis that physical activity (when meeting MVPA guidelines) appears to attenuate some of the effects of prolonged sitting. However, as sitting increases so does the risk of mortality from all causes (e.g., cardiovascular disease). The study found that risks for earlier death increased when adults sat for greater than 7 hours/day.

Hamilton, Hamilton, and Zderic (2007) suggest that public health campaigns aimed at reduction in overall sitting time and prolonged sitting bouts may not exist

because of the current limited research base on the topics. This is of practical importance as numbers of low caloric expenditure jobs have increased over the past 50 years (Church et al., 2011). Hamilton et al. (2007) suggest an inactivity paradigm that consists of four tenets: (1) sitting more and performing less non-exercise activity increases once risk of mortality, (2) various times that people spend sitting or participant in exercise-based leisure-time physical activity are distinct classes of behavior, with distinct determinants and independent effects on risk for disease, (3) there are different physiological responses involved in prolonged sitting and light exercise, and (4) cohorts of people who do not exercise have higher risks of health issues which are not caused by exercise deficiency (p. 2656). Further, the authors found that of the physiological studies they reviewed, the risks of CVD, heart disease, diabetes, “inactivity (sitting) and low non-exercise activity may produce serious health problems...cannot be simply be explained by exercise deficiency” (p. 2659).

Physiological Studies

While higher risk of death is related to increased levels of prolonged sitting, the immediate physical effects of sitting are documented as well. Thosar (2014) describes endothelial function (i.e., healthy blood flow) as a marker of cardiovascular risk. Thosar conducted two studies describing the physiological benefits of taking regular breaks. In controlled trials, one group of participants took breaks every 30 min, and the other group sat for 3 consecutive hours. Blood flow was measured in the femoral artery. For the group that took 30-minute breaks, blood flow did not decrease. This indicates that regular breaks in prolonged sitting are beneficial for blood flow.

Thosar (2014) recommends limiting overall sitting time, take frequent breaks every 30 min, and avoid prolonged sitting after consuming high sugar and high fat foods. While the duration of a recommended break is yet to be established, Thosar recommends any physical activity that breaks the “sitting pattern”. Healy et al. (2007) found that light-physical activity (LIPA) “is beneficially associated with blood glucose and that sedentary time is unfavorably associated with blood glucose.” This statement describes a significant finding in terms of obesity and diabetes. This was the first study to objectively measure levels of activity as they relate to blood glucose measures, instead of relying on self-report to compute correlations. This study suggests that LIPA may be good substitution for sedentary time.

Duvivier et al. (2013) observed that engaging in minimal intensity physical activity (MIPA) showed decreases in triglycerides and improvements in insulin control when compared to separate condition of sitting and exercise. The authors suggest that “one hour of daily physical exercise cannot compensate for the negative effects of inactivity on insulin sensitivity and plasma lipids if the rest of the day is spent sitting” and then stating “...a minimal daily amount of non-sitting time should also be promoted” (p.7).

Healy et al. (2008a) found that frequent breaks were associated with certain health benefits. Breaks were defined as accelerometer counts that were ≥ 100 counts/min that interrupted sedentary activity (i.e., accelerometer counts of < 100 counts/min; cut off points greater or less than 100 counts/min are common in this type of research). Results indicated that frequent breaks were correlated with a lower waist

circumference, lower BMI and benefits in metabolic markers such as triglycerides and 2-hour plasma glucose uptake (i.e., individuals who take more breaks can clear sugar out of the bloodstream faster than those who do not take as many breaks). This indicates that the more frequent breaks an individual takes, the greater the physical benefit. As a result, it is not only important to consider the amount of sedentary behavior an individual engages in, but how that time in a sedentary position is distributed. The authors stated that breaks might be easy to implement in the workplace as each break requires minimal time engaged in physical activity. A limitation cited in this study was the arbitrary assignments of quartile breaks. That is, an accelerometer count of 1 was considered “active,” a break in sedentary activity, which is not an indicator of the amount of time engaged in active behavior. The authors note that more research is needed to uncover the casual variables responsible for sedentary and physically active behavior. While Healy et al. (2008a) addressed the physical benefits of routinely taking breaks, what is lacking is the manipulation of environmental variables to increase breaks. The current study addresses this issue.

The results of Healy, Matthews, Dunstan, Winkler, and Owen (2011) also suggest reducing extended durations of sedentary activity should lead to decreases in risks for cardiovascular disease (CVD) and related diseases. While the authors found that certain biomarkers (e.g., C-reactive protein) were inversely associated with prolonged sitting time, the study also confirmed the findings of Healy (2008b) that the accumulation of prolonged sitting is equally important in predicting biomarkers just as

the total amount of time spent sitting. Breaks in this study could be as “short as 1 min”, but the authors did not formally control the break durations in their study.

Latouche et al. (2012) studied the effects of breaking up prolonged sitting by having participants either engage in LIPA or MVPA, and observing the effects on cardiometabolic risk markers. Individuals were assigned to one of the following conditions: (1) uninterrupted sitting, (2) prolonged sitting plus light intensity activity breaks, or (3) prolonged sitting plus moderate activity breaks. Activity breaks required participants to walk on a treadmill for two min. The moderate activity group had a faster treadmill speed than the light activity group. Results indicated that interruptions (i.e., every 20 min) of sitting led to significant reductions in postprandial glucose and insulin, irrespective of physical activity intensity. These results indicate that CVD risks may be reduced by replacing sedentary activity with LIPA or MVPA. Alternatively, sitting is related to higher levels of postprandial glucose and insulin responses.

Break Guidelines

Healy et al. (2008b) conducted a study to objectively measure sedentary behavior, light intensity- and moderate-to-vigorous activity with a hip-placed accelerometer. The authors found a strong negative correlation between sedentary behavior and light-intensity activity. This finding suggests brief bouts of light activity such as walking may be an acceptable substitute for sedentary behavior. Citing these data as correlational, the authors suggest that behavioral mechanisms should be

determined. Again, the current study addresses the need for understanding what variables can produce changes in physical activity in a person's day.

Current standing break recommendations vary. In the Australian health campaign, *Worksafe Victoria*, information stated that workers should take brief activity breaks every 20-30 min, lasting 20-30s (Worksafe Victoria, 2006). Atlas and Deyo (2001) recommended for patients experiencing low back pain to take a break every 30 min and walk around. Rutten, Savelberg, Biddle, and Kremers (2013) recommended one 5-min break every 30 min. Owen, Bauman, and Brown (2009) state that "commonsense" should indicate a need to take a 5-min break every hour. Owen et al. (2009) also mention that we should be thinking about how to break up the 15.5 hours of waking time everybody has.

McLean, Tingley, Scott, and Rickards (2000) found that regularly scheduling "microbreaks" in a simulated office environment showed beneficial effects of reporting on pain discomfort. That is, participants reported being in less neck, low back, shoulder, and forearm pain when taking both 20- and 40-min microbreaks. Interestingly, the authors found that when breaks were regularly scheduled, rather than allowing participants to take breaks on their own, participants had less discomfort. Further, productivity was not lost during 30-s breaks.

Ryan, Grant, Dall, and Granat (2011) assessed compliance with different recommended guidelines for breaking up prolonged sitting, and required participants to take 20-, 30-, or 55-min breaks. The authors found that adherence to recommendations were low and cited that making the recommendations as "clear" was

important. The authors noted that the 55-min recommendation should be more motivating because it was more achievable. However, given the design of the study, the number of intervals was reduced to 7 bins, thus it is mathematically easier to adhere to this guidelines or be more “compliant”. The authors concluded, “There is a need for future research to investigate if adverse sitting behavior could be reduced in the workplace using simple environmental interventions.” This study lacked isolating variables that were responsible for behavior change. That is, participants received compliance guidelines and began wearing the measurement devices simultaneously. The current study separates these variables and addresses the differences in compliance of break recommendations over time.

Verweij, Proper, Weel, Hushof, and Mechelen (2012) conducted a 6-month study on adherence to physical activity guidelines. The authors conducted a questionnaire 6-months apart with intervention and control groups. Results indicated that the intervention group, who were told about the importance of breaking up their sitting at work, reported an average reduction of 15 min per day in sedentary behavior. The authors also noted the need for objective measurement of sedentary behavior. The current study will not only use verbal report of sedentary behavior (i.e., with the use of a social validity questionnaire), but also objectively measure sedentary behavior.

In a unique study, Otten, Jones, Littenberg, and Harvey-Berino (2009) investigated how decreasing TV viewing time might have an impact indirectly on sedentary behavior. The dependent variables used were energy expenditure, BMI, changes in energy balance, and energy intake. Participants were randomly assigned to

a control and intervention group following baseline. Baseline consisted of measuring the average amount of television viewing time per week, over a 6-week period, for each participant. For participants in the intervention condition, allotted viewing time was reduced by 50% relative to baseline (e.g., 20 hours of viewing time/week were reduced to 10 hours/week). When the participants reached their allotment for the week, the TV had a device that “locked” the TV out until the beginning of the new week. The authors found that the intervention group had significant increases in estimated energy expenditure and decreases in sedentary activities (<1METs).

