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Investigating the Effects of Observer Presence and Feedback on Individuals' Work-Related Behavior

Angela R. Lebbon

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INVESTIGATING THE EFFECTS OF OBSERVER PRESENCE AND FEEDBACK ON INDIVIDUALS’ WORK-RELATED BEHAVIOR

by

Angela R. Lebbon

A Dissertation
Submitted to the
Faculty of The Graduate College
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requirements for the
Degree of Doctor of Philosophy
Department of Psychology
Advisor: John Austin, Ph.D.

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Angela R. Lebbon

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INTRODUCTION

Direct observation procedures have been widely used by applied behavior analysts to examine the effects of various interventions on behavior in the areas of developmental disabilities, clinical psychology, school psychology, and organizational psychology. Utilizing direct observations provides many benefits to researchers as it offers a means for capturing behavior in real time, eliminates the reliance on interviews or surveys, allows for observed behaviors to be verified by another individual, and offers a way to calculate frequency and rates of behavior (Gardner, 2000). From an organizational perspective, direct observations can be a beneficial technique that offers managers opportunities to observe employee behavior and provide appropriate consequences (e.g., praise or corrective feedback) to employees. However, direct observations can also have some drawbacks which include the time-consuming nature of conducting observations and training reliability observers, participant fatigue due to repeated exposure to the observer, loss of participants due to uneasiness with observation procedures, and possible threats to the internal and external validity of research utilizing direct observations (Gardner).

With regards to internal validity threats, direct observations can and do lead to demonstrations of behavior that are not as representative of naturally occurring behavior (i.e., reactive effects to observer presence) as previously thought by scientists. Recent research has systematically examined the effects of an observer’s presence on the behavior of individuals being observed (e.g., Brackett, Reid, & Green, 2007; Lebbon, 2007) and found that participants behave in ways that are not representative of their behavior when an observer is not present. Although much research has been conducted
on the effects of direct observation, a great deal still remains unknown about the variables mediating reactive effects. That is, it is common thought in the behavior analytic community that reactivity can be controlled by prolonged exposure to the observers which would lead to participants habituating to the presence of the observer, thus dissipating reactive effects and leaving only accurate representation of behavior. However, a study conducted by Lebbon (2007) found that while all participants reacted and habituated to the presence of an observer with safety behavior and productivity measures, habituation was demonstrated among fewer behaviors than reactivity. Therefore, it remains unclear which variables mediate reactive effects with individuals. Haynes and Horn (1982) noted that this necessity of identifying and measuring reactive effects may not only lead to pinpointing variables (e.g., discriminative stimulus properties) that mediate but may also lead to identifying observation procedures (e.g., frequency or rate of observer presence) that better control reactive effects.

**Discriminative Stimuli**

In the 1940's, social psychologists believed that much remained unknown around individuals’ development of social behavior and therefore, set out to examine the effects of direct observations on the social behavior of children. While research was uncovering a great deal of information on the development of social behavior and interactions, Arrington (1943) acknowledged that a key issue with utilizing direct observations resided with determining the specific combination of environmental variables that would lead to greater demonstrations of the behavior of interest. Arrington believed that an individual’s history of interaction with his/her parents and other adults was possibly one of those environmental variables that affected behavior change during direct observation
of individuals. Arrington noted that any combination of the following variables could potentially influence the demonstration of reactive effects: a) familiarity with the observer, b) previous interactions with the observer or with being observed, c) observation setting, d) the number of individuals observed in a setting, and e) number of observations conducted on the individual.

In 1982, Haynes and Horn concurred with Arrington and discussed in detail how one of the factors possibly mediating reactive effects is the discriminative stimulus properties of the observation procedure. More specifically, it is thought that the differences (i.e., degree and direction) between individuals' demonstration of reactivity may be due to individuals’ previous experiences with observers watching their behavior and providing praise or punishment. During an experiment, the observer serves as a discriminative stimulus for the delivery of praise or punishment and participants act according to their perceptions of what they “think” the observer is observing (i.e., in accordance with their reinforcement history in ostensibly similar circumstances) in order to avoid possible delivery of punishment and await possible delivery of feedback and praise. However, when an observer in an experiment does not follow participants’ behavior with consequences, the observer loses his/her function as a discriminative stimulus for praise or punishment and thus, the observer exerts less stimulus control over participant behavior. It is therefore possible that the variability often demonstrated in studies examining reactivity is due to a failure of delivering consequences after participants engage in what they deem to be “appropriate” behavior, thus placing responses on extinction.

Kazdin (1982) additionally concluded that participants come under stimulus
control when an observer is present in their environment due to either knowledge of the observer’s purpose or the participant’s perception of the observer’s purpose in combination with the participant’s previous experiences with an individual observing his/her behavior. Kazdin continued by explaining the following:

A stimulus-control view of reactivity is consistent with selected findings. First, reactive effects often occur early in the assessment procedures but dissipate over time. If subjects learn that no immediate consequences follow, the assessment situation can lose the control that it exerts over behavior. (p. 10)

In contrast to Kazdin (1982) and Haynes and Horn (1982), a number of individuals (Baker & Wright, 1954; McGrew, 1972; Polanskey et al., 1949) have suggested that researchers should not be concerned with the idea that an observer functions as a discriminative stimulus due to the observer acquiring neutral stimulus properties after time and thus, reactive effects by participants will either disappear or not be demonstrated at all (Mash & Hedley, 1975). However, Mash and Hedley note that numerous studies have demonstrated that the amount and consistency of reactive effects could be an intricate relationship between the observer, the individual being observed, and the environmental variables. Mash and Hedley suggest that one of those possible complex interactions is that of an observer functioning as a discriminative stimulus due to the individual’s prior history with the observer or observers in general and therefore, the observer cannot function as a neutral stimulus. Hash and Medley wanted to systematically examine this possibility and conducted a study to examine the effects of an adult observer’s presence on 5 year-old children’s performance on a marble dropping task. In addition, the children were exposed to the observer prior to the marble dropping
task with positive (e.g., “That was nice”, “I like you”), negative (e.g., “That’s not nice”, I don’t like what you are doing”), or neutral interaction (e.g., Observer read a book and did not talk or attend to the participant). Mash and Hedley found that the response rate for marble dropping improved when they were watched by the observer who previously interacted positively with the children, whereas decreases in response rate were found for children watched by the observer who previously interacted negatively with the children. These results suggest that the observer does function as a discriminative stimulus due to previous interaction and therefore, is not a neutral stimulus that yields accurate representations of behavior. Given that demonstrations of reactivity have been inconsistent throughout the years and given that a great deal of discussion has occurred around discriminative stimulus properties, it appears that more attention to this variable and its possible affects on behavior is warranted.

Feedback

Another variable possibly mediating reactive effects in direct observation procedures is the delivery of feedback by the observer. Feedback has been defined as: a) information delivered to individuals pertaining to the quantity or quality of their past performance (Prue & Fairbank, 1981), b) information delivered immediately after a specific instance of behavior (Sulzer-Azaroff & Mayer, 1991), c) information that an individual receives about his/her behavior that can be used during future opportunities to improve that behavior (Daniels & Daniels, 2004), and d) a technique that improves behavior by praising appropriate behavior and correcting inappropriate behavior (Krause, 1995).

Previous research has demonstrated that feedback can be an effective tool for
enhancing individuals’ performance in a variety of settings, most notably in organizational settings. Feedback is commonly utilized in organizations to improve safety culture and behavior and has become an integral part of the behavior-based safety process. The delivery of feedback often occurs immediately after an individual’s behavior has been observed by a manager or peer and provides opportunities for managers/peers to praise safe behavior, communicate why behavior was unsafe, and inform the employee on how the unsafe behaviors can be performed safely (McSween, 2003). While feedback has been discussed as an antecedent and as a consequence, Sulzer-Azaroff and Mayer (1991) noted that feedback may function as a discriminative stimulus for some individuals. Kazdin (1982) explains that feedback can function as a discriminative stimulus as it provides important information which starts the processes of an individual examining their own behavior and making adjustments according to feedback previously delivered. More specifically, Kazdin (1974) discusses that individuals who self-monitor must attend to their behavior, discriminate appropriate and inappropriate behavior (according to what they perceive is the behavior of interest) and then adjust accordingly to fulfill “appropriate” behavior as they deem it. According to Kazdin, this discriminative stimulus function has been demonstrated by Kazdin (1974) and Richards, Anderson, and Baker (1978) and both found that participants demonstrated performance improvements during self-monitoring or direct observation by another individual when feedback was delivered on their performance in comparison to when feedback was not delivered.

Kazdin (1974) conducted a study to examine the effects of setting a goal on performance (e.g., sentence construction) in the presence of an observer versus self-
monitoring. For the observer presence condition, direct observations were not conducted, however, this condition consisted of participants being informed that the experimenter would count the number of sentences constructed according to the appropriate criteria established at the beginning of the study (i.e., subjects were told, “frequent use of ‘I’ and ‘We’ statements are related to high intelligence, creativity, sensitivity”). Kazdin found that overall, the delivery of goals and feedback improved performance for individuals being observed by another individual whereas behavior in the self-monitoring plus goals and feedback improved but to a lesser degree and the behavior in the no monitoring condition resulted in no improvements. Based on Kazdin’s findings, it appears that feedback may allow for greater knowledge of what is being observed and therefore, provides direction on which behaviors need to be adjusted in order to act according to what is deemed “appropriate” behavior in the current situation (Kazdin, 1974).

The effects of feedback were examined in an organizational setting by Komaki (1986) who sought to better understand what constituted effective manager supervision from ineffective supervision. Komaki recorded and coded 24 manager behaviors from a medical insurance company and separated the managers according to a ranking of the 12 most effective managers in motivating others and the 12 least effective managers in motivating others. Over the course of 465 30-min observations of managers, Komaki found that a key difference between effective and ineffective managers was that the top 12 effective managers observed their subordinates’ behavior and collected performance information. Komaki also found that the delivery of consequences (either positive or negative) based on the performance information did not affect the effectiveness of managing subordinates, that is, no difference was observed between the positive or
negative consequences provided by both the top and bottom groups of managers. According to Komaki, these results appear to demonstrate the importance of direct observations improving performance but also possibly demonstrate the importance of delivering feedback and consequences contingent on that performance.

Given the great importance and use of feedback in the behavior-analytic community, its use in combination with direct observations, and the conflicting results from research examining the effects of feedback on behavior when an observer is present suggests that much remains unclear about the variables affecting performance when direct observations and feedback are utilized.

Previous Research on Reactivity

Group Examinations

In order to expand on Komaki (1986) and determine if performance monitoring was largely effective due to being combined with managers delivering feedback and praise for appropriate behavior, Larson and Callahan (1990) examined the effects of observing individuals' work-related performance while additionally delivering performance feedback on individuals' previous performance. Larson and Callahan utilized a 3 x 2 factorial design which included the following groups: 1) exposure to an observer and delivery of performance consequences, 2) exposure to an observer and no delivery of performance consequences, 3) control group with no exposure to an observer and no delivery of performance consequences. Experimental sessions consisted of four participants sitting in the experimental room together while they were tested on their ability to read, spell, and alphabetize words. During the two-hour session, the experimenter entered the room every 20 minutes and informed participants in both the
monitoring-only group and monitoring plus consequences group that the experimenter was monitoring the quality of the work (e.g., "Let’s see how many lines you’ve proofread"). However, the monitoring plus consequences group also received the following statement when the observer entered the experimental room: “During the last 20 min period you competed a total of _____ lines. This is better (worse) than your previous average, which was about _____ in 20 min. That’s very good (That means you probably didn’t do as well as you could have)” (p. 532). Results showed that performance was highest in the monitored plus consequences group and performance for the monitored-only group was lower than the monitored plus performance consequences group but higher than the non-monitored group thus suggesting that feedback is a variable which does mediate reactive effects.

While Larson and Callahan (1990) systematically examined the effects of direct observation and feedback on performance, limitations were present and include the following: a) examining behaviors not relevant to work, b) the absence of measuring and examining safety behaviors that are present in organizational settings, c) the presence of multiple individuals in the experimental room during the experimental task and during the delivery of performance consequences, d) the absence of direct observation (i.e., recorded behavior via permanent products), and e) including positive and negative evaluative statements in the delivery of performance feedback. More specifically, the limitation of including praise and negative evaluative statements with the delivery of feedback to participants is important as this part is not included in many definitions of feedback. That is, according to definitions provided by numerous behavior analysts, feedback involves the delivery of information to individuals regarding the quantity and
quality of their performance only; the definition does not mention the inclusion of following performance information with evaluative statements (e.g., you did very well or you did not do as well as you could have). Larson and Callahan (1990), in essence, provided a performance standard by informing participants what their previous performance was, a statement in regards to that performance being better or worse than his or her last performance followed by an evaluative statement such as “that was very good” or “that means you didn’t do as well as you could have”. Based on research from Kazdin (1974) and Cole and Hopkins (1995), it has been demonstrated that when performance standards and evaluative comments are delivered to individuals, behavior changes are observed shortly after.

Furthermore, according to research conducted in the area of social psychology, multiple individuals (i.e., co-actors) present during the experimental task can lead to individuals demonstrating reactive effects to both the observer and the co-actors. The presence of co-actors during an experiment has been defined as multiple individuals (i.e., more than one individual) being present in the same room, engaging in the same experimental task, and both their presence and behavior are visible to each other (Zajonc, 1965). According to social facilitation research, individuals demonstrate reactive effects due to engaging in competitive behavior that ultimately results in the increased performance or demonstrate performance decreases due to fear and nervousness of being observed and evaluated (Gore & Taylor, 1973; Martens & Landers, 1972).

Additionally, researchers have conducted studies examining the effects of delivering feedback in coordination with the delivery of behavioral consequences. Research that has employed both feedback and behavioral consequences as an
intervention have defined it as being comprised of the following components: “participants received feedback, and additionally, events such as praise, monetary incentives, and time off work were given following desired changes in the target behaviors” (Alvero, Bucklin, & Austin, 2001, p. 13). A review of research examining feedback applications revealed that the delivery of feedback and behavioral consequences lead to consistent performance effects for 58% of the studies whereas the delivery of feedback alone was found to result in consistent performance effects for only 47% of the studies thus appearing to suggest that the addition of consequences may lead to higher levels of performance (Alvero, Bucklin, & Austin). These results suggest that the delivery of not only feedback but statements of praise can lead to performance improvement which might suggest that the performance improvements demonstrated in Larson and Callahan (1990) were not solely the result of feedback alone but a possible combination of feedback and praise/punishment.

