The Effects of Self-Monitoring on Safe Postural Performance

Nicole Gravina
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THE EFFECTS OF SELF-MONITORING ON SAFE POSTURAL PERFORMANCE

by

Nicole Gravina

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Submitted to the
Faculty of The Graduate College
in partial fulfillment of the
requirements for the
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The purpose of the present study was to examine the effects of self-monitoring on safe positioning of individuals performing a typing task and an assembly task using a multiple baseline design across behaviors and tasks. The study took place in an analogue office setting with seven college student participants. The dependent variable was the percentage of observations scored as safe and each session was recorded via a hidden camera. During baseline, participants received information regarding safe positions and then completed a typing task and an assembly task during nine-minute sessions. In the self-monitoring phase, participants recorded whether a targeted posture was safe or at-risk. In the third phase, if the targeted postures improved at least 20-percentage points over baseline during self-monitoring, additional behaviors were monitored. Otherwise, an overt camera condition was implemented in addition to self-monitoring. Five of the 17 dependent variables exposed to the self-monitoring intervention resulted in substantial changes in safety performance and an additional six behaviors resulted in a mean improvement of more than 10% from baseline to intervention. The camera present condition produced differential improvement for two of the 12 exposed postures. This information could lead to a viable alternative for improving occupational safety.
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INTRODUCTION

Injuries in the workplace are a major concern to organizations and their employees. Each minute of the 40-hour work week almost 50 American workers sustain an injury (Safety and Health News, 2004). The Bureau of Labor Statistics, US Department of Labor (2005), reported that in 2003 there were 4.1 million injury cases in organizations, and that more than 1.4 million (34%) of those cases resulted in at least one day away from work. Of those injuries that resulted in time spent away from work for recuperation, 500,000 (36%) were musculoskeletal disorder (MSD) related injuries. The Occupational Safety and Health Administration (OSHA, 2004a) defines work-related MSDs as injuries caused by “physical work activities or work place conditions in the job that are reasonably likely to be causing or contributing to injuries and disorders of the muscles, nerves, tendons, ligaments, joints, cartilage and spinal disc” (p. 1). Examples of MSDs include carpal tunnel syndrome, tendonitis, and tension neck syndrome. Employees that suffer from severe MSDs “can face permanent disability that prevents them from returning to their jobs or handling simple, everyday tasks like combing their hair, picking up a baby, or pushing a shopping cart” (OSHA, 2004b, p. Introduction).

Musculoskeletal-related injuries cost the United States an estimated $20 billion each year in direct costs alone (Safety and Health News, 2004) and perhaps 3 – 4 times that amount in indirect costs. Additionally, these injuries result in the longest average number of days required away from work – 23 days. The injury type resulting in the next highest average days lost is “falls to a lower
level,” which resulted in an average of 14 lost work days per injury (Bureau of Labor Statistics, 2005). According to the Bureau of Labor Statistics (2002), typing and repetitive grasping or moving of objects (e.g., assembly tasks) account for the majority of repetitive motions injuries. However, many injuries, including those caused by repetitive activities, have been declining in the past 14 years. Primary factors causing this decline may likely include: more effective safety interventions (such as better employee awareness and training), ergonomic equipment innovations, and human factors advances in hardware design. Although these and other interventions are making a difference in workplace safety, it is clear that additional improvements are needed.

Behavioral Safety

A widely used approach to reducing worker injuries is the behavioral safety process based on the basic principles of behavior described by B. F. Skinner (1953). The goal of behavioral safety is to reduce injuries by changing critical safety-related behaviors of employees. This behavior change is typically accomplished through the application of various environmental manipulations, which are largely made possible through the development of a systematic behavioral safety process. The behavioral safety process usually involves creating a safety committee within the organization, assessing current safety levels and practices, developing an observation and feedback system, setting goals for safety performance, and providing recognition for attaining safety goals (McSween, 2004). This process has demonstrated effectiveness in numerous
organizations of varying sizes and in a variety of industries (Krause, Seymour, & Sloat, 1999).

Cooper, Phillips, Sutherland, and Makin (1994) used a behavioral safety process to improve safe behaviors in a large production plant. Researchers examined accident records and conducted interviews with employees and managers to determine critical safety behaviors. Employees were asked to set achievable, but difficult goals for safety performance. Forty-eight of the 540 employees were then trained to conduct safety observations and their results were posted weekly on a graph. Results indicated that the percentage of safe behaviors increased considerably, and the injury rate was reduced by almost 50%.

Observation and feedback are integral components of a behavioral safety process (McSween, 2004). In the typical observation and feedback process, safety observers observe work situations and record safe and at-risk behaviors and conditions. Observers then verbally convey the information they recorded to the employees, and graph the data. Sulzer-Azaroff (1998) recommended several possible sources of observers from among organizational employees, and held that managers, supervisors, safety committee members, and even line-workers themselves are all capable of observing and delivering feedback.

Feedback is a widely used intervention in organizations. A review of the literature conducted by Nolan, Jarema, and Austin (1999) found that feedback was at least one independent variable in more than 70% of the studies published in the Journal of Organizational Behavior Management (JOBM). In another review of JOB, and other journals, Alvero, Bucklin, and Austin (2001) found
that feedback, alone or in combination with other interventions, consistently improved performance for 58% of the studies and produced mixed effects for 41% of the studies. Conducting observations has also been demonstrated to change the behavior of the observer (Alvero & Austin, 2004) as well as the behavior of the person observed, even when no feedback is provided. The behavior change of the person being observed has been termed reactivity by Kazdin (1982) and, despite the fact that it has only been reported in a few studies (Lebbon, Austin, VanHouten, & Malenfont, 2004; Zegiob & Forehand, 1978), is a well-accepted concept in the area of behavior analysis.

The Observer Effect

Observations affect not only the observed but they also have an effect on the individual conducting observations. Alvero and Austin (2004) assessed the effects of peer observations on eight typing behaviors in an analogue office setting. Participants were randomly assigned to either group A or B. Before the intervention was implemented, group A was exposed to information on four of the eight target behaviors and group B was exposed to information on the other four behaviors. Performance of the behaviors targeted in the information phase increased slightly for group A but not for group B. This suggests that information alone was an ineffective intervention to substantially improve safety behaviors.

Following the information phase, participants used a behavioral checklist to evaluate the videotaped safety performance of a confederate on each of the target behaviors for which they had previously received information. During the following experimental phase, participants observed the remaining four target
behaviors as well. When peer observations were implemented, performance improved above baseline for both groups A and B by 70.5% and 64.4%, respectively. This study demonstrated that peer observations effectively improve the observer's similar safety behaviors in an analogue setting.

Sasson and Austin (2004) systematically replicated the Alvero and Austin (2004) study in an applied setting. The study evaluated safe typing behaviors of 11 hospital employees who worked in billing and scheduling roles. The study utilized a multiple-baseline design, and participants received information on safe typing behaviors following baseline. Following the information phase, six randomly selected employees were trained to conduct peer observations while the other five participants were exposed to no further treatment until the feedback phase. During feedback, all but one peer observer continued to conduct observations, and all participants received written feedback based on researcher observations. Although the safety performance of all participants improved during the feedback phase, peer observers' performance improvement resulted in an effect size twice as large as that of non-observers. Further, for some observers, there was a strong positive relation between accuracy of their observations and the amount of behavior change demonstrated by these same participants.

Although peer observations have been demonstrated to be an effective intervention for changing behavior, they have some major limitations. Being observed can potentially be aversive for the person observed. For example, Rohn (2004) found that, after having been exposed to both conditions, participants almost always selected the no observer condition over the observer present
condition when given the choice. Another possible limitation of peer observations is their ineffectiveness in the absence of an observer. Rohn (2003) used a hidden camera to compare safety performance in the presence and absence of an observer. Results showed that, whereas safe positioning improved substantially in the presence of an observer, safety returned to baseline levels when the observer was absent. This is consistent with other research findings on reactivity.

Reactivity to Observations

Lebbon et al. (2004) demonstrated reactivity to observations by participants observed in a study aimed at increasing the use of safety belts by three maintenance drivers at a university. A device placed in each vehicle automatically recorded safety belt use. This same device introduced a shift-interlock delay during the intervention period, whereby drivers who did not buckle their safety belts were prevented from moving the vehicle for a short duration (i.e., 5-20s). Observers also recorded safety belt use for 60-70 min blocks one to two times per day and always conducted the observations in the same location that was clearly visible to the participants as they drove past it. Data from the automatic recording device showed that participant A's safety belt use averaged 62 percentage points higher when observers were present than when they were absent during baseline, and 19 percentage points higher during the intervention. Participant C's safety belt use was eight percentage points higher in the observer present condition compared to the observer-absent conditions during baseline, but no difference was detected during the intervention. This study
suggests the reactive effect that observations can potentially have on the person observed.

Rusch, Menchetti, Crouch, Morgan, and Agran (1984) also examined the effects of reactivity to overt observations in a work setting. The participants were five adults diagnosed with mental retardation who worked as dishwashers. During the first phase of the experiment, special educators (SEs) overtly observed participants' on-task behaviors. During phase two, SEs continued observations with the same participants while a second group of observers posing as kitchen laborers covertly measured on-task behaviors when SEs were absent. In the final phase, SEs and coworkers observed the participants' behavior concurrently. The results of the experiment suggest that the participants were on-task more often when they were being overtly observed.

Perhaps an even more problematic feature than aversiveness and reactive effects is the impracticality of peer observations for many occupations and organizations. Numerous jobs are not conducive to employees leaving their workspace to conduct observations of other employees. Even if jobs are flexible enough to allow employees to leave the work area and conduct peer observations, there are costs of wages paid during observation sessions and lost productivity associated with this down-time. For these and other reasons, employers are often reluctant to allow employees to interrupt work to monitor the safety behavior of their peers. Furthermore, peer observations are not a reasonable option for employees who work alone. The often impractical nature of peer observations establishes a clear need for the development of other effective occupational safety
management techniques. One possible alternative to peer observations is self-monitoring. Self-monitoring does not require employees to leave their workspace, is more acceptable to employees who resist peer observations, does not require feedback training, and is a plausible alternative for lone workers (McSween, 2004).

Self-Monitoring

Few research studies have been conducted to examine the effects of self-monitoring on safe working behaviors. Furthermore, self-monitoring is often not viewed by employees and managers as a viable option for changing behavior, possibly because it appears to be a rather simplistic or insignificant intervention compared to peer observations or engineering efforts. However, Alvero and Austin (2004) speculated from anecdotal reports that the observer effect demonstrated in their study may have been due in part to the observer’s self-monitoring his or her own behavior. More research is necessary to establish the effectiveness of self-monitoring in the workplace.

Self-monitoring has, however, been demonstrated as an effective behavioral intervention in non-work settings numerous times for an assortment of behaviors. Nelson and Hayes (1981) describe self-monitoring as “an individual recording the occurrences of his or her own target behavior” (p. 3). Recording one’s own behavior has been demonstrated to decrease face touching (Hayes & Cavior, 1977; Hayes & Nelson, 1983; Nelson, Boykin, & Hayes, 1982; Nelson, Lipinski, & Black, 1975), vocalizing value judgments in group conversations (Hayes & Cavior), and negative vocalizations by teachers (Nelson, Hay, Hay, &
Carstens, 1977). It has also been used clinically in combination with other interventions to reduce tics (Dillenburger & Keenan, 2003) and binge eating (Latner & Wilson, 2002) as well as a myriad of other behaviors.

Nelson et al. (1975) evaluated the effects of self-monitoring on face touching. The participants were 20 college students in a classroom with a one-way mirror. Trained observers recorded incidents of face touching during class. During baseline, participants were unaware they were being observed. After baseline, participants were assigned to one of four "expectancy groups." Each group was provided different information on the expected effects (such as increase, decrease, no effect, and no information) self-monitoring would have on their behavior. Results showed that participants in all four groups decreased face touching during the self-monitoring phase and then increased close to baseline levels during the withdrawal phase. This study suggests that giving participants information on expected effects of self-monitoring does not affect the direction of behavior change.

Hayes and Cavior (1977) also utilized self-monitoring to reduce face touching along with non-fluencies and value judgments during informal group discussions that were overtly videotaped. During self-monitoring, all seven groups were informed of the dependent variables and given instructions to self-monitor and were instructed not to mention the dependent variables or self-monitoring during discussions. Participants within each group all self-monitored the same behavior(s), but each group was assigned to monitor one to three behaviors, with no two groups monitoring the exact same combination. Results
indicated that self-monitoring only one behavior produced significantly greater effects than self-monitoring two or three behaviors. A statistically significant difference was not found between monitoring two and three behaviors, although they both resulted in a decrease in behaviors compared to baseline.

