The Effects of On-The-Spot Observations in a Behavioral Safety Application

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THE EFFECTS OF ON-THE-SPOT OBSERVATIONS
IN A BEHAVIORAL SAFETY APPLICATION

by

Sigurdur Oli Sigurdsson

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Sigurdur Oli Sigurdsson
The purpose of this study was to examine the effects of a package intervention on critical safety behaviors and conditions in a food and drinking industry setting. The intervention involved training a sub sample of employees to conduct safety observations, providing all employees with safety information, and posting weekly graphic safety feedback on six safety-related variables based on employee observations. A multiple baseline design across departments was used to assess the effects of the interventions in two dining services kitchens on the campus of a midwestern university. Overall, the intervention implemented in this study had mixed effects on safety behavior, as moderate increases were observed for only three out of eight dependent variables, as observed by trained research assistants. The intervention had almost no positive effects on conditions, and significant decreases in safety conditions were obtained for three condition variables of the eight observed by research assistants. The possible behavioral functions responsible for these performance improvements are discussed. Future research is suggested to further examine the effectiveness of this behavioral technology to improve injury prevention efforts in industry, and to bring about lasting changes in safety behavior and conditions.
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INTRODUCTION

The purpose of this study was to examine the effects of a package intervention on critical safety behaviors and conditions in a food and drinking industry setting. Critical safety behavior and safety conditions were targeted, and following a safety assessment, a subset of full-time employees was trained to conduct safety observations of conditions and the behavior of peers and student employees. All full-time and student employees received informational handouts on the safety targets, and graphic safety feedback on six safety-related variables was delivered weekly, based on observations conducted by employee observers. The data analyzed in this study were collected by trained research assistants. The research was conducted in two dining services kitchens on the campus of a midwestern university. A multiple baseline design across departments was used to assess the effects of the intervention. Some improvements were observed in safety behavior, but the intervention was not effective in reducing the frequency of hazardous work conditions. Results are discussed in terms of the benefits to organizations attempting to evaluate and improve the effectiveness of their injury preventions programs, and the possible behavioral mechanisms responsible for the effects obtained.
REVIEW OF LITERATURE

It has been estimated that the annual direct cost to U.S. employers from injuries to their workers may be as high as $200 billion (Miller, 1997), and it is probably fair to assume that this number has increased somewhat in the seven years that have passed since this estimate was published. Certain professions seem to be particularly at risk for work-related injuries and illnesses. For example, truck drivers consistently reported the highest number of occupational injuries of all professions from 1993 through 1999 (United States Department of Labor [DOL], 2001).

Workers in food preparation industries regularly engage in behavior that can put them at risk for injuries, and routinely come into contact with hazardous conditions through their day-to-day tasks. In the United States, approximately 300,000 nonfatal occupational injuries and illnesses involving days away from work (e.g., carpal tunnel syndrome, sprains, strains, back pain, fractures, and burns) were reported by workers in the food and drinking industries in 2001 (DOL, 2002a). This corresponds to 5.3 injuries per 100 full-time workers.

Injuries in the food and drinking industries may result from a single instance of contact with sharp objects, machinery, slippery floor surfaces, and hot surfaces or produce (DOL, 2002b). Lifting heavy pots and kettles, and working near hot ovens and grills are common causes of injuries in food and drinking industries, and common injury types include slips and falls, cuts, and burns. The injuries suffered by workers in food and drinking industries can also occur through repeated at-risk behaviors, such as lifting heavy objects and working in static positions for long periods of time. For example, work-related musculoskeletal disorders (MSDs) can result from repetitive
motion, poor posture at workstations, and equipment variables (Blake-McCann & Sulzer-Azaroff, 1996). An MSD is defined by the U.S. Department of Labor as "an injury or disorder of the muscles, nerves, tendons, joints, cartilage, and spinal discs" (DOL, 2001, p.3). In 1999, there were more than 580,000 lost work time cases involving MSDs reported in the United States, and employers pay approximately $20 billion annually in direct workers’ compensation costs, and another $60 billion in indirect costs related to MSD injuries and illnesses (DOL, 2001).

Incidence rates of injuries are the most commonly used measures of safety in organizations (Chhokar & Wallin, 1984). One problem with relying on injury numbers as indices of safety performance is that injuries are events that are highly dependent on chance. In fact, the average worker suffers one lost-day injury or illness per 33 years of work (McSween, 2003). Moreover, if injury statistics are to function as feedback for safety performance, numbers would have to be collected and published somewhat frequently. In reality, injury statistics are collected infrequently (i.e., quarterly) in most organizations, making such statistics ill suited as a basis for performance feedback.

Behavioral safety is an approach to injury reduction that focuses on observable phenomena as they occur in real time, particularly on critical safety behaviors and safety conditions. By focusing on observable events and conditions rather than injury statistics, employee behaviors can be managed through, for example, regular performance feedback, goal setting, and rewards (Reber, Wallin, & Chhokar, 1984). Krause, Seymour, and Sloat (1999) analyzed up to 5 years of injury data from 73 companies in 12 industries that had implemented behavioral safety in some form. On average, injury reductions of 26% were observed in the first year after starting a behavioral safety process, and continued reductions were observed in each of the
Behavioral safety has been demonstrated to be effective in a wide variety of settings (Sulzer-Azaroff & Austin, 2000), such as at construction sites, grocery distributorships, manufacturing plants, shipyards, and many more. For example, Komaki, Barwick, and Scott (1978) used a feedback procedure to reduce the frequency of at-risk behaviors in a food manufacturing plant, Lingard and Rowlinson (1997) used a combination of feedback and goal setting to increase the frequency of safety behaviors and conditions at construction sites, and Alavosius and Sulzer-Azaroff (1990) increased the number of client-transfer tasks completed safely among nursing staff through a training and feedback intervention.

DePasquale and Geller (1999) sought to establish the critical success factors for behavioral safety interventions through one-on-one interviews and focus group meetings in 20 organizations. DePasquale and Geller found that trust in management abilities, perceived effectiveness of behavioral safety training, accountability, amount of education about behavioral safety, and tenure were all predictive of employee participation in behavioral safety processes. Contrary to what the authors had hypothesized, participants in mandated safety programs reported higher satisfaction with behavioral safety processes as compared to employees in organizations where participation was optional. The authors also noted that organizations with mandated safety processes allowed employees considerable leeway in scheduling and conducting observations. DePasquale and Geller however warned against these results being interpreted as prescriptive. Vredenburgh (2002) surveyed employees from 62 workplaces in order to investigate links between specific management practices and low injury rates. Vredenburgh found that preventive measures were predictive of injury rates, as well as front-end hiring and training of personnel in
safety. Yet another finding of the Vredenburgh study was that organizations should strive for safety specialists to be at management levels.

The behavioral approach to safety typically involves the following five steps (Sulzer-Azaroff & Austin, 2000):

1. Identify behaviors that impact safety.
2. Define these behaviors precisely enough to measure them reliably.
3. Develop and implement mechanisms for measuring those behaviors in order to determine their current status and set reasonable goals.
4. Provide feedback.
5. Reinforce progress.

In spite of the guidelines listed above, the techniques of behavioral safety are not always uniformly applied. For example, feedback can vary in terms of who delivers the feedback, whether it is privately or publicly delivered, how it is presented (e.g., visually, vocally, or in written form), and how frequently it is delivered. Goal setting is also a common element in behavioral safety applications that has been found to increase the effectiveness of safety interventions when coupled with feedback (Balcazar, Hopkins, & Suarez, 1985/1986; Reber, Wallin, & Chhokar, 1990). An important dimension of goal setting is whether goals are assigned or participative, as employees can participate in setting goals for their own behavior, or the goals can be assigned by management or researchers.

Fellner and Sulzer-Azaroff (1985) compared the effects of participative goal setting with assigned goals, and found that assigned goals resulted in statistically significant improvements in safety conditions, but not in improvements in employees' safety behaviors. Participative goals resulted in statistically significant improvements in neither conditions nor behaviors, although an overall pattern of mostly small
improvements was observed on eight out of ten safety measures (behaviors and conditions). Ludwig and Geller (1997) combined group feedback of complete stops on intersections with either participative or assigned goals, and found no differences in complete stops across groups based on level of participation in setting a goal. The authors did, however, identify differences in group performance on untargeted behaviors (safety belt use, and turn signal use). More specifically, employees who participated in the goal setting were more likely to fasten their seat belts and give a turn signal than employees that did not participate in goal setting. The generalization effects observed in the Ludwig and Geller study have, however, not yet been replicated.

In behavioral safety applications, the position of the observer within the organization may vary. Observations in behavioral safety can be conducted by supervisors, consultants, safety personnel, or even by employees themselves. Alvero and Austin (2003) noted that although there is anecdotal evidence to indicate that employees may work more safely as a result of conducting safety observations of their peers (i.e., “the observer effect”), the research literature on the topic is virtually nonexistent. In a series of laboratory studies, Alvero and Austin have consistently demonstrated that conducting observations results in increases in safety behavior on behalf of the observer. In a recent study, Sasson and Austin (2004) examined the effects of conducting safety observations on office workers' postural behavior in an applied setting. Safety behaviors of two groups of employees were observed, and both groups of employees received instructions on how to perform targeted behavior safely following baseline. One group of employees was exposed to safety-related feedback, while the other group conducted safety observations on the behavior of peers before feedback was introduced. Sasson and Austin averaged effect sizes across
the two groups, and found that employees that conducted safety observations of peers demonstrated relatively higher increases in safe behaviors as compared to employees that only received feedback.