Lastly, Cooper (2006) examined the effects of a behavior-based safety process over a 70 week period at a paper mill wherein participants included both managers and subordinates from 55 work groups. Cooper’s behavioral safety process included behavioral safety observations and manager involvement of goal-setting and feedback with subordinates which resulted in safety behaviors improving 45 percentage points while concurrently resulting in a 45 percentage point decline of injuries. These results suggest that the delivery of performance standards can lead to participants changing their behavior which would suggest that the performance standards delivered during the Larson and Callahan (1990) study may have contributed to performance improvements and that the performance improvements were not due to feedback alone.
Brackett, Reid, and Green (2007) systematically examined the effects of observer presence and absence on the work-behavior of individuals at a publishing company to gain greater understanding of individuals’ reactivity to direct observations. Participants were three employees that served as job coaches to three support workers with work responsibilities that included administrative assistant duties such as labeling fliers and envelopes. Throughout the work-day, job coaches’ supervisors monitored and recorded the extent to which the job coaches completed four of the support workers’ duties (e.g., job coach moves work materials to table for support worker). Participants were exposed to a “baseline” condition that consisted of overt observations followed by an observer absent condition and then reversal to the observer present condition (i.e., overt observations). During the overt observation conditions, participants’ behavior was recorded on a checklist by their supervisor who stood in close visual and physical proximity, and immediately following the observation period, supervisors delivered feedback to job coaches regarding the amount of duties they completed for their support workers. During the observer absent condition, participants’ behavior was secretly observed by supervisor while engaging in other work-related duties and then recorded when the participant was not present; feedback was not provided to participants during this phase.

Brackett, Reid, and Green (2007) found that individuals will change their behavior when they are being ostensibly observed in comparison to when they are not being ostensibly observed. These findings appear to show that individuals demonstrate reactive effects during direct observation, yet, it is difficult to conclude that participants
were exclusively reactive to their supervisor observing work behavior given that supervisors delivered feedback during the overt observation condition but not during the covert observation condition. It is additionally difficult to know the exact effects of observation alone given that a true baseline (i.e., pre-observation) was not utilized and therefore, it is unclear the extent to which performance decrements were due to reactive effects, feedback effects, or a combination of both reactive effects and feedback effects.

In order to better understand the effects of observer presence on individuals' work-related behavior, an examination of observer presence in the absence of feedback was conducted by Lebbon (2007). Lebbon conducted a laboratory study in a simulated office setting to examine the effects of observer presence on six participants' work-related behavior both within-session and across sessions. In the study, participants were provided definitions of safe and unsafe body posture behavior and then asked to type an article into a Word file for 54 minutes while their body posture behavior, time on task, productivity, and quality of work were measured via hidden camera and a computer macro embedded into Word. During baseline, participants received the body posture definitions for five minutes and then proceeded to the experimental session for 54 minutes wherein an observer was never present. During the information plus observation phase, participants received the body posture definitions for five minutes and then proceeded to the experimental session for 54 minutes wherein an observer was present for the entire 54 minute session. Prior to the start of the observational experimental sessions, participants were informed that the observer was present to observe their safety behavior; neither feedback nor consequences was delivered during the observer present condition. Overall, Lebbon found that reactivity and habituation were demonstrated to
the presence of the observer both within session and across sessions, however, habituation was demonstrated for fewer behaviors than reactivity. That is, for all participant data combined, inter-session reactivity was demonstrated with 70% of behaviors and inter-session habituation was demonstrated with 33% of behaviors while intra-session reactivity was demonstrated for 81% of behaviors and intra-session habituation was demonstrated for 42% of behaviors.

Additionally, Lebbon (2007) found that the amount and rate of reactivity and habituation was highly idiosyncratic, however, reactivity and habituation were generally demonstrated with the same behaviors – leg position, feet position, and on-task behavior. Lebbon systematically examined the effects of observer presence and found that participants can and do react and habituate to observer presence, however, it remains unclear which variables mediate the differences in both reactivity and habituation across participants and therefore, it appears more research is warranted to examine possible variables that mediate the observer presence effects.

Lebbon (2007) expanded the literature by systematically examining the effects of observer presence on participants’ work-related behavior without the effects of multiple observers or consequences, however, a primary limitation involves the small number of participants utilized to examined the effects of observer presence. Furthermore, Lebbon speculated that participants’ behavior habituated due to the lack of delivering consequences following observation, yet, that analysis is post-hoc and only speculative. Therefore, what remains is unclear, and appears warranted for study, is the extent to which the presentation of feedback following direct observations can sustain reactive effects (e.g., safe behavior) and minimize possible habituation to the observer and
observational procedures.

Previous research (e.g., Arrington, 1943; Kazdin, 1982; Mash & Hedley, 1975) examining the effects of observer presence has often discussed the possible effects of discriminative stimuli on behavior, however, the concept has mainly been employed as a post-hoc explanation for behavior changes that were not anticipated and thus, the reasons for such changes are unclear. The possible role of an observer as a discriminative stimulus has received little research attention and has yet to be systematically examined with work-related performance and safety behavior. Therefore, the purpose of the current study is to examine the effects of observer presence (with and without feedback) on individuals’ work and safety-related behavior. The current study will additionally attempt to expand on the following perceived limitations of Larson and Callahan (1990): 1) eliminate numerous individuals in the room as most individuals in a corporate office environment work alone in an office or closed off cubicle; 2) conduct direct observation on both work-related safety and productivity behavior; and 3) deliver feedback according to behavioral definitions (e.g., Alvero, Bucklin, & Austin, 2001; Krause, 1995) and abstain from including positive and negative evaluative statements in the delivery of performance feedback.

METHOD

Participants

Participants in this study were 8 students (4 women, 4 men) enrolled in undergraduate psychology courses at a Midwestern university. Participants were paid $7.00 per hour and received extra credit for participating in the current study.
Participant Recruitment

Participants were recruited from various psychology undergraduate courses via an announcement (see Appendix A, adapted from Rohn, 2004). Students interested in learning more about participating in the current study were asked to fill out a recruitment form (see Appendix B) and return the recruitment form to the student investigator. Students that filled out the recruitment form were told that the experimenter would contact them with more information.

Participants were selected based on their availability and had to fulfill the following criteria: 1) they had not previously participated in a research study in the Performance Management (PM) labs, 2) they had demonstrated the ability to touch-type on a computer at a rate of at least 10 words per minute, 3) they had not suffered a repetitive stress injury and/or did not have a history of bodily pain or discomfort related to sitting and typing, and 4) they had demonstrated that the current intervention for improving body posture behavior and/or productivity was warranted (i.e., at least one body posture or productivity baseline below 30% on average, after three experimental sessions). Two participants were released shortly after starting the study (i.e., 2-3 sessions) because one did not demonstrate at least one body posture or productivity baseline below 30% on average and the other suffered a fractured ankle and thus, experienced pain and discomfort while sitting.

Consent Process

Participants were exposed to the consent process prior to the start of their first session. The student investigator read aloud a script (see Appendix C, adapted from Rohn, 2004) explaining the consent process and the consent form (see Appendix D,
adapted from Rohn, 2004). After the student investigator read aloud the consent script and form, the participant was given the choice to either sign the consent form (i.e., agree to participate in the current study) or decline to sign the consent form (i.e., choose not to participate in the current study). Participants were informed that they would not be penalized if they chose not to sign the consent form. Participants were not allowed to participate in the current study until they read and signed the consent form. All participants read and signed the consent form.

At the conclusion of the study, participants were asked to sign another consent form, allowing or declining use of the hidden camera data. The student investigator read aloud a script (see Appendix E) explaining the consent process and the consent form (see Appendix F). Participants were informed that they would not be penalized (i.e., they would receive monetary payment and extra credit for their participation) if they chose not to sign the consent form. All participants read and signed the consent form thus giving the student investigator permission to use their hidden camera data.

*Human Subjects Protection*

This study was approved by the Human Subjects Institutional Review Board (HSIRB) (see Appendix G for a copy of the approval letter).

*Screening*

Participants were exposed to a screening process prior to the initiation of their first session in order to determine if they met the requirements for inclusion in the study. In order to conceal the true purpose of the current study, participants were informed that the current study was designed to examine computer work tasks that may lead to body discomfort.
The screening process began with asking participants if they had previously participated in a research study in the PM labs. Participants were then asked to complete a body discomfort survey (see Appendix H, adapted from Gravina, 2005) to determine if they had suffered a repetitive stress injury and/or had a history of bodily pain or discomfort. Participants had to indicate that they had not suffered a repetitive stress injury and/or score an average of four or less (i.e., participant’s overall discomfort ranges from some discomfort, 1, to intolerable, 10) out of a 10-point scale on the discomfort survey to be included in the study. All participants indicated they had not suffered a repetitive stress injury and scored an average of four or less out of the 10 point scale on the discomfort survey.

Lastly, participants were asked to type an article (see Appendix I for a sample article) into a computer file for 10 min to determine their touch-typing abilities. The criterion for inclusion in the current study was the ability to touch-type 10 words or more per minute. All participants met the criterion for touch-typing 10 words or more per minute.

Duration

Each session was approximately 35 minutes in duration. Each session began with a 5-min information period followed by a 30-min work session. Participants usually completed one session per day, and if scoring capabilities and participants’ schedules permitted, participants were allowed to complete at most three sessions per day wherein each session would be separated by one hour. Due to the duration of each session, participants were informed that they could take a break at any point during a session without penalty (i.e., they would receive full monetary payment and credit for the
Setting

The current study was conducted in a 3.7 x 2.4 m laboratory room. The laboratory room was furnished to simulate an office setting, equipped with a desk, a computer, an adjustable office chair, a radio, and a bookshelf containing various books. The laboratory room contained a door used to enter and exit the room.

Apparatus

Participants' behavior was recorded on DVDs via a .15 x .10 m wireless hidden camera with audio capabilities (C1182 5.8 GHZ Wireless Color Camera) located behind a bookshelf. The camera directed a signal to a wireless receiver located in a nearby laboratory room equipped with a television and DVD player. This allowed continuous monitoring of participant behavior even when an observer was not in the observation room recording participant behavior.

Dependent Variables

The dependent variables in this study were: (a) measures of two work-related body posture behaviors, (b) the percentage of time spent on-task within a 30-min session, and (c) a production measure based on the number of words and spelling errors typed within a 30-min experimental session.

Work-Related Body Posture Behavior

The two work-related body posture behaviors were expressed as the percentage of safe intervals observed. Research assistants scored a behavior as “safe” when the behavior fulfilled the operational definition and scored a behavior as “unsafe” when the behavior did not fulfill the operational definition. Safe and unsafe body posture
behaviors definitions were based on Occupational and Safety Health Administration recommendations (2006).

*Leg position.* Leg position refers to a participant’s thighs and lower legs. Leg position was scored as safe when the angle between the thighs and lower legs was between 90-120 degrees. Leg position was scored as unsafe when the angle between the thighs and lower legs was less than 90 degrees or greater than 120 degrees. That is, if a participant sits on his/her feet, tucks his/her legs underneath the base of the seat, or extends his/her legs beyond the 120-degree angle, leg position was scored as unsafe.

*Feet position.* Feet position was defined as safe when both of the participant’s feet were flat on the floor (heels and toes flat). Feet position was defined as unsafe if one or both of the participant’s feet were not flat on the floor.

The computer workstation was adapted to fit each participant’s body size based on OSHA (2006) recommendations prior to the start of participants’ first session. The chair height, keyboard position, and mouse arrangement was measured using a tape measure. The SI recorded the measurements in order to ensure that participants’ specific workstation arrangements were utilized for each session.

*Time On-Task*

The percentage of time on-task within a 30-min session for each phase in the current study was recorded by a Visual Basic Editor macro utilizing a frequency count in 20-s intervals. On-task behavior was recorded via the macro recording the number of words typed in 20-s intervals. If the number of words typed increased from the previous 20-s interval then the participant was scored as on-task, however, if the number of words did not increase from the previous 20-s interval then the participant was scored as off-
Productivity Measure

The productivity measure was based on the number of words and spelling errors (i.e., misspelled words) typed in a Word document within a 30-min experimental session. The productivity measure was calculated into a percentage by dividing the number of spelling errors by the number of words typed in a 20-s interval thus yielding errors as percentage of words typed per 20-s interval. Participants were instructed to type an article into a Word document for the duration of experimental sessions. The number of words and errors typed was recorded by a Visual Basic Editor macro utilizing a frequency count in 20-s intervals.

Data Collection

Participant behavior was scored on a data sheet (see Appendix J) by trained undergraduate psychology students. Research assistants were trained as observers on the criteria for “safe” and “unsafe” body posture through information sessions, simulated live observation, and simulated video observation sessions. Assistants were tested on correctly defining posture behavior and visually differentiating between “safe” and “unsafe” behavior. Mastery criteria was set at 100% for correctly defining body posture during a written assessment, and 80% agreement with the experimenter when scoring three consecutive training DVDs. Mastery criteria had to be achieved in both areas to serve as an observer.

Assistants used a data sheet to record participants’ safety performance on the body posture behaviors. Data were collected using a 20-s momentary-time sampling procedure via video captured from the hidden camera. A behavior was scored as “safe”
only if the behavior fulfilled the operational definition of “safe” at that moment, and “unsafe” if it did not. Data collection occurred for each participant approximately five to seven sessions each week over a maximum of a five-week period.

Each participant’s percentage safe for body posture behavior, percentage of time on task, and errors as a percentage of words typed was graphed separately across sessions for visual analysis. Each data point represents the percentage of intervals safe (or percentage of time on-task or errors as a percentage of words typed) for a 5-min time block during the 30-min session, therefore, each session contains six data points. Each session was separated into three periods based on the observer’s presence and consists of the following: a) pre-observation period (00:00-10:00), b) during-observation period (10:01-20:01), and c) post-observation period (20:02-30:02).

Experimental Design

A non-concurrent multiple baseline design across participants was used to evaluate the effects of observer presence and feedback on participants’ body posture behavior, time on-task, and productivity. The first group of four participants was exposed to information (A) and information plus observation (B). The second group of four participants was exposed to information (A) and information plus observation and feedback (B).

Participants were separated into two groups instead of exposing all participants to the information plus observation phase and the information plus observation and feedback phase in order to prevent the possibility of carry-over effects and to allow for longer, more stable baselines to reduce the possibility of reactivity to experimental conditions carrying over to the intervention phase. Each participant was exposed to the
observer in a staggered fashion during the course of the study. A multiple-baseline design was selected as it offers the possibility to demonstrate that behavior changes only when the intervention is implemented and allows participants to serve as their own control.