Self-monitoring has not only been shown to decrease behavior, but it has also been shown to increase a variety of behaviors. Examples of behavior that have been increased through self-monitoring include laps swum at swimming practice (Critchfield, 1989, 1999; Critchfield & Vargas, 1991) participation in class (Komaki & Dore-Boyce, 1978), appropriate verbalizations by adolescents diagnosed with developmental disabilities (Nelson, Lipinski, & Boykin, 1978) and math performance (Kirby, Fowler, & Baer, 1991).

Maag, Reid, and DiGangi (1993) used self-monitoring to improve academic performance of six elementary school students. During the first self-monitoring phase, a multi-element design was used to compare on-task behavior when students self-monitored one of the following variables: productivity, accuracy, or teacher attention. All of the self-monitoring targets resulted in an improvement in percentage of intervals on-task for four of the six students. The remaining two students showed increases in on-task behavior when they self-monitored accuracy but there were no effects for the other two variables.

Following this phase, students were allowed to choose a self-monitoring target for the remainder of the study. Four students chose to monitor productivity while the other two chose to monitor accuracy. All of the students’ percentages of intervals on-task stayed above baseline during the choice phase. Finally, self-
monitoring was faded by removing the signal to record. Students were instructed to self-monitor whenever they “thought about it,” which resulted in a slight decrease in performance. Self-monitoring was then removed, and performance was observed for one or two follow-up days immediately following the fading phase. Results indicated a decrease in percentage of intervals on-task after the intervention had been removed, but performance remained above baseline levels for five out of the six students during the one to two days of follow-up. Self-monitoring productivity resulted in a larger number of math problems being completed than any other phase for all participants. Perhaps more interesting is the fact that self-monitoring productivity also improved the accuracy of tasks completed over baseline for four of the participants. Self-monitoring accuracy produced inconsistent results in the accuracy of task completion, and in productivity. These findings suggest that when people are required to self-monitor one element, collateral improvements in other related performances may emerge.

Maag et al. (1993) speculated that the collateral effects of self-monitoring on related behavior observed in their study (but not in earlier studies) occurred because each variable was a target for a longer period of time (one day) with a larger interval between targets (one day) than in previous studies that compared different targets. Maag et al. recommended maintaining the self-monitoring target for a sufficient amount of time for the differential effects to become apparent.

Stevenson and Fantuzzo (1984) showed similar response covariation when they used self-monitoring as part of an intervention package to increase accuracy
of math performance. The researchers taught underachieving fifth grade children to set a goal, self-monitor, and reward themselves for math problem completion. They found that the intervention not only produced improvements in math performance, but that there was also a decrease in disruptive behavior, an increase in math performance at home, and sustained levels of math performance over time. These findings suggest that the effects of self-monitoring may generalize across settings and behaviors.

Another benefit of self-monitoring is its potential for long-term behavior change. Nelson et al. (1982) compared the effectiveness of short-term self-monitoring with long-term self-monitoring. Sixteen college students self-monitored face-touching during a two and a half hour class; eight of those students self-monitored for two weeks and the other eight students self-monitored for nine weeks. Observers were two college students that were not discernable by the class and thus no reactivity to being observed was likely. Baseline lasted for two weeks and then participants were informed of the target behavior and trained to self-monitor all instances of face-touching during class. The amount of behavior change was comparable between groups. The frequency of face touching returned to baseline levels when self-monitoring was removed. This suggests that, irrespective of the number of times a behavior is monitored, the reactive effects of self-monitoring may persist, but only as long as the self-monitoring continues to occur. However, the findings are confounded by the fact that participants were unaware of the target behavior until self-monitoring was implemented.
Self-Monitoring in Work Settings

The effects of self-monitoring have also been demonstrated in work settings. Richman, Riordan, Reiss, Pyles, and Bailey (1988) used a multiple baseline design across homes to evaluate self-monitoring used to improve staff adherence to a schedule of activities in an intermediate-care facility. Self-monitoring consisted of employees writing their activity schedules on a card at the beginning of the work shift and placing a check mark next to tasks that were completed. Participants also recorded on the card the reason why any tasks were not completed. Recording activities resulted in almost a twofold increase for both being on-schedule and being on-task. Some of the employees did not maintain improved performance, so supervisor feedback was added to the intervention. The addition of supervisory feedback resulted in even higher performance than the initial improvements exhibited during the self-monitoring-only phase. Possible confounds include the fact that employees did not write down their schedules so therefore there was no information on how often employees checked their daily schedule prior to the self-monitoring phase. It is possible the improvements in staff schedule adherence were due to repeated exposure to the schedule rather than self-monitoring.

Belfiore, Mace, and Browder (1989) examined the effects of self-monitoring on work tasks performed by two mentally impaired women. Using a multiple-phase reversal design, the experimenters evaluated performance using a rate per min measure during a baseline condition, a self-monitoring as a solitary intervention condition, and a self-monitoring plus observer-present condition.
The first participant self-monitored a copying task by crossing off page numbers of completed copies. Baseline photocopying averaged 1.17 copies per min and self-monitoring with no-observer presented yielded only 1.28 photocopies per min. When the observer presence was added, performance increased to 2.22 copies per min. When observer presence was removed, performance dropped to 1.78, and then increased again to previous levels when the observer was reinstated. The second participant self-monitored bagging silverware by placing a wooden dowel in a base after each bag was completed. During baseline the participant bagged 7.88 forks per min and this increased to 12.2 forks per min during the self-monitoring observer present phase. Performance dropped to 9.68 during the self-monitoring no-observer present stage. Similar results were obtained during another implementation of the observer present and no-observer present self-monitoring phases.

The results of Belfiore et al. (1989) indicate that self-monitoring when an observer is present changes behavior. However, the results of self-monitoring when no observer is present are inconclusive. Any change in behavior during the self-monitoring with no observer present phase could have been due to carryover effects. Participant 1 did not show a behavior change in the first self-monitoring phase, but did improve during the self-monitoring phase that followed the observer present condition. The second participant did not self-monitor in the absence of the observer until after the observer present condition. Therefore, it is not possible to attribute any changes in behavior to self-monitoring alone. The behavior change seen in the observer present condition could have resulted from
reactivity to being observed or from the combination of self-monitoring and the observer presence. Additionally, no IV integrity data were presented in the study, and therefore it is unclear whether self-monitoring actually occurred in either of the phases.

Austin, Olson, and Wellisley (2001) used a package intervention that included self-monitoring, task clarification, and public posting to improve customer service at an insurance agency. A multiple-baseline design was used across two target behaviors: using the customer’s name, and suggesting additional services. Self-monitoring consisted of estimating the percentage of each target behavior occasionally during the day. The intervention resulted in an increase in both target behaviors. When the intervention was implemented with the first target behavior, there was an increase in the second target behavior, suggesting possible covariation or diffusion of treatment across behaviors. The second behavior increased even more when the intervention was implemented.

Self-Monitoring and Safety

Olson and Austin (2001) used a self-monitoring package to improve bus operator safety. A multiple-baseline design across four performances was utilized to evaluate the package for four bus operators at a city bus service. Several performances were targeted, including complete stopping, and loading and unloading passengers safely. The intervention package included self-monitoring, prompts for self-monitoring by the dispatchers, publicly posted group feedback, and occasional ride-alongs from supervisors, during which supervisors conducted direct observations of the driver’s behavior while on the bus. The intervention
increased safe operating behaviors among bus drivers an average of 12.3% (range: 14-41%) when compared to baseline rates. Performance improved further on occasions when supervisors conducted observations. These results suggest that a package intervention that includes self-monitoring may be effective at improving safe bus operating. However, no conclusions about self-monitoring as a solitary intervention can be drawn from this study, as self-monitoring was implemented as only one part of an intervention package. Furthermore, this study did not control for awareness of the target behavior (i.e., drivers were informed of the targets at the same time they began to monitor the behaviors), or the act of pausing to self-monitor. It is possible that the pause drivers took to self-monitor (rather than the act of recording) caused drivers to change their behavior, and to become more aware of their own behavior.

McCann and Sulzer-Azaroff (1996) used self-monitoring, feedback, goal-setting, and reinforcement to improve postural behavior of participants while typing. Data were collected for six postures (back, shoulders, neck, legs and feet, arms, and wrists) by a video camera present in the room for 6 full-time secretaries. Following baseline, discrimination training and self-monitoring were implemented simultaneously. Training consisted of showing pictures of examples and non-examples of correct components of posture. Following training, participants were asked to demonstrate that they had mastered the material by correctly labeling ten pictures as correct or incorrect postures. Participants moved on to the next phase when they demonstrated a minimum of 80% correct for the testing procedure.
Self-monitoring of safety behavior was conducted at the end of each observation session. Participants were asked to estimate the percentage of time they were safe for the entire session. Discrimination training and self-monitoring improved the percentage of intervals with correct postures above baseline levels. Subsequently, feedback on the accuracy of participant self-monitoring, goal-setting, and reinforcement were added to the intervention, which resulted in further improvements. The authors argued that improvements in accuracy of self monitoring seemed to correspond with the largest performance improvements. This is, however, confounded with the fact that goal-setting and reinforcement were implemented at the same time that feedback on accuracy was implemented, which means that any of these factors could have contributed to the relation between accuracy and performance. The effects of the intervention are also confounded by the participants' awareness that their posture was being recorded.

Self-Monitoring as a Solitary Intervention

Although self-monitoring has been demonstrated to be effective, it is usually implemented at the same time that participants are made aware of the target behavior or observations, during training, or in conjunction with other interventions. For example, in the Nelson et al. (1975) study, participants were not aware of what was being observed until it was explained at the start of the self-monitoring phase. Therefore, it is not clear whether the outcome was a result of information (and/or reactivity from external monitoring), self-monitoring, or some combination of these.
In the few studies during which participants were aware of what was being observed prior to the implementation of self-monitoring, further clarification was given about the dependent variable when self-monitoring was implemented. In the McCann and Sulzer-Azaroff (1996) study, it is assumed that participants were aware of the general orientation of the study since they were tested for carpal tunnel syndrome prior to the beginning of the study. However, at the start of the self-monitoring intervention, discrimination training of safe and at-risk postures at a computer workstation was provided for participants. This indicates that the participants were not well informed about the target behavior/posture prior to the self-monitoring phase. Therefore, the effects of self-monitoring should be evaluated as a solitary intervention to determine if self-monitoring by itself generates behavior change, or if other components, such as information and/or reactivity to the presence of an external observer, are necessary to produce a change in performance.

Nelson and Hayes (1981) proposed that the external cuing component of self-monitoring is actually responsible for behavior change, and that other components of self-monitoring could be eliminated. Hayes and Nelson (1983) compared one component of self-monitoring, external cuing, with a self-monitoring package to determine if the single component or the entire self-monitoring package was responsible for behavior change. The study was conducted in a small private room where participants viewed a lecture about autism on a television. They were told one or two observers would be present in the room to observe their listening style. Participants were divided into four
groups: (a) control group, who took a two min break during the lecture, (b) self-monitoring group, that self-monitored face touching by pressing a key, (c) contingent external cuing group, in which participants were exposed to a slide reading: "Don't touch your face," each time a face touch occurred, and participants were told to press the key when the slide appeared, (d) non-contingent external cuing, in which participants were exposed to the same slide as participants from the contingent external cuing group every two mins, and participants were required to press the key each time the slide appeared. Results indicated that both contingent and non-contingent external cuing alone were equally effective at reducing the number of times students touched their face as the self-monitoring package.

One limitation of the Hayes and Nelson (1983) study is that participants were not aware of what was being observed before the intervention was implemented. While the experimenters continued to tell participants that they were observing their listening style, the three intervention groups were also given the definition of face touching at the start of the intervention. Therefore, they were indirectly made aware of the target of the intervention at the start. It is possible that the reduction in behavior was due to reactivity of being observed and information regarding the target behavior rather than the external cue. Further research should be conducted to control for awareness of the dependent variable before an external cue or self-monitoring is introduced. Additionally, while ANOVA tests identified no significant difference between the groups, the self-monitoring group experienced a slightly larger reduction in face touching (a
reduction of seven face touches) than the contingent cuing group (a reduction of 5.6 face touches) and non-contingent cuing groups (a reduction of 6.5 face touches). The possible reactivity and slight difference in reduction of face touches could open these results to alternative explanation.

Much of the research that has been conducted on self-monitoring (with the exception of McCann & Sulzer-Azaroff, 1996), including the Hayes and Nelson (1983) study previously mentioned, targeted discrete behaviors. In other words, most self-monitoring studies instruct participants to monitor the target behavior each time the target behavior occurs. However, many important safety behaviors are not discrete, but are instead continuous. In other words, the behavior does not have a clear beginning and ending. Continuous behavior creates various procedural difficulties in executing self-monitoring, as well as methodological difficulties in studying the effects of self-monitoring. Postural safety is a continuous target behavior and a comprehensive literature search revealed no research studies that that examined self-monitoring as a solitary intervention for continuous behavior. Therefore, the absence of research on this topic precludes a conclusion that the self-monitoring techniques proven effective for discrete behaviors would be as beneficial for continuous behaviors.

