Increasing Accurate Use of Personal Protective Equipment and Reducing Injuries in the Workplace Using a Computer-Based Behavioral Skills Training Package

Amanda Cano

A Dissertation Submitted to the Faculty of

The Chicago School of Professional Psychology

In Partial Fulfillment of the Requirements

For the Degree of Doctor of Philosophy in Applied Behavior Analysis

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Abstract

Workplace safety is a socially significant concern. Injuries and accidents on the job can result in serious consequences for employees and can be a liability to employers and owners. The accurate use of personal protective equipment (PPE) is required for on-the-job safety, and performance of skills, such as the accurate use of PPE, may be taught using behavior skills training (BST). Recently, the efficiency of BST has been improved with the incorporation of media (i.e., computers). In the current study, a concurrent multiple-baseline design was used to evaluate the effectiveness of a computer-based BST (CBST) package on increasing the use of PPE and reducing accidents and injuries in the workplace. Three full-time contractors at a glass and mirror company located in Florida participated in the study. Results included immediate increases in accurate use of PPE following CBST. Results did not show any significant change in injuries or accidents following intervention; however, this was likely due to the limited data following intervention. Additionally, positive feedback obtained from the owner of the company lends to the high social validity of CBST as a training module.

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Chapter 1: Nature of the Study

Background

In 2016, the most recent year for which data have been published, there were approximately 2.9 million nonfatal workplace injuries (i.e., sprains, tears, cuts, lacerations, fractures) and illnesses (i.e., contact dermatitis, carpal tunnel syndrome, etc.) reported by private-industry employers (United States Department of Labor [USDL], n.d.). These figures are equal to roughly 3 per 100 personal injury cases for full-time employees. Approximately one-third (892,270 cases) of reported nonfatal occupational injuries and illnesses resulted in multiple (i.e., 2 or more) days missed from work (USDL, n.d.). Cuts, lacerations, or punctures accounted for 13% cases in 2016 which resulted in employees being absent from work (USDL, n.d.). Although these are relatively minor injuries, they may be easily prevented by properly using personal protective equipment (PPE). There is a lack of adequate training in many occupational settings, and thus research for better, more efficient teaching methodologies with this population is required.

Behavioral skills training (BST) may be an effective procedure to teach on-the-job safety skills. BST has previously been used in the clinical setting to teach safety skills to children and adults (Fisher, Burke, & Griffin, 2013; Himle, Miltenberger, Flessner, & Gatheridge, 2004; Himle & Wright, 2014). Himle, Miltenberger, Flessner, and Gatheridge (2004) used BST supplemented with in-situ training to teach eight children to respond safely to unattended firearms. In a similar study, Fisher, Burke, and Griffin (2013) used classroom BST, in-situ training, and booster sessions to teach young adults to respond appropriately to lures from strangers. Himle and Wright (2014) used BST to teach ten undergraduate students to install rear-facing child-passenger safety restraints. At the end of all these studies, there were substantial

increases across the various behaviors and populations as a result of the BST protocol implemented.

Problem Statement

One of the primary limitations of BST is the potential impracticality and inefficiency of the procedures, meaning that typically, the resources needed to conduct the training are time-consuming and expensive. Implementing all steps of the BST package requires more time than other training methods, such as lecture-based trainings. A possible solution to increase the efficiency of BST includes incorporating visual media, such as video modeling and computers, within the training (Parsons, Rollyson, & Reid, 2012).

Vanselow and Hanley (2014) did just this and evaluated the effects of a computerized behavioral skills training (CBST) package on the acquisition, maintenance, and generalization of safety skills with typically developing children. The CBST package was in the form of a video game developed to teach abduction prevention, poison avoidance, and lighter safety skills. The researchers conducted in-situ assessments before and after the client completed the CBST. If the client did not protect themselves (i.e., telling stranger "no," advising known adult of stranger's presence, advising adult of presence of poison and lighter in room) following CBST, an in-situ training was implemented. Generalization to novel dangers was also tested using in-situ assessments. One limitation of this study was erroneous feedback on the rehearsal components of the CBST program. Participants' feedback was time-based, rather than performance-based, which potentially resulted in errors.

Purpose of the Study

The purpose of the current study was to replicate and extend Vanselow and Hanley's study (2014) by implementing similar procedures with a different population, setting, and target

behaviors. This type of training was ideal for the current setting because it was much more time and cost efficient, as the experimenter did not need to be present for the entire duration of training sessions. A social validity measure was administered to the owner of the target company to determine acceptability of the treatment and its outcomes.

Research Questions and Hypotheses

Research Question 1: Is CBST an effective method for increasing accurate use of personal protective equipment (PPE) in a hazardous workplace?

$H_1$1: CBST increases contractors' compliance with accurate use of PPE while carrying glass/mirrors on the job.

Research Question 2: Is CBST an effective method for decreasing injuries and accidents in a hazardous workplace?

$H_1$2: CBST training on accurate use of PPE will result in a decrease in the number of injuries and accidents in the workplace.

Research Question 3: Is CBST an acceptable method of training employees from the perspective of the owner of the company?

$H_1$3: CBST is an acceptable method of providing training to employees.

Scope of the Study

The scope of this study includes three full-time glaziers at a privately-owned glass and mirror company located in Florida. CBST was chosen as the training intervention for this study based on evidence of its effectiveness for teaching a wide variety of safety targets.

Summary

Behavioral skills training is a viable option for teaching safety skills on the job. Despite the research available on BST for teaching safety targets, safety training in the workplace

typically consists of complex treatment packages. Thus, research on more efficient yet effective methods of on-the-job training are needed. This dissertation will examine the use of CBST to increase accurate use of PPE and decrease injuries and accidents in a hazardous workplace.

Chapter 2 will present literature related to the United States Department of Labor's Occupational Safety and Health Administration's (OSHA) guidelines for safety in the workplace, behavior-based safety (BBS) Training, and BST. Procedures to use in combination with BST will also be discussed, as well as limitations of in-vivo BST. Chapter 3 will present the methods that will be used for this dissertation study.

Chapter 2: Review of the Literature

Introduction

The United States Department of Labor's Occupational Safety and Health Administration (OSHA) sets standards and regulations for employers to assure safe and healthful working conditions, as well as providing resources, training programs, education, and assistance (OSHA, n.d.). According to OSHA (n.d.), nearly all workplace fatalities, injuries, and accidents are preventable; therefore, the focus of training should be on prevention of injuries and illnesses as compared to reactions and treatment. The use of personal protective equipment (PPE) is required by OSHA for hazardous or dangerous workplaces, such as construction and manufacturing sites. PPE is designed to minimize exposure to and decrease the likelihood of injuries, illnesses, and other hazards in the workplace; however, adequate training on proper usage of PPE is needed to effectively decrease these injuries and illnesses (OSHA, n.d.).

One occupation in which PPE is a needed safety precaution is glazing. "Glazing" falls under OSHA's Major Group 17: Construction Special Trade Contractors, and the Industry Group 1793 refers to Glass and Glazing Work. In the glass and glazing industry, there were a total of 146 injury cases per 10,000 full-time workers in 2016. Additionally, there were 57 cases involving sprains, strains, and tears, and approximately 11 involving fractures. There were also roughly 19 reported cases of cuts, lacerations, and punctures. OSHA reported that glaziers have a higher rate of injuries and illnesses than the national average (USDL, n.d.). Although there is a heightened risk for injuries and illnesses, there is rarely adequate training to increase safety precautions in this environment.