Group Assignment

Participants were randomly assigned to either the information plus observation group or to the information, observation, and feedback group. Prior to participant selection, six numbers (i.e., 1-6 which pertained to the original participant size of six) were entered into an electronic randomizer in order to generate two sets of 3 numbers, per set. It was decided before randomization that the first set of numbers would be the information plus observation group and the second set of numbers would be the information, observation, and feedback group. The randomizer generated the following two sets of numbers: 1) 5, 1, 6 and 2) 3, 4, 2. Participants were assigned a number at the start of the study based on the order in which they agreed to participate in the study. For example, the number 2 was randomly assigned to the information, observation, and feedback group and therefore, the second participant that signed on to participate in this study was assigned to the information, observation, and feedback group. Participants 8 and 9 were not included in the random assignment as they were added as participants mid-way through the study; it was only decided prior to their selection that the 8th participant would be a female and assigned to the information plus observation group and that the 9th participant would be a male and assigned to the information, observation, and feedback group.
Procedure

Information

During the information phase, participants were given a handout (see Appendix K, adapted from Rohn, 2004) with the definitions of productivity behavior and safe body posture behavior before each experimental session. The student investigator asked participants to review the definitions for five minutes and sign the handout indicating they received the definitions. After reviewing the definitions, the experimenter asked participants to demonstrate the safe posture for each body posture DV; if incorrect body posture was observed, the experimenter provided corrective feedback and asked the participant to demonstrate the DV again (see Appendix L for script). Demonstration of safe body posture behavior and corrective feedback only occurred for participants’ first information session. In all other information phase sessions, following the five-minute review of the definitions, participants began the experimental session. Participants were presented an article and asked to type the article into a computer file for a 30-min period (see Appendix M for script, adapted from Rohn, 2004). The experimenter exited the room and returned after 30 minutes had elapsed to inform the participant that the session was over.

The first three sessions of this phase also served as a screening process wherein participants’ data were analyzed to determine if their body posture behavior and/or productivity measures yielded an opportunity for improvement. The criterion for continuation in the current study was defined as demonstration of at least one body posture or productivity baseline average below 30%. Participants demonstrating at least one body posture or productivity baseline average below 30% continued to be observed
and exposed to the below treatment(s) after demonstrating stable body posture and productivity behavior during the information phase.

*Information plus Observation*

During the information plus observation phase, participants continued to receive the handout with definitions of safe body posture behavior prior to each experimental session for five minutes, as they did in the previous phase. After participants reviewed and signed the safety handout, participants were led to the experimental room where they were presented an article, and asked to type the article into a computer file for a 30-min period. After 10 minutes has elapsed (0:00-10:00), the experimenter knocked on the door and entered the experimental room to inform participants (see Appendix N for script, adapted from Rohn, 2004) that the experimenter would be present for 10 minutes (approx. 10:01-20:01) to observe the participant's safety and productivity behavior. Participants were not informed which specific safety and productivity behaviors would be observed nor was feedback on safety and productivity performance provided to participants.

During the observation period, the experimenter sat approximately 1.2 m from the participant with a clipboard, paper, and pencil to simulate direct observation. The experimenter did not engage in “small talk” with the participant during the session. If the participant asked a question, the experimenter informed the participant that his or her question would be answered after the session was over. After 10-min elapsed, the experimenter informed the participant that the observation period was over and asked to continue working for the remainder of the session (approx. 20:01-30:00). Each participant was presented the same articles to work on, in the same order, throughout the
study wherein a different article was presented each session.

**Information, Observation, and Feedback**

During the information, observation, and feedback phase, participants continued to receive the handout with definitions of safe body posture behavior prior to each experimental session for five minutes. After participants reviewed and signed the safety handout, participants were led to the experimental room where they were presented feedback regarding their safety and productivity performance from the previous session. For example, at the beginning of the seventh session, participant 3 received her sixth session’s data for percentage safe for legs and feet, number of minutes spent on-task, number of words typed, and number of spelling errors typed. Participants did not receive feedback during their first session of the information, observation, and feedback phase to prevent the possibility that participants would become suspicious and question how the student investigator calculated his/her performance given that ostensible observation was not conducted the previous session.

After feedback was delivered, participants were presented an article, and asked to type the article into a computer file for a 30-min period. After 10 minutes had elapsed (0:00-10:00), the experimenter knocked on the door and entered the experimental room to inform participants (see Appendix N for script, adapted from Rohn, 2004) that the experimenter would be present for 10 minutes (approx. 10:01-20:01) to observe the participant’s safety and productivity behavior.

During the observation period, the experimenter sat approximately 1.2 m from the participant with a clipboard, paper, and pencil to simulate direct observation. The experimenter did not engage in “small talk” with the participant during the session. If the
participant asked a question, the experimenter informed the participant that his or her question would be answered after the session was over. After 10-min elapsed, the experimenter informed the participant that the observation period was over and asked to continue working for the remainder of the session (approx. 20:01-30:00). Each participant was presented the same articles to work on, in the same order, throughout the study wherein a different article was presented each session.

Definitions of Reactivity and Habituation

Definitions for reactivity and habituation were established in order to prevent experimenter bias that may occur with visual analysis and to provide more conservative estimates of reactivity and habituation. In order to determine if performance improved during the observation period compared to the non-observation period (i.e., reactivity) and to determine if performance declined during the observation period (i.e., habituation), a method provided by Koenig and Kunzelmann (1980, in Cooper, Heron, & Heward, 1987) was altered and utilized in the current study to determine mean level changes between periods and within periods. Koenig and Kunzelmann determined median level changes within a phase by calculating the median value of the first three data points within a phase and comparing that value to the median value of the remaining three data points within that phase.

For the current study, mean level changes were calculated for the pre-observation period and for the during-observation period for the information plus observation phase and the information, observation, and feedback phase. A mean level change was calculated by dividing the pre-observation period in half and calculating a mean for the first half of the period and a mean for the second half of the period. For example, the pre-
observation period consists two data points (i.e., 00:00-05:00 and 05:01-10:01), a mean for the first half of the period was calculated by adding all of the safe intervals during 00:00-05:00 and dividing it by the total number of intervals during 00:00-05:00 for all of the sessions during the information plus observation phase (or information, observation, and feedback phase); a mean for the second half of the period was calculated by adding all of the safe intervals during 05:01-10:01 and dividing it by the total number of intervals during 05:01-10:01 for all of the sessions during the information plus observation phase (or information, observation, and feedback phase).

In order to determine if reactivity was demonstrated, a mean level change between the pre-observation period and the during-observation period was calculated by subtracting the mean for the 2nd half of the pre-observation period (i.e., 05:01-10:01) from the mean for the 1st half of the during-observation period (i.e., 10:01-15:01). Reactivity was defined as participant performance data (i.e., body posture behavior, time on-task, productivity measure) demonstrating an increase of five percentage points or greater in the 1st half of the during-observation period mean data path when compared to the 2nd half of the pre-observation period.

In order to determine if habituation was demonstrated, a mean level change between the 1st and 2nd half of the during-observation period was calculated by subtracting the mean for the 2nd half of the during-observation period (i.e., 15:01-20:01) from the mean for the 1st half of the during-observation period (i.e., 10:01-15:01). Habituation was defined as participant performance data (i.e., body posture behavior, time on-task, productivity measure) demonstrating a decrease of five percentage points or greater in the 2nd half of the during-observation period mean data path when compared
to the 1st half of the during-observation period. It should be noted that the definitions for reactivity and habituation are arbitrary as there was no basis in the literature for which criteria should be set.

All participants' performance data were aggregated and graphed across groups, dependent variables, and participants for visual analysis of reactivity and habituation effects (refer to pages 33-34 for Figures). To create a summary of reactivity and habituation across groups, each participant's performance data for each dependent variable for all sessions were averaged across 5-min time blocks, thus resulting in six 5-min percentages per dependent variable. After 5-min time block percentages were calculated for each dependent variable, the definitions of reactivity and habituation were utilized to determine if a participant demonstrated reactivity and habituation for each dependent variable. After a frequency count of reactivity (and habituation) was calculated for each participant and each behavior, the total number of behaviors demonstrating reactivity (and habituation) for each group (i.e., observation only group and observation plus feedback group) was divided by the total number of behaviors exposed to the observer for each group, resulting in a percentage of behavior demonstrating reactivity (or habituation) across each group. For example, in the observation plus feedback group, there were a total of 16 behaviors exposed to the observer (i.e., 4 dependent variables multiplied by 4 participants equals 16 behaviors exposed to the observer) wherein reactivity was demonstrated for 10 behaviors and habituation for 2 behaviors, thus resulting in 63% of behavior demonstrating reactivity and 13% of behavior demonstrating habituation. A summary for reactivity and habituation across dependent variables and participants was calculated in a similar
manner by dividing the total number of behaviors demonstrating reactivity (and habituation) for each dependent variable (or participant) by the total number of behaviors exposed to the observer for each dependent variable (or participant), which resulted in a percentage of behavior demonstrating reactivity (or habituation) across each dependent variable (or participant).

Debriefing Session

Debriefing sessions were conducted with each participant after all the participants completed their last session. At the end of each participant’s last session, the student investigator scheduled a meeting with the participant to explain the purpose of the current study and to provide him or her with the opportunity to receive information regarding his or her individual performance.

The student investigator began the debriefing session by conducting an exit interview (see Appendix P, adapted from Rohn, 2004) to inquire about participants’ thoughts on the purpose of the study and the observer’s presence. Immediately following the exit interview, participants were informed (see Appendix Q for debriefing script, adapted from Rohn, 2004) that a hidden camera was utilized and an explanation was provided regarding the purpose of the study and the hidden camera. After the student investigator explained the purpose of the study and how their hidden camera data were utilized, participants were asked to verbally summarize the student investigator’s explanation of the study and use of hidden camera data to assess the participant’s understanding. Participants were informed that consent was required (see Appendix E for script, adapted from Rohn, 2004), presented the consent form (see Appendix F) and given an opportunity to accept or refuse use of their hidden camera data. Participants
were informed that they would not be penalized (i.e., they would receive monetary payment and extra credit for their participation) if they chose not to sign the consent form. The debriefing sessions concluded by giving participants an opportunity to ask any questions they had regarding the study. Participants were paid $2.50 for attending the debriefing session.

Reliability

Work-Related Body Posture Behavior

Inter-observer agreement (IOA) data collected on the dependent variables were calculated for agreements on both “safe” and “unsafe” body posture behavior. Two independent observers simultaneously recorded body posture behavior for 29% of sessions (i.e., 43 of 147 total sessions). The total number of IOA sessions for each participant was 4 of 17 total sessions for participant 1, 8 of 22 total sessions for participant 2, 5 of 16 total sessions for participant 3, 6 of 21 total sessions for participant 4, 6 of 22 total sessions for participant 5, 7 of 21 total session for participant 6, 3 of 13 total sessions for participant 8, and 4 of 15 total sessions for participant 9. Data were collected for IOA, on average, every two to three sessions and were spaced across both information and treatment phases. Overall, IOA agreements (i.e., “safe” plus “unsafe” agreements for all DVs) were 99.71% for participant 1, 98.63% for participant 2, 96.36% for participant 3, 93.62% for participant 4, 97.79% for participant 5, 96.72% for participant 6, 99.78% for participant 8, and 98.05% for participant 9.

Agreements for “safe” were calculated by dividing the number of “safe” agreements by the number of “safe” agreements plus the number of “safe” disagreements and multiplying by 100. Inter-observer agreement for “safe” agreements was assessed for
each posture variable throughout the course of the study. Table 1 shows each
participant's IOA scores for "safe" agreements and ranges for each body posture over the
course of the study. Agreements for "unsafe" body posture behavior were calculated by
dividing the number of "unsafe" agreements by the number of "unsafe" agreements plus
the number of "unsafe" disagreements and multiplying by 100. Inter-observer agreement
for "unsafe" agreements was assessed for each posture variable throughout the course of
the study. Table 2 shows each participant's IOA scores for "unsafe" agreements and
ranges for each body posture over the course of the study.

Table 1
IOA Safety-Related Dependent Variables for "Safe" Agreements

<table>
<thead>
<tr>
<th>Dependent Variables</th>
<th>Part. 1</th>
<th>Part. 2</th>
<th>Part. 3</th>
<th>Part. 4</th>
<th>Part. 5</th>
<th>Part. 6</th>
<th>Part. 8</th>
<th>Part. 9</th>
</tr>
</thead>
<tbody>
<tr>
<td>% IOA (Range)</td>
<td>NA</td>
<td>99.66</td>
<td>100</td>
<td>89.58</td>
<td>99.30</td>
<td>97.67</td>
<td>100</td>
<td>97.87</td>
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<tr>
<td>Legs (Range)</td>
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<td>(97-100)</td>
<td>(13-100)</td>
<td>(92-100)</td>
<td>(94-100)</td>
<td>(66-100)</td>
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<td></td>
</tr>
<tr>
<td>Feet (Range)</td>
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<td>98.19</td>
<td>95.51</td>
<td>95.55</td>
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<td>(81-100)</td>
<td>(85-100)</td>
<td>(93-100)</td>
<td>(90-100)</td>
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</tr>
</tbody>
</table>

Table 2
IOA Safety-Related Dependent Variables for "Unsafe" Agreements

<table>
<thead>
<tr>
<th>Dependent Variables</th>
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<th>Part. 2</th>
<th>Part. 3</th>
<th>Part. 4</th>
<th>Part. 5</th>
<th>Part. 6</th>
<th>Part. 8</th>
<th>Part. 9</th>
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<tr>
<td>% IOA (Range)</td>
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<td>100</td>
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<td>(85-100)</td>
<td>(97-100)</td>
<td>(84-100)</td>
<td>(97-100)</td>
<td>(96-100)</td>
<td></td>
</tr>
</tbody>
</table>

Time On-Task and Productivity Measure

Inter-observer agreement data were not collected for time on-task and
productivity measures because data were collected automatically through a Visual Basic
Editor macro.
Independent Variable Integrity

Independent variable integrity (IVI) data were collected by an independent observer for 99% of the sessions (i.e., 90 of 91 total sessions) in the treatment phase across all participants. Independent variable integrity data were collected for the 10-min observation period to ensure that the observer did not interact with the participant by smiling, laughing, or talking. Independent variable integrity was calculated by dividing the number of correctly implemented observation periods by the total number of observation periods IVI was conducted on. An observation period was scored as correctly implemented based on the following two categories: 1) Smiling and laughing - the observer did not smile or laugh at the participant, and 2) Talking - the observer did not engage in dialogue with the participant beyond dialogue listed in the observation session script. Independent variable integrity was 100% for all participants for the smiling and laughing category and 100% for all participants for the talking category.

RESULTS

A multiple baseline design across participants was used to evaluate the effects of observer presence and feedback on participants’ body posture behavior, time on-task, and productivity (see Appendix R for single-subject graphs for all participants and behaviors).

Reactivity and Habituation Analysis

In general, reactivity was demonstrated for both groups (i.e., information plus observation group and information, observation, and feedback group), however, habituation was demonstrated less frequently than reactivity for both groups. Across all participants in the information plus observation group (i.e., participants 1, 5, 6, 8), 16
behaviors were exposed to the observer presence during the study. Of those 16 behaviors, 9 demonstrated reactivity and 1 demonstrated habituation when analyzed across sessions. Across all participants in the information, observation, and feedback group (i.e., participants 2, 3, 4, 9), 16 behaviors were exposed to the observer presence during the study. Of those 16 behaviors, 10 demonstrated reactivity and 2 demonstrated habituation when analyzed across sessions. Figure 1 is a graphic representation of the overall percentage of behavior demonstrating reactivity and habituation to the presence of an observer for both observation groups.