Self-monitoring has rarely been evaluated as a solitary intervention, and in those studies in which self-monitoring alone was investigated (Hayes & Nelson, 1983, Nelson, et al. 1975), the reactive effects of information and being observed were not controlled for in the study. Therefore, it cannot be determined if the behavior changes observed in those studies were a result of being made aware of
the dependent variable, being made aware of an external observer, being aware of the expectations of performance of the dependent variable, self-monitoring, or a combination of these factors and perhaps some others. Skinner (1953) discusses awareness as the ability to tact one's own behavior or the controlling variables influencing one's own behavior. He also suggests that an individual may be able to "control" his or her own behavior by identifying the "behavior to be controlled" (p. 229) and manipulating relevant consequences. Research should attempt to control for awareness of the target behavior (i.e., the behavior to be controlled) and potential self-controlling behaviors by providing the circumstances under which such behavior could take place prior to baseline. Lastly, none of the studies reviewed controlled for interruption of the work task to self-monitor.

Purpose of the Current Study

The purpose of the current study was to evaluate the effectiveness of self-monitoring as a solitary intervention on the percentage of safe observations of typing and assembling postures. The current study controlled for awareness and understanding of the dependent variable by providing information regarding safe positioning to participants prior to baseline. It also controlled for the interruption of the work task to self-record by having participants check a blank box during baseline. Reactivity to observation was also be controlled for by using a hidden camera. Results of this study indicated that self-monitoring as a solitary intervention may be a viable solution for improving safe postures during typing and assembly. Moreover, data were examined to determine if covariation
occurred across behaviors and/or settings. If constraints of the study permitted, a third phase was implemented. In the third phase, if the targeted postures improved at least 20-percentage points over baseline during the self-monitoring phase, additional behaviors were added to monitoring. If there was not a 20-percentage point improvement, an overt camera condition was implemented during the third phase in addition to self-monitoring.
METHOD

Participants and Setting

The participants were seven college students recruited from a large mid-western public university using a recruitment script (see Appendix A, based on Rohn, 2004). Students were asked to fill out a sign-up sheet (see Appendix B) if they were interested in learning more about the study. To be included in the study, participants' average typing speed was required to be at or above 25 words per min, and they were required to be able to touch type so they did not have to repeatedly look down at the keyboard while typing. Typing speed was assessed using a standard typing test that occurred before observation sessions begin. Individuals were also screened for bodily pain or discomfort, or a history of such pain or discomfort, and asked to complete the Postural Discomfort Survey (see Appendix C). If a history of pain or discomfort was reported or if an overall score of 4 or higher was reported on the discomfort survey, the individual was excluded from the study. Individuals were asked whether they have previously participated in observational studies conducted at the Performance Management Lab. Only those who reported not having previously participated in observational studies were considered for participation in the study. After the completion of four baseline sessions, if there were not at least two dependent variables at or below a 50% percentage safe baseline average, the participant was excluded from the study. Based on these criteria, no participants that signed the consent form were excluded from the study.
The study took place in an analogue work setting. The room resembled an office in that it included one computer, a desk and chair, and a CD player that played the recording of beeps. A brief ergonomic assessment was conducted for each participant that joined the study. The assessment was based on the Occupational Safety and Health Association (OSHA) Workstation Posture Checklist (OSHA, 2004b). The workstation was adjusted according to the recorded results of the initial ergonomic assessment each time a participant attended a session in order to reduce variability due to workstation set up. The room also contained a CD player that played CD’s with recordings of beeps, used to cue monitoring responses. Three CD’s with four tracks each of varying beep schedules were used randomly. A sound sensitive light was attached to the CD player so that the occurrence of the beep could be recorded by the hidden camera. The assembly supplies consisted of a bin of washers, a bin of nuts, a bin of bolts, and an empty bin. A hidden camera (X10 Wireless Technology, Inc., Xcam2) was placed in the room on a bookshelf for data collection purposes. Participants were paid $5 for each four-session block (40 mins) completed or received extra credit at the end of the study, regardless of their performance.

Dependent Variables

The study employed a safety checklist with six postures, including: wrists, head, shoulders, back, arms, and legs (see Appendix D for a sample of the experimental data sheet). The dependent variable was the percentage of intervals scored as safe for each posture. Each nine-min session was graphed as a separate data point. The safe definitions for each dependent variable were derived from
the ergonomic guidelines and recommendations by the Occupational Safety and Health Administration (OSHA, 2004b).

*Back position.* The lower back (lumbar) is touching the chair, the back is straight, and the angle of the back and the thigh is between 100-110 degrees.

*Shoulder position.* The upper arms are tucked close to the body and hanging relaxed, not extended out to the side. Shoulders are relaxed, not hunched or rolled forward.

*Head position.* The head is in line with the torso and facing forward and the chin is parallel to the floor.

*Leg position.* The knees are bent forming an angle between 90-120 degrees. Legs are not crossed.

*Arm position.* The upper arm and elbow angle is between 90-120 degrees.

*Wrist position.* The wrists are flat (not bent up or down) and straight (not bent right or left).

Trained observers scored each posture from a video obtained by a hidden camera using a momentary time sampling procedure with a two-s-recording pause between each dependent variable. Because of the two-s pause and the length of time required for each posture to be spoken on the momentary time sampling recording, each posture was observed every 15.3 s. Each postural dependent variable was expressed as the percentage of intervals scored as safe for each nine-min session and was graphed separately.

Productivity and accuracy of participant monitors were considered secondary dependent variables. Productivity was measured for typing by using
the computer’s word count function to determine the number of words typed during each session. Widget productivity was measured by counting the number of widgets assembled and placed in the bin at the end of each session. Accuracy was measured as agreement between the participant’s self-recorded observation and the trained observers’ observation for the observation immediately preceding the self-monitoring response and was depicted using a scatterplot. Only sessions occurring prior to the camera phase with four self-monitoring responses occurring separately on the video and with four self-monitoring responses marked on the sheet were included in the correlational analyses.

Procedure

Informed Consent Process and Screening

The informed consent process occurred prior to each participant’s initial session and after the study was completed (for consent to use hidden camera data). The researcher met with each individual one-on-one and read a script (see Appendix E, adapted from Rohn, 2004) and reviewed the consent form (see Appendix F, adapted from Rohn, 2004). Individuals were then informed that the study involved examining discomfort caused by work tasks using a discomfort survey. Individuals were given the opportunity to sign, or refuse to sign, the consent form. They were informed that they would not be penalized in any way if they decided not to sign the consent form. No participants refused consent at the beginning of the study. After signing the consent form, individuals were asked if they have ever participated in a study in the Performance Management Lab. Only
those that indicated that they have never participated in a study in the Performance Management Lab were included in the study.

Next, individuals were given the discomfort survey (Appendix C) and were asked if they currently had or had a history of chronic back problems, existing MSDs, such as carpal tunnel syndrome, or any other conditions that might have increased the risk of injury associated with participating in the study. Only individuals that did not report previous or current MSD's or back problems and that reported an overall discomfort level of four or less on the discomfort survey were included in the study. Lastly, a typing test was administered. Only individuals that were able to touch type 25 words or more per min were included in the study. No participants were excluded from the study based on these criteria.

At the conclusion of the study, consent for the use of data was requested using the Consent for Use of Data Form (see Appendix G, adapted from Rohn, 2004) and the Consent for Use of Data Script (see Appendix H, adapted from Rohn, 2004). All participants in the study consented for use of their data.

Ergonomics Training

Prior to the first baseline session, participants were given information on safe ergonomic postures to control for information effects during self-monitoring. The information was presented orally by the experimenter using an informational sheet (see Appendix I) of safe posture definitions. Following the training, as an IV check for the effects of information, participants were asked to model correctly all six postures, and were given corrective verbal feedback for any at-risk
postures. Participants were asked to demonstrate correct posture in the presence of the experimenter until the correct posture was exhibited. The informational sheet was then placed in the experimental room on the table next to the work area during all sessions.

**Baseline**

During baseline, participants were asked to perform one of two tasks, typing or assembly, during each nine-min session. Each observation day, participants completed two sessions of the typing tasks and two sessions of the assembly task in randomized order. The typing task consisted of typing a copy of a document provided by the researcher. Fourteen different documents (see Appendix J for a sample document) were randomly ordered and each participant received the documents in a different random order throughout the study. Each document contained 800-900 words. This number was selected because it exceeded the number of words that a skillful typist could complete in 9 mins. The assembly task involved assembling “widgets.” To assemble a widget, the participant placed a nut, then two washers, and then another nut on a bolt.

During baseline sessions, participants were asked to check a blank box (see Appendix K) on a sheet of paper whenever a beeper sounded. The beeper sounded on a random schedule, allowing for four opportunities to record during each nine-min session. This baseline recording procedure was designed to control for the breaks associated with self-monitoring during subsequent phases. Participants’ posture was not scored while they engaged in recording responses. When the participants resumed the task, scoring began again at the next
observation interval. Resuming the task was defined as a finger touching the keyboard for typing and a finger touching an assembly part for the assembly task.

In addition, although participants were trained on safe body positioning, they were not made aware (until debriefing, after the study was concluded) that safe positioning was being monitored via a hidden camera. At the end of each four-session block, participants were asked to complete a form designed to assess discomfort (see Appendix L for the discomfort survey script).

**Self-Monitoring Phase**

Before the participants began each self-monitoring session, the experimenter gave instructions on when and how to self-monitor (see Appendix M) using the self-monitoring recording form (see Appendix N). The posture and task with the lowest percentage and greatest stability of safe observations was selected as the target behavior for self-monitoring, with stability being the more important of these two factors. Self-monitoring was introduced for either the typing task or the assembly task first and the other task later in a multiple-baseline fashion. Participants were asked to attend to the target posture when the beep sounded and then to immediately record on the self-monitoring form whether he/she was safe or at risk at the moment the beep sounded. During each nine-min session, participants were randomly prompted (in the same manner as during baseline) to self-monitor a total of four times. As during baseline, participant behavior was not scored during recording responses and sessions were recorded by a hidden video camera. The self-monitoring phase lasted between 4-22 sessions. Phase changes were determined through visual inspection of the level,
trend, and variability of the data, and in some cases, phase changes were made based on the financial and participant time constraints of conducting the study.

Overt Observation or Multiple Behaviors

Following the self-monitoring phase, if the constraints of the study (and funding) allowed for additional sessions to be conducted, an additional phase was implemented. During this phase, participants continued to self-monitor. If self-monitoring in phase two improved the percentage of safe intervals by 20 percentage points or more for the target behavior, an additional two behaviors were added to self-monitoring. If however, self-monitoring did not result in a 20-percentage point increase, an obvious camera condition was implemented. In this condition, an obvious camera was present in the experimental room in a multi-element design for both the typing task and the assembly task. Sessions with the camera present were semi-randomly assigned, with the camera being present for no more than two sessions in a row and for one typing and one assembly task each four-session block. The participants were told that the camera was recording his or her target behavior and the posture would later be scored as safe or at-risk (see Appendix O for the Obvious Camera Instructions).

Exit Interview

At the conclusion of the study, participants were asked a series of questions regarding the experiment (see Appendix P, adapted from Rohn, 2004). The purpose of the exit interview was to obtain as much information as possible about why the participants performed as they did.
Debriefing

Following the exit interview, all participants were debriefed using a script (see Appendix Q, adapted from Rohn, 2004). Participants were informed about the presence of the hidden camera and why it was critical for the purpose of the study. To ensure the integrity of study, participants who excused themselves from the study before it was completed were not debriefed until all participants completed the study. During debriefing, participants were given the opportunity to refuse to allow use of the videotapes as data. No participants refused the use of data. At the conclusion of the debriefing meeting, all of the money earned during the entire study was paid to the participant or a letter indicating the number of hours participated was provided for extra credit purposes.

Experimental Design

The study evaluated the effects of the self-monitoring on the percentage of intervals scored as safe using an AB (and C, if a third phase was included) multiple-baseline design that was counterbalanced across tasks.

Interobserver Agreement (IOA)

A second observer independently scored a portion of observation sessions to assess interobserver agreement. For each interval and each behavior, either an agreement or a disagreement between the two observers was scored. An agreement was calculated when both observers score a particular posture identically during a given interval, and a disagreement was recorded when observers scored an interval differently. Point-by-point agreement was calculated for each behavior, and for both occurrence and nonoccurrence agreement by
dividing the number of agreements by the sum of agreements and disagreements and multiplying by 100.