Behavior-Based Safety

Safety in the workplace has previously been examined using a behavior-based safety (BBS) approach (Hagge, McGee, Matthews, & Aberle, 2017; Hermann, Ibarra, & Hopkins, 2010; Myers, McSween, Medina, Rost, & Alvero, 2010). The BBS approach consists of seven characteristics, which include the following: a) focus intervention on observable behavior, b) identify external factors to understand and improve behavior, c) direct activators and motivate with consequences, d) focus on positive consequences to motivate behavior, e) apply the scientific method to improve intervention, f) use theory to integrate information, and g) design interventions with consideration of internal feelings and attitudes (Geller, 2005).

Bumstead and Boyce (2005) evaluated the BBS procedure in two different worksites, a gold mine and a public works facility. These companies differed substantially in their safety cultures and the researchers wanted to identify which organizational practices supported or inhibited the implementation of BBS procedures. The approximately 200 employees at the gold mine worked in and around an open-pit mine and were responsible for driving haul trucks, crushing rock, assaying metals, operating bulldozers and shovels, and maintaining large pieces of machinery. At the public works facility, 80 employees were assigned to any of the following tasks: road repair, construction, clearing debris from ditches, and flushing storm drains.

The experimenters compared the level of three dependent variables: employee-driven decisions, employee participation, and injury reductions before and after BBS (Bumstead & Boyce, 2005). Employee-driven decisions were defined as those that affect the BBS process, such as decisions to increase employee participation in BBS and methods for increasing and measuring employee participation. Employee participation at the gold mine was measured by the percent of employees who completed observation cards each week, and at the public works

facility by the total count of observation cards completed each week. Injuries were measured by the number of reported injuries, reported safety incidents, injury claims, and cost of injury claims. Reported injuries were incidents where an injury was sustained, was reported by an employee, reported to OSHA, or was a first-aid incident. Safety incidents were defined as reported near-misses, safety hazards which did not result in an injury or require first-aid. Injury claims were incidents in which the employee received medical attention covered by the company's insurance. The intervention package included safety assessments, steering committees, and BBS workshops (Bumstead & Boyce, 2005).

During a safety assessment, Bumstead and Boyce (2005) evaluated the current safety culture of the workplace, and then archival injury data were reviewed, direct observations were conducted, and informal interviews with hourly workers and management were conducted to pinpoint safety targets. Management and safety officers also provided documentation of previous trainings and outcomes. After the safety assessment, "steering committees" of five to ten employees were formed in each company. Steering committees attended a 2-day BBS workshop on the principles of behavior analysis, conducting observations, and providing feedback. Managers participated in a 1-day condensed workshop with a focus on the rationale for BBS, initial processes, and drafting a critical behavior checklist (CBC). All employees attended a 4-hour workshop in groups, which focused on gaining their buy-in, defined as verbal or overt behavior supporting the BBS process. All workshops reviewed the "DO IT" process, which stands for define, observe, intervene, and test. In addition, employees were taught how to calculate percentage of safe behaviors from the completed CBC, graph data, and analyzing trends (Bumstead & Boyce, 2005).

During the intervention component, employees were taught about antecedents and consequences, how and when to provide corrective feedback, and the CBC cards were to be completed at any time. All employees were responsible for filling out at least one card per week. The BBS program developed was implemented in similar fashion across both locations, and increased employee participation was observed at both sites, which resulted in a reduction in injuries at both worksites (Bumstead & Boyce, 2005). However, a major limitation of the study was the lack of integrity checks on the independent and dependent variables. It is unclear if treatment was implemented as described or if the data obtained were accurate. Bumstead and Boyce (2005) suggested that future researchers use more rigorous validity measures to enhance the confidence of the BBS procedural results.

There have been other BBS studies in which a package training was evaluated in workplaces to increase safety precautions (Fox, Hopkins, & Anger, 1987; Komacki, Barwick, & Scott, 1978). For example, Komacki et al. (1978) evaluated a treatment package that included teaching about safe behaviors, goal setting, frequently posted feedback, and praise to increase frequency of safe behaviors and reduce injuries in a food manufacturing plant. Training consisted of a 30-minute session where employees were shown pairs of slides corresponding to safe and unsafe behaviors, and employees were asked to describe what was wrong with the picture or which observational code was relevant. In addition to this training, supervisors were instructed on providing praise to employees engaging in safe behaviors. The supervisors were also responsible for completing a daily checklist, indicating how often they provided praise. The manager was instructed to speak to each supervisor once a week to increase compliance. The results of the study by Komacki et al. (1978) included an increase in safe behaviors and a

reduction of injuries; however, it is unclear which component(s) of the treatment package were effective because a component analysis was not conducted.

In the BBS literature, there is a gap regarding variability of interventions used and the validity of the procedures described. Ludwig and Geller (2000) reviewed seven different studies using different treatment packages, all to improve safety performance of participants. Interventions included assigned goal-setting, participatory goal setting, group goal setting, individualized feedback, public individualized feedback, group feedback, awareness sessions, promise cards, policy statements, and community agents which promoted safe behavior. The results of the review included overall increases in safety behaviors, except for one study in which there was no behavior change. Ludwig and Geller (2000) noted the studies that were rated included high amounts of external contingencies, counter-control was a common side effect, and the non-target safety-related behaviors were observed to decrease.

BBS systems are often complex training packages that sometimes lack efficiency. There is a need for a much simpler, but still effective, system for training safety-related behaviors. There is also a limited demonstration of experimental control in these studies; for example, confounds such as multiple treatment interference, carryover effects, sequence effects, and additive effects were concerns across many studies. In addition, there is a lack of empirically based preventative measures, specifically, training employees on how to perform behaviors which are to be emitted. In each study previously described, there was an assumption made that employees “knew what they should be doing.” This is not always the case, as evident by the high number of injuries and illnesses reported by OSHA as a result of inappropriate use of safety precautions such as PPE.

Behavior Skills Training

Behavior skills training (BST) is an evidence-based protocol previously used to train various skills (Parsons et al., 2012). BST consists of four primary components: a) providing instructions, b) modeling, c) practice, and d) feedback until mastery is achieved (Parsons et al., 2012). First, in the instructions component, the target skill is described and the learner is provided a brief written description of the skill. Second, in the model component, the trainer demonstrates the target skill. Third, in the practice component, the learner is provided the opportunity to practice the target skill. Fourth, in the feedback component, the trainer provides immediate corrective feedback based on the learner's performance. The rehearsal and feedback components may be repeated until mastery is achieved.