McSween (2003) advocates a detailed observation procedure, in which observations are announced beforehand to the employees observed, and a comprehensive checklist with a sizable number (i.e., 15-20) of safety behaviors and conditions is completed. According to McSween, announced observations create the opportunity to provide immediate verbal feedback and to discuss strengths and weaknesses of observed safety performance, even though the knowledge of being observed may change the behavior of the observee in the presence of the observer. McSween also suggests announced observations may serve to foster an atmosphere of openness and respect in which employees do not fear "getting caught" performing unsafely. Krause (1995) further suggests that in order to develop trust in the observation procedure among employees, observers should be carefully selected based on credibility with peers, demonstrated commitment to safety, knowledge of target behaviors, and communication skills.

Agnew and Snyder (2002) recommend a process in which every employee participates as a safety observer by completing check cards that require approximately 10 seconds each to complete. Agnew and Snyder emphasize that all observed employees should know they will be observed occasionally, and employees should know what behaviors would be observed. However, the authors do not recommend all observations be announced beforehand. Agnew and Snyder argue that only by conducting unannounced observations can observers get an unbiased sample of the behavior of their co-workers. Verbal feedback immediately following an observation is not suggested as an integral part of every observation, but is to be delivered
occasionally, when observers "believe it will have the most impact" (p. 101). That is, the authors recommend that verbal and corrective feedback be delivered when an observer notices an observed employee's safety behavior markedly improving (positive feedback), or when employees are clearly putting themselves in danger (corrective feedback). Agnew and Snyder also recommend that verbal corrective feedback be given when unsafe behavior is performed without "awareness." Awareness is informally defined as a worker's being able to gauge him or herself engaging in important safety behaviors, for example, body posture or wearing personal protective equipment. Body posture is behavior that most workers engage in without awareness, according to Agnew and Snyder, as it is virtually impossible for a worker to discriminate between safe and unsafe body posture based only on his/her sensory feedback (e.g., proprioceptive stimulation). Wearing personal protective equipment is, however, an example of behavior that is performed with awareness, as a worker is able to discriminate between safe and unsafe instances of that behavior for himself/herself.

The approaches of both Agnew and Snyder (2002), and McSween (2003) involve regular postings of graphic feedback of group safety performance in public areas, based on employee observations, and both approaches advocate setting difficult, yet attainable safety goals. Both models also emphasize that managers can support the process by reinforcing employee observations, and by reinforcing safe behaviors.

A number of safety studies have been conducted using a relatively long checklist to conduct safety observations, in a manner similar to McSween's approach (2003). Alavosius and Sulzer-Azaroff (1986), for example, used a lengthy checklist that detailed the components of safe client transfers as a basis for a feedback system.
that involved written and verbal feedback delivered by supervisors and experimenters. Sulzer-Azaroff, Loafman, Merante, and Hlavacek (1990) utilized checklists with a number of safety behaviors and conditions in a large industrial plant to deliver graphed feedback on the percentage of behaviors performed safely and percentage of safe conditions. Austin, Kessler, Riccobono, and Bailey (1996) conducted safety observations using a checklist consisting of 21 items to assist supervisors in delivering verbal feedback to workers in a roofing crew.

Studies in Behavior-Based Safety that have utilized checklists consisting of relatively few behaviors for data collection have almost exclusively been conducted in the area of traffic and driver safety. For example, Pasto and Baker (2001) delivered daily feedback in the form of signs to college students on safety belt use, which resulted in increases in safety belt use. Ludwig, Biggs, Wagner, and Geller (2001) delivered weekly posted feedback on critical traffic safety behaviors to two groups of pizza deliverers. Each group received feedback on only one behavior, and significant improvements in safety were observed for both groups.

In a review conducted for the purposes of this study, we found no studies utilizing short checklists as sources of feedback based on observations by peers in a work setting. As an example of one potential exception, DeVries, Burnette, and Redmon (1991) implemented a procedure in which infection control nurses delivered feedback to staff nurses on glove wearing. The DeVries et al. study clearly differed from the Agnew and Snyder model, however, which recommends repeated employee observations of peers, a relatively short checklist or check cards, and public graphed safety feedback. In the DeVries et al. study, although a short checklist was used, it was used only by experimental data collectors, and although graphic feedback was delivered, it was delivered privately along with verbal feedback.
Agnew and Snyder (2002) acknowledge that unsafe behavior often results from production pressure and other organizational variables that interfere and compete with safety. They argue that through peer observations, feedback, and management support, employees will eventually establish good safety habits. According to Agnew and Snyder, safety habits involve doing "safe things consistently and **automatically**" (p. 15) (italics and bold face not added). Therefore, Agnew and Snyder seem to argue that peer observations, graphic (and, occasionally, verbal) feedback, and supervisory support (e.g., in the form of granting employees time for observations, demonstrating a clear and positive concern for safety, and reinforcing safe behavior) provide reinforcement for safe behavior. Contingencies that have led to unsafe behavior are thus overpowered, and unsafe behavior is replaced by alternative safe behavior.

The purpose of this study was to evaluate the effectiveness of a behavioral safety intervention based on the Agnew and Snyder (2002) model. Following a safety assessment, and collaboration with an on-site safety committee, critical categories of safety behavior and conditions were identified. Employee observers were trained to conduct safety observations, and feedback was posted weekly based on their observations. Managers were encouraged to support the process by addressing safety concerns during regular unit meetings, and by giving verbal support to observers. A questionnaire was also administered to the participants at the end of the study for the purposes of social validation.
METHOD

Participants and Setting

Participants were students and full-time unionized employees at two on-campus kitchens at a large midwestern university. Kitchen A employed 15 full-time employees, and 86 student employees. Kitchen B employed 16 full-time employees, and 71 student employees. Employees worked during either morning or afternoon shifts. Students worked between six and twenty hours per week. Both kitchens had student supervisors, who worked twenty hours per week. Full-time employees included cooks, line-workers, salad-preparation workers, stock handlers, and bakers. Students participated to some degree in the same tasks as full-time employees, but all dishwashing and other cleaning of equipment was almost exclusively performed by students.

Participants worked in food preparation areas that included worktables and food preparation equipment, and in dining areas. Tasks included cutting or slicing produce (mechanically or by hand), cleaning or cooking on hot surfaces, handling hot receptacles, lifting heavy stock, and transferring pots, pans, and trays. Task rotation among employees was a common feature of the work. A shift manager was always present in the work areas. Shift managers were generally not involved in food preparation, but scheduled shifts, ordered stock, and engaged in other supervisory duties.

Independent Variables

A Behavior-Based Safety (BBS) process was implemented at both
The BBS intervention package involved providing information to all employees on safe methods of executing pinpointed tasks, training employee volunteers to conduct observation sessions, and delivering graphed feedback to employees on critical behaviors (Agnew & Snyder, 2002).

Training and Observation Procedure

Employee observers were volunteers and were recruited through references from the safety committee and managers. Three observers participated from Kitchen A (20% of all full-time employees in Kitchen A), and four observers participated from Kitchen B (25% of all full-time employees in Kitchen B). One observer from Kitchen A was transferred to another non-targeted kitchen four weeks after receiving observer training (16 days after the onset of the intervention in Kitchen B), and another observer from Kitchen B requested to withdraw from her role as an employee observer 50 days after the onset of the intervention in Kitchen B.

Before beginning to conduct observations, employee observers participated in a training session that lasted approximately four hours. During the training session, employees learned to apply operational definitions of safe behaviors and conditions, conduct observations, and complete safety check cards (i.e., short checklists). In a manner similar to Komaki et al. employee observers were shown slides depicting examples and non-examples of safe behaviors and conditions corresponding to items on the safety check cards. Employee observers were shown simultaneously photos of unsafe and safe behaviors and conditions, and then asked to describe exactly what was being done in a safe or unsafe manner for each slide. An operational definition for every behavior and condition accompanied each slide. This process was repeated for all items corresponding to behaviors and conditions on the safety check cards. At
the end of observer training, six employees' knowledge was evaluated through a written test. The test involved discriminating between safe and unsafe instances of ten checklist items depicted on overhead slides, and accuracy averaged 93.33%.

Small (measuring approximately 4 by 4 inches) check cards were made available to employee observers in easily accessible areas. Each check card included one category of safety behaviors, or one category of safety conditions, to be observed in an on-the-spot observation (Appendix A). The check cards were arranged in the following categories: slip hazards, work surroundings, cuts, and back safety. The check cards did not include all behaviors and conditions observed during research assistant observations. (see Appendix B for a copy of the checklist used by research assistants). The behaviors and conditions that were not listed on the check cards were assessed for generalization effects, based on research assistant observations.