Independent Variable Integrity (IVI)

After ergonomics training, which occurred prior to baseline, participants demonstrated that they learned the correct positions by showing the researcher that they could correctly perform the activity. In addition, the occurrence of the prompted monitoring control responses was assessed during baseline, and monitoring was assessed during the self-monitoring phase. This was accomplished by dividing the number of prompted monitoring occurrences within 10 s of the beep/light by the number of opportunities (number of monitoring prompts).

HSIRB Approval

Approval from the Human Subjects Institutional Review Board was obtained prior to the start of the study (see Appendix R for the approval form).
RESULTS

Participants 1, 2, 3, 5, 6, and 7 all self-monitored their head position during the assembly task. Participants 2, 3, 6, and 7 self-monitored their head position during the typing task. Participant 1 self-monitored her arm position during the assembly task and participant 4 self-monitored her arm position during both tasks. Participant 5 self-monitored her wrist position during the assembly task and participants 5 and 7 self-monitored their wrist position during both tasks. Participant 3 also self-monitored her shoulder position during the assembly task. Participants 1, 2, 4, 5, and 7 were all exposed to the camera present conditions. Results will be described in detail for each participant. When a statistically significant correlation was detected between self-monitoring accuracy and safety performance, a scatterplot was included.

Participant 1

Figure 1 illustrates the percentage of safe intervals for participant 1’s targeted behaviors as well as her productivity for the typing task and assembly task during each phase of the study. The bottom panel of Figure 1 depicts the statistically significant relationship between self-monitoring accuracy and observed percentage safe for head posture in a scatterplot graph. Graphs for all postures measured are displayed in Appendix S.

Safety Performance

Head position, assembly. Percentage of safe observations for head position during the assembly task averaged 4.8% (SD: 10.4; range: 0% to 26%) during baseline and improved to 24.3% (SD: 23.7; range: 0% to 74%) during the
Figure 1. Data for participant 1.
self-monitoring phase. A booster session was conducted with participant 1 for head position during assembly immediately before the fifth session in the self-monitoring phase. Prior to the booster session, the average percentage safe for head position during assembly in the self-monitoring phase was 4.5% (SD: 3.0; range: 0% to 6%). Following the booster session, average percentage safe for head position improved to 32.2% (SD: 23.8; range: 0% to 74%). Average safety performance for head position during assembly improved to 70.1% (SD: 25.1; range: 47% to 100%) during the camera present phase and averaged 30% (SD: 9.8; range: 18% to 44%) in the absence of the camera.

Arm position, assembly. Percentage of safe intervals for arm position during the assembly task averaged 18.4% (SD: 12.8; range: 0% to 38%) during baseline and improved to 66.7% (SD: 32.1; range: 22% to 94%) during the self-monitoring phase. Average safety performance for arm position during assembly improved to 94.2% (SD: 6.7; range: 86% to 100%) during the camera present phase and averaged 88.6% (SD: 9.8; range: 76% to 100%) in the absence of the camera.

Productivity

As depicted in Figure 1, productivity for participant 1 for the typing task averaged 40.2 words per min (SD: 4.6; range: 31 wpm to 51 wpm). Productivity for the assembly task averaged 7.2 widgets per min (SD: .7; range: 6.0 wpm to 7.8 wpm) during baseline and 8.0 widgets per min (SD: .95; range: 6.0 wpm to 10.0 wpm) during the intervention.
Self-Monitoring Integrity and Accuracy

For participant 1, the light flashed at the beep for 85% of the self-monitoring opportunities, allowing for the integrity of self-monitoring to be scored by video for 85% of the self-monitoring occurrences. Participant 1 self-monitored within 10 s of the beep (as observed by the light flash) during 100% of the opportunities observed. Overall, participant 1’s self-monitoring was 57.8% accurate when compared to the trained observers’ observations. There was a positive correlation between self-monitoring accuracy and percentage safe \((r = .89, \ p < .01)\) for head posture during the assembly task. There was not a significant correlation between these two variables for arm assembly \((r = .23, \ n.s.)\).

Participant 2

Figure 2 shows the percentage of safe observations for participant 2’s targeted behaviors and productivity for the typing task and assembly task over the course of the study. Graphs for all postures measured are shown in Appendix T.

Safety Performance

Head position, typing. Percentage of safe intervals for head position during the typing task averaged 2.3\% (SD: 2.9; range: 0\% to 6\%) during baseline. During the self-monitoring phase average percentage of safe intervals was 4.8\% (SD: 6.3; range: 0\% to 18\%) for head position during the typing task. A booster session was conducted immediately before the fifth observation session for the head position during the typing task. Average percentage of safe intervals during the self-monitoring sessions that occurred prior to the booster session was 11.5\% (SD: 6.6; range: 3\% to 18\%). The percentage of intervals scored as safe for head
position for self-monitoring sessions that followed the booster session was 1.5% (SD: 2.3; range: 0% to 6%). Average safety performance for head position during typing improved to 17.6% (SD: 21.4; range: 0% to 41%) during the camera present phase and averaged 6.6% (SD: 7.5; range: 0% to 18%) in the absence of the camera.

Head position, assembly. Average safety performance for head position during the assembly task was .6% (SD: 1.3; range: 0% to 3%) during baseline and
during the self-monitoring phase improved to 15.2% (SD: 13.5; range: 3% to 40%). Percentage of intervals scored as safe for head position during assembly when the camera was present improved to 68.2% (SD: 36.2; range: 10% to 100%) and when the camera was absent it averaged 21.2% (SD: 18.7; range: 3% to 44%).

**Productivity**

As depicted in Figure 2, productivity for participant 2 for the typing task averaged 46.4 words per min (SD: 3.3; range: 42.7 wpm to 50.7 wpm) during baseline and 47.6 words per min (SD: 7.2; range: 36.9 wpm to 56.7 wpm) during intervention. Productivity for the assembly task averaged 8.3 widgets per min (SD: .6; range: 7.6 wpm to 9.3 wpm) during baseline and 9.0 widgets per min (SD: .7; range: 7.6 wpm to 10.1 wpm) during intervention.

**Self-Monitoring Integrity and Accuracy**

For participant 2, the light flashed at the beep for 88% of the self-monitoring opportunities, allowing for the integrity of self-monitoring to be scored for these occasions. Participant 2 self-monitored within 10 s of the beep (as observed by the light flash) during 100% of the observed opportunities. Overall, participant 2’s self-monitoring was 23.5% accurate when compared to the trained observers’ observations. There was a not a significant correlation between self-monitoring accuracy and percentage safe for head posture for the assembly task ($r = .28$, n.s.) or the typing task ($r = .47$, n.s.).
Participant 3

Figure 3 illustrates the safety for participant 3’s targeted behaviors as well as productivity for the typing task and assembly task during each phase of the study. Graphs for all postures measured are shown in Appendix U.

Safety Performance

*Head position, assembly.* Average percentage safe for head position during the assembly task was 0% (SD: 0; range: 0% to 0%) during baseline and during the self-monitoring phase improved to 27.0% (SD: 21.9; range: 0% to 73%). A booster session was conducted immediately before self-monitoring session seven. Average percentage safe for the sessions during the self-monitoring phase that preceded the booster session was 4.8% (SD: 4.6; range: 0% to 11%). For sessions that followed the booster session, safety performance for head during the assembly task averaged 35.4% (SD: 19.8; range: 9% to 73%).

*Shoulder position, assembly.* Average safety performance for shoulder position during the assembly task was 10.5% (SD: 7.3; range: 0% to 20%) during baseline and during the self-monitoring phase improved to 62.2% (SD: 33.97; range: 9% to 100%). Percentage of safe intervals for head position during the typing task averaged 26.0% (SD: 11.5; range: 6% to 40%) during baseline sessions. Average safety performance improved to 42.5% (SD: 4.7; range: 38% to 50%) during the self-monitoring phase. A booster session was conducted immediately prior to the fifth self-monitoring session. Prior to the booster
Figure 3. Data for Participant 3.
session, average percentage safe during the self-monitoring phase for head position during the typing task was 41.8% (SD: 3.5; range: 40% to 47%). For self-monitoring sessions that followed the booster session, the level of safety performance averaged 43.3% (SD: 6.18; range: 38% to 50%).

Head position, typing. Average percentage of intervals scored as safe for the head position during the typing task was 26.0% (SD: 11.5; range: 6% to 40%). During the self-monitoring phase, the average safety performance improved to 42.5% (SD: 4.7; range 38% to 50%).

Productivity

As depicted in Figure 3, productivity for participant 3 for the typing task averaged 33.8 words per min (SD: 2.8; range: 27.0 wpm to 35.2 wpm) during baseline and 36.3 words per min (SD: 4.7; range: 31.8 wpm to 44.4 wpm) during intervention. Productivity for the assembly task averaged 6.1 widgets per min (SD: 1.0; range: 5.2 wpm to 7.3 wpm) during baseline and 8.1 widgets per min (SD: .67; range: 6.7 wpm to 10.3 wpm) during intervention.

Self-Monitoring Integrity and Accuracy

For participant 3, the light flashed at the beep for 96% of self-monitoring occurrences, allowing for the integrity of self-monitoring to be scored for these occasions. Participant 3 self-monitored within 10 s of the beep (as observed by the light flash) during 13% of the opportunities observed. Overall, participant 3’s self-monitoring was 56.9% accurate when compared to the trained observers’ observations. There was no significant correlation between self-monitoring accuracy and percentage safe for the head posture during assembly (r = .50, n.s.)
or for shoulder posture during the assembly task \( r = .40, \text{n.s.} \). There was only one session with four independent self-monitoring responses for head posture during typing so its relationship to behavior change could not be evaluated.

Participant 4

The percentage of intervals scored as safe for participant 4’s targeted behaviors are illustrated in Figure 4 along with productivity for the typing task and assembly task for the course of the study. The bottom panel of Figure 4 depicts the correlation between self-monitoring accuracy and percentage of observations scored as safe for arm posture during typing in a scatterplot graph. Graphs for all of participant 4’s postures measured are displayed in Appendix V.

Safety Performance

Arm position, typing. Percentage of intervals scored as safe for arm position during the typing task averaged 5.8\% (SD: 4.5; range: 0\% to 11\%) during baseline and improved to 53.5\% (SD: 35.8; range: 0\% to 97\%) during the self-monitoring phase for participant 4. Average safety performance for arm position during the typing task was 60.3\% (SD: 45.4; range: 9\% to 95\%) during the camera present phase and averaged 84\% (SD: 13.23; range: 69\% to 94\%) in the absence of the camera.

Arm position, assembly. Percentage of safe intervals for arm position during the assembly task averaged 16.2\% (SD: 7.3; range: 9\% to 27\%) during baseline and improved to 26.5\% (SD: 18.9; range: 0\% to 55\%) during the self-monitoring phase. Average safety performance for arm position during assembly averaged 27.3\% (SD: 17.2; range: 12\% to 46\%) during the camera present phase.
and 30.0% (SD: 4.6; range: 26% to 29%) in the absence of the camera. A booster session was conducted with participant 4 for arm position during the assembly task immediately before the fifth session. Prior to the booster session, the average percentage safe for arm position during assembly was 21.5% (SD: 19.5; range: 0% to 47%). Following the booster session, average percentage safe for arm position improved to 31.5% (SD: 19.6; range: 9% to 55%).

**Productivity**

Productivity for participant 4 for the typing task averaged 29.7 words per min (SD: 2.3; range: 26.4 wpm to 31.6 wpm) during baseline and 31.6 words per min (SD: 3.9; range: 24.2 wpm to 41.9 wpm) during intervention. Productivity for the assembly task averaged 8.6 widgets per min (SD: .67; range: 7.2 wpm to 9.3 wpm) during baseline and 9.18 widgets per min (SD: .43; range: 7.2 wpm to 8.4 wpm) during intervention.

**Self-Monitoring Integrity and Accuracy**

For participant 4, the light flashed at the beep for 93% of self-monitoring opportunities, allowing for the integrity of self-monitoring to be scored for these occasions. Participant 4 self-monitored within 10 s of the beep (as observed by the light flash) during 100% of the opportunities observed. Overall, participant 4's self-monitoring was 56.3% accurate when compared to the trained observers' observations. There was a positive correlation between self-monitoring accuracy and percentage safe for arm posture during typing \((r = .88, p < .01)\) but not during assembly \((r = .06, \text{n.s.})\).
Figure 4. Data for participant 4.
Participant 5

Figure 5 shows the safety performance for participant 5’s targeted behaviors as well as productivity for the typing task and assembly task during each phase of the study. Graphs for all of participant 5’s postures measured are shown in Appendix W.