BST packages have been used to teach various skills (i.e., implementation of functional analysis procedures [e.g., Iwata et al., 2000], implementation of discrete trial training procedures [e.g., Lerman, Hawkins, Hillman, Shireman, & Nissen, 2013], implementation of a picture exchange communication system [e.g., Homlitas, Rosales, & Candel, 2014], EpiPen administration [e.g., Whiting, Miller, Hensel, Dixon, & Szekely, 2014], and card counting in blackjack [e.g., Speelman, Whiting, & Dixon, 2015]) to diverse populations (i.e., school children [e.g., Johnson et al., 2006], children with autism [e.g., Bergstrom, Najdowski, & Tarbox, 2014; Gunby, Carr, & LeBlanc, 2010; Gunby & Rapp, 2014], youth football players [e.g., Tai & Miltenberger, 2017], young adults with disabilities [e.g., Fisher, Burke, & Griffin, 2013], typically developing adolescents [e.g., Houvouras & Harvey, 2014], undergraduate and graduate students [e.g., Himle & Wright, 2014; Rosales, Stone, & Rehfeldt, 2008], adults with autism [e.g., Lerman et al., 2013], parents [e.g., Dogan et al., 2017], teachers [e.g., Homlitas et al., 2014], teaching aides [e.g., Nabeyama & Sturmey, 2010], and cocktail servers [e.g., Scherre &

Wilder, 2008]). For example, Rosales, Stone, and Rehfeldt (2009) used a BST package to teach implementation of the picture exchange communication system (PECS) to two undergraduate students and one graduate student. The researchers measured percent of correct responses performed using a checklist. For the first component of BST (i.e., information), participants viewed a 26-minute video on PECS and a 15-minute video of a training session. The instructor verbally described each item and then modeled correct implementation with the confederate learner as a mock participant for the second component (i.e., modeling). Then, the third and fourth components were completed, which consisted of participants practicing each component and receiving feedback until at least 80% steps correct were reached on two consecutive trial blocks. The results included a significant increase in percentage of correctly performed steps from baseline to BST for all participants, and the increases maintained for one participant for 1 month following training (Rosales et al., 2009).

Additionally, Dogan et al. (2017) implemented a BST package to instruct four parents how to use BST to teach social skills targets to their children diagnosed with autism spectrum disorders (ASD). The primary dependent variable was the percentage of BST steps implemented correctly out of 15 total steps. Following implementation of an information, modeling, practice, and feedback intervention, correct implementation of BST procedures increased across parents and maintained at a 1-month follow-up (Dogan et al., 2017). Similar results have been observed with other programs as well (i.e., treating noncompliance [e.g., Forehand et al., 1979; Magen & Rose, 1994], managing aggressive behaviors [e.g., Magen & Rose, 1994], implementing discrete trial training procedures [e.g., Lafaskis & Sturmey, 2007], social skills [e.g., Stewart, Carr, & LeBlanc, 2007], guided compliance [e.g., Miles & Wilder, 2009], and incidental teaching [e.g., Hsieh, Wilder, & Abellon, 2011]).

Behavior Skills Training for Safety Targets

BST has also been used in clinical settings to teach safety skills to children and adults, including safe responding to unattended firearms (e.g., Gross, Miltenberger, Knudson, Bosch, & Breitweiser, 2007; Himle et al., 2004), safe tray carrying (e.g., Scherrer & Wilder, 2008), correct staff guarding and posture (e.g., Naebeyma, 2010), installing child passenger safety restraints (e.g., Himle & Wright, 2014), safe responses to lures from strangers (e.g., Bergstrom et al., 2014; Fisher et al., 2013), fire safety skills (e.g., Houvouras & Harvey, 2014), lockdown drill procedures (e.g., Dickson & Vargo, 2017), and safe tackling skills (e.g., Tai & Miltenberger, 2017). BST is often used with in-situ assessments, which include probes in the learner's naturalistic environment which may or may not be contrived. In-situ assessments promote generalization of the target skill (Houvouras & Harvey, 2014); however, if the participant does not engage in the correct responses during the probe, *in-situ training* (IST) must also be implemented. IST is identical to the rehearsal and feedback components of BST.

Houvouras and Harvey (2014) evaluated BST to teach fire safety skills to three 10-year-old boys, two of whom had a history of fire setting. The researchers used a 4-point Likert scale to rate the participants' behavior during in-situ assessments according to the following scale: 0 = touched lighter, 1 = did not touch lighter and remained in room, 2 = did not touch lighter and left room within 10 seconds of finding the lighter, 3 = did not touch lighter, left room within 10 seconds, and 4 = informed an adult about the presence of the lighter. To conduct in situ assessments, researchers placed a lighter on a table in a clear plastic box with crayons and markers (Houvouras & Harvey, 2014). A hidden video camera was placed so as to observe the participants' behavior around the unattended lighter. During baseline, the participants were told to go draw a picture until an adult came. If the child handled the lighter, the therapist entered the

room and waited until the child placed it down. If the child informed the therapist about the presence of the lighter, the therapist took the lighter from the box, returned to the child, and engaged in conversations about the child's picture. If the child did not handle the lighter within 3 minutes, the therapist also talked to the child about his picture. Two BST sessions were conducted with each participant.

During instruction, Houvouras and Harvey (2014) provided each participant information on the dangers of handling lighters, and the researchers identified the four steps in the target behavior chain: do not touch the lighter, leave the room within 10 seconds, and inform an adult about the lighter. During modeling, the therapist modeled the behavioral chain. Then, the participants were asked to verbally state what the four steps were and to then demonstrate the steps for the rehearsal/practice component. If the participant performed the steps correctly, praise was provided. If an incorrect response was made, the therapist immediately provided corrective feedback and retested the participant. During the in-situ assessments following BST sessions, all participants engaged in safe responses following BST. During 1-month follow-up probes conducted with two of the three participants, both participants still engaged in safe responses. The authors noted future researchers should use a variety of fire-starting agents (such as firecrackers, matchboxes, etc.), continue assessing maintenance, and assess generalization to novel settings (Houvouras & Harvey, 2014). Another limitation of this study was the limited settings and the fact that participants were told to wait until a therapist came into the room during the in situ assessments. It is possible that instructional (i.e., stimulus) control exerted more control over participants' behavior than finding a lighter. In addition, IST was not used in this study, and it is uncertain if the results would generalize to other settings or be maintained past 1 month if that had been added.

Himle et al. (2004) demonstrated the effectiveness of BST and IST to teach gun safety skills to eight preschool children. The target behavior chain was similar to Houvouras and Harvey's study (2014), where participants' performances were scored on a scale as follows: 0 = touched the firearm, 1 = did not touch the firearm but did not leave the room or tell an adult, 2 = did not touch the firearm and left the room but did not tell an adult, or 3 = did not touch the firearm, left the room, and told an adult. During each assessment, a disabled firearm was placed on a shelf in a room located in the preschool, but always in a different area of the room. During in-situ assessments, the children were told that a "teaching assistant" was going to be working with them. The teaching assistant told the child to play in a room (with the firearm), while he prepared tasks to work on and left the participant alone in the room for 5 minutes. After the 5 minutes, the experimenter retrieved the participant and worked in another room for 10 minutes (Himle et al., 2004). During baseline, in situ assessments were conducted and no feedback was provided to the children. After baseline, each participant received two individual 30-minute BST sessions at the preschool similar to those described by Houvouras and Harvey (2014). However, only three of eight participants performed gun safety skills after BST alone. Therefore, IST was added, and the remaining five participants also performed gun safety skills. Performance maintained in all participants at 2- and 8-week follow-up sessions (Himle et al., 2004).

As it was implemented in these studies, BST can be costly and inefficient. For example, in a workplace, this type of training would take time away from the trainer and the participating employee(s; Parsons et al., 2012). Therefore, a method of improving BST efficiency was developed which incorporated the use of media, such as videos within the training (Vanselow & Hanley, 2014).

BST and the Use of Media

Vanselow and Hanley (2014) evaluated the effects of a computerized version of BST (CBST) on the acquisition, maintenance, and generalization of safety skills to protect from other dangers with typically developing children. In Study 1: Abduction Prevention, the researchers evaluated the effectiveness of CBST for teaching participants to respond to one danger, lures from strangers. In situ assessments were conducted before and after CBST, and following CBST, if a participant did not engage in the safety responses, IST was conducted. Four responses were measured: interacting with the danger, staying near the danger, getting away, and telling an adult (Vanselow & Hanley, 2014).