Multi-component Interventions

Gardiner, Eakin, Healy, and Owen (2011) aimed to decrease sedentary time in a population of elderly adults (>60 years/old) with the use of treatment package consisting of self-monitoring, goal setting, feedback, and a formulation of an action plan. Results showed that the group (n = 59) decreased their sedentary time and increased the number of breaks in sedentary behavior per day. However, the controlling variables remain unclear due to the nature of numerous variables being introduced at once. For example, feedback on accelerometer use was not controlled for as this information was mailed to all participants. Overall, individual effects of the treatment package remain obscured. This study was unique as it reported on using surveys to assess whether or not participants enjoyed the intervention. Results indicated that 97% of participants reported an 8/10 or higher on the post-study satisfaction survey, with 10 being the most satisfied with the program.

Kozey-Keadle, Libertine, Staudenmayer, and Freedson (2012) investigated the feasibility of measuring sedentary behavior and how much reduction in sedentary activity could be achieved with one-week of intervention. During baseline, participants wore a physical activity measurement device for 7 days and were instructed to engage in their regularly scheduled weekly activities. The intervention phase consisted of participants receiving information on the benefits LPA, health risks associated with sedentary behavior, a packet of preventative strategies, a checklist (self-monitoring), consultation to reduce any barriers to active behavior, a pedometer (visual feedback) to wear, goal setting, and instructions on how to accumulate steps in 5-15 min intervals. The intervention resulted in an approximately 5% reduction in sedentary behavior (i.e., 48 min during a 16-day period). Further, some participants reported that the step goals were too high, and it should be noted that goals were not set relative to baseline levels. The authors noted that individual goal setting should be considered. In addition, the authors recommended that the use of instantaneous (quantitative) feedback on sedentary activity might be useful as well. The authors concluded that it is feasible to monitor, and change sedentary behavior. However, what is responsible for the sedentary behavior change is unknown due to the number of variables introduced simultaneously.

Healy et al. (2013) investigated the effects of a 4-week information intervention. The intervention consisted of 3 health phrases (i.e., “Stand up, Sit Less, Move more”), along with a 45-min consultation, feedback on study progress given twice each week, and a “standing tip of the week”. Results indicated the intervention

reduced workplace sitting greater than two hours for the intervention group. The authors also found that more sit-and-stand transitions occurred with the intervention. The above multi-component interventions lack experimental control of decreasing sitting. The current study aims to demonstrate experimental control of bouts of prolonged sitting by manipulating one variable in each experimental phase.

Research Among Office Workers

Cooley and Pedersen (2013) studied the effects of prompting on nonpurposeful movement. Nonpurposeful movement can be loosely defined as any physical activity unrelated to the current work environment. Office workers either had a software program (Exertime; Pedersen and Cooley, 2012) automatically run on their computer (passive prompt condition) or participants had to start the program themselves at the beginning of the workday (active prompt condition). When a timer went off, a screen appeared on the computer screen and prompted the individual to engage in a brief exercise (e.g., walking stairs, doing push-ups, stretching). Participants were also exposed to information on the benefits of breaking up sitting, as well as general health guidelines during pre-intervention. The authors found that employees in the passive prompt condition were five times more likely to complete a work break. That is, when the Exertime program filled up the employees' screen, they were more likely to report physical activity engagement.

These results are encouraging, however, the study did not record if any physical activity actually took place. That is, the software program required participants to log if they engaged in a physical activity, and if so, what type of

activity. In addition, participants were reminded by a researcher with a phone call once a week to accurately report that data. Similarly, Smith, Pedersen, and Cooley (2013) found that when an experimental group received information on the importance of moving throughout the workday and taking standing breaks, compliance with Exertime software was much higher than for the group that did not receive the same information.

Evans et al. (2012) studied the effects of point-of-choice (PoC) prompts to reduce sitting at work. PoC prompts were delivered with software (MyRestBreak 1.0, Vikram Sharma). Groups either: (1) received information (the benefits of breaking sitting and health risks involved with prolonged sitting) and (2) the other group received information and prompting software. Results indicated there was no difference on total time spent sitting. However, both the number of, and the time spent sitting in prolonged sitting periods (30 min) were reduced in the group that had the PoC software. Whether or not the participants were responding to the software or pre-intervention education is also unclear. The current study addresses these issues by introducing health information in its own experimental phase.

Pronk, Katz, Lowry, and Payfer (2011) found total sitting time could be significantly reduced when individual standing desks were made available to office workers. The intervention group reduced non-sitting time by over an hour each day when the environment was arranged to provide employees the opportunity to complete work while standing. Gilson, Suppini, Ryde, Brown, and Brown (2012) evaluated the same environmental manipulation however standing desks were available to a group

rather than changing an employee's work station from a sitting desk to a standing desk. The researchers arranged an office work environment to include a pod, or grouping, of 4 height-adjustable desks in a designated office location. The authors found minimal differences in the amount of sedentary behavior when comparing baseline to intervention. Desk use varied from individual to individual, however there were no data collected on the opportunities for employees to use the height adjustable desk(s). That is, 11 employees participated in the study, but only 4 desks were available to use. Thus, not all participants could use the standing desks simultaneously. The current study is not limited by these opportunities to stand and work, as each participant is able to freely break bouts of prolonged sitting.

Applied Behavior Analysis Research

In the current behavioral literature, no studies exist on breaking up instances of prolonged sitting at work. Applications to health behaviors have been limited. Anderson and Goss (1998) also noted that single-subject designs are needed to evaluate effective health interventions. Since that time, Van Camp and Hayes (2012) made a call for action for additional research regarding physical activity.

An attempt to understand the functional relation between physical activity and the environment was studied by Hyusti, Normand, and Larson (2012). The authors manipulated the children's playground environment in an attempt to increase the physical activity of children. The research showed that the fixed equipment (e.g., jungle-gym) condition produced the highest levels of MVPA when compared to other conditions, such as open spaces and outdoor toys made available.

VanWormer (2004) measured physical activity with pedometers and tracked individual weight in obese participants. With the use of self-monitoring and goal setting (GS), a functional relation was demonstrated between self-monitoring and physical activity for two out of three participants. Overall weight change was negligible (3 lb loss, 12 lb loss, and no weight loss across three participants) given the length of the study (greater than 45 days), however its application to increase healthy behaviors was unique. Normand (2008) also investigated how to increase physical activity through the use of self-monitoring, GS, and feedback (FB). Normand found that three out of four participants increased their steps with this intervention. Donaldson and Normand (2009) sought to increase caloric expenditure in obese adults using a similar treatment package. This intervention consisted of a heart rate monitor with and without FB, GS, and self-monitoring. All five participants receiving the intervention increased caloric expenditure. Finally, Hyusti et al. (2011) conducted a behavioral assessment with obese school children. Their study provided evidence that FB and GS can be effective to promote healthy behavior change across age groups.

FB and GS are common motivational strategies used in behavioral research. FB is defined as “information about behavior or performance that allows a person to change his/her behavior.” This information is typically delivered following a target behavior. GS is “defining a specified, or preset, level of performance to be attained” (Daniels & Bailey, 2014).

Kurti and Dallery (2013) increased walking in sedentary adults with the use of GS and internet-based contingency management. When participants met step goals,

they were rewarded with a monetary consequence. Two experiments by Kurti and Dallery (2013) increased overall step goals by 182% and 108% relative to baseline. Wack, Crosland, and Miltenberger (2014) increased running distance for all 5 participants in the study by the use of FB. Participants increased miles ran per week with the implementation of either daily or weekly FB, and GS.

Purpose of Current Study

The purpose of the current study determined what environmental variables may or may not occasion interruptions on prolonged bouts of sitting. This study evaluated the effects of two antecedent interventions: (1) rules/information and (2) a prompt, in addition to one motivational intervention (3) GS and FB. The first two interventions are best conceptualized as antecedent interventions, and the third as a consequence-based intervention. The arrangement of experimental conditions allowed the experimenter to briefly compare the effectiveness of antecedent-based procedures against consequence-based procedures.

Current research has indicated the need to understand the determinants of sedentary and physically inactive behavior. Studies cited above included a wide variety of treatment packages, so it remains unclear what variables were necessary or sufficient for decreasing sedentary behavior and/or increasing breaks in sedentary behavior. This study adds to the literature base and will attempt to fill these gaps by using a repeated-measures design, manipulation, and evaluation of one variable at a time.

CHAPTER 2

Method

Participants and Setting

Three participants for this study were recruited from the Florida Institute of Technology (FIT). A participation survey was given to an office administrator to post on FIT's internal discussion board. Participants were full-time employees that work in an office setting. The study took place in a small southeastern university campus, specifically in each participant's office/cubicle. Claudia, Pat and Gretchen were all female, full-time university employees and 44-, 59-, and 20-years old, respectively. A demographic survey was administered at the beginning of the study and revealed that all participants were 'somewhat' to 'very interested' in improving their health and participants reported varying levels (e.g., 51 – 300 min per week) of exercise (See Appendix A). Participants reported 70-85% of their work was at their personal computer, that 83-93% of work time was spent sitting, and that 2-5% was spent standing (See Appendix B). Work time at the computer was not formally measured.