On-the-spot observations involved observations of either one category of safety behaviors, or one category of safety conditions at a time, and observations were not announced beforehand to the employees being observed. During an on-the-spot observation, an employee completed the check card at an opportune time of the employee's own choosing, but during the normal course of work. Employee observers were encouraged to complete at least five check cards per day.

For check cards that involved behaviors, the employee observer was instructed to conduct a 10-15 second observation of employees working in his/her work area, and to identify whether any employees were engaging in any of the behaviors identified on the check card. Based on an operational definition provided on the back of the check card, the employee observer was to mark the behavior as either "Safe", if all employees engaged in that behavior were performing it safely, or "Unsafe" if one or more employees engaged in that behavior performed it unsafely. Under normal
circumstances, employee observations did not involve any contact between the employee observer and the employee(s) observed. However, when observers felt that verbal feedback and/or praise would have a large effect on the safety performance of the observee, observers were encouraged to deliver feedback and/or praise (as described in Agnew & Snyder, 2002). Observers were also encouraged to give feedback to the observee(s) when the observed behaviors were perceived to be very likely to result in injury. Neither the names nor the positions of the employees observed were recorded on the check cards, but employee observers initialed completed check cards.

For check cards that involved conditions, the employee observer conducted a 10-15 second observation of conditions in his/her work area, and identified whether any of the conditions listed on a check card were safe or unsafe, based on an operational definition that was provided on back of the check card.

Completed check cards were deposited in a sealed envelope, and handed to kitchen secretaries on site before the end of each workweek. Envelopes were sent to an assistant to the director of the campus' kitchens. Neither kitchen managers nor directors viewed the completed check cards.

During week ten of the intervention in Kitchen A, and week nine of the intervention in Kitchen B, all full-time employees in both kitchens received informational handouts with detailed information on all target behaviors and conditions (reproduced in Appendix C), and were invited to conduct observations.

Information

All full-time employees received an instructional flyer that included operational definitions of all critical behaviors and conditions targeted by the BBS
intervention (see Appendix D). Flyers were distributed to full-time employees during a kick-off meeting that signaled the start of the intervention. The kick-off meeting was scheduled when all volunteer employee observers had completed observer training.

Student employees also received information about targeted behaviors and conditions through a flyer (see Appendix E). The flyers were placed in slots that stored students' time cards next to time clocks in each kitchen. Items on student flyers focused on safety behaviors and conditions that were applicable to the tasks they routinely carried out. Student supervisors also directed student employees' attention to information about the intervention that was posted in prominent places in both kitchens. Students were also instructed to initial their name on a sheet that was placed next to the time clock after reading the information.

**Graphed Feedback**

Graphed feedback of group safety performance was posted publicly at prominent locations in employees' work-areas on a weekly basis, along with feedback on the total number of check cards completed each week. The graphed feedback was based on data collected by employees, and all safety scores (percent safe) were calculated by dividing the number of check cards that were scored as "Safe" by the total number of check cards handed in per week. Employees received graphic feedback on the following measures:

1. Full-time employees: percentage of cuts check cards scored as safe.
2. Full-time employees: percentage of back safety check cards scored as safe.
3. Student employees: overall percent safe for all behaviors.
4. Percentage of slip hazards check cards scored as safe.
5. Percentage of work surroundings check cards scored as safe.
6. Number of check cards handed in per week.

The six graphs were maintained and updated on a weekly basis by an assistant to the director of the campus kitchens. When no observations were done in a week, a zero was entered on the graph depicting the number of check cards completed weekly.

Independent Variable Integrity

The number of check cards completed by each employee observer per week was monitored, and served as a measure of the frequency and regularity of observations. The percentage of weeks in which delivery of graphic feedback occurred as planned was also monitored.

Research Assistant Observations

Trained undergraduate research assistants, who were not employees of the university, collected data for the dependent variables using a comprehensive safety checklist (see Appendix B). Employees were observed by research assistants twice daily, during morning and afternoon "rush hours" (approximately 9:00-11:00 a.m., and approximately 2:00-4:00 p.m.). Research assistants first walked through the work area and completed a safety checklist based on conditions in the kitchens at the beginning of the observation session. The research assistants then looked for employees engaging in target behaviors. Each employee that was engaging in task-relevant safety behavior was observed for a duration of 20 seconds. After observing an employee and scoring the safety of all task-relevant behavior, the research assistants looked for another employee, and repeated the observation process. During an observation session, research assistants observed between five and ten full-time employees and between five and ten student employees. In order for a dependent
variable score to be calculated for either category of employees across an observation session, at least five employees had to be observed. No employee was observed more than once during a session. Research assistants were instructed to conduct observations in a manner that drew minimal attention, and disrupted the normal work process at the work site as little as possible.

A primary observer was selected for each experimental session. To ensure that both observers observed at the same time, the primary observer was responsible for announcing when to begin the observation procedure. When observing individual employees, the primary observer was fitted with an audio tape player that prompted when to observe, and when to end the observation interval. The primary observer was responsible for signaling to the reliability observer the start and end of each observation interval.

Interobserver agreement (IOA) measures were calculated separately for behaviors and conditions. IOA for behaviors was calculated by dividing the number of agreements during an experimental session by the number of agreements plus disagreements, and then multiplying by 100. An agreement was scored either when both observers agreed that all task-relevant behaviors were safe, or agreed on at least one task-relevant behavior being unsafe. Disagreements were scored when observers did not agree on at least one behavior being unsafe. Whereas this procedure may lead to a slight overestimate of interobserver agreement, this measure was selected to most accurately reflect the reliability of the particular dependent measure (percentage of employees engaging safely in all targeted behaviors) in the study.

IOA was calculated for conditions using the following formula (Kazdin, 1988):

\[
\text{IOA} = \frac{\text{Number of Agreements}}{\text{Number of Agreements and Disagreements}} \times 100
\]
Dependent Variables

The primary dependent variables in this study were the percentage of employees observed as performing all behaviors relevant to their tasks safely during an observation session, and the percentage of critical workplace conditions observed as safe during an observation session. These data were collected by research assistants, using a comprehensive checklist of pinpointed behaviors and conditions (see Appendix B). A safety score for behaviors was only calculated if five or more employees were observed during an observation session, and the same rule was applied to student employees.

Behaviors

All targeted behaviors relevant to tasks in which a participant was engaging during an observation period were marked as having occurred safely or unsafely, using a 20 second whole interval time sampling procedure. If a participant’s performance on a relevant dependent variable met all of the criteria of the operational definition during the entire 20-second interval, the dependent variable was scored as safe. If the participant’s performance failed to meet any part of the definition at any time during the observation period, the relevant dependent variable was scored as unsafe. The participant’s behavior was observed for 20 seconds, followed by a 10 second recording period. A portable tape player was used to play back sound recordings to cue the appropriate observation and recording behaviors. Observation sessions varied in duration, based on the number of employees working and engaging in work behaviors during the session. The percent safe proportion for critical safety behaviors was calculated by dividing the number of employees observed performing all targeted task-relevant behaviors safely by the total number of employees observed
(as in Reber et al., 1990). Data were also collected on non-targeted behaviors to assess possible generalization effects of the intervention.

Data collection was arranged in a fashion that allowed for separate analyses of group performance on any given behavior or condition, as analyzing individual items could help in identifying areas in which participants were consistently safe or unsafe.

Thirty behaviors were observed throughout the study and were divided into five categories: (a) generic, (b) slicing, (c) cutting, (d) lifting, and (e) other. Behaviors targeted by the intervention are marked with an asterisk (*).

Five dependent variables fell into the “generic” category and were defined as follows:

1. *Repetitive twisting. Back is not twisted repeatedly, two or more times, while engaging in the same work behavior. Displacement of shoulders and hips on a horizontal plane should not exceed 30 degrees during task completion.

2. *Back safety. If employee bends forward more than 30 degrees at any point during a 20 sec observation interval, score as unsafe.

3. *Walking, no rushing. Employee is not running, but maintains a walking pace. Eyes are directed towards path of walking.

4. *Shoulder level. Any part of arm is not raised above shoulder level when working continuously at stirring in kettles or spraying pots and pans.

Five dependent variables fell into the “slicing” category and were defined as follows:

1. *Eyes on task when using slicer or cutter. Eyes are on task when using mechanical slicer or buffalo cutter.

2. Slicer shield in place. Protective shield is used to press food down on slicer blade, not fingers.
3. *Slicer pick-up. Back of hand rests on surface where sliced products fall down from slicer blade, or slicer is turned "Off" when sliced products are transferred from slicer to receptacle.

4. Personal protective equipment (PPE) when cleaning slicer. Protective mesh gloves are worn on the hand that touches the slicer blade when cleaning the slicer.

Five dependent variables fell into the “cutting” category and were defined as follows:

1. *Cut away from self. Employee cuts away from self (torso and arm) when preparing food and opening containers.

2. *Eyes on task when using knife. Eyes are pointed in the direction of the knife when cutting.

3. *Fingers curled when cutting. All fingers are curled, not straight, when cutting down on an item resting on the cutting board.

4. *Two-by-two feet uncluttered workspace when cutting. Employee has a two-by-two feet uncluttered workspace when cutting produce on cutting board. Cut produce and waste are removed from the cutting board before a new piece of produce is transferred to the cutting board.