To conduct in situ assessments, Vanselow and Hanley (2014) told the participants they were going to a different room to play a game. The participant was asked to choose a toy to play with in the room for 10 minutes. On the way to the room or on the way back to the classroom, the experimenter pretended to forget something or to take a phone call and moved 1.5 meters away from the participant and around the corner of the hallway. Then, a stranger approached the participant, made a comment about his or her clothes or something he or she had, and asked the participant to leave with him while extending his hand to the participant. If the participant and stranger walked more than 3 meters away from the experimenter, the experimenter interrupted them and continued with the participant to the room or classroom. If the participant did not move more than 1 meter in 5 seconds following the lure, the stranger asked the participant to leave for a second time. If the participant reported the stranger to the experimenter, the experimenter thanked the participant in a neutral tone for telling him. If the participant moved away from the stranger, but did not report the incident to the experimenter, the experimenter did not provide praise. If the participant moved away from the stranger to the experimenter within 5 seconds and

reported the incident to the experimenter, the experimenter provided specific praise and continued to the classroom with the participant (Vanselow & Hanley, 2014).

Next, CBST in the form of a computer game was presented to the participant (Vanselow & Hanley, 2014). The main character of the game provided instructions and praise throughout the CBST. Ten tokens were placed near the participant, and the experimenter explained that these would be used later. In the instructions and modeling module, descriptions of strangers and how to respond to strangers were provided. Participants watched videos of other children safely responding to strangers, as well as incorrect responses which resulted in reprimands by a parent and directions on the correct responses. Next, four games were presented to the participants (e.g., Order game, Go! game, Act Out game, and Act + Run! Game). In the Order game, the participant was instructed to place three videos, which corresponded to responses in the target behavior chain (e.g., say "no," get away, & tell an adult), in the correct order. In the Go! game, the participant was to click a button which said "Go!" and depicted a stick figure running within 3 seconds of a stranger asking the participant to leave. In the Act Out game, the participant rehearsed the safety responses when a stranger appeared on the screen and delivered a lure and received feedback. The participant was to place a token in a pouch of a life-sized cutout of the main character and say, "I saw a stranger," return to the computer and click "OK." The computer provided praise if 4 sec elapsed between the lure of the stranger and the participant clicking "OK" to end the trial. If the participant clicked "OK" before 4 seconds, the program instructed the participant to try again. The Act + Run! game was the same as the Act Out game, except when a stranger appeared, the main character alerted the participant to run away from the stranger. If the participant did not engage in the safe response when presented with a lure from a stranger after the last post-CBST session, the participant replayed the videogame and then IST

was implemented. During IST, the experimenter interrupted the incorrect response, described the correct steps, and asked the participant to rehearse the target responses (Vanselow & Hanley, 2014).

All participants in Vanselow and Hanley's (2014) research demonstrated the target safety responses at the end of the study, and these results maintained for four of five participants 8 weeks after the study. One limitation was the potential for erroneous feedback in the rehearsal components of the CBST program. The feedback was time-based, rather than performance-based. This could explain why only one participant acquired the target responses following CBST, whereas the remaining ten participants required IST. However, the additional of media components increased the efficiency of the BST package, and may be very applicable to other settings and populations.

Summary

The purpose of the current study was to replicate and extend Vanselow and Hanley's (2014) research by implementing similar procedures with a different population, setting, and target behaviors. The setting was a local glass and mirror company, specializing in fabricating custom glass and mirrors as well as installation, repair, and removal of glass and mirrors. The effects of CBST on increasing the proper usage of PPE and decreasing number of presumably preventable injuries and accidents was evaluated. As mentioned previously, a primary limitation of Vanselow and Hanley's (2014) study included the possibility of erroneous feedback in the rehearsal components; therefore, an additional extension was to provide feedback based on performance of an individual contractor.

Chapter 3: Research Design and Method

Participants

The participants receiving training in this study included three full-time contractors. All participants were Caucasian-American, English-speaking men ranging in age from 28 to 63. Inclusion criteria for participation included full-time employment status with the glass and mirror company as a glazier. The owner of the company was asked to complete a social validity measure. Participants included Mac, Jimmy, and Miller. Their names have been changed to ensure confidentiality.

Settings and Materials

The location of the research was a small privately-owned glass and mirror company located in Florida. The CBST sessions were completed in the showroom for two participants and at the register for one participant. In-situ assessments were conducted in the showroom, workshop, garage, and parking lot. Materials for this study included the computerized BST program (see below) and the desktop computer located in the showroom, as well the researcher's laptop. The company's desktop was an HP Pavilion and the motherboard had a 16.0 GB RAM and Intel® Core ™ i7 processor. The researcher's laptop was a Toshiba Satellite, with Intel® Core ™ i5-4200U processor. In addition, the Hikvision application was used by the owner to retrieve surveillance videos of the worksite. There was a total of eight cameras from which footage was obtained. Also, at the beginning of the CBST, participants were provided with a panel of glass for use during the rehearsal component of the training. A CBST program was developed for employees using Microsoft PowerPoint. The PowerPoint presentation consisted of ten slides.

Dependent Variables and Measurement

Data were collected on three dependent variables: injuries, accidents, and use of PPE. *Injuries* were operationally defined as bodily harm to the contractor such, as in cuts, bruises, and broken bones. *Accidents* were operationally defined as any damage to glass or mirrors (e.g., chipping, breaking, shattering) while the contractor was handling the material. Frequency and intensity were collected daily on injuries and accidents by the lead contractor, who was responsible for documenting all injuries and breakage of materials per company policy. *Accuracy of PPE* was operationally defined as wearing hardhat, safety spectacles, nitrile-coated gloves, wrist guards, jeans, and composite toe shoes. Frequency data were collected on each of these PPE components for each opportunity during in situ assessments. An opportunity was counted when the participant carried glass/mirror from one location to another by ambulating. The beginning of the trial was counted when the participant picked up the glass/mirror and the end of the trial was counted when the participant let go of the glass/mirror. At the end of each opportunity, a percentage was calculated by taking the number of PPE components worn by the total number of PPE components (6) and multiplying by 100. A social validity measure was administered to the owner of the company when the last participant to receive CBST had received three in-situ assessments. The questionnaire used a 3-point Likert scale and asked the owner to rate his agreement on five different statements.

Interobserver Agreement

A second observer collected reliability data during pre- and post-CBST sessions to calculate interobserver agreement (IOA). Trial-by-trial IOA was calculated for use of PPE. For each trial, an agreement was be counted if the two observers both marked an occurrence or non-occurrence of each PPE item per opportunity. The total number of agreements was divided by

the total number of components per opportunity and multiplied by 100 to obtain a percentage. During baseline, data were collected for 33% of Mac's in-situ assessments, 50% of Jimmy's in-situ assessments, and 44% of Miller's in-situ assessments. During the post-CBST phase, data were collected for 50% of Mac's in-situ assessments, 80% of Jimmy's in-situ assessments, and 67% of Miller's in-situ assessments. IOA scores were 100% for all participants.

Treatment Integrity

Treatment integrity data were collected by having an observer watch a recording of the training sessions. A procedural integrity checklist including four items were used. The items included: experimenter provided participants with the CBST, experimenter did not provide prompts as trainee orally completed competency assessment, experimenter provided approving gestures (such as "high five") and/or descriptive praise contingent on correct responding, and implementer provided corrective feedback contingent on incorrect responding. Scores were 100% for all participants.