Apparatus

Physical activity data were recorded using a hip-worn Actigraph GT3X+ unit (Actigraph Corp. Pensacola, FL). Data were imported into and analyzed in Actilife 6, which is a data analysis software package that is bundled with Actigraph units. The Actigraph has been used in multiple studies to measure sedentary activity (e.g., Healy

2008b; Kozey-Keadle, Libertine, Staudenmayer, and Freedson, 2011; Kozey-Keadle et al. 2012). The device delivering the tactile prompt was a WatchMinder 3 (WatchMinder, Irvine, CA).

Calibration

All units were worn by the investigator towards the mid-point of the study and at the conclusion of the study. This step ensured that all units were reliably collecting data. During the mid-point of the study, the investigator wore all units (i.e., 4 total) simultaneously on the left hip for periods of 501 minutes and 60 minutes. Bouts are reported as raw values from the devices. Tables 1a – 1c display each device's value compared to another. The first number in each pairing represents the number of bouts recorded for that device. The second number in each pairing represents the number of bouts recorded for the device that is being contrasted with that device. The mid-study calibration step counts yielded Pearson's $r^2 = .99$ between all devices and for all wear periods. The end-of-study calibration for steps yielded an average $r^2 = .99$ between all units and for all wear periods.

Wear Time Validation

Prior to analyzing dependent variable data, total wear time was validated for each participant for each day. Determining wear time is part of the Actilife 6 software. Standardized accelerometer cut points from Freedson, Melanson, and Sirad (1998) were used to establish when participants wore the Actigraph unit. Cut points are ranges of accelerometer counts over time and are used to determine sedentary and active behavior. The investigator set the minimum wear time criterion to 420 min, or 7

hours. That is, for any data to be counted, the participant needed to wear the Actigraph unit for a minimum of 420 min. On days that wear time fell below 420 min, data were not used in the analysis. After each participant's data were uploaded into Actilife 6 wear time was calculated. Seconds were not counted or used to round up or down. Wear time never exceeded 540 min (i.e., 9 hours) because data were only collected from 8:00am – 5:00pm. Actilife 6 also reports conflicts in wear time based on cut point parameters (e.g., Freedson et al., 1998). This allows the investigator to manually override wear time. The use of conflicts and manual overrides were not used in this data analysis. In addition, data were downloaded into 2-sec epochs. Epochs are the intervals by which accelerometer counts are sorted in Actilife 6.

Dependent Variables

The dependent variable was the rate of daily bouts of prolonged sitting that are greater than 30 min in duration. Rate was reported as bouts per day. One bout of prolonged sitting was defined as any interval of the workday in which an individual engaged in sedentary activity for greater than 30 min. This interval length was chosen due to its use in previous research and recommendations made by content experts (e.g., Evans et al. 2012; Ryan et al. 2011; Thosar 2014). Sedentary analysis options were set at a minimum of 30 min, drop time 1 min, and using a maximum of 99 accelerometer counts per min. At this setting, a sedentary bout was only counted if 30 or more consecutive min of sedentary activity passed without disruption. A drop time of 1 min accounts for any type of disruption in sedentary activity, and thus, resets the bout.

Determination of Bout Duration. One bout of prolonged sitting was counted if it was less than 31 min. This rule was arbitrarily chosen to account for the tactile prompt phase. When the prompt was delivered every 30 min, the investigator allowed participants to respond to the stimulus within one min. For every bout of prolonged sitting that increased by 30 min, an additional bout was counted. The range for zero bouts of prolonged sitting was 0s – 30min 59s, for one bout 31min 00s – 59min 59s, and for two bouts 60m 00s – 89m 59s. This pattern continued as needed and seconds were not used to round up or down for each bout. In addition to these rules, if participants reported that they spent two or more hours working off-campus (e.g., meetings in another city) or were engaged in a special event (e.g., working outside with vendors), then data were not used in the analysis as this physical activity would not reflect a normal office work day.

The number of steps per day, average bouts per day and average bout duration across phases were used as secondary dependent variables. Phase change decisions were based on the primary dependent variable. Interaction with participants was reduced as much as possible by requiring participants to leave the Actigraph units in a designated area in their work setting at the end of each workday. The experimenter downloaded the Actigraph data after normal work hours and on weekends.

Design

A multiple baseline across participants design was used with an A-B-C-D sequence for each participant. Prior to the start of each phase, the experimenter read prepared transcripts to introduce participants to each new phase. Each script was read

once, during the first day of each phase (See Appendix C). Transitions between phases were made when data stabilized in the current phase.

Baseline (A). Participants wore the Actigraph accelerometer to measure sedentary behavior during their workday. The device was worn on the hip (attached with an elastic belt) throughout the entire study. Rosenberger et al. (2013) found that accelerometers placed on the hip provide more accurate measure of sedentary behavior when compared to devices worn on the wrist. The device used, the Actigraph 3GTX+, provides a reliable source of data for sedentary and active behaviors (Kozey-Keadle et al., 2011; Gardiner et al., 2011; Reilly et al., 2003).

Information (B). When participants were in this phase, they were given brief information regarding the risks associated with prolonged sitting. Participants were instructed to take short breaks (i.e., 30s - 2 min). This break interval was chosen due its feasibility, and previous use in the literature (Cooley & Pedersen, 2013; Healy et al., 2011; Thosar, 2014).

Tactile prompt (C). The tactile prompt was designed to remind participants to break bouts of prolonged sitting. The WatchMinder 3 was used to deliver this prompt. This device was chosen because of its minimal intrusiveness, and ease of prompt delivery. The device was worn on the wrist, and the experimenter programmed the watch to deliver tactile prompts every 30 min. The WatchMinder included an additional feature that allowed a text to be displayed on the watch face. That is, after the alarm went off, the words “Stand Up” were programmed to appear along with the tactile prompt. The experimenter conducted weekly treatment integrity probes to

ensure that each watch was accurately delivering prompts, had sufficient charge, and participants wore both the watch and Actigraph unit. If participants were not wearing either device, the experimenter would have emphasized the importance of wearing the devices, and then stated that participation may be terminated if further noncompliance was observed.

Tactile Prompt, Feedback and Goal Setting (D). Tactile prompt delivery continued during this phase in addition to FB and GS. On the first day of this phase, FB and GS were delivered in person. Each following day, FB and GS were delivered via email by 8:00am of the next workday. FB and GS delivered in person consisted of telling the participant the average number of bouts per phase the participant sat for longer than 30 minutes (e.g., 8 bouts of sitting longer than 30 min in the first part of the study, 7 bouts of sitting in the second part). Then, participants were asked to set a goal for themselves for that day. Research on GS has shown that employees prefer to set goals for themselves over having them assigned (Fellner and Sulzar-Azaroff, 1985). FB and GS delivered via email consisted of telling the participants via email how many bouts of prolonged sitting they engaged in during the previous workday. Goals were required to be at least 50% less than the average level of the previous phase and were adjusted if the participant met the goal for three consecutive days (see transcript; Appendix C). If data from the previous day could not be used (e.g., participant did not wear the device long enough, participant reported being off-campus), then data from the most recent workday was used.

Accuracy Checks

Accuracy checks were conducted on data transferred from Actilife 6 into Microsoft Excel. A research assistant was trained on how to locate wear time, bout frequency, and step data in Actilife 6. Using sample data, training concluded when the research assistant matched the investigator's data with 100% accuracy. Training only required two sets of sample data. Accuracy checks were conducted on 50% (19/38) of experimental days for Claudia. Data were 94%, 100%, and 98% accurate for bouts, steps, and minutes worn, respectively. Pat's data were checked on 33% (13/39) of experimental days and were 94%, 100%, and 98% accurate for bouts, steps, and minutes worn, respectively. Gretchen's data were checked on 55% (18/33) of experimental days and were 97%, 100%, and 100% accurate for bouts, steps, and minutes worn, respectively.

Treatment Integrity

To ensure all WatchMinders were functioning properly and participants were wearing them, the investigator conducted on average two treatment integrity checks each week. Participants were visited at random times each week, asked if the watch was working properly, and the investigator noted if the watch was worn. Claudia wore the WatchMinder 90% (9/10) of experimental sessions of the 53% (10/19) treatment days that were checked. Pat wore the WatchMinder 91% (10/11) of experimental sessions of the 48% (11/23) treatment days that were checked. Gretchen wore the WatchMinder 100% (7/7) of experimental sessions of the 44% (7/16) treatment days that were checked. Anecdotally, on the two instances when Claudia

and Pat were not wearing the WatchMinder, the investigator or research assistant arrived at the participants' work place at about the same time as the participants. The participants more than likely had not yet put on the WatchMinder as a part of their morning routine.

Read receipts were attached to each email during the D-phase. This informed the experimenter that each participant received their feedback at the start of their workday. Claudia sent a read receipt on 100% (4/4) of phase-D read receipt opportunities, Pat sent a read receipt on 67% (8/12) of phase-D read receipt opportunities, and Gretchen sent one on 83% (5/6) of phase-D read receipt opportunities.