5. *No cutting into palm. Every time a participant is observed cutting into palm, this dependent variable will be scored as unsafe, regardless of whether participant is wearing a mesh glove or not.

Four dependent variables fell into the “lifting” category and were defined as follows:

1. *Use legs to lift. Legs are bent when heavy items are lifted. An approximately 120 degree angle of the knee is recommended.
2. *Straight back when lifting. Spine is bent less than 30 degrees when heavy items are lifted. Back should not be parallel to the floor.

3. *Twisting when lifting. There is no twisting of back when lifting a heavy load. Displacement of shoulders and hips on a horizontal plane should not exceed 30 degrees.

4. *Load close to body. Load is no more than two inches away from torso when lifting.

Twelve dependent variables fell into the “other” category and were defined as follows:

1. PPE worn when cleaning hot surfaces. Thick rubber gloves are worn when cleaning hot surfaces (e.g., flat top grill).

2. PPE worn when transferring hot items. Towel or pot-holder (e.g., not an apron) is used to shield hands from heat when transferring hot containers, and when loading and unloading rotary ovens.

3. Eye on task when cooking. Eyes are on task while cooking on hot surfaces.

4. Mixer in "OFF" position for pouring produce into bowl or when stirring. Mixer is in "OFF" position when ingredients are added to mixer bowl or when any utensils are put inside bowl.

5. Sliding and rotating when emptying Henney Penney basket. Fryer basket is hoisted up using two fingers and by sliding the basket against back wall of vat. No lifting of basket by grabbing the handle with whole palm. When emptying the basket, the side of the vat is used for leverage.

6. Rotating when emptying deep fryer basket. When emptying the basket, the side of the vat is used for leverage.

7. Stacking warm trays on carts. Hot trays and pans are transferred in cart
shelves, not stacked on top of each other on the top of the cart.

8. Rotary oven rotating mechanism in "OFF" position. Shelves in rotary oven are not moving when checking on product, or when loading pans into the oven, or unloading.

9. *Spatula in buffalo cutter bowl. Spatula is used to move food around in buffalo cutter bowl, not hands, when buffalo cutter is on. When buffalo cutter is off and blade is exposed, spatula is used to remove food from the bowl, not hands.

10. Stand back when opening combi-ovens. Employee stands back at least two feet when opening combi-oven doors.

11. PPE worn in dishwashing. Uses canvas gloves when removing hot items from dishwasher conveyor belt.

12. *Organization in dishwashing. Clean ware is only picked up from dishwashing machine at end of conveyor belt.

Conditions

At the start of an observation session, research assistants walked through the entire work area to identify critical workplace conditions. All variables related to conditions were scored as either safe or unsafe, based on operational definitions. If a freezer or cooler was too congested for an observer to enter, the dependent variable pertaining to that area was scored as not applicable. The safety score for critical conditions was calculated by dividing the number of items observed as "safe" by the total number of items observed. All conditions were targeted by the intervention.

Twelve critical safety conditions were monitored throughout the study. These conditions were defined as follows:

1. Walkways free of congestion. No equipment is left in walkways (e.g.,
electrical cords, carts) unless it is essential to tasks being carried out at the time of observation.

2. Stacking items. Items are not stacked higher than 1 foot on top shelves inside cooking area (not stock area). Handles (e.g., of pots and pans) are not sticking outside the edge of shelves in cooking area.

3. Dry floor around deep fryers. Floors are dry around deep fryers (old models and Henney Penneys). Scored as safe if no substantial drops larger than 1 inch, or grease smears larger than palm of hand are left on the floor, or less than 3 drops smaller than 1 inch clustered together.

4. Dry floor around grills. Floors are dry around grills (old models and Henney Penneys). Scored as safe if no substantial drops larger than 1 inch, or grease smears larger than palm of hand are left on floor, or less than 3 drops smaller than 1 inch clustered together.

5. Dry floor around kettles. Floors are dry around kettles. Scored as safe if no substantial drops larger than 1 inch, or grease smears larger than palm of hand are left on the floor, or less than 3 drops smaller than 1 inch clustered together.

6. Dry floor around ice machines. Floors are dry around ice machines. Scored as safe if no substantial drops larger than 1 inch, or grease smears larger than palm of hand are left on the floor, or less than 3 drops smaller than 1 inch clustered together.

7. Dry floor in coolers. Floors are dry in cooler walkways. Scored as safe if no substantial drops larger than 1 inch, or grease smears larger than palm of hand are left on the floor, or less than 3 drops smaller than 1 inch clustered together.

8. Dry floor in freezers. Floors are dry in freezer walkways. Scored as safe if no substantial drops larger than 1 inch, or grease smears larger than palm of hand are
left on the floor, or less than 3 drops smaller than 1 inch clustered together. No ice build-up or loose ice is on freezer floor.

9. Dry floor in dishwashing area. Floors are dry in the dishwashing area. Scored as safe if no substantial drops larger than 1 inch, or grease smears larger than palm of hand are left on the floor, or less than 3 drops smaller than 1 inch clustered together.

10. No unattended knives in work area. No sharp knives are left unattended (no employee standing by the knife or using it). Knives left sitting on counters, around pots and pans area, or in dishwasher racks.

11. Clean floor. No food bits exceeding one inch in diameter is left on the floor, and no slippery debris is left on the floor.

Experimental Design

The experimental design utilized in this experiment was a multiple baseline across settings and participants. The BBS process was introduced to the two experimental sites in a temporally staggered fashion, and one week separated the kickoff meetings in the sites.

Informed Consent

Participants' consent was not formally sought before this study was carried out. As part of the implementation plan, participants had the right to refuse to participate in conducting observations and/or in receiving feedback without negative consequences. Employee observers were informed during employee observer training of their right to withdraw from their role as observers at any time without penalty. As participants' behavior and workplace conditions were observed as part of regular management practices by inspectors from food safety and occupational safety
inspectors, it was not considered necessary to solicit informed consent.

HSIRB Approval

Protocol clearance from the Human Subjects Institutional Review Board was obtained for this project (see Appendix F).
RESULTS

Primary Dependent Variables

Behaviors

Figure 1 displays the percentage of full-time morning shift employees observed as performing all task-related behaviors safely during an observation session. During baseline, 34.06% (range: 0%-87.50%; \(sd = 21.16\%\)) of employees were observed as performing completely safely in Kitchen A, and 47.05% (range: 14.29%-100%; \(sd = 21.17\%\)) performed completely safely in Kitchen B. During the intervention phase, 45.10% (range: 0%-100%; \(sd = 25.52\%\)) of employees were observed as performing completely safely in Kitchen A, and 55.40% (range: 14.30%-100%; \(sd = 20.18\%\)) performed completely safely in Kitchen B. A statistically significant increase was not detected between experimental conditions for Kitchen A, \(z = 1.21, p = .22\). A statistically significant increase was not detected between experimental conditions for Kitchen B, \(z = 0.90, p = .36\).

Figure 2 displays the percentage of full-time afternoon employees observed as performing all task-related behaviors safely during an observation session. During baseline, 54.76% (range: 14.29%-100%; \(sd = 23.87\%\)) of employees were observed as
Legend. An asterisk indicates the first session after employees received observer training. A “+” represents the first posting of graphed feedback. An arrow indicates the start of a new school semester.

Figure 1. Percentage of Full-time Morning Shift Employees Observed as Performing All Task-related Behaviors Safely, and Number of Employee Observations. Kitchen A is represented on the top panel, and Kitchen B on the bottom panel.

performing completely safely in Kitchen A, and 54.08% (range: 14.29-100%; sd = 23.08%) performed completely safely in Kitchen B. During the intervention phase,
Legend. An asterisk indicates the first session after employees received observer training. A "+" represents the first posting of graphed feedback. An arrow indicates the start of a new school semester.

Figure 2. Percentage of Full-time Afternoon Shift Employees Observed as Performing All Task-related Behaviors Safely, and Number of Employee Observations. Kitchen A is represented on the top panel, and Kitchen B on the bottom panel.

55.49% (range: 0%-100%; $sd = 27.29\%$) of employees were observed as performing completely safely in Kitchen A, and 47.84% (range: 0%-100%; $sd = 24.17\%$) performed
Legend. An asterisk indicates the first session after employees received observer training. A “+” represents the first posting of graphed feedback. An arrow indicates the start of a new school semester.

Figure 3. Percentage of Morning Shift Student Employees Observed as Performing All Task-related Behaviors Safely, and Number of Employee Observations. Kitchen A is represented on the top panel, and Kitchen B on the bottom panel.
Legend. An asterisk indicates the first session after employees received observer training. A “+” represents the first posting of graphed feedback. An arrow indicates the start of a new school semester.