![Figure 1. The overall percentage of behavior (i.e., all participants and all behaviors) demonstrating reactivity and habituation.

Across dependent variables, we generally observed reactivity and habituation for the same behaviors for both groups. That is, reactivity to the observer was demonstrated with legs, feet, and on-task behavior in both the information plus observation group and the information, observation, and feedback group, however, reactivity to observer presence was not demonstrated with errors as a percentage of words typed for either group. Furthermore, habituation to the observer was demonstrated with feet for both groups while the information, observation, and feedback group additionally
demonstrated habituation with legs, yet this was only demonstrated for two participants, one participant from each group. Figures 2 and 3 are graphic representations of the effects of observer presence on all participants' behavior dependent variable and participant.

Figure 2. Percentage of behavior demonstrating reactivity and habituation for all participants across dependent variable.

Figure 3. The overall percentage of behavior (i.e., body posture behavior, time on task, and productivity) demonstrating reactivity and habituation across participants.

**Within-Subjects Analysis**

*Body Posture Behavior*

All participants demonstrated reactivity to the observer’s presence in at least one
body posture behavior, however, only two participants demonstrated habituation to the observer’s presence. Each participant’s body posture behavior is graphed separately across sessions for visual analysis. Each data point represents the percentage safe during a 5-min time block with a total of six data points per session (see Appendix R for single-subject graphs for all participants and behaviors).

Legs. All participants (besides participant 6) demonstrated reactivity to observer presence with leg position (range: 16 - 71 mean percentage point increase), whereas, only participant 9 demonstrated habituation to observer presence with leg position. The largest effect of reactivity to observer presence was seen in participant 8, demonstrating a 71 percentage point mean increase over the 5-10min time block. An effect of reactivity and habituation to observer presence is seen with participant 9 demonstrating an overall increase from 51 percentage points in the 5-10min time block to 83 percentage points in the 10-15min time block and then an overall decrease from 83 percentage points to 70 percentage points in the 10-15min time block. Figure 4 is a graphic display of participant 9’s reactivity and habituation to observer presence.

Feet. All participants (besides participant 6) demonstrated reactivity to observer presence with feet position (range: 18 - 49 mean percentage point increase), whereas,
only participants 1 and 9 demonstrated habituation to observer presence with feet position. The largest effect of reactivity to observer presence was seen in participant 1, demonstrating a 49 percentage point mean increase over the 5-10min time block. An effect of reactivity and habituation to observer presence is seen with participant 1 demonstrating an overall increase from 10 percentage points in the 5-10min time block to 59 percentage points in the 10-15min time block and then an overall decrease from 59 percentage points to 44 percentage points in the 5-10min time block. Figure 5 is a graphic display of participant 1’s reactivity and habituation to observer presence.

![Graph of Participant 1's reactivity and habituation to observer presence.](image)

Figure 5. Participant 1’s percentage safe for feet across periods.

*Time On-Task*

Participants 1, 4, 6, 8, and 9 demonstrated reactivity to observer presence with time on-task (range: 15 - 67 mean percentage point increase) while no participants demonstrated habituation to observer presence. The largest effect of reactivity to observer presence was seen in participant 4, demonstrating a 67 percentage point mean increase over the 5-10min time block. Figure 6 is a graphic display of participant 4’s reactivity to observer presence with time on-task.

*Errors as a Percentage of Words Typed*

No participants demonstrated reactivity to observer presence with errors as a
percentage of words typed and therefore, no participants demonstrated habituation to observer presence either.

![Graph](image)

Figure 6. Participant 4’s percentage of time on-task across periods.

Between-Subjects Analysis

Means for body posture behavior, time on-task, and errors as a percentage of words typed during the treatment phase were compared using a 2 (Group) X 3 (Period) analysis of variance (ANOVA). If statistical significance was found between periods for a dependent variable, a Tukey HSD post-hoc test was conducted to evaluate the differences among the 10-min time block means (i.e. 0-10min time block, 10-20min time block, and 20-30min time block). Tables reporting the descriptive statistics and univariate between-subjects ANOVAs of all main and interaction effects for all dependent variables can be found in Appendices S and T, respectively.

Body Posture Behavior

Legs. The mean percentage safe for leg position was compared using a 2 (Group) X 3 (Period) ANOVA. Percentage safe for leg position in the information plus observation group was significantly lower than percentage safe for leg position in the information, observation, and feedback group during the treatment phase, $F(1, 267) = 19.097, p < 0.00$. Additionally, percentage safe for legs was found to be significantly
different between the 10-min time blocks (i.e., 0-10min time block, 10-20min time block, and 20-30min time block), $F(2, 267) = 30.414, p < 0.00$. Lastly, there was not a significant Group X Period interaction, $F(2, 267) = 1.153, p < .317$.

Follow-up tests were conducted to evaluate differences among the period means using a Tukey HSD test. There was a significant difference in the means between the 10-20min time block (when the observer was present), and the 0-10min time block and the 20-30min time block (when the observer was absent) at the .05 level, but no significant difference between the 0-10min time block and the 20-30min time block. A graphic representation of the mean differences for percentage safe for leg position between groups and periods can be seen in Figure 7. The results of the Tukey test are reported in Appendix U.

![Figure 7. Mean differences for percentage safe for leg position between groups and periods.](image)

*Feet.* The mean percentage safe for leg position was compared using a 2 (Group) X 3 (Period) ANOVA. Percentage safe for feet position in the information plus observation phase was significantly lower than percentage safe for feet position in the information, observation, and feedback group during the treatment phase, $F(1, 267) =$
Additionally, percentage safe for feet was found to be significantly different between the 10-min time blocks (i.e., 0-10min time block, 10-20min time block, and 20-30min time block), $F(2, 267) = 42.970, p < 0.00$. Lastly, there was not a significant Group X Period interaction, $F(2, 267) = .685, p < .505$.

Follow-up tests were conducted to evaluate differences among the period means using a Tukey HSD test. There was a significant difference in the means between the 10-20min time block (when the observer was present), and the 0-10min time block and the 20-30min time block (when the observer was absent) at the .05 level. Additionally, there was a significant difference in the means between the 0-10min time block and the 20-30min time block at the .05 level. A graphic representation of the differences in mean percentage safe for feet position between groups and periods can be seen in Figure 8.

\[\text{Figure 8. Mean differences for percentage safe for feet position between groups and periods.}\]

\textit{Time On-Task}

The mean percentage of time on-task was compared using a 2 (Group) X 3 (Period) ANOVA. Percentage of time on-task in the information plus observation phase was not significantly lower than percentage of time on-task in the information,
observation, and feedback group during the treatment phase, \( F(1, 267) = .416, p < .519 \). However, time on-task was found to be significantly different between the 10-min time blocks (i.e., 0-10min time block, 10-20min time block, and 20-30min time block), \( F(2, 267) = 44.185, p < 0.00 \). Lastly, there was not a significant Group X Period interaction, \( F(2, 267) = 2.041, p < .132 \).

Follow-up tests were conducted to evaluate differences among the period means using a Tukey HSD test. There was a significant difference in the means between the 10-20min time block (when the observer was present), and the 0-10min time block and the 20-30min time block (when the observer was absent) at the .05 level. Additionally, there was a significant difference in the means between the 0-10min time block and the 20-30min time block at the .05 level. A graphic representation of the differences in mean percentage safe for leg position between groups and periods can be seen in Figure 9.

![Figure 9. Mean differences for percentage safe for time on-task between groups and periods.](image)

**Errors as a Percentage of Words Typed**

The mean errors as a percentage of words typed were compared using a 2 (Group) X 3 (Period) ANOVA. Errors as a percentage of words typed in the information
plus observation phase was significantly lower than errors as a percentage of words typed in the information, observation, and feedback group during the treatment phase, $F(1, 267) = 7.854, p < 0.005$. Additionally, errors as a percentage of words typed was found to be significantly different between the 10-min time blocks (i.e., 0-10min time block, 10-20min time block, and 20-30min time block), $F(2, 267) = 4.803, p < .009$.

Lastly, there was not a significant Group X Period interaction, $F(2, 267) = .217, p < .805$.

Follow-up tests were conducted to evaluate difference among the period means using a Tukey HSD test. There was a significant difference in the means between the 10-20min time block (when the observer was present), and the 0-10min time block (when the observer was absent) at the .05 level, but no significant difference between 0-10min time block and the 20-30min time block. A graphic representation of the differences in means for errors as a percentage of words typed between groups and periods can be seen in Figure 10.

Figure 10. Mean differences for percentage safe for errors as a percentage of words typed between groups and periods.
DISCUSSION

Key Findings

Reactivity and Habituation Analysis

The purpose of the current study was to examine the effects of observer presence, with and without feedback, on individual's work- and safety-related behavior. Overall, reactivity was demonstrated for both groups (i.e., information plus observation group and information, observation, and feedback group), however, habituation was demonstrated less frequently than reactivity for both groups. That is, the information plus observation group demonstrated reactivity for 56% of behaviors and habituation for 6% of behaviors, whereas the information, observation, and feedback group demonstrated reactivity for 63% of behaviors and habituation for 13% of behaviors. Additionally, the general effect of observer presence on behavior was consistently demonstrated for legs, feet, and on-task behavior for both groups with performance improvement being greatest for feet position with both groups. These findings appear to support previous research demonstrating that participants behave in ways that are not representative of their behavior when an observer is not present. Additionally, the current study has demonstrated that repeated exposure to the presence of an observer does not consistently result in declines in improved performance.

The current study does replicate previous research demonstrating reactivity to the presence of an observer and appears to replicate the inconsistent demonstration of habituation found in Lebbon (2007). Given that there was no difference in the demonstration of habituation between the observation only group and the observation and feedback group, it appears that feedback is not a variable mediating reactive effects during the observation period. More specifically, it appears that the observer did not
function as a discriminative stimulus for the delivery of feedback, otherwise, demonstrations of habituation would have been greater in the observation only group due to the observer not following participant behavior with feedback, thus losing her function as a discriminative stimulus for feedback and exerting less stimulus control over participant behavior. Therefore, while participants in the observation only group did engage in safe body posture and on-task behavior, it appears that the absence of delivering feedback for behaving “appropriately” did not place participant responses on extinction.

**Between-Subjects Analysis**

The current study additionally attempted to examine the differences in both work- and safety-related improvements between the observation only group and the observation and feedback group. Overall, both work- and safety-related behavior was higher for the observation and feedback group compared to the observation only group. Furthermore, the general effect of combining observation and feedback was consistently demonstrated to be higher with legs, feet, on-task behavior, and errors as a percentage of words typed, with the greatest difference of performance improvement being demonstrated with feet and leg position. More specifically, when compared to the observation only group, the observation and feedback group’s feet performance during the treatment phase was 21 percentage points higher for the pre-observation period, 22 percentage points higher for the during-observation period, and 30 percentage points higher for the post-observation period. During the treatment phase for leg position, performance was 7 percentage points higher for the pre-observation period, 23 percentage points higher for the during-observation period, and 22 percentage points higher for the post-observation period.
These findings appear to support previous research (refer to Alvero, Bucklin, and Austin, 2001 for review of feedback’s effectiveness in organizations) demonstrating that the delivery of feedback alone leads to consistent performance improvements.

The current study additionally examined the effect of the observer on work- and safety-related behavior prior to the observation period and after the observation period was terminated. Overall (i.e., for both the observation only group and the feedback group), there was a significant difference in the means between the during-observation period and the pre- and post-observation periods, wherein the greatest difference was seen between the during- and post-observation periods. Additionally, there was a significant difference in the means between periods for legs, feet, time-on-task, and errors as a percentage of words typed with the greatest difference in means seen in legs, feet, and on-task behavior. More specifically, for feet position, there was a mean difference of 29 percentage points in the during-observation period when compared to the pre-observation period and a mean difference of -41 percentage points in the post-observation period when compared to the during-observation period. Furthermore, there was a mean difference of 12 percentage points in the pre-observation period when compared to the post-observation period. For leg position, there was a mean difference of 28 percentage points in the during-observation period when compared to the pre-observation period and a mean difference of -39 percentage points in the post-observation period when compared to the during-observation period. For time on-task, there was a mean difference of 23 percentage points in the during-observation when compared to the pre-observation period and a mean difference of -39 percentage points in the post-observation period when compared to the pre-observation period.
Furthermore, there was a mean difference of 16 percentage points in the pre-observation period when compared to the post-observation period. These findings suggest that while observation does lead to improved performance during the observation period, the improved performance levels do not sustain beyond the observation period and after the observer is no longer present.

Both work- and safety-related behavior were significantly higher when feedback was delivered in conjunction with observer presence, however, the percentage of performance decrements from the during-observation period to the post-observation period was not consistently different between groups. That is, leg position increased 36 percentage points in the during-observation period from the pre-observation period when feedback was delivered compared to only 20 percentage point increase in the observation only group, yet, both groups’ performance declined roughly 40 percentage points from during-observation period to post-observation period (i.e., 39 percentage points for the observation only group and 40 percentage points for the observation and feedback group). Conversely, for both feet and on-task behavior, the percentage point decrease was smaller from the during-observation period to the post-observation period when feedback was delivered during observation. More specifically, for feet position, the percentage point increase from the pre-observation period to the during-observation period was 29 percentage points for both groups yet the percentage point decrease from the during-observation period to the post-observation period was 37 percentage points for the observation and feedback group and 45 percentage points for the observation only group. Similar differences in decrements were seen with time on-task where the percentage point increase from the pre-observation period to the during-observation
period was 27 percentage points for the observation and feedback group and 21 percentage points for the observation only group yet the percentage point decrease from the during-observation period to the post-observation period was 35 percentage points for the observation and feedback group and 45 percentage points for the observation only group. On the whole, performance in the observation and feedback group had smaller decrements than the observation only group with two of the dependent variables (i.e., feet and on-task behavior). These results appear to suggest that feedback alone might help sustain improved performance that is demonstrated when an observer is present and after the observation has been terminated. However, since the sustained improved performance was not great and given that two safety-related behaviors (i.e., legs and feet) differed on the percentage of change from the during-observation period to the post-observation period between the observation and feedback group and the observation only group, it is unclear which variables mediate safety and performance improvements after the observer leaves.

The current study sought to examine the effects of observer presence, with and without feedback, on individuals’ work- and safety-related behavior and found that in general, participants exposed to an observer (with and without feedback) showed improvements in both work- and safety-related behavior yet showed few declines in that performance across time when an observer was present. The current study additionally attempted to examine the differences in work- and safety-related behavior prior to observation and after observation for individuals that did and did not receive feedback on their performance. Overall, individuals that received feedback demonstrated greater performance improvements during the observation period compared to individuals that
did not receive feedback, and additionally, individuals that received feedback demonstrated lower performance decrements after the observation was terminated.