Safety Performance

Wrist position, assembly. Percentage of safe intervals for wrist position during the assembly task averaged 14.0% (SD: 19.2; range: 0% to 24%) during baseline and it was 20.6% (SD: 7.7; range: 12% to 34%) during the self-monitoring phase. A booster session was conducted with participant 5 for wrist position during the assembly task immediately before the fifth session. Prior to the booster session, the average percentage safe for wrist position during assembly was 16.5% (SD: 1.7; range: 15% to 18%) during the self-monitoring phase. Following the booster session, mean percentage safe for wrist position was 22.6% (SD: 8.8; range: 12% to 34%). Average percentage of safe intervals for wrist position during assembly decreased to 6.8% (SD: 8.1; range: 0% to 21%) during the camera present phase and to 5.25% (SD: 5.7; range: 0% to 15%) in the absence of the camera.

Head position, assembly. Percentage of safe intervals for head position during the assembly task averaged 11.7% (SD: 5.7; range: 0% to 15%) during baseline and improved to 29.8% (SD: 19.4; range: 6% to 53%) during the self-monitoring phase. Safety performance for head position during assembly averaged 19.0% (SD: 9.8; range: 6% to 36%) during the camera present phase
Figure 5. Data for participant 5.

and averaged 14.3% (SD: 13.3; range: 0% to 35%) in the absence of the camera.

Productivity

As depicted in Figure 5, participant 5’s productivity for the typing task averaged 31.9 words per min (SD: 4.7; range: 25 wpm to 47 wpm). Average productivity for the assembly task was 5.3 widgets per min (SD: .4; range: 4.6 wpm to 5.7 wpm) during baseline and 6.2 widgets per min (SD: 1.4; range: 4.9 wpm to 7.8 wpm) during intervention.
Self-Monitoring Integrity and Accuracy

For participant 5, the light flashed at the beep for 96% of self-monitoring occurrences, allowing for the integrity of self-monitoring to be scored for these occasions. Participant 5 self-monitored within 10 s of the beep (as observed by the light flash) during 62% of the opportunities observed. Overall, participant 5's self-monitoring was 27.5% accurate when compared to the trained observers' observations. There was not a significant correlation between self-monitoring accuracy and percentage safe for wrists during assembly ($r = .27$, n.s.) or head posture during assembly ($r = -.02$, n.s.)

Participant 6

Figure 6 displays the percentage of intervals scored as safe for participant 6's targeted behaviors along with productivity for the typing task and assembly task during each phase of the study. Graphs for all of participant 6's postures measured are displayed in Appendix X.

Safety Performance

Head position, assembly. Percentage of intervals scored as safe for head position during the assembly task averaged 1.5% (SD: 1.7; range: 0% to 3%) during baseline and improved to 59.4% (SD: 22.1; range: 26% to 94%) during the self-monitoring phase.

Head position, typing. Percentage of safe intervals for head position during the typing task averaged 46.2% (SD: 22.5; range: 12% to 71%) during baseline and improved slightly to 56.1% (SD: 20.9; range: 23% to 88%) during the self-monitoring phase. A booster session was conducted with participant
Figure 6. Data for participant 6.

6 for head position during typing immediately before the seventh session. Prior to the booster session, the average percentage safe for head position during assembly was 52.5% (SD: 24.1; range: 23% to 88%). Following the booster session,
average percentage safe for head position was 61.5% (SD: 16.7; range: 46% to 83%).

Productivity

As depicted in Figure 6, productivity for participant 6 for the typing task averaged 57.7 words per min (SD: 6.0; range: 49.7 wpm to 69 wpm) during baseline and 58.3 words per min (SD: 5.4; range: 49.6 wpm to 66.9 wpm) during the intervention. Productivity for the assembly task averaged 4.5 widgets per min (SD: .4; range: 3.9 wpm to 4.7 wpm) during baseline and 5.5 widgets per min (SD: .9; range: 4.1 wpm to 7.0 wpm) during the intervention.

Self-Monitoring Integrity and Accuracy

For participant 6, the light flashed at the beep for 92% of self-monitoring occurrences, allowing for the integrity of self-monitoring to be scored for these occasions. Participant 6 self-monitored within 10 s of the beep (as observed by the light flash) during 98% of the opportunities observed. Overall, participant 6’s self-monitoring was 53.1% accurate when compared to the trained observers’ observations. Although the former was characteristic of a strong relationship, there was not a significant correlation between self-monitoring accuracy and percentage safe for head position during the assembly task ($r = .47$, n.s.) or during the typing task ($r = .12$, n.s.).

Participant 7

Figure 7 displays the percentage of intervals scored as safe for participant 7’s targeted behaviors along with productivity for the typing task and assembly task during each phase of the study. The bottom right panel of Figure 7 depicts
the statistically significant correlation between self-monitoring accuracy and observed safety performance for two of the targeted postures targeted in a scatterplot graph. Graphs for all of participant 7's postures measured are displayed in Appendix Y.

Safety Performance

Head position, assembly. Percentage of safe intervals for head position during the assembly task averaged 8.6% (SD: 15.8; range: 0% to 41%) during baseline and improved to 60.1% (SD: 33.7; range: 3% to 100%) during the self-monitoring phase. Average safety performance for head position during assembly fell to 3% (SD: 5.2; range: 0% to 9%) during the camera present phase and averaged 0% (SD: 0; range: 0% to 0%) in the camera present phase.

Wrist position, assembly. Average percentage safe for wrist position during the assembly task was 6.6% (SD: 9.4; range: 0% to 30%) during baseline and 5.6% (SD: 6.8; range: 0% to 26%) during the self-monitoring phase. A booster session was conducted with participant 6 for head position during typing immediately before the fifth session. Prior to the booster session, the average percentage safe for wrist position during assembly was 2.3% (SD: 2.9; range: 0% to 6%). Following the booster session, average percentage safe for head position was 7.2% (SD: 7.4; range: 0% to 26%). The percentage of intervals scored as safe for arm position during assembly was 0% (SD: 0; range: 0% to 0%) during the camera present phase and averaged 0% (SD: 0; range: 0% to 0%) in the absence of the camera.
Figure 7. Data for participant 7.
Wrist position, typing. The level of safety performance for wrist position during the typing task averaged 32.6% (SD: 20.7; range: 0% to 73%) during baseline and improved to 36.7% (SD: 19.1; range: 9% to 63%) during the self-monitoring phase. Average safety performance for wrist position during typing improved to 49.3% (SD: 25.7; range: 20% to 68%) during the camera present phase and averaged 64.7% (SD: 5.5; range: 59% to 70%) in the absence of the camera.

Head position, typing. Percentage of safe intervals for head position during the typing task averaged 26.7% (SD: 21.2; range: 0% to 68%) during baseline and improved to 42.2% (SD: 34.4; range: 9% to 88%) during the self-monitoring phase. Safety performance for head position during typing averaged 33.3% (SD: 6.0; range: 9% to 21%) during the camera present phase and averaged 11.7% (SD: 3.1; range: 9% to 15%) in the absence of the camera.

Productivity

Typing productivity for participant 7, as depicted in Figure 7, averaged 35.3 words per min (SD: 3.4; range: 29.9 wpm to 41.2 wpm) during baseline and 37.3 words per min (SD: 4.0; range: 30.4 wpm to 44.4 wpm) during intervention. Productivity for the assembly task averaged 9.1 widgets per min (SD: .4; range: 8.6 wpm to 9.6 wpm) during baseline and 10.4 widgets per min (SD: .6; range: 8.9 wpm to 11.8 wpm) during the intervention.

Self-Monitoring Integrity and Accuracy

For participant 7, the light flashed at the beep for 72% of self-monitoring occurrences, allowing for the integrity of self-monitoring to be scored for these occasions. Participant 7 self-monitored within 10 s of the beep (as observed by
the light flash) during 100% of the opportunities observed. Overall, participant 7 was 29.9% accurate in self-monitoring compared to the trained observers. There was a positive correlation between self-monitoring accuracy and percentage safe for head position during typing ($r = .83, p < .05$) and for wrist position during tying ($r = .66, p < .05$). There was not a statistically significant correlation for head position during assembly ($r = .45, \text{n.s.}$) or wrist position during assembly ($r = .46, \text{n.s.}$).

Effect Size and Accuracy

Table 1 lists each of the treatment-exposed postures by order of treatment exposure for each participant. The effect size ($d$) for each posture is listed along with the correlation ($r$) between self-monitoring accuracy and safety performance. Effect size was calculated using the formula $d = (\text{experimental mean} - \text{control mean}) / \text{pooled standard deviation}$). Effect sizes ranged from -.13 to 3.17. Cohen (1969) recommended the following general guidelines to interpret the $d$ statistic: .2-.49 is considered a small effect; .5-.79 is considered a medium-sized effect; and greater than .8 is considered a large effect. The correlations ranged from -.02 to .94 and there was a statistically significant correlation between self-monitoring accuracy and safety performance for four of the 17 postures that were exposed to the intervention. The correlation between safety performance and accuracy was higher for the first posture exposed to the intervention for five of the seven participants.
Table 1.

*Effect size and correlation between accuracy and safety performance for each posture exposed to the intervention.*

<table>
<thead>
<tr>
<th>Participant</th>
<th>Posture</th>
<th>$d$</th>
<th>$r(n)$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Head Assembly</td>
<td>1.01</td>
<td>.89**(8)</td>
</tr>
<tr>
<td>1</td>
<td>Arm Assembly</td>
<td>2.65</td>
<td>.23(3)</td>
</tr>
<tr>
<td>2</td>
<td>Head Typing</td>
<td>.51</td>
<td>.28(11)</td>
</tr>
<tr>
<td>2</td>
<td>Head Assembly</td>
<td>2.03</td>
<td>.47(6)</td>
</tr>
<tr>
<td>3</td>
<td>Head Assembly</td>
<td>1.42</td>
<td>.50(15)</td>
</tr>
<tr>
<td>3</td>
<td>Shoulder Assembly</td>
<td>2.19</td>
<td>.40(13)</td>
</tr>
<tr>
<td>3</td>
<td>Head Typing</td>
<td>1.78</td>
<td>NA(1)</td>
</tr>
<tr>
<td>4</td>
<td>Arm Typing</td>
<td>1.65</td>
<td>.88**(10)</td>
</tr>
<tr>
<td>4</td>
<td>Arm Assembly</td>
<td>1.96</td>
<td>.60(4)</td>
</tr>
<tr>
<td>5</td>
<td>Wrist Assembly</td>
<td>.54</td>
<td>.27(5)</td>
</tr>
<tr>
<td>5</td>
<td>Head Assembly</td>
<td>1.71</td>
<td>-.02(4)</td>
</tr>
<tr>
<td>6</td>
<td>Head Assembly</td>
<td>3.17</td>
<td>.47(14)</td>
</tr>
<tr>
<td>6</td>
<td>Head Typing</td>
<td>0.51</td>
<td>.12(10)</td>
</tr>
<tr>
<td>7</td>
<td>Head Assembly</td>
<td>1.83</td>
<td>.45(18)</td>
</tr>
<tr>
<td>7</td>
<td>Wrist Assembly</td>
<td>-0.13</td>
<td>.46(14)</td>
</tr>
<tr>
<td>7</td>
<td>Wrist Typing</td>
<td>0.22</td>
<td>.66*(10)</td>
</tr>
<tr>
<td>7</td>
<td>Head Typing</td>
<td>0.69</td>
<td>.83*(6)</td>
</tr>
</tbody>
</table>

** denotes a statistically significant correlation at the .01 level and * denotes a statistically significant correlation at the .05 level.
Exit Interview

At the completion of the study participants were asked a series of questions during an exit interview. Answers provided by participant 1 are noted as P1, answers provided by participant 2 are noted as P2, etc.

Q1: What did you think the study was about? Answers:

P1, P4, P5, P6: Comfort at work.

P1, P3: How body position affects pain.

P7: Productivity.

Q2: What did you think about when you checked the blank boxes? Answers:

P1, P6, P7: Nothing.

P3, P5: Taking a break.

P4: Where I left off on the task.

Q3: Why do you think you were asked to check the blank box? Answers:

P1, P5: Thought about safety after self-monitoring started.

P2, P6, P7: Not sure.

P3, P4: For a break/interruption of the task.

Q4: What did you think about when you were self-monitoring? Answers:

P1: Thought specifically about the postures I was self-monitoring but also thought about the other postures and I thought about them throughout the session, not just when self-monitoring.

P2: I thought about my head position and if it was left or right or up or down. I thought about my entire body a little before the self-monitoring but then when I started self-monitoring I concentrated mostly on my head.
P3: If I was sitting correctly and I would read over the information on safe postures a lot.

P4: I thought about my arms.

P5: My position at the beep, I would try to freeze and look.