Figure 4. Percentage of Afternoon Shift Student Employees Observed as Performing All Task-related Behaviors Safely, and Number of Employee Observations. Kitchen A is represented on the top panel, and Kitchen B on the bottom panel.

completely safely in Kitchen B. No difference was detected between experimental conditions for Kitchen A, $z = 0.07, p = .94$. No difference was detected between experimental conditions for Kitchen B, $z = -0.66, p = .52$. 
Figure 3 displays the percentage of morning student employees observed as performing all task-related behaviors completely safely during an observation session. During baseline, 37.34% (range: 14.29%-80%; sd = 14.21%) of employees were observed as performing completely safely in Kitchen A, and 30.86% (range: 0%-60%; sd = 18.62%) performed completely safely in Kitchen B. During the intervention phase, 52.54% (range: 0%-100%; sd = 25.02%) of employees were observed as performing completely safely in Kitchen A, and 34.81% (range: 0%-80%; sd = 23.66%) performed completely safely in Kitchen B. A statistically significant increase was not detected between experimental conditions for Kitchen A, $z = 1.59, p = .12$. A difference was not detected between experimental conditions for Kitchen B, $z = 0.36, p = .72$.

Figure 4 displays the percentage of afternoon student employees observed as performing all task-related behaviors completely safely during an observation session. During baseline, 45.80% (range: 0%-80%; sd = 20.93%) of employees were observed as performing completely safely in Kitchen A, and 39.02% (range: 0%-100%; sd = 25.06%) performed completely safely in Kitchen B. During the intervention phase, 42.70% (range: 0%-80%; sd = 22.05%) of employees were observed as performing completely safely in Kitchen A, and 34.91% (range: 0%-80%; sd = 22.39%) performed completely safely in Kitchen B. No difference was detected between experimental conditions for Kitchen A, $z = -0.30, p = .76$, or for Kitchen B, $z = -0.45, p = .66$.

Table 1 lists all targeted behaviors, and the degree to which safe performance changed from baseline conditions to intervention. Increases were observed for six out of 15 targeted behaviors: no cutting into palm, fingers curled while cutting, using legs to lift, twisting torso, cutting away from self, and keeping load close to body while
lifting. Table 2 lists all non-targeted behaviors, and the degree to which safe performance changed from baseline conditions to intervention. Increases were observed for four out of 14 non-targeted behaviors: wearing PPE when cleaning slicer, pick-up away from slicer blade, turning rotary ovens "OFF", and turning mixers "OFF" when adding to or stirring in mixer bowl.

Table 1
Percentage Point Changes in Targeted Behaviors Across Experimental Conditions

<table>
<thead>
<tr>
<th>Behavior</th>
<th>Percentage Point Change</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cut: No cutting into palm</td>
<td>40.46</td>
<td>138</td>
</tr>
<tr>
<td>Cut: Fingers curled</td>
<td>28.70</td>
<td>331</td>
</tr>
<tr>
<td>Use legs to lift</td>
<td>7.88</td>
<td>147</td>
</tr>
<tr>
<td>Twisting</td>
<td>5.80</td>
<td>5128</td>
</tr>
<tr>
<td>Cut away from self</td>
<td>3.46</td>
<td>554</td>
</tr>
<tr>
<td>Load close to body</td>
<td>1.14</td>
<td>167</td>
</tr>
<tr>
<td>Back Safety</td>
<td>-0.35</td>
<td>5022</td>
</tr>
<tr>
<td>Shoulder level</td>
<td>-0.35</td>
<td>849</td>
</tr>
<tr>
<td>Walking, not rushing</td>
<td>-1.23</td>
<td>2068</td>
</tr>
<tr>
<td>Slicer: Eyes on task</td>
<td>-2.53</td>
<td>69</td>
</tr>
<tr>
<td>Cut: Workspace uncluttered</td>
<td>-4.09</td>
<td>407</td>
</tr>
<tr>
<td>Straight back: lifting</td>
<td>-5.37</td>
<td>163</td>
</tr>
<tr>
<td>Cut: eyes on task</td>
<td>-5.53</td>
<td>585</td>
</tr>
<tr>
<td>Twisting</td>
<td>-10.77</td>
<td>156</td>
</tr>
<tr>
<td>Dishwashing: organization</td>
<td>-11.36</td>
<td>299</td>
</tr>
</tbody>
</table>
Table 2
Percentage Point Changes in Non-targeted Behaviors Across Experimental Conditions

<table>
<thead>
<tr>
<th>Behavior</th>
<th>Percentage Point Change</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slicer: PPE worn when cleaning</td>
<td>30.91</td>
<td>26</td>
</tr>
<tr>
<td>Slicer: Pick-up away from blade</td>
<td>30.38</td>
<td>57</td>
</tr>
<tr>
<td>Rotary oven: &quot;OFF&quot;</td>
<td>24.09</td>
<td>189</td>
</tr>
<tr>
<td>Mixer: &quot;OFF&quot; for adding + stirring</td>
<td>14.34</td>
<td>35</td>
</tr>
<tr>
<td>PPE: cleaning</td>
<td>0.00</td>
<td>58</td>
</tr>
<tr>
<td>Slicer: Shield on</td>
<td>-1.34</td>
<td>60</td>
</tr>
<tr>
<td>Eye on task: cooking</td>
<td>-2.21</td>
<td>413</td>
</tr>
<tr>
<td>PPE: transferring</td>
<td>-3.53</td>
<td>554</td>
</tr>
<tr>
<td>Dishwashing PPE</td>
<td>-5.58</td>
<td>299</td>
</tr>
<tr>
<td>Stacking warm trays on carts</td>
<td>-13.49</td>
<td>110</td>
</tr>
<tr>
<td>Buffalo cutter: spatula</td>
<td>-21.43</td>
<td>18</td>
</tr>
<tr>
<td>Combi-ovens: stand back</td>
<td>-21.72</td>
<td>111</td>
</tr>
<tr>
<td>Henney Penney: slide and rotate</td>
<td>-26.86</td>
<td>74</td>
</tr>
<tr>
<td>Deep fryer: rotate</td>
<td>-32.48</td>
<td>66</td>
</tr>
</tbody>
</table>

Conditions

Figure 5 displays the percentage of areas observed as being completely free of slip hazards during morning observations. During baseline, 30.54% (range: 0%-62.50%; $sd = 14.12\%$) of areas were observed as being completely free of slip hazards in Kitchen A, and 44.98% (range: 12.50%-75%; $sd = 15.48\%$) were completely free of slip hazards in Kitchen B. During the intervention phase, 42.29% (range: 12.50%-87.50%; $sd = 18.44\%$) of areas were observed as being completely free of slip hazards in Kitchen A, and 45.58% (range: 0%-100%; $sd = 21.36\%$) were completely free of
Legend. An asterisk indicates the first session after employees received observer training. A "+" represents the first posting of graphed feedback. An arrow indicates the start of a new school semester.

Figure 5. Percentage of Areas Observed as Being Free of Slip Hazards During Morning Observations, and Number of Employee Observations. Kitchen A is represented on the top panel, and Kitchen B on the bottom panel.

slip hazards in Kitchen B. A statistically significant increase was not detected between experimental conditions for Kitchen A, $z = 1.31, p = .19$. A difference was not detected between experimental conditions for Kitchen B, $z = 0.07, p = .94$. 
Legend. An asterisk indicates the first session after employees received observer training. A “+” represents the first posting of graphed feedback. An arrow indicates the start of a new school semester.

Figure 6. Percentage of Areas Observed as Being Free of Slip Hazards During Afternoon Observations, and Number of Employee Observations. Kitchen A is represented on the top panel, and Kitchen B on the bottom panel.

Figure 6 displays the percentage of areas observed as being completely free of slip hazards during afternoon observations. During baseline, 50.21% (range: 12.50%-
Legend. An asterisk indicates the first session after employees received observer training. A "+" represents the first posting of graphed feedback. An arrow indicates the start of a new school semester.

Figure 7. Percentage of Work Surroundings Checklist Items Observed as Being Safe During Morning Observations, and Number of Employee Observations. Kitchen A is represented on the top panel, and Kitchen B on the bottom panel.

87.50% (sd = 18.43%) of areas were observed as being completely free of slip hazards in Kitchen A, and 40.69% (range: 0%-75%; sd = 18.78%) were completely free of slip hazards in Kitchen B. During the intervention phase, 29.50% (range: 0%-85.71%; sd = 21.57%) of areas were observed as being completely free of slip
hazards in Kitchen A, and 31% (range: 0%-86%; sd = 19.84%) were completely free of slip hazards in Kitchen B. A statistically significant decrease was detected between experimental conditions for Kitchen A, $z = -2.31, p = .02$. A statistically significant decrease was not detected between experimental conditions for Kitchen B, $z = -0.96, p = .34$.

Figure 7 displays the percentage of work surroundings checklist items observed as being safe during morning observations. During baseline, 42.88% (range: 25%-75%; sd = 14.67%) of work surroundings checklist items were observed as being completely safe in Kitchen A, and 38.43% (range: 0%-75%; sd = 24.63%) were completely safe in Kitchen B. During the intervention phase, 23.88% (range: 0%-75%; sd = 20.15%) of work surroundings checklist items were observed as being completely safe in Kitchen A, and 36.64% (range: 0%-100%; sd = 26.85%) were completely safe in Kitchen B. A statistically significant decrease was detected between experimental conditions for Kitchen A, $z = -2.08, p = .04$. A difference was not detected between experimental conditions for Kitchen B, $z = -0.21, p = .84$.