CHAPTER 3

Results

Dependent Variables

Bouts per day. Figure 1 depicts the results of rate of bouts per day. Table 2 lists the mean, standard deviation, and number of sessions in each phase for all participants. Claudia's baseline data were fairly stable and did not trend up or down. The information phase for Claudia yielded several data points that were lower than baseline and the level remained relatively unchanged, but showed an increasing trend towards the end of the phase. The tactile prompt phase resulted in an immediate reduction in bouts per hour and variability was reduced during the first half of this phase. The later part of this phase resulted in greater variability with a slight increasing trend. The final phase of the study resulted in a slight reduction in bouts per hour following the introduction of FB and GS, a decreasing trend with the last three data points, and reduced variability. However, this reduction in variability is also observed at the beginning of the tactile prompt phase.

Pat's baseline data were moderately variable, had a higher level compared to other participants, and a sharp, increasing trend occurred at the end of this phase. The information phase resulted in a similar level compared to baseline, however variability between sessions was reduced. Data in phase B were on a slight decreasing trend but within the range of baseline data. The tactile prompt phase for Pat resulted in an

immediate, but slight reduction in bouts per hour. The overall level was reduced and variability was similar to prior phases. The final phase resulted in the lowest overall level for Pat. A sharp, and immediate decrease was observed during the first session of the FB and GS phase. The lowest six data points all occurred in this final phase. However, high levels of variability were observed in this final phase, with the highest points in the same range as previous phases. The trend increased during the first half of the phase, but decreased in the second half of this phase.

Gretchen's baseline data were stable and did not trend up or down. The information phase resulted in an immediate decreasing trend following the start of this phase. The overall level was slightly lower than baseline, but data were highly variable compared to baseline. The highest data points were recorded during this phase. The introduction of the tactile prompt phase produced a decreasing trend at the start, but increased as this phase progressed. The overall level was very similar to the previous two phases, and data at the end of this phase had reduced variability. Gretchen's data in the FB and GS phase produced an immediate decrease in bouts per hour, but data later trended upward. The overall level was lowest during this final phase, and shared similar variability to phases B and C. This final phase contained one zero point, which occurred in the previous two phases.

Secondary Dependent Variables

Figure 2 depicts the results of steps per day. Step data is scaled on the y-axis to allow comparison of the daily recommendation of reaching 10,000 steps per day. Claudia's overall step count trend decreased from the beginning to the end of the

study. Variability was reduced beginning in phase C and continued in phase D. The highest level of step counts occurred during the information phase. The lowest levels of step counts are observed in the final phase. Pat's step count level remained constant between all phases with the exception of the first four days of the study. There were no changes in trend and variability among all phases. Gretchen's step counts trended downward during phases A and B, but trended upward during the final phases.

Gretchen's highest step counts occurred during phase D. Variability in Gretchen's data were fairly consistent between each phase.

Tables 3 – 5 display each participant's average steps per day, average bouts per day, and average bout duration across all phases. Claudia's average steps per day in each phase decreased from the previous phase, average bouts per day were highest during the information phase, and the average bout duration was lowest in the final two phases. Pat's average steps per day in each phase were similar, average bouts per day were lowest in the final phase, and average bout duration lowered to a similar value (i.e., an average of 40 min) in phase B, C, and D. Gretchen's average steps per day were highest in the final phase by over 1,000 steps, average bouts per day were lower in the intervention phases compared to baseline, and average bout duration was lowest in phase C.

Social Validity

A social validity questionnaire was planned but could not be implemented due to unforeseen circumstances. The best way to complete this would have been to ask participants to complete a survey about the targets, procedures, and goals of the study.

This questionnaire could ask participants' opinions (i.e., from strongly agree to strongly disagree) of the following statements: (1) "Wearing the vibrating watch was uncomfortable (2) "I found it easy to leave my work and pick up where I left when returning from a standing break and (3) "After participating in the study, it is not my goal to sit less."

In addition, a measure of bodily discomfort would be a good indicator if any improvement or worsening of symptoms were experienced over the course of the study. For example, the Cornell Musculoskeletal Discomfort Questionnaire (CMDQ) is specifically designed to assess pain and discomfort in office workers. The CMDQ asks individuals to report any level of pain or discomfort during the past work week, a frequency count (e.g., 1 – 2 times per week, every day) and the area of the body where pain or discomfort has occurred.

CHAPTER 4

Discussion

The current study is the first to attempt to apply behavior analysis to reduce bouts of prolonged sitting in the workplace. The systematic manipulation of antecedent- and consequence-based stimuli allowed a brief comparison of each intervention's effectiveness. The results are indicative of what is commonly found in the behavioral literature. That is, antecedent manipulations (i.e., information and tactile prompts) set the occasion for behavior, but rarely maintain behavior change. The multiple-baseline across participants design demonstrated that a combination of tactile prompting, FB and GS was the most effective intervention at reducing the prolonged bouts per hour than information alone. However, this combination may have only been effective following extended periods of information and tactile prompt phases.

The motivational strategies used in the last phase (i.e., FB and GS) were found to be most effective for one participant (Pat) at reducing bouts of prolonged sitting per hour. Additional data collection is necessary to determine the long-term effectiveness of FB+ GS for Claudia and Gretchen. However, the reduction in level and variability for Claudia and reduction in level for Gretchen indicate preliminary success of this treatment package. Reduced variability for all participants may have been observed had criteria been set for workdays in terms of time at desk. These criteria could have

led to the exclusion data from days when participants' schedule took them out of their office building or if the daily schedule was atypical (e.g. all-day meetings outside of participant's office).

The information phase was purposefully manipulated as a separate intervention to evaluate its effectiveness. Previous research (Gardiner et al., 2011; Healy et al., 2013; Kozey-Keadle et al., 2012; Smith, Pedersen, and Cooley, 2013) bundled this treatment component for experimental groups. This phase was parsed out as a separate intervention to evaluate what effects, if any, would be observed. For two out of three participants, the information phase produced lower data points compared to baseline. However, overall levels remained relatively unchanged for all participants during this phase. The tactile prompt phase produced lower rates of bouts per hour for each of the participants compared to the information phase.

A few interesting patterns emerged during this study. During FB and GS, when FB was delivered following a relatively high point, the next data point resulted in a sharp decrease in bouts per day. This happened twice for Pat and once for Gretchen. However, the following day resulted in a higher data point for both participants. This demonstrated the immediate effectiveness that FB had on each participant's high performance days. When delivering FB in person, each of the participants stated they thought they were doing better, and began problem solving about their own behavior. They made statements such as "I was in a meeting one day and could not get up", "I am going to try harder today and get up when the watch goes off," and "What do I have to do to get this thing (Actigraph unit) to work?" These statements are

encouraging as these participants wanted to improve yet breaking up prolonged sitting during an entire workday proved to be a difficult.

Gretchen's data reveal an interesting pattern regarding her bouts per hour. Each time an intervention was introduced, bouts per hour immediately decreased, but the effects wore off as the phase progressed. Given the type of dependent variable (i.e., related to physical activity) studied, Gretchen's results may be indicative of why exercise regimens are difficult to maintain. A new exercise program starts, participation is high, but those procedures that initially change healthy behavior change are effective only in the short term.

Surprisingly, the amount of steps taken decreased through each phase of the study for Claudia (Figure 2). It is possible that Claudia's physical activity came under the stimulus control of either a rule (i.e. "Get up every 30 min"), wearing the watch, or a combination of both. Over time, she may have moved only during the half hour intervals set by the fixed time schedule of the watch. Thus, any naturally occurring physical activity that she engaged in may have been reduced because of her participation in this study. This overall decrease in steps per day was not observed for Pat and Gretchen. Pat's steps remained relatively unchanged, but Gretchen's steps per day increased as the study progressed. It is important to note that although Pat's step counts did not change throughout the study, her number of bouts reduced markedly (from 7.0 to 4.4 bouts per day) during the last two phases.

The difference in step counts may be indicative of what part of the script (e.g., "stretch briefly" or "take a walk") was most salient to each. Claudia may have

responded to “stretch briefly,” Pat did not respond to any specific part of the rule, and Gretchen may have responded to “take a walk.” The increasing trend of Gretchen’s step count is encouraging as 10,000 steps per day is the goal of many popular physical activity programs (Tudor-Locke & Bassett, 2004). Overall, Gretchen’s physical activity during her workday increased as a result of participating in the study. Unfortunately, Pat and Claudia’s daily step counts are representative of the lower physical activity levels of office workers that have been previously documented (Chastin et al., 2009; Church et al., 2011).

The current study extends previous research (Donaldson and Normand 2009; Normand, 2008; Wack et al., 2014) in the application of FB and GS to other health-related behaviors. The current study differed from Donaldson and Normand (2009) such that participants did not receive graphic feedback on their performance. Rather, the experimenter told participants about their performance from the previous day. In addition, the current study did not include a self-management procedure.

Weaknesses

There are a few weaknesses of this study that are worth noting. Experimental control of what variables were responsible for reduction in the bouts per hour is unclear because the investigator could not remove some intervention components. In addition, the investigator relied on the verbal report of when participants stated they were out of the office or engaged in atypical office work (e.g., setting up tables outside), so a few data points were left out of participants’ data sets. This could have changed the analysis and later treatment decisions. Further, the information phase

provides evidence that this intervention alone was not effective at reducing bouts per hour for these participants. The tactile prompt phase reduced the level for one participant (Claudia) but not for other participants. The high variability in Claudia's data during the tactile prompt phase is a concern for the long-term effectiveness of this intervention.