P6: I became constantly aware of my neck position and it made me tense.

P7: I thought about where my head and wrists were at the moment.

Q5: Did you try to perform more safely when you were self-monitoring?

Answers:

P1: Yes, I felt like I should be in the right position because I was monitoring it.

P2: No.

P3, P6: Yes, for all postures.

P4: Yes.

P5: Yes, at first but after a while I forgot about it.

P7: I tried to perform the way you said was safe and get used to it and not worry about it when checking the box.

Q6: Do you think you performed more safely when the camera was present?

Answers:

P1: Kind of, for all postures.

P2, P4: Yes.

P5: I'm not sure but it made me think about it all of the time and not just when it beeped.

P7: Didn't think differently and I wondered if the camera could see much.
P3 and P6 were not exposed to camera presence and so they were not asked this question.

Q7: If yes to number 6, why do you think you performed more safely? Answers:

   P1: Because you would view them and see my posture.

   P2: I thought about it more because I was being taped.

   P4: It’s like having someone watch you.

   P5: I was more cautious because you would see it and I wondered a little if I was wrong about my scoring.

   P7: Probably because you could see if I was being accurate.

P3 and P6 were not asked this question because they were not exposed to camera presence.

Q8: Did you say anything to yourself while you were self-monitoring? Answers:

   P1, P3, P4: When I heard the beep I thought about the definition for scoring it.

   P2: I thought about the rule and would try to correct my posture.

   P5: I asked myself if it was right or wrong.

   P6: I evaluated myself.

   P7: I didn’t say anything to myself because I knew what they should look like.

Q9: What did you think about when the camera was present? Answers:

   P1: I wondered what you would think and felt pressure to be safe.

   P2: I thought it was a little stressful.

   P4: I just thought you were trying to make sure we weren’t lying and I tried not to do anything embarrassing.

   P5: I just thought about my posture more.
P7: Nothing.

P3 and P6 were not asked this question because they were not exposed to camera presence.

Q10: Did you notice the hidden camera in the room? Answers:

P1, P6, P7: No, but I thought it was possible that you were recording me.
P3: No, I thought it was possible but didn’t see one and didn’t know where you could put it so after a while I decided there wasn’t one.
P2, P4, P5: No.

At the end of the exit interview participants were asked if they had any additional comments. P2 said, “The self-monitoring was fine for the study but it would be a pain in a job.” P3 said, “I was really concerned with having high productivity. I also always tried to be safe when you opened the door and were in the room.” P5 said, “I didn’t like checking to boxes when I was in the middle of something so sometimes I would make my own beep in my head and then check the box.” P7 said, “The tasks were really boring. It would have been good if I could have listened to music.” He also commented that, “It was hard to judge my head and neck and I think over time I forgot what the safe position was.”

Reliability

Interobserver agreement (IOA) was calculated using point-by-point agreement for 36% of typing and 39% of assembly observation sessions. Agreement averaged 89.9% (range: 79% to 98%) for typing and 89.8% (range: 79% to 100%) for assembly, when averaged across all behaviors by session.
DISCUSSION

The primary purpose of this study was to determine if self-monitoring as a solitary intervention could improve safe postures of participants working in a simulated office setting. For five of the seven participants, the effect of having a camera present was also evaluated. The study yielded mixed results, which will be discussed in detail in the following sections. Secondarily, the study evaluated whether safety performance improved as function of self-monitoring accuracy. Data were also collected on productivity for both typing and widget assembly. These secondary measures will be described as well.

Safety Performance

Self-Monitoring

Overall, self-monitoring, as implemented in this study, appeared to produce relatively modest effects on safe postures. When considered across the seven participants, seventeen postures were exposed to the self-monitoring intervention. Visually speaking, five postures yielded substantial improvements in safety performance, defined as a mean percentage point increase of 35% or more from baseline to intervention, and an additional six yielded improvements of 10% or more in the mean percentage of intervals scored as safe but are less convincing graphically. Self-monitoring produced substantial improvements in the percentage of intervals scored as safe for participant 1’s arms during assembly, participant 3’s shoulders during assembly, participant 4’s arms during typing, participants 6 and 7’s head during assembly. However, three of those five substantial effects listed (participants 1, 6 and 7) tapered off toward baseline over
time. There was no evidence to suggest that the effects of self-monitoring were decreased when additional targets were in place.

Changes in mean from baseline to self-monitoring of 10% or more were also noted for participants 1, 2, 3, and 5's head during the assembly task, participant 4's arm during the assembly task, and participant 7's head during the typing task. However, caution is encouraged when interpreting these mean changes. Close inspection of the graphs revealed high variability, making mean changes less convincing from a visual inspection perspective. For both participant 1 and 3's head position during the typing task, improvements in safety percentage occurred only after a booster session. For participant 3, the booster session corresponded with better compliance with the self-monitoring intervention. Therefore, the booster session, which perhaps improved accuracy of monitors, improved compliance, or a combination of the two could have been responsible for the improved safety performance.

Participants 3 and 5 had low compliance with the self-monitoring intervention. They would often check more than one or all of the boxes after the first self-monitoring prompt. As previously mentioned, this improved after a booster session for participant 3 but compliance remained low for participant 5 throughout the course of the study. Participant 5 reported in the exit interview that she did not comply because self-monitoring interrupted completing the task. The lack of compliance may be evidence that the participants were unaware of the hidden camera and therefore a similar result is possible among lone workers in an organizational setting. Although participant 3 improved her safety performance it
was only after compliance increased. Participant 5's safety performance improved only slightly for one dependent variable and no improvement was noted in the other dependent variable. This may suggest that compliance with self-monitoring is essential to an effective program.

No covariation occurred across behaviors with the exception of participant 6. When self-monitoring was implemented for participant 6's head position during the assembly task, a substantial improvement was not only identified for her head position, but also for her back and shoulder position during the assembly task.

Of the behaviors targeted for treatment, head position during assembly was the most reliably affected posture by the self-monitoring intervention. A substantial improvement, defined as a mean change of 35% or greater, or a mean change of 10% or greater was observed for all six participants' head position during assembly when exposed to the intervention. Wrist position appeared to be least affected by the self-monitoring intervention. Two participants were exposed to self-monitoring wrist position for the assembly task and one for the typing task, none of which demonstrated an improvement in safety performance following the intervention. This may suggest that certain behaviors are more amenable to a self-monitoring intervention.

Overall, these findings are consistent with previous self-monitoring studies that yielded fairly modest improvements in the dependent variables (Belfiore et al, 1989; McCann & Sulzer-Azaroff, 1996; Olson & Austin, 2001). For example, Olson and Austin obtained an overall effect size of 1.8 from
baseline to intervention (Sigurdsson & Austin, in press) compared to the average effect size of 1.9 found in this study. However, in some cases, low effort interventions, such as self-monitoring, that produce modest effects may be a more reasonable option for some organizations than a highly intensive, effortful intervention that may produce more robust effects. Additionally, other components may be added to self-monitoring to create a more effective intervention package.

Due to the paucity of literature on this topic, we can only speculate about the behavioral mechanisms underlying self-monitoring effects. It is likely that rule-governed behavior played a role in improving safety during the self-monitoring intervention. Participants were provided all of the information about safety and definitions prior to the first baseline session. However, all participants reported during the exit interview that they did not think about the safety definitions during baseline very often. Six of the seven participants reported that, during the self-monitoring phase, they stated the definition to themselves. In addition, all participants were observed reading the definitions for safe postures posted on the desk during the self-monitoring phase. This suggests that self-monitoring increased the extent to which participants stated rules to themselves about safety.

Malott and Trojan-Suarez (2004) define a rule as a “description of a behavioral contingency” (p. 380). They propose that a rule works as an establishing operation, “making non-compliance with the rule an aversive condition” (p. 414). Self-monitoring may have increased the frequency of self-
rule statements about safety, establishing non-compliance with the safe definition rules as an aversive condition. This may have resulted in participants improving their safety performance to escape or avoid the aversive condition established by the rule.

Another possible explanation of the effects produced by self-monitoring is described by Hayes and Nelson (1983) who suggest that behavior change associated with self-monitoring results from the entire self-monitoring procedure including training, the self-monitoring device, the self-monitoring response, and other events such as evaluating performance and self-delivered consequences. They propose that these components of self-monitoring may serve to prompt and consequate the targeted behavior and may increase the reactivity associated with the targeted behavior, resulting in the desired behavior change. This present study attempted to eliminate some of these factors by using a hidden camera to reduce reactivity, providing safety training for the targeted behaviors prior to baseline, and controlling for the self-monitoring response by requiring arbitrary box checking during baseline conditions. However, reactivity may still have been a factor because participants gave their self-monitoring forms to the researcher after each session. Additionally, self-delivered consequences could not be measured. Therefore, some of the components mentioned by Nelson and Hayes (1981) may have led to the changes in behavior.

Camera Presence

The camera presence phase was implemented for five of the seven participants. Twelve dependent variables that had previously been exposed to
self-monitoring were exposed to the camera presence plus self-monitoring condition. An obvious improvement in percentage of safe observations was detected for only two of those dependent variables: Participant 1’s head during the assembly task and participant 2’s head during the typing task. Additionally, participant 1’s head position during the typing task was tapering off during self-monitoring but recovered back to the initially high intervention level when the camera presence phase was implemented for both the camera present and absent conditions. Interestingly, the percentage of safe intervals decreased for participant 5 and 7’s wrist position during the assembly task and participant 7’s head position during both tasks for both camera present and absent conditions. During the exit interview, participant 5 indicated that she thought about safety at first but “forgot about it after a while.” This could account for the decrease in safety performance in later intervention sessions for participant 5.

Overall, the camera presence condition did not produce any consistent findings. It is possible that participants were not generally reactive to the presence of the camera. However, during the exit interview, participants reported they thought the camera was in the room to assess their accuracy, not their safety. Therefore, participants may have been reactive in terms of accuracy instead of safety. Also, participant 7 mentioned during the exit interview that the camera position was unlikely to capture all of his posture. This may have resulted in less reactivity to the camera presence as well. Behaviors that were not targeted by the intervention did not improve in the camera present condition. This may be due to minimal reactivity effects produced by the camera presence condition or may
have been due to the fact that they were not targeted by the intervention and therefore may have been less likely to be reactive.

Safety Performance as a Function of Accuracy

Overall, participants were 43.6% (range: 23.5% to 57.8%) accurate at self-monitoring for sessions in which four independent self-monitoring responses were observed and four self-monitoring responses were noted on the self-monitoring form. A statistically significant correlation between percentage of intervals scored as safe by the observers and the participants’ accuracy of self monitoring was achieved for four of the 17 postures exposed to the intervention. Similarly, Sasson and Austin (2004) found a correlation between peer observations accuracy and safety performance. This suggests that accuracy may possibly be related to the amount of performance improvement attained.

Productivity

Productivity improved slightly throughout the course of the study. Average productivity improved slightly from baseline to intervention for all participants. Because the assembly task was arbitrary, participants probably increased their productivity as their familiarity with the task improved. Some participants reported more difficulty with typing some of the documents than others, which could account for the slight variability in typing productivity. The reported difficulty was attributed to having to type more numbers or technical terms for some documents.
Discomfort

The amount of discomfort reported on the 1-10 overall likert scale was visually compared to overall percentage safe for each four-session block using graphs. No correlation existed between discomfort level reported and percentage safe. This could partly be due to the fact that the participants had no musculoskeletal disorders and reported low levels of discomfort throughout the study.

Strengths and Weaknesses

This was the only study located through our literature search of research involving self-monitoring of work behavior that examined the effects of self-monitoring alone. Additionally, this was the only known behavioral postural safety study that utilized a hidden camera to eliminate the potential reactivity associated with being observed. In these ways, this study extends the current self-monitoring work literature and postural safety literature.

The hidden camera allowed for better simulation of work conditions experienced by those who work alone. However, this study did not take place in an actual work environment and participants were college students with no history of musculoskeletal disorders. This is a potential weakness limiting the generality of the findings. Sasson and Austin (2004) found that participants who reported MSDs showed the largest improvement in typing posture. It is possible the self-monitoring intervention may have been more effective if it was implemented with employees currently experiencing discomfort associated with work posture.
A strength of this study is that the intervention implemented requires little time, effort, or training and is therefore cost effective. It would be a simple program to design and implement in a work setting and could be used to target a myriad of safety or other work behaviors. However, the self-monitoring intervention did not produce robust effects. Although a self-monitoring program may result in overall improvements in safety in an organization, additional components or a more salient intervention may be required to make a dramatic impact on safety in an organization.