Figure 8 displays the percentage of work surroundings checklist items observed as being safe during afternoon observations. During baseline, 58.51% (range: 0%-100%; sd = 21.03%) of work surroundings checklist items were observed as being completely safe in Kitchen A, and 37.02% (range: 0%-100%; sd = 23.48%) were completely safe in Kitchen B. During the intervention phase, 25.70% (range: 0%-100%; sd = 22.65%) of work surroundings checklist items were observed as being completely safe in Kitchen A, and 34.10% (range: 0%-100%; sd = 22.23%) were completely safe in Kitchen B. A statistically significant decrease was detected between experimental conditions for Kitchen A, $z = -3.69, p < .01$. A difference was not detected between experimental conditions for Kitchen B, $z = -0.2, p = .84$. 

**Legend.** An asterisk indicates the first session after employees received observer training. A “+” represents the first posting of graphed feedback. An arrow indicates the start of a new school semester.

Figure 8. Percentage of Work Surroundings Checklist Items Observed as Being Safe During Afternoon Observations, and Number of Employee Observations. Kitchen A is represented on the top panel, and Kitchen B on the bottom panel.
Independent Variable Integrity

During the course of the study, employee observers completed 419 check cards. Slip hazards were observed 110 times, work surroundings were observed 101 times, cutting was observed 104 times, and back safety was observed 104 times. Employee observers in Kitchen A completed 145 check cards during the 82 work day (approximately 16 work weeks) intervention period, while observers in Kitchen B completed 274 check cards during the 77 work day intervention period (approximately 15 work weeks). Observations were not evenly distributed across employees. In Kitchen A, one employee observer completed 89 check cards. One employee observer in Kitchen A completed 47 check cards, and two employees completed three and one check cards respectively. In Kitchen B, the one employee observer completed 174 check cards. One employee observer in Kitchen B completed 55, and another employee observer completed 31 check cards. Three other employees in Kitchen B completed 13, four, and one check card(s) respectively.

Inter-observer Agreement

A total of 116 reliability sessions were conducted (24.42% of observations) during the course of the study, and agreement averaged 84.60% for behaviors (range: 60% to 100%; sd: 12.03%), and 92.80% for conditions (range: 74% to 100%; sd: 7.10%).

Injury Data

In the three semesters preceding the intervention, the two kitchens averaged 4.67 work-related injuries per semester (each semester lasted roughly 14 work weeks). The intervention was evaluated over the course of one semester and
approximately one month, and four work-related injuries were recorded while the intervention was in place. Of the four injuries recorded during the intervention, two involved cuts, one involved body mechanics, and one involved repetitive motion or overuse.
DISCUSSION

Overall, the intervention implemented in this study had mixed effects on safety behavior and no positive effects on safety conditions. More specifically, the intervention resulted in some increases in safe performance in five out of eight dependent variables, although none of these increases were statistically significant. No decreases in safety behaviors observed were statistically significant.

Of the eight dependent variables observed for safety-related conditions, a statistically significant difference in safety percentages from baseline to intervention was not obtained for any variable, but statistically significant decreases were observed for three variables.

Overall Effects

Behaviors

For full-time morning shift employees in Kitchen A, percentage increases in safety behaviors were not statistically significant, and visual inspection revealed a high degree of variability in both phases. For full-time morning shift employees in Kitchen B, improvements in safety behaviors were not statistically significant. Visual inspection further revealed a high degree of variability in the baseline phase for full-time morning shift employees in Kitchen B, and a slight up trend during baseline. However, the last three data-points in baseline were stable, and high levels of safety performance were observed towards the end of the intervention phase, which would suggest that experimental control was achieved to some degree for full-time morning shift employees in Kitchen B.
For full-time afternoon shift employees in Kitchen A, improvements in safety behaviors were not statistically significant. An upward trend was observed during the intervention phase, and the last four baseline sessions for full-time afternoon shift employees in Kitchen B were stable, which suggests that experimental control was achieved for full-time afternoon shift employees in Kitchen A to some extent. However, the small improvements in safe behaviors observed for full-time afternoon shift employees in Kitchen A were not replicated across Kitchen B.

For morning shift student employees in Kitchen A, improvements in safety behaviors were not statistically significant. A slight upward trend was observed during the intervention phase, which might suggest that experimental control was achieved for these employees. However, this small effect was not replicated across morning shift student employees in Kitchen B. The change in mean level across baseline and intervention phases was not statistically significant for morning shift student employees in Kitchen B, and high levels of variability in safety behaviors were observed during both experimental phases.

Small and statistically non-significant decreases in safe behaviors were observed for both afternoon shift student employees in Kitchen A and Kitchen B. Furthermore, visual analysis revealed no obvious trends during baseline or intervention conditions for afternoon shift student employees in Kitchens A or B.

Effects on Specific Behavioral Variables

Six out of 15 targeted behaviors improved from baseline to intervention, when averaged across locations and jobs. Of the six behaviors that improved during intervention, three involved cutting, and three involved back safety. Of the nine targeted behaviors that did not improve during intervention, four behaviors involved back safety, three behaviors involved cutting, and two behaviors involved prevention
of slipping and slip hazards. The two behaviors for which the greatest percentage point improvements were observed both involved cutting (cut: no cutting into palm, and cut: fingers curled). These improvements seem to suggest that the intervention was effective in improving the safety performance of two cutting behaviors that were clearly defined and demanded relatively little response cost. The intervention was not entirely effective in changing back safety behaviors. As Agnew and Snyder (2002) point out, behaviors that workers perform without awareness can be resistant to change, and safety behaviors that involve the back are a prime example of behaviors performed without awareness. Agnew and Snyder advocate that employee observers deliver verbal feedback when behaviors are performed unsafely, and without awareness. In the present study, employee observers were instructed to deliver verbal feedback in cases where behaviors were performed unsafely, and seemingly without awareness. However, no data were collected on how many times verbal feedback was delivered by employee observers, which makes it difficult to interpret the failure of back safety behaviors to improve.

Four out of 14 non-targeted behaviors improved from baseline to intervention, but safe performance of nine non-targeted behaviors decreased from baseline to intervention. Safe performance of one behavior did not change between baseline and intervention (PPE: cleaning).

There is no compelling evidence to suggest that the intervention implemented in this study resulted in improvements in non-targeted behaviors, as no clear patterns of improvements emerged for non-targeted behaviors. However, the most improved behaviors (slicer: PPE worn when cleaning, and slicer: pick-up away from blade) were related to prevention of cuts. Even though these behaviors were not specifically observed on the "Cuts" check cards used for employee observations, employees might
have understood graphed feedback on "Cuts" to also apply to work with slicers. This interpretation must be tempered by the fact that decreases were observed for two other behaviors related to slicing, one targeted (slicer: eyes on task) and one non-targeted (slicer: shield on), although the percentage point decreases for these two behaviors were very small.

Two other non-targeted behaviors improved during the intervention: rotary oven "OFF", and mixer "OFF" when adding or stirring. Whereas turning the rotary oven off is not immediately relevant to any of the check card categories used for feedback purposes, this behavior represented a safety issue that was clearly communicated by the organization. As this behavior demanded very little effort, it could have easily been reactive to research assistant observations during the intervention phase, when employees were explicitly told that research assistants were observing them for safety behaviors. The interpretation of the increases observed in safety when working with mixers is somewhat complicated by the fact that this behavior was observed quite infrequently during the course of the study, and that there were almost twice as many instances of that behavior observed during intervention (n=22) than during baseline (n=13).

Conditions

There are at least two possible reasons for the overall failure of the intervention to effect changes in conditions. It is possible that feedback on conditions was not meaningful to employees, as no specific behaviors were specified for how to actually reduce slip hazards, or make work surroundings safer. Another possible reason that conditions failed to improve is that the measurement of the dependent variables by research assistants was insensitive to changes in conditions. For example, in order for an area to be scored as free of slip hazards, no drops of liquids
or debris larger than one inch could be found in that area. This is a very conservative
measure, and even though small drops do constitute slip hazards, it is possible that the
intervention resulted in a reduction of large spills or large debris on floors. A
reduction in large spills and/or debris would have been an improvement in safety, as
employees are less likely to slip on smaller drops or debris than larger ones. Another
variable that might have been defined in a manner that was relatively insensitive to
change was unattended knives. Over the course of the study, only 19 instances were
recorded of all knives in an area being safely stowed away. However, employees in
both kitchens reported that as a result of new procedures suggested by the
organization's safety committee, the number of unattended knives had decreased after
the implementation of the intervention. The dependent variable as defined for
research assistant observations would have been insensitive to these changes, if they
in fact did occur.

Employee Observational Data

Figures 9 and 10 display simulations of the feedback graphs posted in the
kitchens during the intervention phase. Data points were added as completed check
cards were handed in. During some weeks, no check cards were handed in. When no
check cards were completed for a whole week in either kitchen, the first author met
informally with employee observers in that kitchen to trouble-shoot and help the
observers find opportunities to conduct observations.