The final phase of the study leaves the data open to interpretation regarding whether tactile prompting prior to FB and GS was necessary to produce these changes during the final phase. Future research could address what combination of prompting, FB and GS, and if any particular order, produce the best results. The tactile prompt phase may have been more effective following the feedback and goal setting phase or vice versa. In addition, future studies could investigate if information and prompt phases need to precede FB and GS to produce an effect similar to that observed in this study

Other interventions may also be evaluated for comparison to the procedures in this study. For example, deposit contracting, which requires participants to earn deposited money back in addition to an incentive for meeting performance criteria, may be an effective method for reducing bouts per hour. In a recent study, Dallery, Meredith and Glenn (2008) effectively used such deposit contracts for smoking cessation.

Limitations

These results are limited because the investigator did not observe participants wearing the watch every day of the C- and D- phases. However, treatment integrity

results indicate the participants wore the WatchMinder for the majority, if not all, of experimental sessions. The WatchMinder and Actigraph units were stored in the same location for each participant, which makes the later point unlikely.

There are additional limitations that should be considered. First, all participants in this study were interested in improving their health which may have contributed to compliance throughout the study. Second, the researcher may have chosen too stringent of an interval (i.e., 30 min) and limited hold for participant to react. The fixed interval length may have interrupted the work of participants, and if participants were in the middle of a project, made compliance within the 1 min period less likely. The raw scores (data not shown) indicate that this may have been the case. Across all intervention phases, Claudia, Pat, and Gretchen had 25, 13, and 19 bouts of prolonged sitting between 31min 00s – 31min 59s, respectively. Future research can evaluate the ideal bout of prolonged sitting, limited hold, and use the results of the aforementioned social validity questionnaire to determine the ideal bout length that results in the best health outcomes for office workers. Positioning of Actigraph units on participants' hips is a final possible limitation. That is, participants may have not worn the unit everyday in the same location (e.g., too far forward, not on the hip), resulting in the unit collecting data that are not representative of actual sedentary behavior. Future studies could include treatment integrity measures or participant training for correct wear position.

Future Research

Analyzing the types stimulus prompts may be important to research as well. For example, a tactile prompt delivered on the wrist was used in this study and its effectiveness can be compared to other modalities and locations (e.g., vibrating phone in your pocket). Other categories of stimuli can be evaluated such as computer prompting software (e.g., Exertime; Cooley and Pedersen, 2013), an email reminder, or a fellow employee. In addition to assessing effective prompting strategies or support from employee's managers or peers may be needed to increase treatment effectiveness. Creating a work culture of an active workplace may increase the effectiveness of the interventions in this study.

Further, investigation of the contingent or non-contingent prompt delivery is warranted too. Each prompt delivered in the study was delivered independent of the participant's physical activity. Even though the Actigraph unit technology could reset intervals in its data set, the WatchMinder could not be programmed to capture this information. Future studies should explore the utility of a resetting prompt contingent on a participant's physical activity.

Although the goal of the study was to evaluate how prolonged sitting can be interrupted, the total duration of sedentary behavior may have been reduced throughout the study. That is, participants may have reduced overall sitting time throughout the day, but the investigator made decisions primarily on bouts of prolonged sitting per hour. While the current study investigates the behavioral components of reducing bouts of prolonged sitting, future collaboration should include

a medical team. It may be important to determine what tests are medically necessary to indicate how health is affected both positively and negatively when bouts of prolonged sitting or total sitting time is reduced. Collaboration between behavioral and medical researchers is imperative to determine what interventions produce desired health benefits in the workplace.

Conclusion

In conclusion, the current study provides an answer to the call for additional behavioral research needed for reducing sedentary behavior (Owen et al., 2011; Van Camp and Hayes, 2012). This study provides a framework to design future interventions for reducing bouts of prolonged sitting in the work place. Overall, the antecedent interventions (i.e., information, tactile prompting) provided slight improvements in behavior, but the effects were temporary. The introduction of FB and GS produced encouraging results for decreasing bouts of prolonged sitting per hour, yet its durability remains unknown.

The goal of the current study was to evaluate effectiveness of various interventions at reducing the number of bouts of prolonged sitting. Results are preliminary as each of the interventions reduced physical inactivity to some extent. Sedentary behavior is prevalent (Church et al., 2011) and discovering how environmental manipulations can reduce physical inactivity levels will benefit society. The first step is learning how to successfully decrease bouts of prolonged sitting.

References

- Ainsworth, B.E., Haskell, W.L., Whitt, M.C., Irwin, M.L., Swartz, A.M., Stratch, S.J., O'Brien, W.L., Basset, D.R., Schmitz, K.H., Emplaincourt, P.O., Jacobs, D.R., & Leon, A.S. (2000). Compendium of Physical Activities: an update of activity codes and MET intensities. *Journal of the American College of Sports Medicine*, S498-S516.
- American College of Sports Medicine (ACSM) Guidelines. (2014). ACSM Issues New Recommendations on Quantity and Quality of Exercise. Retrieved July 22, 2014 <http://acsm.org/about-acsm/media-room/news-releases/2011/08/01/acsm-issues-new-recommendations-on-quantity-and-quality-of-exercise>
- Anderson, J.E., & Goss, A.M. (1988). Behavioral Obesity Research: Where Have All the Single Subject Gone? *The Behavior Analyst*, 2(11), 141-148.
- Atlas, S.J., & Deyo, R.A. (2001). Evaluation and Managing Acute Low Back Pain in the Primary Care Setting. *Journal of General Internal Medicine*, (16), 120-131.
- Brandt, M., Sundstrup, E., Jakobsen, M. D., Jay, K., Colado, J. C., Wang, Y., ... & Andersen, L. L. (2014). Association between neck/shoulder pain and trapezius muscle tenderness in office workers. *Pain research and treatment*, 2014.
- Bureau of Labor Statistics (BLS). (2015). Safety and Health Topics. *Prevention of Musculoskeletal Disorders in the Workplace*. Retrieved from <https://www.osha.gov.SLTC/ergonomics/index.html>

- Center for Disease Control (CDC). (2014). Physical activity. *How much physical activity do you need?* Retrieved from <http://www.cdc.gov/physicalactivity/everyone/guidelines/>
- Chastin, S.F., Dall, P.N., Tigbe, W.W., Grant, P.M., & Ryan, C. (2009). Compliance with physical activity guidelines in a group of UK based postal workers using an objective monitoring technique. *European Journal of Applied Physiology*, *106*(6), 893-899.
- Chau, J.Y., Grunseit, A.C., Chey, T., Stamatakis, E., Brown, W.J., Matthews, C.E., Bauman, A.E., & van der Ploeg, H.P. (2013). Daily Sitting Time and All-Cause Mortality: A Meta-Analysis. *PLoS ONE* *8*(11).
- Cho, C. Y., Hwang, Y. S., & Cherng, R. J. (2012). Musculoskeletal symptoms and associated risk factors among office workers with high workload computer use. *Journal of Manipulative and Physiological therapeutics*, *35*(7), 534-540.
- Church, T.S., Thomas, D.M., Tudor-Locke, C., Katzmarzyk, P.T., Earnest, C.P., Rodarte, R.Q., Martin, C.K., Blair, S.N., & Bouchard, C. (2011) Trends over 5 Decades in U.S. Occupation-Related Physical Activity and Their Associations with Obesity. *PLoS ONE*, *6*(5)
- Cooley, D. & Pedersen, S. (2013). A Pilot Study of Increasing Nonpurposeful Movement Breaks at Work as a Means of Reducing Prolonged Sitting. *Journal of Environmental and Public Health*, Retrieved from <http://www.hindawi.com/journals/jep/2013/128376/>

- Dallery, J., Meredith, S., & Glenn, I. M. (2008). A deposit contract method to deliver abstinence reinforcement for cigarette smoking. *Journal of Applied Behavior Analysis, 41*(4), 609-615.
- Daniels, A.C., & Bailey, J.S. (2014). *Performance Management*. Atlanta, GA: Aubrey Daniels International, Inc.
- Donaldson, J.M., & Normand, M.P. (2009). Using goal-setting, self-monitoring, and feedback to increase caloric expenditure in obese adults. *Behavioral Interventions, (24)*, 73-83.
- Duvivier, B.M.F.M., Schaper, N.C., Bremers, M.A., Crombrugge, G.v., Menheere, P.P.C.A., Kars, M., Savelberg, H.H.C.M. (2013). Minimal Intensity Physical Activity (Standing and Walking) of Longer Duration Improves Insulin Action and Plasma Lipids More than Shorter Periods of Moderate to Vigorous Exercise (Cycling) in Sedentary Subjects When Energy Expenditure in Comparable. *PloS ONE 8*(2), e55542.
- Evans, R.E., Fawole, H.O., Sheriff, S.A., Dall, P.H., Grant, M., & Ryan, C. (2012). Point-of-Choice Prompts to Reduce Sitting Time at Work. *American Journal of Preventive Medicine, 43*(3), 293-297.
- Fellner, D. J., & Sulzer-Azaroff, B. (1985). Occupational safety: Assessing the impact of adding assigned or participative goal-setting. *Journal of Organizational Behavior Management, 7*(1-2), 3-24.