Another strength of the study was the evaluation of accuracy of participants' self-monitoring. Information about accuracy gathered suggests that accurate self-monitoring may be important to the effectiveness of the intervention. The assessment of accuracy was limited because it could not be precisely determined at what instance the participant was attending to his or her behavior. However, the nature of the tasks required little movement with the exception of arms and wrists during the assembly tasks, which suggests the observers scoring videos observed behavior similar to or the same as that being observed by the participant.

Participant 3 and 5's lack of compliance with the self-monitoring intervention is a potential weakness of the study and procedure. This suggests that additional procedures to ensure compliance may be necessary for employees who work alone. Additionally, the lack of compliance resulted in only a small number of sessions qualifying to be included in the correlational statistic.
calculated to compare safety performance with self-monitoring accuracy for participant 5.

Future Research

The results of the current study suggest that self-monitoring is a potentially propitious intervention that warrants additional examination and refinement. Further research that increases the salience of certain aspects of the self-monitoring intervention, including more intensive training, more intensive or frequent self-monitoring, or devices such as a mirror or video camera that increases the ease with which behavior can be monitored, should be examined to determine if greater improvements in safe postures can be realized. The study should also be replicated with a population that is experiencing discomfort associated with work posture to evaluate whether the intervention would be more effective with a more relevant population. More robust effects may also be achieved if participants are allowed to choose the behavior to self-monitor. Participants may choose behaviors that "concern" them the most or that produce pain and this may impact the effectiveness of the intervention.

The current study revealed a correlation between self-monitoring accuracy and safety performance for four of the 17 postures exposed to the intervention. However, the participants only averaged 43.5% accurate. Future studies should program more intensive self-monitoring training so as to improve overall self-monitoring accuracy. A study that directly manipulates self-monitoring accuracy should be conducted to determine the extent to which self-monitoring accuracy and safety performance are related. Such a study may yield a better estimate of
the effects of accuracy than does the current study, in part, because researchers could ensure that a full range of accuracy values are represented rather than the somewhat restricted range found in the current study. If future research indicates that an improvement in accuracy is related to an improvement in safety, interventions that focus on training high levels of accuracy could produce more substantial changes in behavior.

It may also be interesting to compare within session self-monitoring to post-session self-monitoring estimations that have been used in previous safety research (e.g., McCann & Sulzer-Azaroff, 1996; Olson & Austin, 2001). The within-session self-monitoring may be more effective or equally effective compared with post-session estimations.

The present study required self-monitoring of continuous behaviors. In other words, participants were continuously performing each of the behaviors with no clear beginning or end to them. Future research should investigate the effectiveness of self-monitoring to improve discrete safety behaviors (e.g., using safety equipment, following safety procedures). Research could also compare intervention effectiveness for discrete and continuous behaviors. It is possible that self-monitoring may be a more effective intervention for discrete behaviors that lend themselves to easier self-observation and recording.

The behavioral mechanism and important variables underlying self-monitoring should be investigated through future research to identify the factors responsible for behavior change. A component analysis may help identify the most important features of self-monitoring. Additionally, a protocol analysis
procedure may facilitate further investigation of the possible rule-governed aspect of self-monitoring. Alvero (2004) found that improvements in safety created by observing others were maintained by self-statements about the target behavior. Self-monitoring may produce similar self-statements that influence behavior. Further research in this area could lead to an even less intrusive, more effective intervention for improving safety.

The practical implications of this and future research could aide in the development of better, easier to implement safety interventions. This line of research is particularly important for employees who work alone and therefore cannot be exposed to traditional behavioral safety programs. Further research on self-monitoring could reveal a more robust self-implemented intervention that can be utilized to improved a variety of safety and other work-related behaviors in a relatively cost effective, unobtrusive manner.
Appendix A

Recruitment Script
Participant Recruitment Script
To be read aloud by the student investigator at undergraduate classes.

“Hi, my name is Nicole Gravina and I am graduate student at Western conducting a research study examining comfort levels in work settings. I hope to recruit 7 participants for the following study. In order to participate, you will need to be available a total of at least 2 hours each week for 4-6 weeks. Participation will involve completing a simple typing task and a simple assembly task during each session. Sessions will last approximately 40 minutes and will be held in Wood Hall. You will attend 2-4 sessions each week for a total of 3-6 weeks. To be included in the study you must be able to touch type, meaning not look at the keyboard while typing, and you must be able to type 25 words per min. You must not have participated in any research studies conducted by members of Dr. Austin's PM lab. Participants must also not have chronic back pain, musculoskeletal disorders, or any other conditions that may preclude them from doing typical office work for a short period of time. Participants must also not have had a history of such problems. You can choose to earn either $5.00/hour or class extra credit if its offered by your instructor for your participation. I am going to pass out sign up forms. If you are interested in learning more about participating in the study, please fill out the form and return it to me. Thank you for your time.”
Appendix B

Recruitment Sign-up Sheet
Sign-Up Form for Indicating Interest in Participation the “Evaluating Comfort in a Work Setting” Research Study

If you fill out and return this form you will be contacted by phone or email to see if you are interested in coming to a one-on-one meeting to learn more about participation in the study.

Name________________________
Phone Number__________________

Email Address__________________________
Appendix C

Postural Discomfort Survey
POSTURAL COMFORT SURVEY

Purpose: Determine the level of pain or discomfort at an individual or department level

First Name ___________________ Last Name ___________________
Department Name ___________________ Date ___________________
Supervisor ___________________ Time on This Job ___________________
Shift ___________________ Job Causing Discomfort ___________________

Instructions: Complete each of the measures of discomfort

# 1 Assess your overall comfort or discomfort in the top box
# 2 Rate discomfort for specific body parts in the left box
# 3 Shade the body parts in pain or discomfort in the right box

THINK ABOUT HOW YOU FEEL RIGHT NOW
What is your overall level of discomfort?

1 2 3 4 5 6 7 8 9 10
very comfortable some discomfort uncomfortable very uncomfortable intolerable

Indicate your comfort in the box below using a 1-10 scale, 1 being very comfortable to 10 being very uncomfortable.

<table>
<thead>
<tr>
<th>Area of Body</th>
<th>Left Front</th>
<th>Back</th>
<th>Right Front</th>
<th>Back</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neck</td>
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<tr>
<td>Chest</td>
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<tr>
<td>Abdomen</td>
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<tr>
<td>Upper Back</td>
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<tr>
<td>Mid Back</td>
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<tr>
<td>Low Back</td>
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<tr>
<td>Shoulder</td>
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<tr>
<td>Upper Arm</td>
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<td>Elbow</td>
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<td>Forearm</td>
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<tr>
<td>Foot</td>
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</table>
Appendix D

Experimental Data Sheet
| Behavior | + = Performed Safely / - Performed Un Safely / X = Not Performed | SM = Self-Monitoring |
|----------|---------------------------------------------------------------|
|          | 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  | 0  | 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  | 0  | 1  | 2  | 3  | 4  | 5  |
| Head     | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  |
| Neck     | -  | -  | -  | -  | -  | -  | -  | -  | -  | -  | -  | -  | -  | -  | -  | -  | -  | -  | -  | -  | -  | -  | -  | -  |
| Back     | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  |
| Shoulder | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  |
| Arm      | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  |
| Wrist    | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  |
| Legs     | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  | +  |

**PARTICIPANT # _______ DATE: _______ OBSERVER: _______(RELIABILITY OBSERVER _______)**
Appendix E

Informed Consent Script
SCRIPT FOR CONSENT PROCESS
To be read aloud by either the student investigator or research assistant

“Before you begin participation in this study you must carefully read a consent form. I will read over the consent form with you. If you have any questions concerning the information we go over, please feel free to ask them. After you have read the consent form, you may either sign it or choose not to participate by not signing. If you choose not to sign, you will not be penalized.

{Hand participant a consent form and read it aloud to them}

Then ask, “Do you have any questions regarding the consent form? Please sign a copy of the consent form for my records and keep the other copy for your records.”
Appendix F

Consent Form
Purpose. You are invited to participate in a research study that will evaluate comfort levels in a work setting. The intent of this study is to determine the effects of work tasks on comfort levels.

Duration. You are asked to participate in approximately 20-28 36 minute (9 minutes each session and 4 session per block) experimental blocks over 4-6 weeks. The length of your participation in the study will vary depending on your availability. You may schedule sessions as often as two times per day with a minimum of two hours in between sessions. Sessions can be scheduled any day from Monday through Sunday.

Explanation of Study Procedures. Your ability to touch type will be assessed before the first session. You will then be asked to engage in an assembly task and a typing task that will simulate the type of work a person might perform in a work setting. You will perform the task in a simulated work environment in the Performance Management laboratory located in Wood Hall. The assembly task will involve putting together a nut, 2 washers and a bolt arrangement while at a workstation. The typing task will involve transcribing a written document onto a computer. Following each block of sessions, you will be asked to fill out a discomfort survey. At the conclusion of the study, you will be given an exit interview.

Compensation. You can choose to receive either $5.00 for each 4 session block that you attend (36 minutes) or extra credit for one class, provided that your instructor allows for extra credit to be earned for research participation. Your money or extra credit earned will not be penalized or forfeited should you choose to withdraw from the study.

Benefits. You will not receive any direct benefits from this study, however, you may be able to perform some tasks related to assembly and typing more efficiently. Data gained from your participation in the study may benefit the general scientific community by providing information on the efficacy of a discomfort survey.

Risks and Protections. The nature of the tasks is one that requires little physical exertion, and should not expose you to risks greater than those presented by your everyday activities. During sessions you may experience minor fatigue. To lessen fatigue, you are allowed and encouraged to take breaks if you feel tired or experience any physical discomfort. The study will take a total of 6 to 8.5 hours to complete cumulatively. To minimize this concern, you will be able to schedule sessions at times that are convenient for you and you can decide to no longer participate if the study takes too much of your time.
As in all research, there may be unforeseen risks to the participant. If an accidental injury occurs, appropriate emergency procedures will be taken; however, no compensation or additional treatment will be made available to you except otherwise stated in this consent form.

Confidentiality. All of the information collected from you and about your performance is confidential. That means that your name and other identifying information will not appear in any publications or presentations of the data collected. Both group and individual data will appear in publications and presentations of this research. However, each student will be assigned a code number when his or her data are entered into an electronic database for analysis purposes.

Any presentations or publications will use code numbers to label individuals. Any forms with identifying information will be retained by Nicole Gravina over the course of study and entered into the database using code numbers. Nicole Gravina will keep a separate master list with the names of participants and the corresponding code numbers. Once the data are collected and analyzed, the master list will be destroyed. Data gathered from the study will be kept in a locked cabinet in the primary investigator’s office for at least three years.

Nicole Gravina and Dr. John Austin are prepared to meet personally with any student who wishes to discuss any aspect of this research project and answer questions about the way data may be or are presented. As mentioned above, any information that could identify individuals will be removed from the data used in any publications or presentations.

Voluntary Participation. Your participation in the study is completely voluntary. You are free to withdraw at any time without penalty, and you will receive cash payment for the amount of time you participated. At the end of the study, the experimenter will answer any questions you have and explain how your data helped us learn more about discomfort is a work setting.

Who to Contact with Questions. If you have any questions about this study you may call Nicole Gravina at 269/352-5012. In addition, Dr. John Austin, my faculty advisor can be reached at 387-4495 or the Vice President for Research, 387-8298 if questions or problems arise during the course of the study.

This consent document has been approved for use for one year by the Human Subjects Institutional Review Board as indicated by the stamped date and signature of the board chair in the upper right corner. Do not participate if the stamped date is more than one year old.

Your signature below indicates that you read the above information and agree to participate in the study.

Participant Signature __________________________ Date __________________________

Please keep the attached copy of this form for your records.
Appendix G

Consent for Use of Data Form
Thank you for your participation in this study. We are required to ask you for your permission to use the data gained from your videotapes. We assure you that the videotapes and all identifying student information will be held in the strictest confidence. Dates and times on videos will be obscured or erased so that individuals cannot be identified by this information. Further, at no time will the videotapes themselves be used for public presentations of any sort.

By signing this document you are giving us permission to use only the data obtained from the videotapes. If you choose not to give your permission for the use of data obtained from the videotapes, you may do so without penalty.

This consent document has been approved for use for one year by the Human Subjects Institutional Review Board as indicated by the stamped date and signature of the board chair in the upper right corner. Do not participate if the stamped date is more than one year old.

Your signature below indicated that you read the above information and agree to allow is to use data gained from the videotapes in this research project.

Participant Signature  Date

Please keep the attached copy of this form for your records.
Appendix H

Consent for Use of Data Script
SCRIPT FOR CONSENT FOR USE OF DATA  
To be read aloud by either the student investigator or research assistant.