The current study attempted and succeeded in demonstrating the effects of observer presence, with and without feedback, on the work- and safety-related behavior prior to, during, and after observation. Nevertheless, the study contained both strengths and limitations. The strengths of the study include expanding on the perceived limitations of Larson and Callahan (1990) by conducting direct observations on both work- and safety-related behavior, eliminating additional individuals in the room given that most corporate employees work alone in an office or closed cubicle, and delivering feedback according to behavioral definitions by abstaining from including positive and negative evaluative statements in the delivery of feedback. Additional strengths include systematically manipulating observer presence and absence, examining the possibility that the observer functions as a discriminative stimulus for feedback thus possibly decreasing/slowing habituation, examining the effects of the observer on performance prior to and after observation, and utilizing an observer presence duration that was more analogous to real-world applications of direct observation procedures (i.e., behavior-based safety observations).

The primary limitation of the current study is that the effects of observer presence were not examined in an applied setting on a set of dependent variables that were highly significant to the participants. That is, if the study examined the effects of observer presence in an organizational setting where lives were in danger and risk of injury was high, the results may have been different with improved performance sustaining in both the pre-observation and post-observation periods. Furthermore, the observer utilized in
the currently study had no prior history with participants, and thus, results may have been different if the observer was a supervisor or co-worker to the participants wherein a prior history had been established. That is, supervisors and co-workers can serve different functions for some individuals based on their history of reinforcement with that individual and therefore, it is quite possible that performance would have been higher with a supervisor as an observer and it is quite possible that performance would have been lower with a co-worker as an observer. Another limitation involves the small number of participants wherein the effects of observer presence may have been better to examine with a group design. Lastly, it is possible that the short duration of the study (i.e., number of sessions and number of observation periods) is a limitation given that participants might have needed greater exposure to the observer to habituate to the observer’s presence.

General Discussion

Direct observation procedures have been widely used by applied behavior analysts to examine the effects of various interventions, however, recent research examining the effects of the observer’s presence on behavior (e.g., Brackett, Reid, & Green, 2007; Lebbon, 2007) has found that participants behave in ways that are not representative of their previously observed behavior when an observer is not present. Furthermore, recent research has demonstrated that both reactivity and habituation are idiosyncratic and it remains unclear which variables mediate reactive effects with individuals during and after observation procedures. Researchers have discussed the necessity of identifying and measuring reactive effects in order to discover variables (e.g., discriminative stimulus properties) that may mediate reactive effects. Previous
research has discussed the possible role of an observer as a discriminative stimulus and its effects on behavior, however, the concept has mainly been employed as a post-hoc explanation for behavior changes that were not anticipated and has yet to be systematically examined with work and safety-related behavior.

Given that: a) the demonstration of habituation was minimal and did not vary between the observation only group and the observation and feedback group, and that b) improved performance levels declined after the observation procedures were terminated for both groups, it is unclear if feedback is a variable that mediates reactive effects. Therefore, it seems appropriate to examine what might be mediating improved performance levels after the observation period is terminated.

One possible variable mediating reactive effects after the observer leaves is the schedule of observer presence (e.g., a variable interval schedule). More specifically, participants were on the same schedule of observer presence every session and were aware that the observer entered at a specific time, was present observing for a specific time, and was absent for a specific time after the observation terminated. If participants were not aware of the time an observer would enter the room or could not estimate when the observer would be present, then participants may not be able/likely to generate a rule regarding the observer's presence and the possibility of consequences being delivered. For example, in a corporate work environment, it is well known that employees engage in both work-related behavior and non-work-related behavior (e.g., socializing or surfing the internet); it is feasible that employees engage in work-related behavior most when there is the possibility that a manager could walk by their desk, observe their behavior, and deliver a negative consequence. If an employee is not certain when their manager
may walk by, it is possible that there is greater engagement in work-related behavior in order to avoid possible negative consequences. Conversely, if the employee is aware that his/her manager is in a meeting or out of the office that day, it is probable that employees engage in more non-work-related behavior given that the possibility of the manager walking by the desk is improbable, and therefore, the likelihood of receiving negative consequences is remote. Thus, it may be possible that participants in the current study generated rules about the schedule of observer presence and the resulting probability of consequences being delivered; when those rules were reinforced by affirming that the observer would not be present unexpectedly and would not deliver consequences during observation or after observation, behavior that participants engaged in when the observer was absent (e.g., surfing the internet, reading a book, performing unsafely by tucking legs and feet under the chair) was reinforced, resulting in future performance decrements when an observer was absent, regardless if feedback was delivered or not during the observation procedures.

Another possible variable mediating reactive effects after the observer leaves is rule-governed behavior. Rule-governed behavior has been defined by Mawhinney and Ford (1977, p.403 in Malott, 1992) as: “stimuli in the presence of which a [the specified] response is always reinforced [or punished] on some schedule”. Given that the definition of rule-governed behavior entails a contingency wherein the response is reinforced or punished, and given that participants never received reinforcers or punishers during the current study, it appears that rule-governed behavior describing a direct-acting contingency, as it is explained by Mawhinney and Ford, could not have controlled participants’ behavior during the observation or after the observation was
terminated. It is more plausible that participant behavior would sustain after the observation procedure is terminated due to rule-governed behavior describing indirect-acting contingencies.

According to Malott and Trojan (2004) rule-governed behavior describing indirect-acting contingencies involve a contingency being specified to an individual, the individual covertly restates the rule, and the specified behavior comes under the control of that rule. That is, the statement of the rule begins to control the individual's behavior that is specified in that rule. Additionally, when a consequence following the behavior affirms or opposes the rule, the consequences indirectly controls behavior by increasing or decreasing the individual's frequency of following that rule when stated in the future (Malott & Trojan). At the conclusion of the current study, all of the participants were asked a series of questions regarding the effects of the observer on their behavior in an attempt to acquire information on possible rule-governed behavior. Interestingly, most participants communicated that they wanted to type more words or reach a goal they established for a session, however, not one participant communicated that they created a goal for performing safely during the session. Furthermore, a few participants mentioned thoughts around the possibility that the observer would deliver negative consequences (i.e., penalty) and/or had fears of possible critiques for "bad" behavior if they did not perform well. It appears that some participants created a rule (or rules) that if they did not perform safely or have good performance levels, the observer would deliver some form of consequence. Given that the observer never delivered consequences, it would seem that the rules were established based on previous experiences with an observer and previous consequences from an individual watching them.
It should be noted that it is not clear what function feedback served for participants in the currently study. That is, it is possible that the delivery of feedback functioned as a positive reinforcer for some participants wherein it was reinforcing to receive feedback that described the participant’s improving work- and safety-related behavior. Additionally, it is possible that for other participants, feedback served as a negative reinforcer wherein participants improved their work- and safety-related behavior in order to avoid or delay future consequences. Lastly, it is possible that for some participants, feedback functioned as an antecedent prompting work- and safety-related behavior. Regardless, it seems plausible that participants in the current study did create rules around the observer and it does seem possible that consequences brought participants work- and safety-related behavior under the control of the rule(s), resulting in participants avoiding (perceived) consequences and improving participant performance when an observer was present.

In regards to participant behavior after the observer had left the room, it is possible that participants’ self-generated rules functioned as an establishing operation that established failure to comply with those rules as an aversive condition (Malott & Trojan, 2004). Participants did communicated during the debriefing that they wanted to type more words or reach a goal they established for a session because they wanted to perform well and/or impress the observer; it is possible that these established goals functioned as rules, and not following the rule (e.g., playing on the internet, reading a book) produced an aversive condition (e.g., guilt, anxiety, etc.) and working and/or performing safely functioned as an escaped contingency, perhaps reducing any aversiveness (e.g., guilt or anxiety) that was related to not working to meet their
established goals. More specifically, the direct-acting contingency is escaping the aversive condition associated with not following their established goals based on the learned aversive condition that resulted from stating the rule (Malott & Trojan). Therefore, it is possible that this aversive condition acted as a direct-acting contingency controlling the participant’s rule-governed behavior, even when the rules were describing an indirect-acting contingency (Malott & Trojan). It is additionally possible that providing feedback on participants’ performance further reinforced the participants’ establishment of their own goals and rules, which may help explain why performance declined less for individuals in the feedback group after the observation was terminated, even though both groups’ performance did decline. While it appears possible that rule-governed behavior played a role in improving participants’ work- and safety-related behavior, it should be noted that much remains unknown about how rule-governed behavior works. More specifically, rule-governed behavior has been discussed as functioning as discriminative stimuli and as conditioned establishing operations (Galizio, 1992; Malott, 1992 in O’Hora & Maglieri, 2006), however, the criticism of utilizing rule-governed behavior explanations is that they do not clearly explain “how a rule specifies the contingencies that it describes” (O’Hora & Maglieri).

Another variable that should be examined and may help explain what controls performance after the observation is terminated is the likelihood that the observer did not function as a discriminative stimulus \(S^D\) for feedback but instead, functioned as a conditioned establishing operation (CEO). An \(S^D\) is a stimulus condition wherein a response is only reinforced or punished in the presence of a specific stimulus and in the absence of that specific stimulus, the response is not reinforced or punished (Malott &
Trojan, 2004). It appears that the presence of the observer is not an $S^D$ because if there was no observer (S-delta) and the individual moved into a safe position or started working, the individual would still be safe and/or working and thus, would still encounter the reinforcer of working and/or performing safely. Furthermore, in the absence of the observer and in the absence of receiving feedback, when the individual moved into a safe position or started working, the individual would still be safe and/or working and therefore, would still encountered the reinforcer of working and/or performing safely. Likewise, if participants were performing safely and/or working to escape the aversive conditions as stated in their established rules (e.g., typing more and typing to reach a goal so they don’t perform “bad”), reducing any aversiveness would affirm their established rules. Reducing the aversive condition would indirectly control safe behavior and/or working by increasing the individual’s frequency of following that rule when stated in the future, regardless if the observer were present or absent. Given that the presence of the observer was not necessary for participants to encounter the reinforcers or escape (perceived) aversive conditions, it appears that the observer instead functioned as an establishing operation.

According to Michael (1993), an establishing operation (EO) is “an environmental event, operation, or stimulus condition that affects an organism by momentarily altering (a) the reinforcing effectiveness of other events and (b) the frequency of occurrence of that part of the organism’s repertoire relevant to those events as consequences” (pg. 193). If the reinforcing effectiveness is altered, in some part, by the individual’s history then the relation between the EO and reinforcer is said to be learned and thus, is referred to as a CEO. That is, the sight of the observer is a CEO, a
stimulus that increases the reinforcing effectiveness of performing safely and/or working (Malott & Trojan, 2004). In the absence of the sight of the observer, performing safely and/or working would not be as reinforcing. If performing safely and/or working harder were more reinforcing in the presence of the observer, it would help explain why performance declined for both groups when the observation period was terminated and the observer left the room.

It may also be possible that the observer was nothing more than a CEO for safe and working behavior regardless if feedback was delivered or not. That is, the observer could have functioned as a CEO for safe and working behavior based solely on the individual’s previous interactions with an observer, based solely on an equivalence class to which experimenters and observers belong and one that was coordinated with delivery of consequences. Additionally, it is possible that the absence of the CEO (i.e., the observer) provided an opportunity to engage in behavior that was more reinforcing for individuals (e.g., relaxing and performing unsafely, taking breaks, etc.), if performing safely and/or working was less reinforcing in the absence of the CEO. For example, when participants were asked what they thought or felt when the observer was watching them, the overwhelming response by participants was that they felt nervous, wanted to work harder, wanted to impress the observer, and had fears of possible critiques for “bad” behavior. Additionally, when participants were asked why their behavior decreased after the observation was over and what they thought when the observer left the room, most participants communicated that they felt relieved and/or exhausted, they could make themselves more comfortable, and could now take a break; these responses
appear to signal that performing safely and/or working was not as reinforcing in the absence of the CEO.

Therefore, it is quite possible that the observer was a CEO for safe and working behavior (regardless if feedback was or was not delivered) and that the absence of the CEO led to participants engaging in other behavior that was more reinforcing than safe and working behavior. It is feasible that this helps explain why performance dropped for both groups after the observation was terminated and may add to the speculation that feedback played a role in the feedback only group demonstrating smaller performance decrements after the observation was terminated. That is, it may be that the delivery of feedback on participants' performance further reinforced participants establishing their own goals/rules, these rules then functioned as an EO that established noncompliance with the rule (e.g., playing on the internet, reading a book) as an aversive condition (e.g., guilt, anxiety, etc.), and working and/or performing safely functioned as an escape contingency and therefore, other “off-task” behavior would not be as reinforcing in the absence of the CEO as it may for the observation only group.

This analysis suggests that the most valuable route applied behavior analysts interested in examining the effects of observer presence on individuals' work- and safety-related behavior prior to, during, and after observation can take is to examine the following: 1) the effects of a variable schedule of observer presence; 2) how the context of a work environment is changed by perceived risks of consequences from the observer, that is, is it possible to manipulate the observer functioning as a CEO-Surrogate thus, changing the function of the work environment when the observer is no longer present; 3) the role of rule-governed behavior during and after observation periods; and 4) the
possibility that the observer functions as a CEO for safe and working behavior, and attempt to examine how the observer may function as a reflexive CEO (a CEO-R) wherein the observer functions as an aversive stimulus and individuals work harder and/or perform more safely to escape the aversive observation procedures (Rohn, 2004).

Conclusion

This study represents an initial step towards systematically demonstrating the effects of repeated observer presence on work- and safety-related behavior and the effects of attempting to establish the observer as a discriminative stimulus for feedback. The current study suggests that while individuals consistently demonstrate reactivity to an observer’s presence, they do not consistently demonstrate habituation to that observer’s presence. Furthermore, the current study appears to suggest that feedback is not a variable that mediates reactive effects when an observer is present given that a difference in habituation was not observed between groups. However, these results appear to suggest that feedback alone might help sustain improved performance that is demonstrated when an observer is present and after the observation has been terminated. Additionally, this study represents the beginning step toward systematically examining the effects of observer presence on individuals’ work- and safety-related behavior prior to an observation and after the observation has been terminated. The current study appears to provide insight into the difficulty with sustaining improved performance (that is demonstrated during an observation) after the observation has terminated and an observer is no longer present.

Future researchers interested in expanding the literature on reactivity and habituation may find it beneficial to examine different schedules of observer present on
individuals' work- and safety-related behavior. That is, it is possible that individuals will be more likely to habituate to an observer's presence when the schedule of observing is multiple times within a session for short durations. In addition, it may be possible for individuals' improved performance to sustain at greater levels after the observation has terminated when the observations are on a variable schedule. Lastly, it is feasible that the schedule of observer presence is not the important variable for sustaining improved performance after observation has terminated but the delivery of feedback along with consequences (i.e., praise and punishment) is the key variable for sustaining improved performance after observation has terminated.