Overall, employee observers in Kitchen A scored conditions during
intervention as improving, and being safer as compared to research assistant
observations (see Figure 9). This discrepancy might be due to the fact that employee
observers sampled only a small subset of areas, whereas research assistant observers
observed over a dozen areas per session that were combined into a single dependent
variable. It is quite possible that safety conditions did indeed improve in the areas observed by employee observers in Kitchen A, and that the dependent variable based on research assistant observations was insensitive to the improvements. Safety behaviors of full-time employees were scored as somewhat safer by employee observers than research assistants. Student behaviors were observed as improving in Kitchen A, and plateaued at 100% safe for the last three observation weeks.

Employee observers in Kitchen B scored slip hazards as being relatively unsafe (see Figure 10), and employee observer data seem to agree with research assistant observations for slip hazards. Employee observers in Kitchen B scored the safety of their work surroundings as being highly variable. Cutting and back safety were scored consistently as being safer by employees than research assistants. As in Kitchen A, student behaviors were observed as improving in Kitchen B.

Strengths and Weaknesses of the Study

The intervention utilized in this study was based on the model proposed by Agnew and Snyder (2002), and this study is the first experimental evaluation of a short, peer-based observation procedure using a short check card. As Agnew and Snyder suggest that check cards be introduced for one behavior or category of behavior at a time, this study differs from their model, as the four check cards used for employee observations were introduced simultaneously. The simultaneous introduction of a number of check cards was deemed appropriate in this study, as injury rates in the settings were high, and high rates of at-risk behavior and conditions were observed during baseline observations.
Legend. The y-axis indicates the percentage of check cards completed per week that were scored as "Safe".

Figure 9. Feedback Graphs Posted in Kitchen A.
Legend. The y-axis indicates the percentage of check cards completed per week that were scored as "Safe".

Figure 10. Feedback Graphs Posted in Kitchen B.
The intervention was designed so that employee observers could be trained in a relatively short time, and observations would take as little time as possible during the normal course of work. The intervention was designed in this fashion as time was at premium in the experimental sites, and there usually is a host of variables that compete with employees' conducting safety observations in the workplace. Production pressure, for example, is especially high in food service industries in which raw materials, and prepared foods can spoil easily (Sinclair, Smith, Colligan, Prince, Nguyen, & Stayner, 2003), and employees also have to constantly monitor availability of prepared dishes during meal hours, and refill when needed. Even though no explicit consequences were delivered contingent on improvements in safety as a part of the intervention, some positive consequences did occur during the intervention phase. All employee observers were publicly recognized by the directors of the kitchens for completing observer training, and the chair of a campus-wide injury prevention group recognized all safety committee members for their work, and one employee observer in Kitchen B that had completed a large number of check cards.

Some improvements in safety behaviors were observed as a result of the intervention. However, almost no positive effects on safety conditions were noted, and actual injury data did not seem to indicate a decrease in work-related injuries.

The average number of injuries per week recorded by the organization during three semesters prior to the intervention was 0.33, but was 0.26 during the intervention period. However, the low number of injuries in the experimental sites make that outcome somewhat unreliable as an indicator of outcome.

In the approximately 42 workweeks prior to the onset of intervention, a total of 14 injuries were recorded across both units (approximately 30 full-time
employees), which translates to 56 injuries per 100 full-time employees on an annual basis. During intervention (average duration: 15.5 weeks), four injuries were recorded, which translates to 43 injuries per 100 full-time employees on an annual basis. The industry average for food and drinking industries in 2001 was 5.3 work-related injuries or illnesses per 100 employees annually.

The overall failure to demonstrate consistent improvements in safety behaviors and conditions could be attributed to the fact that only a small subset of all employees was trained as observers. Agnew and Snyder (2002) advocate that all employees should receive safety observer training, but due to constraints on resources in the organization, this was not possible. As the intervention was somewhat successful in effecting changes in safety behavior, larger effects on safety behavior could perhaps have been observed if all employees had been trained as observers.

A behavioral safety intervention with different emphases was carried out in four other kitchens on the university campus at the same time as the intervention was carried out in Kitchens A and B. In the intervention carried out in the other kitchens, employees completed extensive checklists with three safety condition categories and five safety behavior categories on each checklist. In addition, employee observers in the other four kitchens could write comments on spaces allotted on the checklist for each safety category, for example, "wet floor in cooler #4," or "employee did not use cutting board." Managers in Kitchen B commented that such an opportunity for employee observers in their kitchen to provide comments would have been beneficial, and would have added more opportunities for managerial support of the safety process implemented in the kitchen. For example, knowing the percentage of slip hazards check cards scored as safe per week was not necessarily helpful in finding out, for example, which areas or specific behaviors were most consistently scored as unsafe,
or if equipment malfunctions were creating slip hazards. The managers of kitchens that served as the experimental site for the current study felt that more detailed safety information, similar to that provided in the other four kitchens of the organization, was needed for them to respond to such issues.

One weakness of the study is that no social validation measures were conducted in order to evaluate the acceptability of the intervention package. Social validation data were not collected due to circumstances that were unrelated to the study, but a questionnaire will be designed to evaluate employees' perceptions of the process.

Possible Behavioral Mechanisms

Agnew and Snyder (2002) present the active components of their intervention (observations of peers, feedback, and managerial support) as having reinforcing properties. While it is possible that, for example, managerial praise immediately following an instance of safe behavior can have reinforcing effects, most of the consequences delivered in this study were too delayed to be considered reinforcers (Michael, 1993). For example, the graphic feedback delivered to employees was updated weekly, and was therefore probably not in close temporal proximity to but an extremely small portion of behaviors that put employees at risk for injuries. It must also be noted that there is not total agreement about the specific functions of feedback (one of the treatment components recommended by Agnew & Snyder), as it has been argued that feedback may have direct reinforcing consequences (Komaki et al., 1978), may function as an establishing operation, or may have reinforcing consequences because of an association with other reinforcers (Agnew, 1998; Duncan & Bruwelheide, 1985/1986).
It is furthermore likely that the improvements in behavior observed in this study were partly a result of rules (Malott & Suarez, 2003) that were generated based on repeated exposure to feedback. Graphs were discussed at unit meetings, and the graphs were displayed in areas that employees frequently walked through. Safety rules, such as: "If I use my legs to lift, I will avoid back injury," or "If I keep my fingers curled while cutting, I will avoid getting cut," could possibly have acquired control over some of the safety behaviors that improved in the present study.

Safety observations of others may result in improvements in safety behavior (Alvero & Austin, 2003; Sasson & Austin, 2004). Alvero and Austin suggest that observations will be more likely to impact behavior that is difficult to perform, and difficult to judge (e.g., posture, and lifting) than behavior that an observer can easily perform, and for which discriminations between safe and unsafe instances is relatively easy (e.g., using personal protective equipment). There appears to be some overlap between the taxonomy of behavior proposed by Alvero and Austin, and the concept of awareness utilized by Agnew and Snyder (2003). Behaviors that are performed without awareness are difficult to judge, and observations of peers provide the observer with information on safe and unsafe instances. Verbal and corrective feedback delivered by employee observers to peers on behavior performed without awareness could have been responsible for the improvements observed in those two behaviors.

As the improvements in behavior that were observed in this study were not large, it is quite possible that only one or two employees per experimental site consistently improved as a result of the intervention. A relatively few employees were observed per session, so only one or two employees were needed to consistently improve in order to show dependent variable changes between conditions. It is quite
possible that employees that received observer training were the only employees that improved as a result of the intervention, which would suggest that training (an antecedent), and conducting observations were the most powerful elements of this package intervention. In this study, however, data on the identity of employees were not collected, making it impossible to calculate improvements for individual workers.

Future Research

In order to increase the impact of the intervention described here, it could be beneficial to train all employees to be observers, and to add the opportunity for employee observers to write down safety-related comments on the check cards. However, writing down comments might make the observation procedure more time consuming.

Managers were not involved to a large degree in the implementation of the intervention. For example, managers did not deliver safety feedback to employees, and no systematic measures were collected on the degree to which they actively supported the safety process. Managers were not involved because employees had stated in interviews that were conducted as a part of the safety assessment that they did not want any kind of systematic feedback from their managers. In other settings it might prove beneficial to include managers in the process to a larger degree than was done in the present study, as there is some evidence that feedback from a supervisor is more effective than feedback from other sources (Alvero, Bucklin, & Austin, 2001).