Experimental Design and Procedure

A concurrent, multiple baseline design across participants was used to evaluate the effects of CBST on the accurate use of PPE and frequency of injuries and/or accidents in the workplace. Across conditions, there were no programmed consequences for accurate use of PPE, reduction of injuries, or accidents. All typical company policies remained in place.

In-Situ Assessments

In-situ assessments were conducted pre- and post-CBST training. These included the researcher observing within the on-site workshop or watching a video of on-site behavior. If an injury or accident occurred, the employee followed the company's protocol in which the employee must alert the lead contractor. The lead contractor documented the employee's injury

or accident. For minor injuries, per company policy, the employee may continue working and may put on adhesive bandage before continuing working. For major injuries requiring immediate medical attention, the lead contractor will call an ambulance.

Computerized Behavior Skills Training (CBST)

All contractors were provided with the CBST module on Microsoft PowerPoint and completed the training during the workday. The training contained four sections: informational, video modeling, competency assessment, and an opportunity to practice the target skill. Before beginning the training, the contractors were provided with a panel of glass or mirror and were told they would need it later.

Information and instruction. The introduction of the training provided the participants with a brief description on the role of Occupational Safety and Health Administration (OSHA) as well as statistics on injuries and accidents in the glass and glazing industry. OSHA's role in regulating use of PPE was described and six PPE items used when carrying glass/mirror were described; these six items are: Type II hardhat, safety spectacles, wrist guard, nitrile-coated gloves, jeans, and composite toe shoes. The participants were provided with information on each of the six PPE items, including: the area of the body the PPE item is intended to protect, descriptions of the item and which variations of the item are not acceptable, how to accurately wear the item, and nonexamples of accurate use of the item. Participants were also provided instruction on inspecting items for visible signs of damage and informing the supervisor, so the item may be immediately replaced.

Video modeling. During the second part of the training, the participants watched a video of the researcher modeling proper use of PPE while handling a glass/mirror. At the beginning of the video, the researcher labeled each of the six PPE items required for safe carrying of

glass/mirrors. Then, the researcher, already in jeans, put the remaining five items on accurately. The researcher then modeled carrying a mirror a small distance and placing the panel on a table. The video was created at the workshop of the research site.

Competency assessment. After watching the video, the employees orally completed a competency assessment on PPE. No prompts were provided to the participant while answering each question. The researcher provided immediate feedback contingent on the participant's answer. If the contractors scored 80% or below, they were required to review the video and retake the assessment. If the contractors scored above 80%, they moved on to the rehearsal component.

Rehearsal. The employees then were provided the opportunity to rehearse accurate use of PPE while transporting a glass/mirror from one location to another. During the rehearsal component, the contractors were asked to practice safely carrying the glass/mirror provided to them at the beginning of the training to another specified location. The contractors were required to put on all PPE items and carry the glass/mirror to the specified location without prompts.

Feedback. The researcher provided immediate praise or corrective feedback based on the contractors' performance during the rehearsal component. Praise consisted of approving gestures, such as "high fives." Corrective feedback included asking the participant which PPE items were needed to safely carry glass/mirror, prompting the client as needed to recall each of the items. If the contractor scored below 100%, he needed to repeat the rehearsal component. The rehearsal and feedback components continued until mastery criterion was reached. Mastery criterion was 100% on one rehearsal.

Post-CBST/In-Situ Training

During post-CBST in-situ assessments, if a contractor engaged in incorrect responding (i.e., failed to wear all PPE while handling glass/mirror) for two consecutive sessions, an in-situ training was initiated on the third session. Contingent on incorrect responding on the third session, the researcher interrupted the contractor's performance and asked him to identify the six items required for safe carrying of glass and mirrors. The contractor provided prompts as needed for the participant to list all six items. The researcher then asked the contractor to ensure all items were on accurately before continuing to carry glass/mirror. If the participant scored 80% or below for three consecutive assessments, he was required to complete CBST again during the next workday. Post-CBST in-situ assessments were completed when eight in-situ assessments, each about a week apart, had been obtained for the first participant and when three in-situ assessments, each about a week apart, had been obtained for the last participant. After all participants met mastery criterion on post-CBST sessions, the owner was asked to complete a social validity measure.

Chapter 4: Results

Figure 1 displays the percentage of PPE pieces that were accurately worn by the three participants during baseline and post-CBST. During baseline, Mac wore less than 20% of the required PPE pieces, but following CBST, there was an immediate increase to over 80%, which later increased to 100% and remained. During baseline, Jimmy wore approximately 20% of the required PPE pieces, but following CBST, there was an immediate increase to 100% accuracy, which remained above 80% during subsequent checks. During baseline, Miller wore approximately 35% of the required PPE pieces, but following CBST, there was an immediate increase to over 60%, which later increased to 100% and remained.

Figure 2 displays the total number of accidents per month reported by the three participants during baseline and post-CBST. During baseline, Mac reported 0-4 accidents per month, and following CBST, he has reported one accident per month. During baseline, Jimmy reported 0-6 accidents each month, and following CBST, he reported one accident. During baseline, Miller reported 0-3 accidents per month, and following CBST, he reported one accident.

Figure 3 displays the total number of injuries per month reported by the three participants during baseline and post-CBST. During baseline, Mac reported 1-4 injuries per month, and following CBST, he has reported 1-2 injuries per month. During baseline, Jimmy reported 0-5 injuries each month, and following CBST, he has reported zero injuries. During baseline, Miller reported 0-3 injuries per month, and following CBST, he has reported zero injuries.