The results from this study imply that direct observations are beneficial in improving both work- and safety-related behavior, however, those improvements do not sustain beyond the observation procedures. Furthermore, the results from this study appear to suggest that habituation is not easy to demonstrate and therefore, researchers should not presume that individuals' reactive effects will dissipate after repeated exposure to the observation procedures and eliminate measurement bias.
REFERENCES


thesis, Western Michigan University, Kalamazoo, Michigan, USA.


Appendix A

Participant Recruitment Script
"Hi, my name is Angie Lebbon and I am a graduate student in the Psychology Department. I am getting ready to start a research study, which will be my Doctoral dissertation. I am here today to recruit participants for my study.

Participation will involve engaging in a simple computer-typing task. A computer typing session will last approximately 30 mins and I need students to participate in approximately 10-25 computer-typing sessions over a three to eight week period. You may schedule one typing session per day or at most three sessions per day and will be given the opportunity to take breaks during the session if need be. If you chose to participate in my study, you will receive extra credit (if your professor offers this) and $7.00 per hour. Extra credit will consist of receiving one extra credit point per hour of participation; the total number extra points allowed will be established by the faculty instructor of this course.

If you are interested in learning more about my study, please provide your contact information on the participant recruitment form. You can also contact me at angela.lebbon@wmich.edu or 352-4275. Please remember that you must be available during the semester. I will contact you within a week to talk more about your possible participation. Thank you for your time."
Appendix B

Participant Recruitment Form
PARTICIPANT RECRUITMENT FORM

Name: ____________________________________________

Email address: ____________________________________

Phone number(s): ____________________________________

Availability: 
Please write the times you are available each day. 
For example, under Monday, one could write 10am-11am and 2:30pm-4:00pm.

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Appendix C

Consent Process Script
CONSENT PROCESS SCRIPT

The student investigator or the research assistant will read aloud the below paragraph.

"Before you begin participating in my study, I need you to read a consent form. First, I will read the consent form aloud to you and then will give you the consent form to read yourself. If you have any questions regarding the information provided, please ask. After you read the consent form, you may choose to either sign the consent form and decline to sign the consent form. You will not be penalized in any manner if you chose not to sign the consent form."

The lead research or the research assistant will now hand both copies of the consent form to the participant and read the consent form aloud to them.

"Now that you have read the consent form, do you have any questions for me? Please sign the consent form, which I will keep for my records and keep the other copy for your records."
Appendix D

Consent Form
Examining Computer Work Tasks That May Lead To Body Discomfort

John Austin (PI) and Angela Lebbon (SI)
Western Michigan University

PURPOSE: The current study is interested in examining the effects of computer work tasks that may lead to body discomfort for individuals. You have been invited to participate in the current study to help us determine how duration spent on a computer work task affects body discomfort for individuals.

DURATION: The current study is asking you to participate in approximately 10-25 35-min sessions over a period of three to eight weeks. You may schedule one typing session per day or at most three sessions per day and will be given the opportunity to take breaks during the session if need be. You may schedule sessions any day and time from Monday through Sunday. No sessions will exceed 35-mins.

EXPLANATION OF STUDY PROCEDURES: The current study is asking you to engage in a simple computer-typing task that will simulate the type of work a person typically performs in an office setting. You will perform the computer-typing task in a simulated office setting in the Performance Management laboratory located in Wood Hall. The task will involve you typing an article into a Word document file while sitting at a computer workstation.

COMPENSATION: For your participation in the study, you will receive (1) extra credit points (if your professor offers this) which will consist of one extra credit point per one hour of participation; the total number extra points allowed will be established by the faculty instructor of the course you were recruited from and (2) $7.00 per hour of participation in this study. If you choose to withdraw from the study, you will not be penalized in any manner. That is, you will still receive your extra credit points and money earned for your participation. Remember that your course provides other means of receiving extra credit and that participating in this study does not prevent you from seeking those options.

BENEFITS: Your participation in this study will not result in any direct benefits to you, however you may be able to perform computer-typing tasks more effectively and/or efficiently. Data received as a result of your participation may be beneficial to the scientific community by providing information on how duration spent on a computer work task affects body discomfort for individuals.

RISKS AND PROTECTIONS: The computer-typing task you are asked to perform is a task that requires little physical energy and thus, you will most likely not be exposed to any risks greater than what your everyday activities present to you. During the course of a computer-typing session, you may experience minor fatigue. To reduce the possibility of experiencing fatigue, you are allowed and encouraged to take a break during the session when you experience any body discomfort and/or fatigue.
However, in all research, participants may encounter risks that were unforeseen by the researchers. If you do experience an accidental injury, appropriate emergency action will be sought. You will not receive any monetary compensation or additional treatment except the stated treatment mentioned above.

CONFIDENTIALITY: During the course of the study, all information received from you and about your performance will be kept confidential. That is, any data collected about/from you that appears in manuscript publications or presentations will not contain your name or other identifying information. To conceal your identity, a code number will be assigned to your performance data when it is electronically entered and analyzed and additionally, will be used in manuscript publications and presentations.

All forms containing information that identifies you will be retained by Angela Lebbon during the study and entered into an electronic database with a code number assigned that that information. Angela Lebbon will keep an electronic master list with names of participants with their assigned code numbers. After all participants’ performance data have been analyzed, this electronic master list will be destroyed. All data collected during the course of this study will be locked in a cabinet Dr. John Austin’s office for at least three years.

If you have any concerns regarding your information or performance data, Angela Lebbon and Dr. John Austin will personally meet with you to discuss your concerns and answer questions.

VOLUNTARY PARTICIPATION: Your participation in this study is completely voluntary. Any time during the course of this study, you are free to withdraw without penalty and you will receive extra credit or monetary payment for the time you did participate. Additionally, withdrawing from the current study will not affect your grades in any courses. At the conclusion of this study, Angela Lebbon will answer any questions you have regarding the study and will explain how your performance data has been beneficial to the scientific community.

WHO TO CONTACT IF YOU HAVE QUESTIONS: If you have any questions regarding the current study, you may contact Angela Lebbon at 352-4275 or my faculty advisor, Dr. John Austin at 387-4495. Additionally, if you encounter any questions or problems during the course of this study, you may contact the Chair of the Human Subjects Institutional Review Board at 387-8293 or the Vice President for Research at 387-8298.

Sign your name on the line below to indicate that you have read the above information and agree to participate in the current study.

Participant Signature          Date

Please keep the attached copy of this form for your records

This consent document has been approved for the use for one year by the Human Subjects Institutional Review Board (HSIRB) as indicated by the stamped date and signature of the board chair in the upper right hand corner. Subjects should not sign this document if the corner does not show a stamped date and signature.

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Appendix E

Hidden Camera Data Use Consent Script
The student investigator or the research assistant will read aloud the below paragraph.

"Before we can use your postural behavior data, we are required to ask for your consent to allow use of the data collected from the hidden camera. I need you to read a consent form. First, I will read the consent form aloud to you and then will give you the consent form to read yourself. If you have any questions regarding the information provided, please ask. After you read the consent form, you may choose to either sign the consent form and decline to sign the consent form. You will not be penalized in any manner if you chose not to sign the consent form."

The lead research or the research assistant will now hand the consent form to the participant and read the consent form aloud to them.

"Now that you have read the consent form, do you have any questions for me?"

Answer any questions the participant has

"Please sign the consent form, which I will keep for my records and keep the other copy for your records."
Appendix F

Hidden Camera Data Use Consent Form
Thank you for participating in the current study. Before we can use your postural behavior data, we are required to ask for your consent to allow use of the data collected from the hidden camera. We assure you that all information received from you and about your performance from the hidden camera during the course of the study will be kept confidential. That is, any data collected about you from the hidden camera that appears in manuscript publications or presentations will not contain your name or other identifying information. To conceal your identity, a code number will be assigned to your performance data when it is electronically entered and analyzed. Furthermore, all DVDs used to record your performance from the hidden camera will be assigned a code number and your DVDs will not be used for public presentation at any time. Lastly, a code number will be used in manuscript publications and presentations when discussing your data.

**WHO TO CONTACT IF YOU HAVE QUESTIONS:** If you have any questions regarding the current study or any concerns regarding your information or hidden camera performance data, you may contact Angela Lebbon at 352-4275 or my faculty advisor, Dr. John Austin at 387-4495. Additionally, you may contact the Chair of the Human Subjects Institutional Review Board at 387-8293 or the Vice President for Research at 387-8298.

Sign your name on the line below to indicate that you have read the above information and agree to allow us to use your data collected from the hidden camera. You will not be penalized in any manner if you chose not to sign the consent form.

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<th>Participant Signature</th>
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*Please keep the attached copy of this form for your records*

*This consent document has been approved for the use for one year by the Human Subjects Institutional Review Board (HSIRB) as indicated by the stamped date and signature of the board chair in the upper right hand corner. Subjects should not sign this document if the corner does not show a stamped date and signature.*
Appendix G

Human Subjects Institutional Review Board Approval Letter
Appendix H

Body Discomfort Survey
**BODY DISCOMFORT SURVEY**

**PURPOSE:** To determine the level of body pain or discomfort you are experiencing.

First and Last Name: ___________________________ Date: __________

Have you ever suffered a repetitive stress injury? YES NO

**INSTRUCTIONS:** Answer each body discomfort section

For this section, rate (circle) your overall discomfort level.

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Shade the area where you feel discomfort. Shade dark for more pain and shade light for less pain.
Appendix I

Sample Computer-Typing Article
Here in their new home there is nothing—not a drop of honey nor a single landmark in
the shape of a piece of wax. The bee has no data and no starting-point; he has nothing but
the desolate nakedness of the walls and the roof of an immense building. The walls are
round and smooth, but all is dark within.... The bee does not understand useless regrets,
or if he does, he does not encumber himself with them. Far from being discouraged by
the conditions which now confront him, he is more determined than ever. The hive is no
sooner set up in its proper place than the disorder of the crowd begins to diminish, and
one sees in the swarming multitude clear and definite divisions which take shape in a
most unexpected manner. The larger part of the bees, acting precisely like an army which
is obeying the definite orders of its officer, at once begins to form thick columns along
the whole length of the vertical partitions of the hive. The first to arrive at the top hang
on to the arch by the claws of their hind legs, those who come after attach themselves to
the first, and so on till long chains are formed which serve as bridges for the ever
mounting crowd to pass over. Little by little these chains are multiplied with indefinite
re-enforcements and interlace each other become garlands, which, owing to the
enormous and uninterrupted mounting of the bees upon them, are transformed into a
thick triangular curtain, or rather into a sort of compact reversed cone, the point of which
is attached to the top of the hive; the base of which is about two-thirds of the total height
of the hive. Then the last bee, which would appear to be summoned by some interior
voice to join this group, mounts this curtain, which is hung in the darkness, and little by
little every movement among the vast crowd ceases, and this strange reversed cone
remains for many hours in a silence which in such a mass of life is almost startling,
waiting for the arrival of the mystery of the wax.

While this is going on, without taking any notice of the wonderful curtain from out of
whose folds so magic a gift will come, without even appearing to be tempted to attach
themselves to it, the rest of the bees, that is all those who are on the floor of the hive,
begin to examine the building and to undertake the work which is necessary to be done.
The floor is carefully swept, dead leaves, twigs, grains of sand are transferred to a
considerable distance one by one, for bees have an absolute mania for cleanliness; so
much is this the case that in the winter, when the extremely cold weather prevents them
from taking what bee lovers know as their flight of cleanliness, rather than soil the
interior of the hive they perish in enormous numbers, victims of a disease of the stomach.

After this cleaning up is done these same bees set themselves to work to carefully close
up every opening which is round about the lower part of the hive. Finally when every
crack has been carefully looked over, filled up and covered with propolis, they begin to
varnish the whole of the interior sides. By this time guardians are placed at the entrance
of the hive, and very soon a number of the working bees start on their first trip to the
fields and begin to come back laden with nectar and pollen....
Let us now lift up, so far as we may, one of the folds of this garlanded curtain in the midst of which the swarm is beginning to produce that strange exudation which is almost as white as snow, and is lighter than the down on a bird's breast. The wax which is now being made does not resemble at all that with which we are acquainted. It is colorless, and may be said to be imponderable. It is the very soul of the honey, which in its turn is the very spirit of the flowers, evolved by the bees in a species of silent and motionless incantation.

It is very difficult to follow the various phases of the secretion and of the manner in which the wax is evolved by the swarm which is just beginning to build. The operation takes place in the midst of a dense crowd which becomes constantly more and more dense, thus producing a temperature favorable to the exudation of the wax in its first stage.

Huber, who was the first to study these operations with marvelous patience, and sometimes not without personal danger, has written more than fifty pages on the subject, but they are very confused. For myself, as I am not writing a scientific book, I shall confine myself to describing what anybody can see if he will watch the movements of a swarm in a glass hive. At the same time I shall not fail to avail myself of Huber's studies whenever they may prove to be of service. We must admit at the very outset that the process by which the honey is transformed into wax in the bodies of this mysterious curtain of bees is still hidden in mystery. All that we know is that after about eighteen or twenty-four hours in a temperature so high that one might almost imagine there was a fire in the hive, small, white, transparent scales appear at the opening of the four little pockets which are to be found on each side of the abdomen of the bee. When the larger part of those who form the reversed cone have their abdomens decorated with these little ivory plates, one of them may be seen, as if under the influence of a sudden inspiration, to detach itself from the crowd and climb over the backs of its passive brethren until it reaches the apex of the cupola of the hive; attaching herself firmly to the top, she immediately sets to work to brush away those of her neighbors who may interfere with her movements. Then she seizes with her mouth one of the eight scales on the side of her abdomen and chews it, clips it, draws it out, steeps it in saliva, kneads it, crushes it, and makes it again into shape as dexterously as a carpenter would handle a piece of veneering. Then when the substance has been treated so as to bring it to the desired size and to the desired consistency, it is affixed to the very summit of the interior of the dome, and thus the first stone is laid of the new city, or rather the key-stone of the new city is placed in the arch, for we are considering a city turned upside down, which descends from the sky and which does not arise from the bosom of the earth as do terrestrial cities. Then she proceeds to apply to this key-stone more of the wax which she takes from her body, and having given to the whole of her part of the work one last finishing stroke, she retires as quickly as she came and is lost in the crowd; another replaces her and immediately takes up the work where she has left it off, adds her own to it, puts that right which appears to her to be not in conformity with the general plan, and disappears in her turn, while a third and a fourth and a fifth succeed her in a series of sudden and inspired apparitions, not one of whom finishes a piece of work, but all bring to it their common share.
Now there hangs from the top of the vault a small block of wax which is yet without form. As soon as it appears to be thick enough there comes out of the group another bee bearing an entirely different aspect from that of those which have preceded it. One may well believe on seeing the certainty, the determination, with which he goes about his work and the manner in which those who stand round about him look on, that he is an expert engineer who has come to construct in space the place which the first cell shall occupy, the cell from which must mathematically depend everything which is afterwards constructed. Whatever he may be, this bee belongs to a class of the sculpturing, of chisel working bees who produce no wax and whose function seems to be to employ the materials with which the others furnish them. This bee then chooses the place of the first cell. She digs for a moment in the block of wax which has already been placed in position, and builds up the side of the cell with the wax that she picks from the cavity. Then in exactly the same way as her predecessors have done, she suddenly leaves the work she has designed; another impatient worker replaces her and carries it on another step, which is finished by a third one. In the meantime others are working round about her according to the same method of division of labor until the outer sides of each wall is finished.