“We are required to ask you for your consent to use the data from the videotapes. If you do not give your permission for the use of these data, you will not be penalized in anyway, and we will destroy your videotapes or give them to you so that you may dispose of them in any way you deem appropriate. I will read over the consent form with you. If you have any questions concerning the information we go over, please feel free to ask them.

After you have read the consent form, you may either sign it or choose to not sign it. If you choose to not sign it, you will not be penalized.”

{Hand the participant a consent form and read it aloud to them.}

Then ask, “Do you have any questions regarding the consent form? At this time, you can either sign or choose not to sign the form, and keep the other copy for your records.”
Appendix I

Safety Information Sheet
Guide to Safe Working Postures

**Back Position** – Your lower back (lumbar) should be supported by the chair. That means you should be resting your back against the chair and the angle of your back and the thigh should be between 100-110 degrees.

**Shoulder Position** – Your upper arms should be tucked close to your body and hanging relaxed, not extended out to the side, extended forwards or backwards or raised up. Shoulders should be relaxed, not hunched.

**Head/Neck** – Your head should be in line with your neck and your chin should be parallel to the floor. Your head should be facing forward. Move your eyes and not your head to look at the document and parts.

**Leg Position** – Your knees should be bent forming an angle between 90-120 degrees. Your legs should not be crossed.

**Arms** – Your upper arm and elbow angle should be between 90-120 degrees.

**Hand-Wrist Position** – Your wrists should be flat (not bent up or down) and straight (not bent right or left).
Appendix J

Sample Document (Chase, 2005)
George Washington (1732-1799), won a lasting place in American history as the "Father of the Country." For nearly 20 years, he guided his country much as a father cares for a growing child. In three important ways, Washington helped shape the beginning of the United States. First, he commanded the Continental Army that won American independence from Great Britain (now the United Kingdom) in the Revolutionary War. Second, Washington served as president of the convention that wrote the United States Constitution. Third, he was elected the first president of the United States.

Most Americans of his day loved Washington. His army officers would have tried to make him king if he had let them. From the Revolutionary War on, his birthday was celebrated each year throughout the country.

Washington lived an exciting life in exciting times. As a boy, he explored the wilderness. When he grew older, he helped the British fight the French and Indians. Several times he was nearly killed. As a general, he suffered hardships with his troops in the cold winters at Valley Forge, Pennsylvania, and Morristown, New Jersey. He lost many battles, but led the American army to final victory at Yorktown, Va. After he became president, he successfully solved many problems in turning the plans of the Constitution into a working government.

Washington went to school only until he was about 14 or 15. But he learned to make the most of all his abilities and opportunities. Washington's remarkable patience and his understanding of others helped him win people to his side in times of hardship and discouragement.

There are great differences between the United States of Washington's day and that of today. The new nation was small and weak. It stretched west only to the Mississippi River and had fewer than 4,000,000 people. Most people made their living by farming. Few children went to school. Many men and women could not read or write. Transportation and communication were slow. It took Washington 3 days to travel about 90 miles (140 kilometers) from New York City to Philadelphia, longer than it now takes to fly around the world. There were only 11 states in the Union when Washington became president and 16 when he left office.

Many stories have been told about Washington. Most are probably not true. So far as we know, he did not chop down his father's cherry tree, then confess by saying: "I cannot tell a lie, Pa." He probably never threw a stone across the Rappahannock River. But such stories show that people were willing to believe almost anything about his honesty and his great strength. One of Washington's officers, Henry "Light Horse Harry" Lee, summed up the way Americans felt and still feel about Washington: "First in war, first in peace, and first in the hearts of his countrymen."

Washington's appearance caused admiration and respect. He was tall, strong, and broad-shouldered. As he grew older, cares lined his face and gave him a somewhat stern appearance. Perhaps the best description of Washington was written by a friend, George Mercer, in 1760:

"He may be described as being straight as an Indian, measuring 6 feet 2 inches in his stockings, and weighing 175 pounds ... A large and straight rather than a
prominent nose; blue-gray penetrating eyes ... He has a clear though rather
colorless pale skin which burns with the sun ... dark brown hair which he wears in
a queue ... His mouth is large and generally firmly closed, but which from time to
time discloses some defective teeth ... His movements and gestures are graceful,
his walk majestic, and he is a splendid horseman."
Washington set his own strict rules of conduct, but he also enjoyed having a good
time. He laughed at jokes, though he seldom told any.
One of the best descriptions of Washington's character was written after his death
by Washington's fellow Virginian Thomas Jefferson:
Perhaps the strongest feature in his character was prudence, never acting until
every circumstance, every consideration, was maturely weighed; refraining if he
saw a doubt, but, when once decided, going through with his purpose, whatever
obstacles opposed.
George Washington inherited much more than a good mind and a strong body.
Washington belonged to an old colonial family that believed in hard work, in
public service, and in worshiping God. The Washington family has been traced
back to 1260 in England. The name at that time was de Wessington. It was later
spelled Washington. Sulgrave Manor in England is regarded as the home of
George Washington's ancestors.
George's great-grandfather, John Washington (1632-1677), came to live in
America by accident. He was mate on a small English ship that went aground in
the Potomac River in 1656 or 1657. By the time the ship was repaired, he had
decided to marry and settle in Virginia. He started with little money. Within 20
years he owned more than 5,000 acres (2,000 hectares), including the land that
later became Mount Vernon. Lawrence Washington (1659-1698), the eldest son
of John, was the grandfather of George
George's father, Augustine Washington (1694-1743), was Lawrence's youngest
son. After iron ore was discovered on some of his land, he spent most of his time
developing an ironworks. He had four children by his first wife, Jane Butler. She
died in 1729. In March 1731, he married Mary Ball (1709?-1789), who became
George's mother.
Appendix K

Checksheet
Checksheet

1. 

2. 

3. 

4. 
Appendix L

Discomfort Survey Script
DISCOMFORT SURVEY SCRIPT
To be read aloud by the student investigator or research assistant.

“During the study you will be asked to complete typing and assembly tasks in a private room. The order of the tasks will vary in order to help us evaluate your comfort level during varied tasks and conditions. Throughout the study we will evaluate your discomfort at the end of each day using a survey. At the end of the study, we will ask you to evaluate your overall level of discomfort. Do you have any questions?”

{All question answers will remain consistent with the plan of telling participants we are evaluating their discomfort level under various conditions.}
Appendix M

Self-Monitoring Form
Self-Monitoring Form

Name

Date

Please record whether or not your back was safe each time the beeper sounds.

<table>
<thead>
<tr>
<th>Observation</th>
<th>Safe</th>
<th>At-Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>1: BACK</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>2: BACK</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>3: BACK</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>4: BACK</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
</tbody>
</table>
Appendix N

Self-Monitoring Script
Self-Monitoring Script
To be read aloud by either the student investigator or research assistant.

{Hand the participant the self-monitoring form}

“Each time the beep sounds you should immediately think about whether your [body position, e.g. back] is in a safe or at-risk position and then immediately place a checkmark next to either safe or at-risk on the form. Score your first observation at number 1, your second observation at number 2, and so on. After you score yourself, immediately resume the task.”
Appendix O

Obvious Camera Instructions
Obvious Camera Instructions
To be read aloud by the student investigator or research assistant.

“Today we are going to have a camera in the room to record your (target behavior) posture so we can score it as safe or at-risk. Please do the task and self-monitor as usual.”
Appendix P

Exit Interview
EXIT INTERVIEW
To be read aloud by either the SI or RA.

1. What do you think the study was about?

2. What did you think about when you checked the blank box?

3. Why did you think you were asked to check the blank box?

4. What did you think about when you were self-monitoring?

5. Did you try to perform more safely when you were self-monitoring?

6. Do you think you performed more safely when the camera was present?

7. If yes to number 6, why do you think you performed more safely?

8. Did you say anything to yourself while you were self-monitoring?

9. What did you think the camera was present?

10. Did you notice a hidden camera in the observation room?
Appendix Q

Debriefing Script
PARTICIPANT DEBRIEFING SCRIPT

This script is to be read aloud to all participants following the completion of the study by either the student investigator or research assistant.

“This is a brief explanation of the purpose of the study. Please feel free to ask any questions you may have after the explanation.

The purpose of this study was to determine the effects of self-monitoring and observer presence on safe positioning while working. Several studies have shown that self-monitoring is effective at changing other types of behaviors but little research has been conducted regarding the effects of self-monitoring on safe positioning. Many of the studies involving self-monitoring also implemented other interventions along with self-monitoring, so we wanted to look at self-monitoring by itself. Additionally, research suggests that behavior changes when an observer was present. So, the study evaluated whether participants became more safe when an observer was present.

The practical significance of this is that many employees who work in hazardous conditions work alone. Therefore, it is not possible to have an outside observer give them information about their safety performance. Therefore, other interventions, such as self-monitoring, need to be developed and refined that will help people who work in solitary become more safe.

In order to evaluate the intervention for people who work alone and the effects of the observer being present, we needed to monitor your performance unobtrusively in order to get a "true" sample of your work behavior. This was done to examine the differences in your performance when self-monitoring was implemented and when the an obtrusive camera was present. In order to do this, we needed to monitor your performance covertly when the obtrusive camera was not present using a hidden camera. Only research assistants have viewed your performance on tape.

We assure you that the videotapes and all identifying information will be held in the strictest confidence. Dates and times on the videos will be obscured or erased so that individuals cannot be identified by this information. Nicole Gravina will maintain the security of all data collection forms and videos gathered over the course of data collection by storing them in a locked cabinet inside of a locked office (2530 Wood Hall) for at least three years. Only Nicole Gravina will have access to the locked cabinet, but 4 graduate student members of the PI’s research laboratory have access to the locked office space.

You are free to view the videotapes of your performance and we invite you to do so. We also invite you to examine your own performance data gathered from the video observation process. If you chose to do so, you may make arrangements with Nicole Gravina following this explanation and after asking any
questions you may have about the study. We are required to ask for your consent to use the data from the video tapes. If you do not consent to the use of these data, you will not be penalized in any way and we will destroy your videotapes or give them to you so that you may dispose of them in any way you deem appropriate.

{Hand the participant the consent form}

Do you have any questions?

{Answer the questions the participant has}

Thank you for participating in this study. Your help is greatly appreciated.”
Appendix R

HSIRB Approval Letter
Date: August 8, 2005

To: John Austin, Principal Investigator
    Nicole Gravina, Student Investigator for thesis

From: Amy Naugle, Ph.D., Vice Chair

Re: HSIRB Project Number: 05-02-09

This letter will serve as confirmation that the change to your research project "The Effects of Self-monitoring on Safe Posture Performance" requested in your memo dated 8/8/2005 (addition of an optional phase) has been approved by the Human Subjects Institutional Review Board.

The conditions and the duration of this approval are specified in the Policies of Western Michigan University.

Please note that you may only conduct this research exactly in the form it was approved. You must seek specific board approval for any changes in this project. You must also seek reapproval if the project extends beyond the termination date noted below. In addition if there are any unanticipated adverse reactions or unanticipated events associated with the conduct of this research, you should immediately suspend the project and contact the Chair of the HSIRB for consultation.

The Board wishes you success in the pursuit of your research goals.

Approval Termination: March 9, 2006
Appendix S

Participant 1 Data
Productivity

Words Typed per Minute

Sessions

Widgets Assembled per Minute

Sessions

SM head

SM arm
Appendix T

Participant 2 Data
Safety Performance

Baseline
Self-Monitoring
Booster
Self-Monitoring + Camera

Head/Neck - Typing
Camera present

Head/Neck - Assembly

Back - Typing
Back - Assembly
Productivity

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Sessions

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SM head

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SM head
Appendix U

Participant 3 Data
Safety Performance

Baseline Self-Monitoring Head/Neck - Assembly

Accuracy Booster

Shoulder - Assembly

Accuracy Booster

Head/Neck - Typing

Back - Typing
Shoulder - Typing

Back - Assembly

Arm - Typing

Arm - Assembly
Productivity

Words Typed per Minute

SM head/neck

Widgets Assembled per Minute

SM head/neck
SM shoulder

Sessions

Sessions
Appendix V

Participant 4 Data
Safety Performance

Baseline

Self-Monitoring

Self-Monitoring + Came

camera present

Accuracy Booster

Arm - Typing

Arm - Assembly

camera present

Back - Typing

Back - Assembly
Productivity

Words Typed per Minute

SM arm

Sessions

Widgets Assembled per Minute

SM arm

Sessions
Appendix W

Participant 5 Data
Appendix X

Participant 6 Data
Appendix Y

Participant 7 Data
Safety Performance

Baseline
Self-Monitoring
Self-Monitoring + Camera

Session

Wrist - Assembly
Camera present

Wrist - Typing
Camera present

Head/Neck - Assembly

 Sessions
Percentage of Observations Safe

0 20 40 60 80 100

3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 60 63 66 69
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