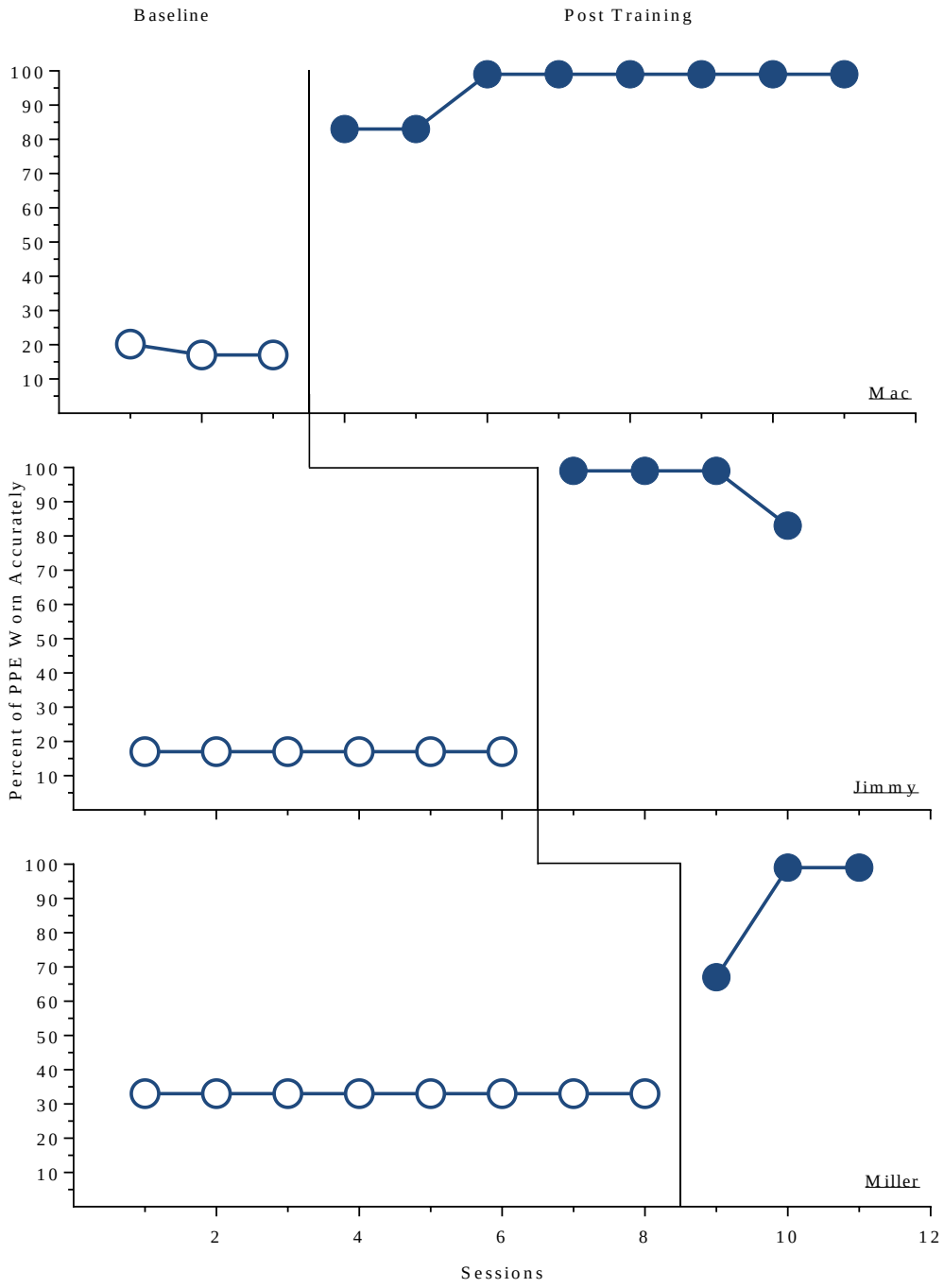

Figure 1. The percent of personal protective equipment (PPE) pieces accurately worn during baseline and post-CBST during in situ assessments.

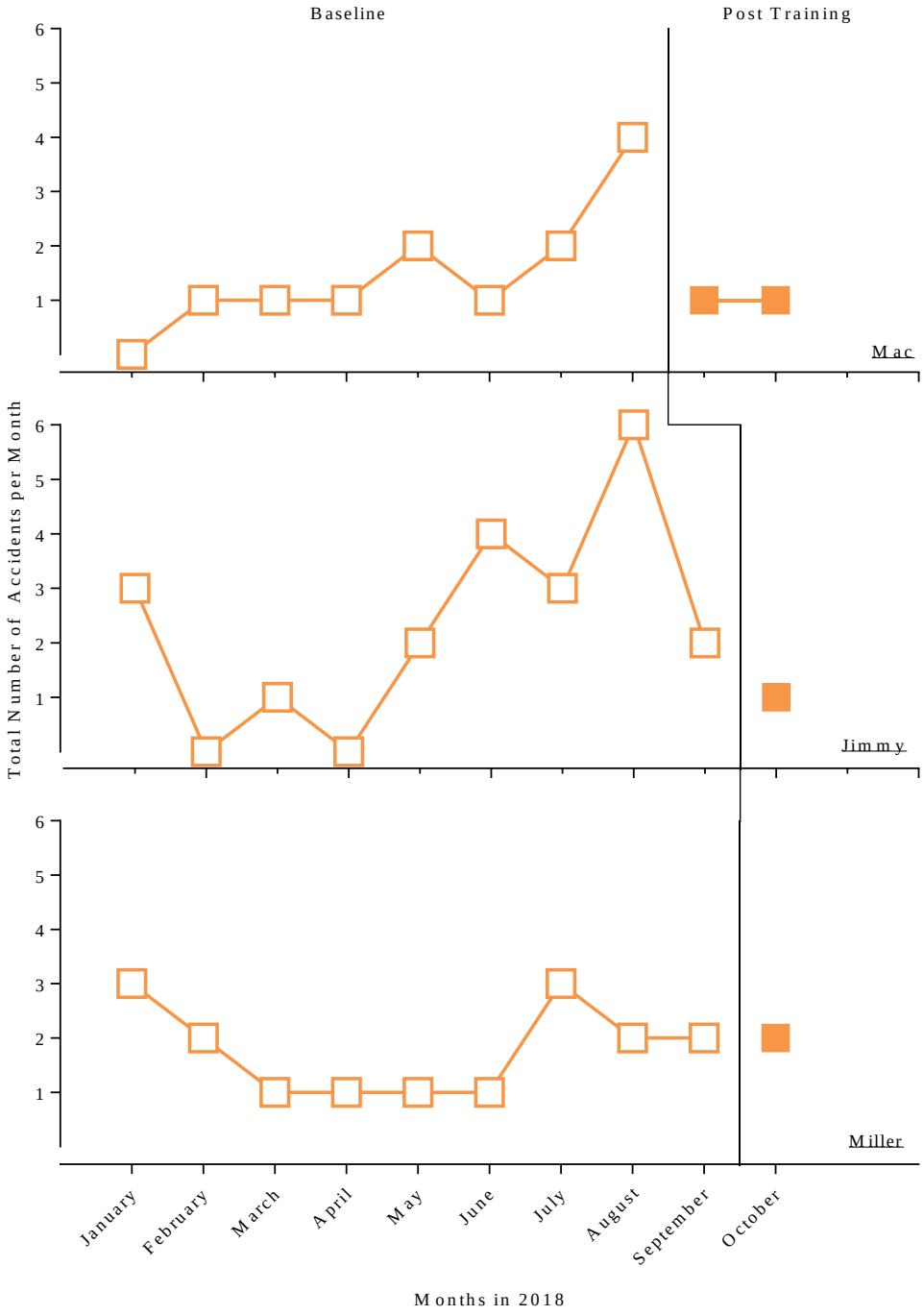

Figure 2. The total number of accidents reported for each employee per month during baseline and post-CBST.