It would almost seem that an essential law of the hive was that every worker should take a pride in its work, and that all the work should be done in common, and so to speak, unanimously, in order that the fraternal spirit should not be disturbed by a sense of jealousy.

Very soon the outline of the comb may be seen. In form it is still lenticular, for the little prismatic tubes of which it is composed are unequally prolonged, and they diminish as they get away from the centre towards the extremities. At this moment it might be compared, both in form and in thickness, to a human tongue hanging down from two of the sides of the hexagonal cells which are placed back to back.

As soon as the first cells are constructed, the workers add a roof to the second and so on to the third and to the fourth. These sets of cells are divided by irregular intervals, and they are calculated in such a manner that when they are made to receive their full complement, the bees always have room enough to move about between the parallel walls of the honeycombs.

It follows then that in making their original plan the different thicknesses of every honeycomb must be fixed upon, and at the same time the alley-ways which separate each must be different in turn, and this width must be twice the height of a bee since they have to pass each other between the upright combs.

But even the bees are not infallible, and they do not always work with exact mechanical certainty. When they find themselves in a difficult place they sometimes make very great blunders. One often finds that they leave too much, and often too little, space between the honeycombs, and they remedy these faults as well as they can—sometimes in finishing the comb which is too near another in an oblique line, or sometimes when they have left too much space they interpose a smaller comb between it.
Reamer, on this subject, says: Since bees sometimes make mistakes and rectify them, this must be a proof that they possess the power of reason.

It is known that bees make four different kinds of cells. There are first the royal cells which are exceptional and are of acorn shape. Then there are the large cells in which the male bees are reared, and in which provisions are stored when the flowers furnish forth of their abundance. Then there are the little cells which may be called the cradles of the working bees, which are also employed as ordinary store-rooms. These generally occupy about eight-tenth’s of the total surface of the combs in a hive; and finally there are a certain number of what may be called transition cells. Although these latter are inevitably irregular, the dimensions of the second or third type are so well calculated that when the decimal system was first established, and people were seeking an incontestable standard of measurement, it was the cell of the bee which was proposed first of all by Reamer. Each one of these cells is an hexagonal tube placed upon a pyramid form, and each honeycomb is formed of two strata of these tubes, base to base, in such a way that the three lozenges which make the pyramid-like base of one cell form at the same time the pyramid-like bases of the three cells on the other side.

In these prismatic tubes the honey is stored away—and so that the honey shall not trickle out as it would be likely to do if they were built strictly horizontal—they are tilted up at the outer edge of an angle of four or five degrees.

Besides the saving in wax, says Reamer, speaking of this marvelous building, which is effected by this arrangement of the cells,—besides the fact that by this plan the comb may be filled without a single gap, there are other advantages in the way of the solidity thus given.... Every possible advantage in the way of the solidity of each cell is brought about by the manner of its construction, and by its place with reference to the rest of the cells in the comb.

Students of geometry know, says Dr. Reid, that there are only three shapes that can be employed to divide a surface into, uniform spaces, that shall be regular in shape, and without interstices.

They are the equilateral triangle, the square, and the regular hexagon, which latter, in the matter of cell construction, is superior to the two first both from the point of view of strength and utility, and it is just this form that the bees have adopted, precisely as though its advantages were familiar to them.

Furthermore, the bottoms of the cells form three planes meeting at one point, and it has been demonstrated that both in economy of labor and material this system of construction is the best—again, the angle of the inclination of the planes affects this question of economy: this problem has been solved by the bees and confirmed by Maclaurin by astruse mathematical calculations published in the Transactions of the Royal Society of London.
Of course I do not suppose for a moment that the bees themselves have made these calculations, but on the other hand I do not believe that chance, or accidental circumstance has brought about, these results. The wasps, for instance, have built hexagonal cells, but they have not displayed such ingenuity as the bees have done. Their combs have only one course of cells, and they have not the foundation which serves the bees for their double rows. Hence there is less strength, more irregularity, and a loss of time, of material, and of room, which really means that a quarter of the labor employed and a third of the space occupied is lost. We also find certain other domesticated bees, not so far progressed in civilization, which only build one row of cells for rearing their young, and which support horizontal combs one above another on costly columns of wax. Their food store-cells, are like a row of round pots, and the bees make but a clumsy use of the spaces between them. Indeed, when we compare their City with the Wonderful City of the bees of which we are speaking, it is like comparing a row of huts with a modern laid out city. If the result is not charming, it is severely logical, and demonstrates the genius of the race which is forever fighting to get the most out of matter, space, and time.

Buffon had a theory which has been revived once more, that the bees did not intend to make hexagonal cells, but rather round ones, and that owing to the crowding of the workers all around, the round ones became hexagonal. It is said also that crystals, fish-scales of certain kinds, soap-bubbles, etc., follow the same law, and Buffon advances this experiment to prove it. Take a vessel and fill it full with peas or any other round grains, pour as much water upon them as will fill the spaces between them, close the vessel tightly, and boil the water. It will be found that the round peas have become six-sided. One sees clearly that this must be so from purely mechanical causes; each one of the round grains tends in the course of swelling as it boils to fill up the utmost space that it can, and by the extension and pressure of all alike they become hexagonal. Each bee wishes to occupy as much room as possible in its allotted space, therefore as the bodies of the bees are round or cylindrical, their cells become hexagonal because of the extension and pressure of all alike.

Here then we see reciprocal obstacles working a wonder, somewhat in the same way perhaps as the vices of men bring about a general virtue, so that the race odious, often so far as individuals are concerned, is tolerable in the mass. Broughman, Kirby, and Spence and others claim that the observations of soap-bubbles and peas prove nothing in this connection, for the effect of compression is only to produce irregular hexagonal forms, and does not explain the earlier form of the base of the cells.

To this one might rejoin that there are more ways than one of dealing with the blind law of necessity, for the wasp and the bumble-bee and many other species in similar circumstances and with the same end in view, arrive at very different, and manifestly inferior, results. Indeed it might be said further that even if the bee-cells did conform to the laws of crystallization as in the case of snow, or Buffon's soap-bubbles, or boiled peas, they show also in their general symmetry, in their well-determined angle of inclination, etc., that there are many other laws not followed by inert matter to which they also conform.
In order to assure myself that the hexagonal form of the cell was the outcome of the bee-brain, I cut out from the centre of a honey-comb a round piece not quite so large as a silver dollar, containing both brood-cells and honey-cells. I cut into this disc, at the point where the pyramidal bases of the cells were joined, and I fixed on the base of the section thus exposed a piece of tin of the same size, and so stout that the bees could not bend or twist it. Then I replaced the disc of comb, with the piece of tin as described. One side of the comb showed, of course, nothing extraordinary, but on the other side was to be seen a hole at the bottom of which was a round piece of tin occupying the place of about thirty cells. At first the bees were disconcerted, and came in crowds to examine and study this wonderful abyss; for some days they wandered about it in agitation without coming to any decision. But as I fed them well every evening, the time soon came when they needed more cells in which to store their provisions. Then most likely the famous engineers, the sculptors, and the waxmakers, were summoned to show the way to fill up this useless chasm.

A heavy curtain, or garland, of the wax-making bees covered the spot so as to develop the necessary heat; others went down into the hole and began the work of solidly fixing the metal in place by means of little claws of wax around its entire circumference, attaching them to the walls of the cells which surrounded it. Then they set to work to make three or four cells in the upper part of the disc, attaching them to these waxen claws. Each of these new cells was more or less unfinished at the top, so as to leave material wherewith to fasten it to the next cell, but below on the piece of tin was always three very clear, and precise angles from which would grow the three upright lines which regularly marked the outline of the first half of the next cell. After about forty-eight hours, although three or four bees at most could work at the same time in the opening, the whole surface of the piece of tin was covered with the outlines of the new cells. They were certainly somewhat less regular than those in an ordinary comb. But they were all perfectly hexagonal; not a line was bent, not an angle out of shape; nevertheless all the ordinary conditions of bee-life were changed. The cells were not dug out of a block of wax as Huber described, nor were they made according to Darwin, circular at first, and then made into hexagons by the pressure of their neighbors. Here was no question of reciprocal obstacles, seeing that the cells were made one by one, and these first outlines were sketched on a kind of table. It would appear therefore that the hexagonal form is not the result of any mechanical necessity, but that it forms the plan resulting from the experience, the intelligence, and the will of the bee. Another curious thing which I accidentally noticed was that the cells built upon the tin were not provided with any other floor than the tin itself. The engineers of the working party evidently reasoned that the tin was sufficient to retain the liquid honey, and that it was not necessary, therefore, to line it with wax. But a little while after, when some honey was placed in the cell, they probably found that the metal effected some change in it, for upon taking counsel together they covered the surface of the tin with a kind of diaphanous varnish.

If we wish to throw light on all the secrets of this geometrical architecture, we shall find many more interesting questions to examine—for example, that of the form of the first cells, which are attached to the roof of the hive—a form which is modified so that the cells can fit its curve and touch the roof at the greatest possible number of points.
It would be necessary to notice also, not only the direction in which the main streets of the hive run, but the alley-ways and passages which run in and out and around the comb, as much for the circulation of the air as for the traffic; and it should be remarked that these are planned so as to avoid long detours or confusion in the traffic.

Before we leave this subject let us, only for a minute, stop to consider the wonderful and mysterious way in which the bees make their plans and work together when they are occupied in carving out their cells, on both sides of the comb, where neither can see the other. Look through one of these transparent combs, and you will see clearly and sharply cut out in this diaphanous wax a network of prisms arranged in so perfectly fitting a manner that one might think they were stamped out of steel.

Those who have never seen the inside of a hive can have little idea of the appearance of these honeycombs. Let us take a countryman’s hive in which the bee has been left free to work as he pleases. This bell-like shape is divided from top to bottom by five, six, eight, and sometimes ten, slices of wax, so to speak, perfectly parallel with each other, which take the exact shape of the curve of the walls of the hive. Between each one of these slices is a space of about half an inch in which the bees move about. When they begin to build one of these slices at the top of the hive, the wall of wax is quite thick, and hides entirely the fifty or sixty bees who are working on one side from the fifty or sixty at work on the other. Unless they have a sight which can pierce the most opaque bodies, neither can see what is doing on the other side. Nevertheless, a bee on one side does not dig a hole or add a fragment of wax which does not correspond exactly with a protuberance or a cavity on the other side. How do they contrive to do this? How does it happen that one does not dig too far, and the other not far enough?

How is it that every angle coincides in such magnificent perfection? Who tells the bee to begin here and to end there? Once again we must be satisfied with the reply that does not answer: It is one of the mysteries of the hive. Huber has tried to explain it by saying that at certain intervals, by the pressure of their feet or their teeth, they produce a slight projection of the wax on the other side of the comb, or that they can determine the thickness of the block of wax by its flexibility, its elasticity, or some other physical property which it may possess; or, again, that their antenna are able to serve as compasses in enabling them to examine what is going on in the darkness of the other side; or, last of all, he suggests that all the cells mathematically derive their shape and dimensions from those of the first row, which is built without the need of further concert on the part of the workers. But one can easily see that these explanations are not sufficient; the first are guesses which cannot be verified; the others simply change but do not remove the mystery. But if it is good to change a mystery as often as possible, it is never good to flatter one’s self that to change it means to remove it!

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WASPS by THOMAS G. BELT

I one day saw a small black and yellow banded wasp hunting for spiders; it approached a web where a spider was stationed in the centre, made a dart towards it—apparently a
feint to frighten the spider clear of its web; at any rate it had that effect, for it fell to the ground, and was immediately seized by the wasp, who stung it, then ran quickly backwards, dragging the spider after it, up a branch reaching to the ground until it got high enough, when it flew heavily off with it. It was so small, and the spider so heavy, that it probably could not have raised it from the ground by flight. All over the world there are wasps that store their nests with the bodies of spiders for their young to feed on. In Australia, I often witnessed a wasp combating with a large flat spider that is found on the bark of trees. It would fall to the ground, and lie on its back, so as to be able to grapple with its opponent; but the wasp was always the victor in the encounters I saw, although it was not always allowed to carry off its prey in peace. One day, sitting on the sandbanks on the coast of Hobson’s Bay, I saw one dragging along a large spider. Three or four inches above it hovered two minute flies, keeping a little behind, and advancing with it. The wasp seemed much disturbed by the presence of the tiny flies, and twice left its prey to fly up towards them, but they darted away with it. As soon as the wasp returned to the spider, there they were hovering over and following it again. At last, unable to drive away its small tormentors, the wasp reached its burrow and took down the spider, and the two flies stationed themselves one on each side the entrance, and would, doubtless, when the wasp went away to seek another victim, descend and lay their own eggs in the nest.

The variety of wasps, as of all other insects, was very great around Santo Domingo. Many made papery nests, hanging from the undersides of large leaves. Others hung their open cells underneath verandahs and eaves of houses. One large black one was particularly abundant about houses, and many people got stung by them. They also built their pendent nests in the orange and lime trees, and it is not always safe to gather the fruit. Fortunately they are heavy flyers, and can often be struck down or evaded in their attacks. They do good where there are gardens, as they feed their young on caterpillars, and are continually hunting for them. Another species, banded brown and yellow, has similar habits but is not so common. Bates, in his account of the habits of the sand-wasps at Santarem, on the Amazon, gives an interesting account of the way in which they took a few turns in the air around the hole they had made in the sand before leaving to seek for flies in the forest, apparently to mark well the position of the burrow, so that on their return they might find it without difficulty. He remarks that this precaution would be said to be instinctive, but that the instinct is no mysterious and unintelligible agent, but a mental process in each individual differing from the same in man only by its unerring certainty. I had an opportunity of confirming his account of the proceedings of wasps when quitting a locality to which they wished to return, in all but their unerring certainty. I could not help noting how similar they were to the way in which a man would act who wished to return to some spot not easily found out, and with which he was not previously acquainted. A specimen was hunting about for caterpillars in my garden. I found one about an inch long, and held it out towards it on the point of a stick. It seized it immediately, and commenced biting it from head to tail, soon reducing the soft body to a mass of pulp. It rolled up about one-half of it into a ball, and prepared to carry it off. Being at the time amidst a thick mass of a fine-leaved climbing plant, before flying away, he took note of the place where it was leaving the other half. To do this, it hovered in front of it for a few seconds, then took small circles in front of it, then larger ones.
round the whole plant. I thought it had gone, but it returned again, and had another look at the opening in the dense foliage down which the other half of the caterpillar lay. It then flew away, but must have left its burden for distribution with its comrades at the nest, for it returned in less than two minutes, and making one circle around the bush, descended to the opening, alighted on a leaf, and ran inside. The green remnant of the caterpillar was lying on another leaf inside, but not connected with the one on which the wasp alighted, so that in running in it missed it, and soon got hopelessly lost in the thick foliage. Coming out again, it took another circle, and pounced down on the same spot again, as soon as it came opposite to it. Three small seed-pods, which here grew close together, formed the marks that I had myself taken to note the place, and these the wasp seemed also to have taken as its guide, for it flew directly down to them, and ran inside; but the small leaf on which the fragment of caterpillar lay, not being directly connected with the outside, it again missed it, and again got far away from the object of its search. It then flew out again, and the same process was repeated again and again. Always when in circling round it came in sight of the seed-pods down it pounced, alighted near them, and recommenced its quest on foot. I was surprised at its perseverance, and thought it would have given up the search; but not so, it returned at least half a dozen times, and seemed to get angry, hurrying about with buzzing wings. At last it stumbled across its prey, seized it eagerly, and as there was nothing more to come back for, flew straight off to its nest, without taking any further note of the locality. Such an action is not the result of blind instinct, but of a thinking mind: and it is wonderful to see an insect so differently constructed using a mental process similar to that of man. It is suggestive of the probability of many of the actions of insects that we ascribe to instinct being the result of the possession of reasoning powers.