- Freedson, P. S., Melanson, E., & Sirard, J. (1998). Calibration of the Computer Science and Applications, Inc. accelerometer. *Medicine and science in sports and exercise*, 30(5), 777-781.
- Gardiner, P.A., Eakin, E.G., Healy, G.N., & Owen, N. (2011). Feasibility of Reducing Older Adults' Sedentary Time. *American Journal of Preventive Medicine*, 41(2), 174-177.
- Gilson, N.D., Suppini, A., Ryde, G.C., Brown, H.E., & Brown, W.J. (2012). Does the use of standing 'hot' desks change sedentary work time in an open plan office? *Preventive Medicine* (54), 65-67.
- Hamilton, M.T., Hamilton, D.G & Zderic, T.W. (2007) Role of Low Energy Expenditure and Sitting in Obesity, Metabolic Syndrome, Type 2 Diabetes, and Cardiovascular Disease. *Diabetes*, 56, 2655-2667.
- Healy, G.N., Dunstan, D.W., Salmon, J., Cerin, E., Shaw, J.E., Zimmet, P.Z., & Owen, N. (2007). Objectively Measure Light-Intensity Physical Activity is Independently Associated with 2-h Plasma Glucose. *Diabetes Care*, 30(6), 384-1389.
- Healy, G.N., Dunstan, D.W., Salmon, J., Cerin, E., Shaw, J.E., Zimmet, P.Z., & Owen, N. (2008a). Breaks in Sedentary Time. *Diabetes Care* (31), 661-666.
- Healy, G.N., Wijndaele, K., Dunstan, D.W., Salmon, J., Cerin, E., Shaw, J.E., Zimmet, P.Z., & Owen, N. (2008b). Objectively Measured Sedentary Time, Physical Activity, and Metabolic Risk. *Diabetes Care* (31), 369-371.

- Healy, G.N., Matthews, C.E., Dunstan, D.W., Winkler, E.A.H., & Owen, N. (2011). Sedentary time and cardio-metabolic biomarkers in US adults: NHANES 2003-06. *European Heart Journal*, doi:10.1093/eurheartj/ehq451.
- Healy, G.N., Eakin, E.G., LaMontagne, A.D., Owen, N., Winkler E.A.H., Wiesner, G., Gunning, L., Neuhaus, M., Lawler, S., Fjedorsoe, B.S., & Dunstan, D.W (2013). Reducing sitting time in office workers: Short-term efficacy of a multicomponent intervention. *Preventive Medicine*, 57(2013), 43-48.
- Hedge, A., Morimoto, S. & McCrobie, D. (1999). Effects of keyboard tray geometry on upper body posture and comfort, *Ergonomics*, 42 (10), 1333-1349.
- Hyusti, K.M., Normand, M.P., & Larson, T.A. (2011). Behavioral assessment of physical activity in obese preschool children. *Journal of Applied Behavior Analysis*, 3(44), 635-639.
- Hyusti, K.M., Normand, M.P., Larson, T.A., & Morley, A.J. (2012). The effect of outdoor activity context on physical activity in preschool children. *Journal of Applied Behavior Analysis*, 2(45), 401-405.
- Katzmarzyk, P.T., Church, T.S., Craig, C.L., & Bouchard, C. (2009). Sitting Time and Mortality from All Causes, Cardiovascular Disease, and Cancer. *Journal of the American College of Sports Medicine*, DOI: 10.1249/MSS.0b013e3181930355.
- Katzmarzyk, P.T. (2013). Standing and Mortality in a Prospective of Canadian Adults. *Journal of the American College of Sports Medicine*, DOI: 10.1249/MSS.0000000000000198.

Kozey-Keadle, S., Libertine, A., Staudenmayer, J., & Freedson, P. (2011). The Feasibility of Reducing and Measuring Sedentary Time among Overweight, Non-Exercising Office Workers. *Journal of Obesity*, Retrieved from doi:10.1155/2012/282303.

Kozey-Keadle, S., Libertine, A., Lyden, K., Staudenmayer, J., & Freedson, P. (2012). Validation of Wearable Monitors for Assessing Sedentary Behavior. *Journal of the American College of Sports Medicine*, DOI: 10.1249/MSS.0b013e31820ce174

Kurti, A.N., & Dallery, J. (2013). Internet-based contingency management increases walking sedentary adults. *Journal of Applied Behavior Analysis*, 3(46)568-581.

Latouche, C., Jowett, J.B.M., Cary, A.L., Bertovic, D.A., Owen, N., Dunstan, D.W., Kingwell, B.A. (2013). Effects of breaking up prolonged sitting on skeletal muscle gene expression. *Journal of Applied Psychology*, 114(4), 453-460.

Matthews, C.E., Chen, K.Y., Freedson, P.S., Buchowski, M.S., Beech, B.M., Pate, R.R., & Troiano, R.P. (2008). Amount of Time Spent in Sedentary Behaviors in the United States, 2003-2004. *American Journal of Epidemiology*, 167(7), 875-881.

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

Normand, M. (2008). Increasing physical activity through self-monitoring, goal-setting, and feedback. *Behavioral Interventions*, (23), 227-236. DOI: 10.1002/bin.267.

- Ogden, C.L., Carroll, M.D., Kit, B.K., & Flegal, K.M., (2014) Prevalence of Childhood and Adult Obesity in the United States, 2011-2012. *Journal of the American Medical Association* 311(8), 806-814.
- Otten, J.J. Jones, K.E., Littenberg, B., & Harvey-Berino, J. (2009). Effects of Television Viewing Reduction on Energy Intake and Expenditure in Overweight and Obese Adults. *Archives of Internal Medicine*, 169(22) 2109-2115.
- Owen, N., Bauman, A., & Brown, W. (2009). Too much sitting: a novel and important predictor of chronic disease risk? *British Journal of Sports Medicine*, 43(2), 81-83.
- Owen, N., Healy, G.N., Matthews, C.E., & Dunstan, D.W. (2011) Too much sitting: The Population-Health Science of Sedentary Behavior. *Exercise Sport Science Review*. 38(3), 105-113.
- Parry, S., & Straker, L. (2013) The contribution of office work to sedentary behaviour associated risk. *BMC Public Health*, 13(296).
- Pate, R.R., O'Neill, J.R., Lobelo, F. (2008) The Evolving Definition of "Sedentary". *Exercise Sport Science Review*, 36(4), 173-178.
- Patel, A.V., Bernstein, L., Deka, A., Feigelson, H.S., Campbell, P.T., Gapstur, S.N., Colditz, G.A., & Thun, M.J. (2010). Leisure Time Spent Sitting in Relation to Total Mortality in a Prospective Cohort of US Adults. *American Journal of Epidemiology*, 172(4), 419-429.

Pedersen, S. & Cooley, D. (2012) Exertime. Retrieved from www.exertime.com.

Pronk N.P., Katz A.S., Lowry M., & Payfer J.R. (2011). Reducing Occupational Sitting Time and Improving Worker Health: The Take-a-Stand Project. *Preventing Chronic Disease*, DOI: <http://dx.doi.org/10.5888.pcd9.110323>.

Romanzini, M., Petroski, E.L., Ohara, D., Dourado, A.C., & Reichert, F.F. (2012). Calibration of ActiGraph GT3X, Actical and RT3 accelerometers in adolescents. *European Journal of Sport Science*, 14(1), 91-99.

Rosenberger, M.E., Haskell, W.L., Albinali, F., Mota, S., Nawyn, J., & Intille, S. (2013). Estimating activity and sedentary behavior from an accelerometer on the hip or wrist. *Journal of Medicine and Sports Exercise*, 45(5), 964-975.

Ryan C.G., Grant, P.M., Dall, P.M., & Granat, M.H. (2011). Sitting patterns at work: objective measurement of adherence to current recommendations. *Ergonomics*, 54(6) 531-538.

Rutten, G.M., Savelberg, H.H., Biddle, S.J.H., & Kremers, S.P.J. (2013). Interrupting long periods of sitting: good STUFF. *International Journal of Behavioral Nutrition and Physical Activity*, Retrieved from <http://www.ijbnpa.org/content/10/1/1>.

Sedentary Behaviour Research Network (2012). Letter to the Editor: Standardized use of the terms "sedentary" and "sedentary behaviours". *Applied Physiology, Nutrition, and Metabolism*, 37, 540–542.

Sharma, V. (2007) MyRestBreak (Version 1.0) Retrieved from

<http://www.softpedia.com/get/Desktop-Enhancements/Clocks-Time-Management/My-Rest-Break.shtml>

Smith, L., Pedersen, S., & Cooley, D. (2013). The Effect of Education on Compliance to a Workplace Health and Wellbeing Intervention: Closing the Loop.

Universal Journal of Public Health, 1(3), 97-102.