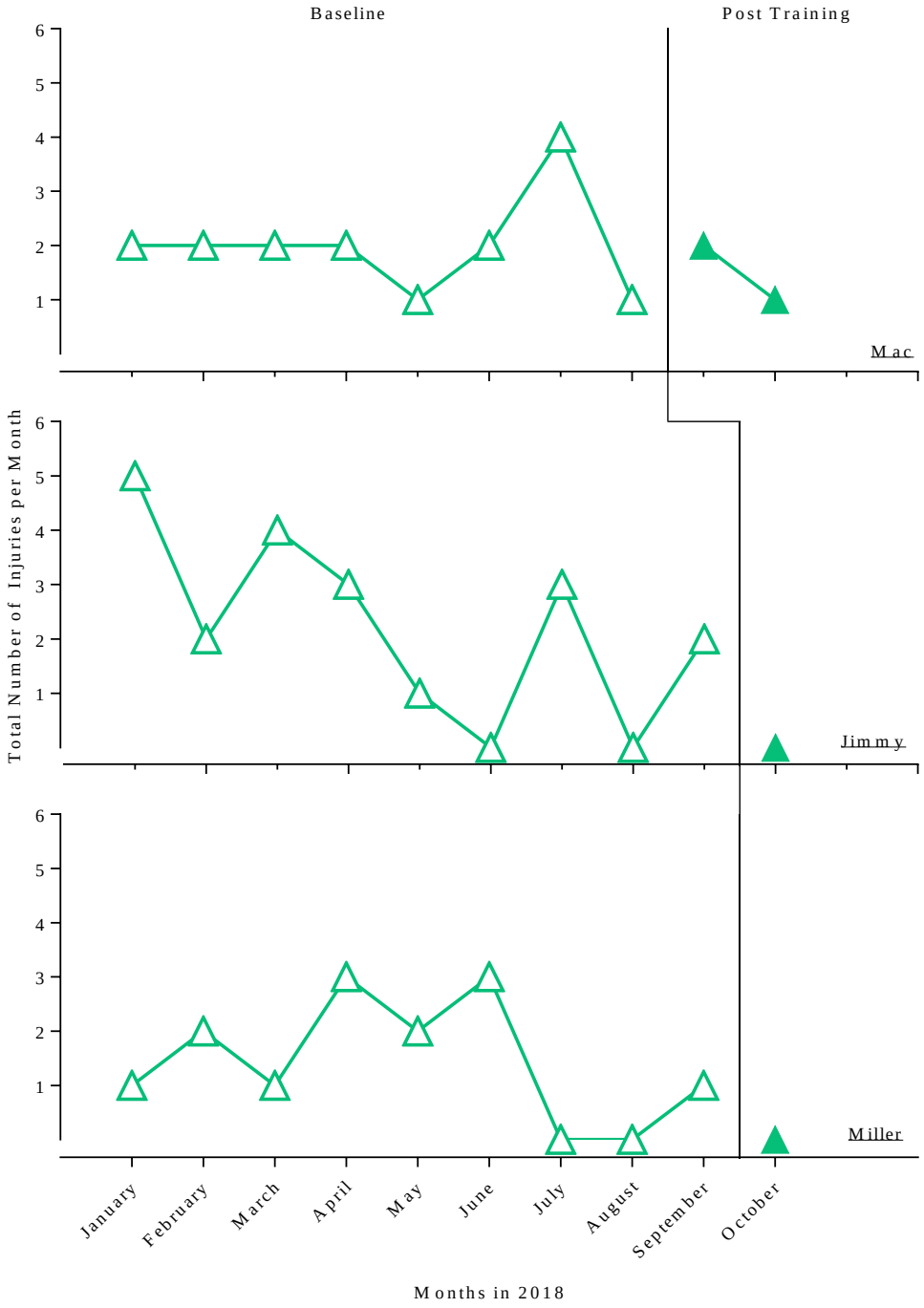

Figure 3. The total number of injuries reported for each employee per month during baseline and post-CBST.

The owner completed the social validity measure 3 weeks after all participants had received CBST. The owner indicated “Strongly Agree” across all statements, including: “It is very useful for employees to know proper usage of Personal Protective Equipment,” “The training was effective in teaching accurate use of Personal Protective Equipment,” “The training provided was effective in preventing injuries in a hazardous workplace,” “I am satisfied with amount of on-the-clock time required by each contractor to receive training,” “I am likely to use this training with future new-hires.”

Chapter 5: Discussion

The results of the current study indicate that CBST is a viable option to increase accurate use of safety precautions, specifically accurate use of PPE, in a hazardous workplace. CBST was effective and efficient, as all trainings were completed in approximately 15 minutes, and none of the participants required any in-situ training following the CBST session. One participant (Miller) required slightly more instruction on how to listen to the narration on each slide in the PowerPoint and how and when to advance to the next slide, but this did not affect the efficacy of the training. Incorporating the use of media in the BST package allowed for less individual time between the trainer and trainee. This factor may be considered an advantage or a disadvantage. In the workplace, this type of package would allow the employer to spend less time and money training employees because the time required for a trainer is minimal, as compared to traditional methods of teaching. Unfortunately, given the minimal interaction with a trainer, there is little time for questions or concerns, should the employee have any. Overall, given the possible reduced costs and high acceptability of the treatment package by the employer, CBST does appear to be a viable option for training new-hires and providing current employees a "refresher" if needed.

Although the study obtained generally positive results, there are limitations which should be noted. First, none of the participants met criteria to receive IST, but it is unknown if this was strictly due to the efficiency of training or if there were other factors. For example, it is possible the participants reminded each other to wear PPE in the presence of the employer. Additionally, although the employer was instructed to not provide directions or prompts regarding use of PPE, it is a possibility this occurred when the researcher was absent. Second, the use of PPE was only assessed at the showroom, garage, workshop, and parking lot of the workplace. Off-site use of

PPE was not assessed due to restrictions placed by the owner of the company. As such, it is possible that the participants had high accuracy within the workshop environment, but it is not certain whether or not that accuracy generalized. Additionally, the number of injuries and accidents per month were reported by the lead contractor per company policy; therefore, the accuracy of these reports cannot be determined. However, the owner reviews these reports and ensures injuries and accidents are reported daily.

Future research should also investigate the use of PPE, particularly the generalization aspect, which this study lacked. It would be interesting to evaluate if there were differences between settings, and why those differences may occur. Additionally, a longer duration of the frequency of injuries and accidents in the workplace following training would be informational. This study was not able to adequately demonstrate long-term effects of CBST on the frequency of injuries and accidents. Future research could also investigate the use of CBST for different safety targets within the glazing industry, such as use of face respiratory protection and hearing protection. Given the effectiveness and efficiency of CBST, evaluating it within different hazardous workplaces, such as construction and manufacturing sites, would also be beneficial.

References

Bergstrom, R., Najdowski, A. C., & Tarbox, J. (2014). A systemic replication of teaching children with autism to respond appropriately to lures from strangers. *Journal of Applied Behavior Analysis, 47,* 861-865. doi:10.1002/jaba.175Top of Form

Bumstead, A., & Boyce, T. E. (2005). Exploring the effects of cultural variables in the implementation of behavior-based safety in two organizations, *Journal of Organizational Behavior Management, 24*, 43-63. doi:10.1300/J075v24n04_03

Dickson, M. J., & Vargo, K. K. (2017). Training Kindergarten student lockdown drill procedures using behavioral skills training. *Journal of Applied Behavior Analysis, 50*, 407-412. doi:10.1002/jaba.369

Dogan, R. K., King, M. L., Fischetti, A. T., Lake, C. M., Mathews, T. L., & Warzak, W. J. (2017). Parent-implemented behavioral skills training of social skills. *Journal of Applied Behavior Analysis, 50*, 805–818. doi:10.1002/jaba.411

Fisher, M. H., Burke, M. M., & Griffin, M. M. (2013). Teaching young adults with disabilities to respond appropriately to lures from strangers. *Journal of Applied Behavior Analysis, 46,* 528-533. doi:10.1002/jaba.32.