A WASP AND ITS PREY by G.W. and E.G. PECKHAM

Most graceful and attractive of all the wasps of all the inhabitants of the garden, hold the first place in our affections. Not so beautiful as the blue nor so industrious as the little red-girdled, their intelligence, their distinct individuality, and their obliging tolerance of our society make them an unfailing source of interest. They are, moreover, the most remarkable of all genera in their stinging habits, and few things have given us deeper pleasure than our success in following the activities and penetrating the secrets of their lives. In our neighborhood we have but two species, both of them being very slender bodied wasps of about an inch in length, all black, and with a red band around the front end of the abdomen.

During the earlier part of the summer we had often seen these wasps feeding upon the nectar of flowers, especially upon that of the sorrel of which they are particularly fond, but at that time we gave them but passing notice. One bright morning in the middle of July, however, we came upon one that was so evidently hunting, and hunting in earnest, that we gave up everything else to follow her. The ground was covered, more or less thickly, with patches, and it was under these weeds that was eagerly searching for her prey. After thoroughly investigating one plant she would pass to another, running three or four steps and then bounding as though she were made of thistledown and were too
light to remain upon the ground. We followed her easily, and as she was in full view nearly all of the time we had every hope of witnessing the capture, but in this we were destined to disappointment. We had been in attendance on her for about a quarter of an hour when, after disappearing for a few moments under the thick leaves, she came out with a green caterpillar. We had missed the wonderful sight of work, but we had no time to bemoan our loss for she was making off at so rapid a pace that we were well occupied in keeping up with her. She hurried along with the same motion as before, unembarrassed by the weight of her victim. Twice she dropped it and circled over it a moment before taking it again. For sixty feet she kept to open ground, passing between two rows of bushes, but at the end of this division of the garden, she plunged, very much to our dismay, into a field of standing corn. Here we had great difficulty in following her, since far from keeping to her former orderly course, she zigzagged among the plants in the most bewildering fashion, although keeping a general direction of northeast. It seemed quite impossible that she could know where she was going. The corn rose to a height of six feet all around us; the ground was uniform in appearance, and, to our eyes, each group of corn stalks was just like every other group, and yet, without pause or hesitation, the little creature passed quickly along, as we might through the familiar streets of our native town.

At last she paused and laid her burden down. Ah! the power that has led her is not a blind, mechanically perfect instinct, for she has traveled a little too far. She must go back one row into the open space that she has already crossed, although not just at this point. Nothing like a nest is visible to us. The surface of the ground looks all alike, and it is with exclamations of wonder that we see our little guide lift two pellets of earth which have served as a covering to a small opening running down into the ground.

The way being thus prepared she hurry her wings quivering and her whole manner betokening joyful triumph at the completion of her task. We, in the meantime, have become as much excited over the matter as she is herself. She picks up the caterpillar, brings it to the mouth of the burrow and lays it down. Then, backing in herself, she catches it in her mandibles and drags it out of sight, leaving us full of admiration and delight.

How clear and accurate must be the observing powers of these wonderful little creatures! Every patch of ground must, for them, have its own character; a pebble here, a larger stone there, a trifling tuft of grass—these must be their landmarks. And the wonder of it is that their interest in each nest is so temporary. A burrow is dug, provisioned and closed up, all in two or three days, and then another is made in a new place with everything to learn over again.
<table>
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<th>Feet</th>
<th>Legs</th>
<th>Feet</th>
<th>Legs</th>
<th>Feet</th>
</tr>
</thead>
</table>
Appendix K

Productivity and Safety Information Handout
Office Setting Guidelines Handout

For the next 5 minutes, please review this safety and productivity handout. After you read the guidelines, sign your name at the bottom to verify that you read this handout.

**Important body posture behaviors:**

**Legs**
Leg position refers to a participant’s thighs and lower legs. The angle between the thighs and lower legs should be between 90-120 degrees.

**Feet**
Should be flat on the floor (both heels and toes should be flat on floor).

Refer to the 2 pictures on the right for examples.

**Productivity behaviors:**

In many companies where employees’ jobs involve transcribing documents, productivity behaviors are important to their job.

Important productivity behaviors include:

**Time on-task**
– Time spent working on transcriptions

**Quantity of work**
– Number of words transcribed

**Quality of work**
– Number of spelling errors

I certify that I have read this document.

Signature __________________________ Date ____________
Appendix L

Safety Information Feedback Script
SAFETY INFORMATION FEEDBACK SCRIPT

The student investigator or the research assistant will read aloud the below paragraph. Safety information feedback will only be delivered during the participant’s first information session.

“Now that you have read the Office Setting Safety Guidelines Handout, I would like you to safely demonstrate each body posture behavior. You may refer to your handout at any time if you need help recalling the guidelines.

1. Can you please safely demonstrate leg position for me?

If the participant safely demonstrates leg position, the lead research or the research assistant will say the following:
“Correct, you safely demonstrated the leg position. The angle between your thighs and lower legs are between 90-120 degrees”

If the participant does not safely demonstrates leg position, the lead research or the research assistant will say the following:
“Your legs are (tell participant what is unsafe about their head/neck). The angle between your thighs and lower legs should be between 90-120 degrees”

2. Can you please safety demonstrate feet position for me?

If the participant safely demonstrates feet position, the lead research or the research assistant will say the following:
“Correct, you safely demonstrated feet position. Your feet are flat on the floor (both heels and toes are flat on floor).”

If the participant does not safely demonstrates feet position, the lead research or the research assistant will say the following:
“Your feet are (tell participant what is unsafe about their head/neck). Your feet should be flat on the floor (both heels and toes should be flat on floor).”
Appendix M

Information Sessions Script
The student investigator will read aloud the below paragraphs at the beginning of each information session.

"Your task for this session will be to type an article into a Word document file. You do not need to spell check your work. If you feel fatigued or need a break, you may take a break and will not be penalized for taking the break. Games and the internet are available for you to access on the computer. The drinking fountain and restrooms are located at the end of the hallway and food is located downstairs.

Please work at your own pace for the next 30 minutes. I will knock on the door when your session is over."

[LEAVE THE OBSERVATION ROOM]

A reminder for the student investigator.

[DO NOT FORGET TO START THE DVD PLAYER!!!]
Appendix N

Information plus Observation Sessions Script
INFORMATION PLUS OBSERVATION SESSIONS SCRIPT

The research assistant will read aloud the below paragraphs at the beginning of each information and observation session.

“Your task for this session will be to type an article into a Word document file. You do not need to spell check your work. If you feel fatigued or need a break, you may take a break and will not be penalized for taking the break. Games and the internet are available for you to access on the computer. The drinking fountain and restrooms are located at the end of the hallway and food is located downstairs.

Please work at your own pace for the next 30 minutes. I will let you know when your session is over.”

[LEAVE THE OBSERVATION ROOM]

The research assistant will read aloud the below paragraph at the 10:01 minute mark of each information and observation session.

For the next 10-min, as the experimenter, I will be present in the room with you to observe your safety and productivity behavior. In order to minimize distraction during your task, I am not allowed to talk with you. If you have any questions during your session, please wait and ask me at the end of your session. If you feel fatigued or need a break, you may take a break and will not be penalized for taking the break. Games and the internet are available for you to access on the computer. The drinking fountain and restrooms are located at the end of the hallway and food is located downstairs. Please work at your own pace for the next 10 minutes. I will let you know when your session is over.

Following the 10-min observation period, the research assistant will read aloud the below paragraph.

The observation period it over, please continue working until the end of the session.

[LEAVE THE OBSERVATION ROOM]
Appendix O

Information, Observation, and Feedback Sessions Script
INFORMATION, OBSERVATION, AND FEEDBACK SESSIONS SCRIPT

The research assistant will read aloud the below paragraphs at the beginning of each information and observation session.

"Your task for this session will be to type an article into a Word document file. You do not need to spell check your work. If you feel fatigued or need a break, you may take a break and will not be penalized for taking the break. Games and the internet are available for you to access on the computer. The drinking fountain and restrooms are located at the end of the hallway and food is located downstairs.

During your last session, your safety and productivity behavior was scored. You scored the following:

a) For feet position, you were safe ______% of the session
b) For leg position, you were safe ______% of the session
c) You spent ______ minutes on-task out of the 30 minute session
d) You typed ______ number of words
e) You typed ______ the number of spelling errors

Please work at your own pace for the next 30 minutes. I will let you know when your session is over.”

[LEAVE THE OBSERVATION ROOM]

The research assistant will read aloud the below paragraph at the 10:01 minute mark of each information and observation session.

For the next 10-min, as the experimenter, I will be present in the room with you to observe your safety and productivity behavior. In order to minimize distraction during your task, I am not allowed to talk with you. If you have any questions during your session, please wait and ask me at the end of your session. If you feel fatigued or need a break, you may take a break and will not be penalized for taking the break. Games and the internet are available for you to access on the computer. The drinking fountain and restrooms are located at the end of the hallway and food is located downstairs. Please work at your own pace for the next 10 minutes. I will let you know when your session is over.

Following the 10-min observation period, the research assistant will read aloud the below paragraph.
The observation period it over. Please continue working until the end of the session.

[LEAVE THE OBSERVATION ROOM]
Appendix P

Exit Interview Questions
EXIT INTERVIEW QUESTIONS

The student investigator or the research assistant will read aloud the below:

1. What do you think the study was about?
2. What do you think was being measured or observed?
3. What did you think about when the observer announced he/she would be present?
4. What did you think/feel about when the observer was observing you?
5. Did you say anything to yourself when you were informed that an observer would be observing you?
6. Did you say anything to yourself when the observer was observing you during the observation period?
7. Did you say anything to yourself when the observer provided you feedback on your safety and productivity?
8. Did you try to work harder or perform more safely when the observer was in the room?
9. (If answer to #8 was “yes”) Why do you think you worked harder or performed more safely when the observer was present?
10. Do you think your performance improved when the observer was present?
11. (If answer to #10 was “yes”) Why did you think your performance improved when the observer was present?
12. Did you have to remind yourself in order to perform safely?
13. Do you think your performance improvement decreased after the observer left the room?
14. (If answer to #13 was “yes”) Why did you think your performance improvement decreased after the observer was left the room?
15. Do you think your performance improvement decreased over time throughout the study?
16. (If answer to #15 was “yes”) Why did you think your performance improvement decreased over time throughout the study?
17. What did you think about or do after the observer left the room?
18. How would you describe your previous experiences with someone observing you while you work?
Appendix Q

Debriefing Script
The student investigator or the research assistant will read aloud the below paragraphs to all participants at the conclusion of the study.

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

The purpose of the current study was to investigate the effects of observer presence and feedback on individuals' work-related behavior across sessions. The current investigation additionally attempted to address the effect that duration of observer presence has on individuals' work-related behavior.

A large volume of research has investigated the effects of observer presence on participant behavior and there is some indication that participants experienced reactivity to the presence of an observer, however it remains unclear if and how performance can be sustained at the enhanced levels after observation is terminated. Extensive research has been conducted examining reactivity yet few studies have been conducted examining the effects of feedback to the presence of an observer. What remains unknown is the most effective schedule of observer (i.e., manager) presence for slowing the habituation process and for sustaining improved performance when the observer is no longer present.

Because participants are likely to change their behavior in the presence of an observer, we needed to monitor your behavior unobtrusively in order to obtain an accurate sample of your behavior when an observer was not present. A hidden camera was used during this study to allow us to capture your behavior when an observer was both present and absent and then examine the resulting differences. Additionally, the hidden camera allowed us to examine your behavior more precisely immediate after sessions to determine when to start a new intervention phase. In order to do this, we needed to monitor your performance covertly when the observer was not present using a hidden camera. Only research assistants have viewed your performance on DVD.

Dr. John Austin and I assure you that DVDs of your behavior and all identifying information will be held in the strictest confidence. DVDs of your performance contain only a date and code number which was used to protect your identity. Angela Lebbon will maintain the security of all data collection forms and DVDs gathered over the course of data collection by storing them in a locked cabinet inside a locked office (2532 Wood Hall) for at least three years. Only Angela Lebbon will have access to the locked cabinet, however four graduate students in the PM laboratory have access to the office space.

You are free to view the DVDs of your performance, and we invite you to do so. We also invite you to examine your own performance data gathered from the observation process. If you chose to do so, you may make arrangements with Angela Lebbon 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 DVDs. If you do not consent to the use of these data, you will not be penalized in any way, and we will destroy your DVDs or give them to you so that you may dispose of the DVDs in any way you deem appropriate.”
Asked the participant to verbally summarize the explanation of the study and use of his/her hidden camera data to assess the participant’s understanding.

Then do one of the following two options:
1) If a participant does not demonstrate an understanding of the study’s purpose and/or use of hidden camera data, conclude the exit interview by saying:

“Thank you for your participation and help with the current study. This concludes the exit interview.”

DO NOT hand the participant the consent form.

If the participant inquires about his/her hidden camera DVDs and/or data, inform the participant that the SI will call him/her tomorrow with more information.

2) If the participant demonstrates an understanding of the study’s purpose and use of hidden camera data, ask the participant the following:

“Do you have any questions?”

Answer any questions the participant has

Read the Hidden Camera Data Use Consent Script

Hand the participant both copies of the consent form
Appendix R

Within-Subjects Graphs
Appendix S

Descriptive Statistics
Table 3
Descriptive Statistics for All Behavior Across All Groups and Conditions

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Appendix T

Factorial ANOVA
### Table 4
ANOVA for All Behavior Across All Groups and Conditions

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Appendix U

Tukey HSD Comparison
Table 5
Tukey HSD Comparison for All Behavior

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