Spyropoulos, P., Papathanasiou, G., Georgoudis, G., Chronopoulos, E., Koutis, H., & Koumoutsou, F. (2007). Prevalence of low back pain in Greek public office workers. *Pain Physician, 10*(5), 651.

Thorpe, A., Dunstan, D., & Clark, B. (2010). Stand up Australia: sedentary behaviour in workers 2008, published by Medibank Private Limited.

Thorp, A. A., Kingwell, B. A., Owen, N., & Dunstan, D. W. (2014). Breaking up workplace sitting time with intermittent standing bouts improves fatigue and musculoskeletal discomfort in overweight/obese office workers. *Occupational and environmental medicine, 71*(11), 765-771.

Thosar, S. (2014, June). *Physiological effects of prolonged sitting*. Presented at Sedentary, Stationary and Physically Demanding Work at Oregon Health and Science University.

Tudor-Locke, C., & Bassett, D.R. (2004). How Many Steps/Day Are Enough? Preliminary Pedometer Indices for Public Health. *Sports Medicine 34*(1), 1-8.

Van Camp, C.M., & Hayes, L.B. (2012). Assessing and Increasing Physical Activity. *Journal of Applied Behavior Analysis, 4*(45), 871-875.

van der Ploeg, H.P. Chey, T., Korda, R., Banks, E., & Bauman, A. (2012). *Archives of Internal Medicine*, 172(6), 494-500.

VanWormer, J.J. (2004). Pedometers and Brief E-Counseling: Increasing Physical Activity for Overweight Adults. *Journal of Applied Behavior Analysis*, 3(37), 421-425.

Verweij, L.M., Proper, K.I., Weel, A.N., Hushof, C.T. & Mechelen, W.v. (2012). The application of an occupational health guideline reduces sedentary behaviour and increases fruit intake at work: results from an RCT. *Occupational and Environmental Medicine*, 69(7), 500-507.

Wack, S.R., Crosland, K.A. & Miltenberger, R.G. (2014). Using goal setting and feedback to increase weekly running distance. *Journal of Applied Behavior Analysis*, 1(47), 181-185.

Work Safe Victoria (2006). *Officewise – A guide to health and safety in the office.*

Retrieved July 25, 2014 from

<http://www.ergonomicsnow.com.au/Assets/14/officewise.pdf>

Wilmot, E.G., Edwardson, C.L., Achana, F.A., Davies, M.J., Gorely, T., Gray, L.J., Khunti, K., Yates, Y., & Biddle, S.J.H. (2012). Sedentary time in adults and the association with diabetes, cardiovascular disease and death: systematic review and meta-analysis. *Diabetologia*, 55, 2895-2905.

Appendix A**Tables**

Table 1a

Bout Calibration Results Mid Study - Raw Values of 510 min wear time

	Unit 1	Unit 2	Unit 3	Unit 4
Unit 1	-	(4,4)	-	(4,4)
Unit 2	(4,4)	-	-	(4,4)
Unit 3	-	-	-	-
Unit 4	(4,4)	(4,4)	(4,4)	-

Note: The position of unit 3 (i.e., worn in the “front bottom position” on the experimenter’s left hip) was found to be unreliable location to wear the device and record steps accurately. The units were rotated by position to ensure neither Actigraph unit was faulty. This table accounts for 510 min of wear time.

Table 1b

Bout Calibration Results Mid-Study - Raw Values of 60 min wear time

	Unit 1	Unit 2	Unit 3	Unit 4
Unit 1	-	-	(1,1)	(1,1)
Unit 2	-	-	-	-
Unit 3	(1,1)	-	-	(1,1)
Unit 4	(1,1)	-	(1,1)	-

Note: Results of this calibration account for the difference in the positions in which the Actigraph units were worn (60 min wear time). Unit 2 was worn in the “front bottom” position and data were not used in this comparison.

Table 1c

Bout Calibration Results End-of-Study - Raw Values of 480 min wear time

	Unit 1	Unit 3	Unit 4
Unit 1	-	(9,9)	(9,9)
Unit 3	(9,9)	-	(9,9)
Unit 4	(9,9)	-	-

Note: Unit 2 was no longer used at the end of the study. The investigator wore units 1, 3, and 4 and neither of the devices were worn in the “front bottom” position. These data represent 480 min of wear time.

Table 2

Primary Dependent Variable - Bouts of Prolonged Sitting per hour across phases

	Baseline			Information			Tactile Prompt			FB + GS		
	<i>M</i>	<i>SD</i>	<i>n</i>	<i>M</i>	<i>SD</i>	<i>n</i>	<i>M</i>	<i>SD</i>	<i>n</i>	<i>M</i>	<i>SD</i>	<i>n</i>
Claudia	.71	.17	4	.62	.22	13	.51	.26	13	.49	.11	4
Pat	.99	.14	9	.98	.11	9	.83	.14	10	.51	.20	11
Gretchen	.52	.06	3	.47	.24	14	.40	.19	9	.25	.18	7

Table 3

Claudia's Secondary Dependent Variables

	Baseline	Information	Tactile Prompt	FB + GS
Average Steps/Day	3,028	2,923	2,343	1,820
Bouts/Day	4.5	5.5	4.5	4.3
Average Bout Duration (min)	45.7	40.6	35.3	37.2

Table 4

Pat's Secondary Dependent Variables

	Baseline	Information	Tactile Prompt	FB + GS
Average Steps/Day	2,551	2,212	2,592	2,508
Bouts/Day	7.4	7.4	7.0	4.4
Average Bout Duration (min)	47.3	41.7	39.0	40.3

Table 5

Gretchen's Secondary Dependent Variables

	Baseline	Information	Tactile Prompt	FB + GS
Average Steps/Day	2,381	1,192	2,070	3,697
Bouts/Day	4.3	4.3	3.6	2.3
Average Bout Duration (min)	39.6	37.3	35.6	34.8

Appendix B

Figures

Figure 1. *Effects of Antecedent and Motivational Interventions on Bouts of Prolonged Sitting*