Forehand, R., Sturgis, E. T., McMahon, R. J., Aguar, D., Green, K., Wells, K. C., & Breiner, J. (1979). Parent behavioral training to modify child noncompliance: Treatment generalization across time and from home to school. *Behavior Modification, 3*, 3-25. doi:10.1177/014544557931001

Fox, D. K., Hopkins, B. L., & Anger, W. K. (1987). The long-term effects of a token economy on safety performance in open-pit mining. *Journal of Applied Behavior Analysis, 20,* 215-224. doi:10.1901/jaba.1987.20-215

Geller, E. S. (2005). Behavior-based safety and occupational risk management. *Behavior Modification, 29*, 539-561. doi:10.1177/0145445504273287

Gross, A., Miltenberger, R., Knudson, P., Bosch, A., & Breitwieser, C. B. (2007). Preliminary evaluation of a parent training program to prevent gun play. *Journal of Applied Behavior Analysis, 40,* 691-695. doi:10.1901/jaba.2007.691-695

Gunby, K. V., Carr, J. E., & LeBlanc, L. A. (2010). Teaching abduction-prevention skills to children with autism. *Journal of Applied Behavior Analysis, 43,* 107-112. doi:10.1901/jaba.2010.43-107

Gunby, K. V., & Rapp, J. T. (2014). The use of behavioral skills training and in situ feedback to protect children with autism from abduction lures. *Journal of Applied Behavior Analysis, 47,* 856-60. doi:10.1002/jaba.173

Hagge, M., McGee, H., Matthews, G., & Aberle, S. (2017). Behavior-based safety in a coal mine: The relationship between observations, participation, and injuries over a 14-Year period. *Journal of Organizational Behavior Management, 37*, 107-118. doi:10.1080/01608061.2016.1236058

Hermann, J. A., Ibarra, G. V., & Hopkins, B.L. (2010). A safety program that integrated behavior-based safety and traditional safety methods and its effects on injury rates of manufacturing workers. *Journal of Organizational Behavior Management, 30*, 6-25. doi:10.1080/01608060903472445

Himle, M. B., Miltenberger, R. G., Flessner, C., & Gatheridge, B. (2004). Teaching safety skills to children to prevent gun play. *Journal of Applied Behavior Analysis, 37,* 1-9. doi:10.1901/jaba.2004.37-1

Himle, M. B., & Wright, K. A. (2014). Behavioral skills training to improve installation and use of child passenger safety restraints. *Journal of Applied Behavior Analysis, 47,* 549-559. doi:10.1002/jaba.143

Homlitas, C., Rosales, R., & Candel, L. (2014). A further evaluation of behavioral skills training for implementation of the picture exchange communication system. *Journal of Applied Behavior Analysis, 47,* 198-203. doi:10.1002/jaba.99

Houvouras, A. J., & Harvey, M. T. (2014). Establishing fire safety skills using behavioral skills training. *Journal of Applied Behavior Analysis*, *47,* 420-424. doi:10.1002/jaba.113

Hsieh, H., Wilder, D. A., & Abellon, O. E. (2011). The effects of training on caregiver implementation of incidental teaching. *Journal of Applied Behavior Analysis*, *44,* 199-203. doi:10.1901/jaba.2011.44-199

Iwata, B. A., Wallace, M. D., Kahng, S. W., Lindberg, J. S., Roscoe, E. M., Conners, J., … Worsdell, A. S. (2000). Skill acquisition in the implementation of functional analysis methodology. *Journal of Applied Behavior Analysis*, *33,* 181-194. doi:10.1901/jaba.2000.33-181

Johnson, B. M., Miltenberger, R. G., Knudson, P., Egemo-Helm, K., Kelso, P., Jostad, C., & Langley, L. (2006). A preliminary evaluation of two behavior skills training procedures for teaching abduction-prevention skills to schoolchildren. *Journal of Applied Behavior Analysis*, *39,* 25-34. doi:10.1901/jaba.2006.167-04

Komacki, J., Barwick, K. D., & Scott, L. R. (1978). A behavioral approach to occupational safety: Pinpointing and reinforcing safe performance in a food manufacturing plant. *Journal of Applied Psychology*, *63,* 434-445. doi:10.1037/0021-9010.63.4.434

Lafasakis, M., & Sturmey, P. (2007). Training parent implementation of discrete-trial teaching: Effects on generalization of parent teaching and child correct responding. *Journal of Applied Behavior Analysis, 40,* 685-689. doi:10.1901/jaba.2007.685-689

Lerman, D. C., Hawkins, L., Hillman, C., Shireman, M., & Nissen, M. A. (2015). Adults with autism spectrum disorder as behavior technicians for young children with autism: Outcomes of a behavioral skills training program. *Journal of Applied Behavior Analysis, 48*, 233-256. doi:10.1002/jaba.196

Ludwig, T. D., & E. Geller, S. (2000). Intervening to improve the safety of delivery drivers. *Journal of Organizational Behavior Management*, *19*, 1-124. doi:10.1300/J075v19n04_01

Magen, R. H., & Rose, S. D. (1994). Parents in groups: Problem solving versus behavioral skill training. *Research on Social Work Practice, 4*, 172-191. doi:10.1177/104973159400400204

Miles, N. I., & Wilder, D. A. (2009). The effects of behavioral skills training on caregiver implementation of guided compliance. *Journal of Applied Behavior Analysis, 42,* 405-410. doi:10.1901/jaba.2009.42-405

Myers, W. V., McSween, T. E., Medina, R. E., Rost, K., & Alvero, A. M. (2010). The implementation and maintenance of a behavioral safety process in a petroleum refinery, *Journal of Organizational Behavior Management*, *30*, 285-307. doi:10.1080/01608061.2010.499027

Nabeyama, B., & Sturmey, P. (2010). Using behavioral skills training to promote safe and correct staff guarding and ambulation distance of students with multiple physical disabilities. *Journal of Applied Behavior Analysis, 43,* 341-345. doi:10.1901/jaba.2010.43-341

Parsons, M. B., Rollyson, J. H., & Reid, D. H. (2012). Evidence-based staff training: A guide for practitioners. *Behavior Analysis in Practice, 5,* 2-11. doi:10.1007/BF03391819

Rosales, R., Stone, K., & Rehfeldt, R. A. (2009). The effects of behavioral skills training on implementation of the picture exchange communication system. *Journal of Applied Behavior Analysis, 42,* 541-549. doi:10.1901/jaba.2009.42-541

Scherrer, M. D., & Wilder, D. A. (2008). Training to increase safe tray carrying among cocktail servers. *Journal of Applied Behavior Analysis, 41,* 131-135. doi:10.1901/jaba.2008.41-131

Speelman, R. C., Whiting, S. W., & Dixon, M. R. (2015). Using behavioral skills training and video rehearsal to teach blackjack skills. *Journal of Applied Behavior Analysis, 48,* 632-642. doi:10.1002/jaba.225

Stewart, K. K., Carr, J. E., & LeBlanc, L. A. (2007). Evaluation of family-implemented behavioral skills training for teaching social skills to a child with Asperger's disorder. *Clinical Case Studies, 6,* 252-262. doi:10.1177/1534650106286940

Tai, S. S. M., & Miltenberger, R. G. (2017). Evaluating behavioral skills training to teach safe tackling skills to youth football players. *Journal of Applied Behavior Analysis, 50,* 849-855. doi:10.1002/jaba.412

United States Department of Labor. (2017). Employer-reported workplace injuries and illnesses-2016. (Report #USDL-17-1482). Retrieved from https://www.bls.gov/news.release/pdf/osh.pdf

United States Department of Labor: Occupational Safety and Health Administration. (n.d.) Incident investigation. Retrieved from https://www.osha.gov/dcsp/products/topics/incidentinvestigation/index.html

United States Department of Labor: Occupational Safety and Health Administration. (n.d.) Personal protective equipment. Retrieved from https://www.osha.gov/SLTC/personalprotectiveequipment/

Vanselow, N. R., & Hanley, G. P. (2014). An evaluation of computerized behavioral skills training to teach safety skills to young children. *Journal of Applied Behavior Analysis, 47,* 51-69. doi:10.1002/jaba.105

Whiting, S. W., Miller, J. M., Hensel, A. M., Dixon, M. R., & Szekely, S. (2014). Increasing the accuracy of EpiPen administration with a brief behavioral skills training package in a school for autism. *Journal of Organizational Behavior Management, 34,* 265-278. doi:10.1080/01608061.2014.973632