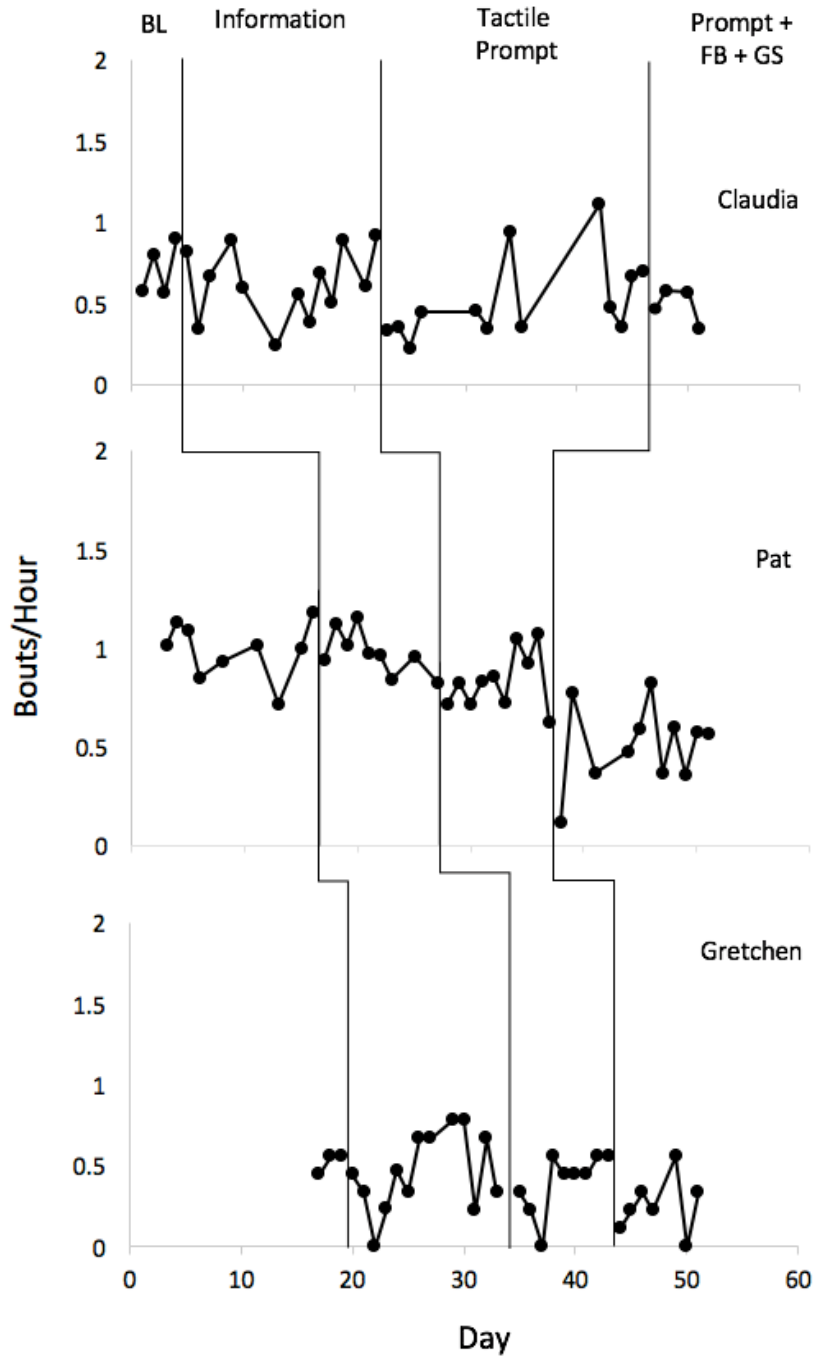
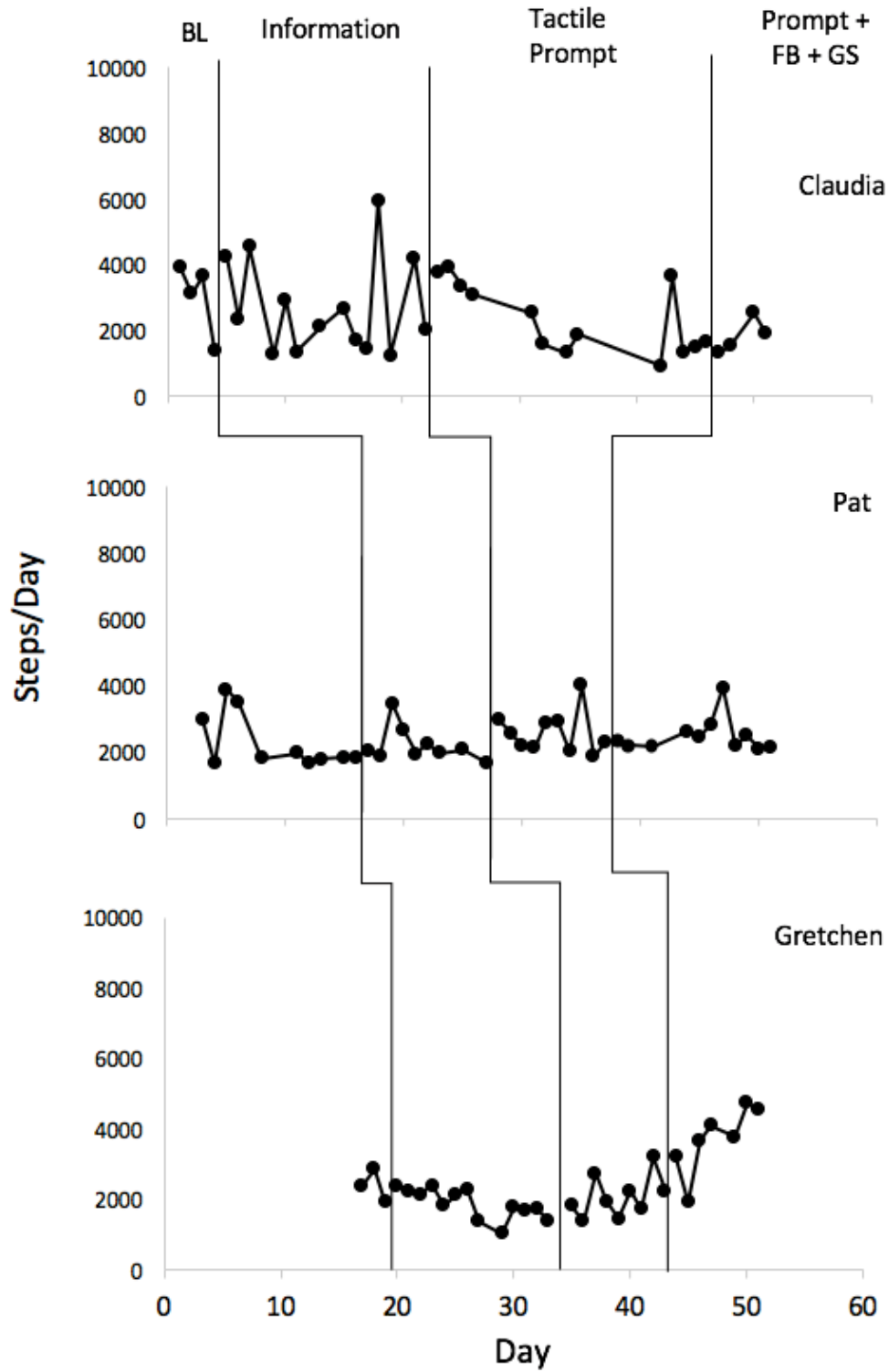


Figure 2. *Effects of Antecedent and Motivational Interventions on Total Step Count*



Demographic Survey

Participant ID: _____	Work Hours: _____
Age: _____	Lunch Hour: _____
Height: _____	Building: _____
Weight: _____	Office No: _____
	Highest Level of Education: _____

1. Do you have any planned days off in the next 60-90 days? (If yes, please note below)

2. What workdays are scheduled off due to holidays?

Questions on currently physical activity:

3. How many times/week do you currently exercise? (Circle)

0 1 2 3 4 5 6 7 8+

4. How much time do you spend exercising each week?

- ___ 0-50 min
- ___ 51-100 min
- ___ 101-150 min
- ___ 151-200 min
- ___ 201-250 min
- ___ 251-300 min
- ___ 301+ min

5. Overall, how interested are you improving your health? (Check the bullet that applies)

- Very interested
- Somewhat interested
- Neutral
- Somewhat disinterested
- Very disinterested

TO BE COMPLETED BY INVESTIGATOR:

Designated device storage location:

Appendix D

Physical Activity at Work Survey

Participant ID: _____

Instructions: For the following questions please write in a number as a percentage in the space provided.

Work activities

1. What percentage of your workday (on average) do you spend on the following tasks?

	Percentage
Working at your computer	_____
Making photocopies	_____
Going to meetings outside your office	_____
Talking on your work phone	_____
Other: _____	_____
Other: _____	_____
Total: <u>100%</u>	

Note: If there is work task (not listed) that you spend a lot of time on, please list this task in ‘Other’

Physical activity during work

2. What percentage of your workday (on average) do you spend:

	Percentage
Walking (ex. going to meetings or lunch)	_____
Sitting (ex. at your computer, in meetings)	_____
Standing (ex. moving about the office)	_____

Note: All numbers in the questions must add up to 100%

Appendix E

Transcripts

Transcript delivered to participants prior to baseline data collection:

“This study is about physical activity in the work place. To accurately record your physical activity throughout the course of your workday, you will need to wear this device, called Actigraph, during your entire work shift (8-5). At the end of your workday, please place the device here (designated location TBD)”

Transcript delivered to participants prior to Phase B (introduction of information):

“Research recent has shown that there are a lot of health risks that come with prolonged sitting. This research indicates that people who spend more time during their workday sitting are at higher risk for type 2 diabetes, cardiovascular disease, and premature death. Current recommendations suggest that office workers should get up and break the sitting pattern at least every 30 minutes. You can do this by simply getting up to stretch briefly, taking a walk to the water fountain, or even throwing a piece of paper in the trash down the hall. These breaks should last no longer than 30 seconds to 2 minutes. Please do your best to take standing breaks every 30 minutes.”

Transcript delivered to participants prior to Phase C (introduction of prompt):

“The WatchMinder is a device that will be used to help remind you to take breaks every 30 minutes. The device is to be worn on the wrist and you will feel it vibrate every 30 minutes... When the WatchMinder vibrates, it is to remind you to stand up and take a standing break like we talked about before. Remember that the break should be for 30 seconds to 2minutes. These activities can include standing up and stretching, getting a drink, or throwing a piece of paper in the trash down the hall. Please do your best to take standing breaks, when the device vibrates.”

Transcript delivered to participants during Phase D (feedback and goal setting phase):

“In the first part of the study you sat on average (#a) times for longer than 30 minutes per day. In the second part of the study, where I told you about the risks of sitting, you sat on average (#b) times for longer than 30 minutes. In the most recent part of the study, with the vibrating watch, you sat on average (#c) times for longer than 30 minutes. So far you have gone from (#a) to (#b) to (#c) times sitting longer than 30 minutes per day. It is ideal to have zero instances of long periods of sitting throughout the day. I would like for you to set a goal for yourself to reduce the number of times you sit for longer than 30 minutes. What do you think is a reasonable goal that you would like to set?”

If goal set by participant is 50% or less of Phase C, then say:

“Great, your goal will be to sit (#d) or fewer times longer than 30 minutes. Please continue to wear the activity recorder and watch as you have before. Each evening I will look at the data and email you by the following morning to tell you how you did the previous day. In the email I will give you feedback on how you are doing and set a new goal if necessary. Do you have any questions?”

If goal set by participant is not less than 50% of Phase C, then say:

“It is important that we set a goal that is 50% or less than the last part of the study. Again, during the last part of the study, you sat (#c) times for longer than 30 minutes per day. What would you like your goal to be, if we try to make it at least 50% of what it was during the last part of the study? Great, your goal will be to sit (#d) or fewer times longer than 30 minutes, please continue to wear the activity recorder and watch as you have before. Each evening I will look at the data and email you by the following morning to tell you how you did the previous day. In the email I will give you feedback on how you are doing and we can discuss setting a new goal if necessary. Do you have any questions?”