Another avenue for further research would be to collect data on the frequency of verbal feedback delivery by employee observers, in order to determine to what extent behaviors that are performed without awareness improve as a result of verbal feedback.
Appendix A

Check Cards: Employee Observations
<table>
<thead>
<tr>
<th>WMU Dining Services</th>
<th>Safety Check Card</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. Slip hazards</strong></td>
<td>S / U / X</td>
</tr>
<tr>
<td>Walking, not rushing.</td>
<td></td>
</tr>
<tr>
<td>No food on floors. Dry floors.</td>
<td></td>
</tr>
<tr>
<td>Organization in dishwashing area.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>WMU Dining Services</th>
<th>Safety Check Card</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>2. Work surroundings</strong></td>
<td>S / U / X</td>
</tr>
<tr>
<td>Handles inside shelf. Uncongested walkways.</td>
<td></td>
</tr>
<tr>
<td>Stacking: 1 foot from top shelf bottom.</td>
<td></td>
</tr>
<tr>
<td>No unattended knives.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>WMU Dining Services</th>
<th>Safety Check Card</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>3. Cuts</strong></td>
<td>S / U / X</td>
</tr>
<tr>
<td>Eyes on task. Uses proper knife.</td>
<td></td>
</tr>
<tr>
<td>Cut away from self. Fingers curled.</td>
<td></td>
</tr>
<tr>
<td>No cutting into palm. Cutting board used.</td>
<td></td>
</tr>
<tr>
<td>Uncluttered workspace.</td>
<td></td>
</tr>
<tr>
<td>Use spatula for buffalo cutter. Slicer pick-up.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>WMU Dining Services</th>
<th>Safety Check Card</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>4. Back safety</strong></td>
<td>S / U / X</td>
</tr>
<tr>
<td>Lifting: Use legs. Straight back.</td>
<td></td>
</tr>
<tr>
<td>Lifting: No twisting. Load close to body.</td>
<td></td>
</tr>
<tr>
<td>Straight back when stationary, or when reaching.</td>
<td></td>
</tr>
<tr>
<td>Repetitive twisting, Shoulder level.</td>
<td></td>
</tr>
</tbody>
</table>
Appendix B

Checklist: Research Assistant Observations
<table>
<thead>
<tr>
<th>Condition</th>
<th>F/S</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry floor: Deep fryers</td>
<td>S/IU</td>
<td>S/IU</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dry floor: Grill</td>
<td>S/IU</td>
<td>S/IU</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dry floor: Dishwashing</td>
<td>S/IU</td>
<td>S/IU</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dry floor: Pots and pans</td>
<td>S/IU</td>
<td>S/IU</td>
<td></td>
<td>S/IU</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Generic</td>
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<td></td>
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</tr>
<tr>
<td>Slicing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cutting</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No cutting into palm</td>
<td>S/IU</td>
<td>NA</td>
<td>S/IU</td>
<td>NA</td>
<td>S/IU</td>
<td>NA</td>
<td>S/IU</td>
<td>NA</td>
<td>S/IU</td>
<td>S/IU</td>
<td>S/IU</td>
</tr>
<tr>
<td>Other</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lifting</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use legs to lift</td>
<td>S/IU</td>
<td>NA</td>
<td>S/IU</td>
<td>NA</td>
<td>S/IU</td>
<td>NA</td>
<td>S/IU</td>
<td>NA</td>
<td>S/IU</td>
<td>S/IU</td>
<td>S/IU</td>
</tr>
<tr>
<td>Load close to body</td>
<td>S/IU</td>
<td>NA</td>
<td>S/IU</td>
<td>NA</td>
<td>S/IU</td>
<td>NA</td>
<td>S/IU</td>
<td>NA</td>
<td>S/IU</td>
<td>S/IU</td>
<td>S/IU</td>
</tr>
<tr>
<td>Comments</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
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</tr>
</tbody>
</table>
Appendix C

Informational Handouts for Conducting Observations
Behavior Based Safety at Western Michigan University

BBS at WMU Dining

- Is anonymous: Employees observed are anonymous
- Is based on co-operation: Not one employee has been written up or given reprimands because of the behavior-based safety process.
- Is positive: safety achievements and improvements are the focus

Results of BBS at WMU Dining BC and Valleys

<table>
<thead>
<tr>
<th>January through April</th>
<th>2002</th>
<th>2003</th>
</tr>
</thead>
<tbody>
<tr>
<td>Worker’s Comp Injuries</td>
<td>25</td>
<td>15</td>
</tr>
<tr>
<td>Lost Days</td>
<td>27</td>
<td>0</td>
</tr>
<tr>
<td>Restricted Days</td>
<td>386</td>
<td>93</td>
</tr>
<tr>
<td>Worker’s Comp Payments</td>
<td>$28,000</td>
<td>$6,500</td>
</tr>
</tbody>
</table>

Slip Hazards

- Walking, not rushing
- No food on floors
- Dry floors:
- Floors are dry around:
  - Deep fryers
  - Flat top grill
  - Kettles
  - Ice machines
  - Customer area (drink, and ice machines & line area)
  - Coolers
  - Freezers
  - Diswashing (dishwashing area, & pots and pans area)

WMU Dining Services Safety Check Card

Walking, not rushing
- Employee is not running, but maintains a walking pace. Eyes are directed towards the path in which he/she is walking.
No food on floors

- No bits of food are on floors that are a slip hazard.

Dry floors:

- Floors are dry around high-risk areas. No drops or grease are on floor that are a slip hazard.

When to observe

- At a good time for you.

- Devin and Judy can assist you in completing your first check cards.

- As often as you can during the shift. At least 1 observation per day.

Hand in Safety Checklist

- Hand in Safety Check cards to unit office at the end of shift, or put it in an envelope in the bakery drawer. Remember: If you note a serious safety hazard, tell your supervisor about it immediately.

- Check cards will be processed by a student assistant to the Director of Dining Services.

- Data will be used to make graphs with safety feedback in kitchen areas. Graphs will be discussed at unit meetings.

How to observe

- Do a quick walkthrough of the work area, coolers, freezers, customer area, etc.

- Complete Check Card, based on Safety Definitions.

- As soon as you see ONE instance of an unsafe condition, score that card as “Unsafe”.

Results of BBS at WMU Dining BC and Valleys

<table>
<thead>
<tr>
<th>January through April</th>
<th>2002</th>
<th>2003</th>
</tr>
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<tbody>
<tr>
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</table>

BBS at WMU Dining

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- **Is based on cooperation:** Not one employee has been written up or given reprimands because of the behavior-based safety process.
- **Is positive:** Safety achievements and improvements are the focus

WMU Dining Services
Safety Check Card

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>Observer</th>
<th>Employee(s)</th>
<th>Full-Time</th>
<th>Student</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2. Work surroundings

Stacking: 1 foot from top shelf bottom

- Items are not stacked higher than 1 foot on top shelves inside working area.

Handles inside shelf

- Handles (of e.g., pots) are not sticking outside the edge of shelves in cooking area.
No unattended knives

- No unattended sharp knives are left on tables, especially in pots and pans), in dishwasher racks, or in sinks.

When to observe

- At a good time for you.
- Devin and Judy can assist you in completing your first check cards.
- As often as you can during the shift. At least 1 observation per day.

Hand in Safety Checklist

- Hand in Safety Check cards to unit office at the end of shift, or put it in an envelope in the bakery drawer. Remember: If you note a serious safety hazard, tell your supervisor about it immediately.
- Check cards will be processed by a student assistant to the Director of Dining Services.
- Data will be used to make graphs with safety feedback in kitchen areas. Graphs will be discussed at unit meetings.

No congested walkways

- No equipment is left unattended in walkways (e.g., electrical cords, carts). Somebody walking through the walkway would have to scoot or walk around equipment.

How to observe

- Do a quick walkthrough of the work area, coolers, freezers, customer area, etc.
- Complete Check Card, based on Safety Definitions.
- As soon as you see ONE instance of an unsafe condition, score that card as “Unsafe”.

Remember: If you note a serious safety hazard, tell your supervisor about it immediately.
Behavior Based Safety
at Western Michigan University

Results of BBS at WMU Dining
BC and Valleys

January through April 2002 2003
Worker's Comp Injuries 25 15
Lost Days 27 0
Restricted Days 386 93
Worker's Comp Payments $28,000 $6,500

BBS at WMU Dining

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WMU Dining Services
Safety Check Card

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>Observer</th>
<th>Employee(s)</th>
<th>Full-Time</th>
<th>Student</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3. Cuts

- Eye on task. Uses proper knife.
- Cut away from self. Fingers curled.
- No cutting into palm. Cutting board used.
- Uncluttered workspace.
- Use spatula for buffalo cutter. Slicer pick-up.

Cuts

- Eye on task (when cutting or slicing)
- Slicer pick-up
- Cut away from self
- No unattended knives
- Fingers curled
- Uncluttered workspace
- Use spatula for buffalo cutter
- Cut on cutting board, not into palm.

Eye on task when slicing

- Employee keeps eyes on task when using mechanical slicer.
Eye on task when cutting
- Employee keeps eyes on task when cutting produce.

Cut away from self
- Employee cuts away from self when preparing food or opening containers.

Uncluttered workspace
- Cut produce and waste are removed from the cutting board before a new piece of produce is transferred to the cutting board.

Worker does not have to modify the way in which he/she cuts because of clutter on cutting board.

Slicer pick-up
- When slicing, the back of employee's hand rests on surface where sliced products fall down from slicer blade OR slicer is turned "OFF" when employee transfers products from slicer.

Fingers curled
- All fingers are curled, not straight, when cutting down on cutting board.

Use spatula for buffalo cutter
- Employee uses spatula to move food around in buffalo cutter bowl, NOT hands. When buffalo cutter is "OFF", and blade is exposed, employee uses spatula to remove food from the bowl.
**Cut on cutting board, not into palm**
- Never cut into palm. Always use cutting board.

**When to observe**
- At a good time for you.
- Devin and Judy can assist you in completing your first check cards.
- As often as you can during the shift. At least 1 observation per day.

**How to observe**
- Do a quick walkthrough of the work area, observing one student or full-time employee at a time.
- Complete Check Card, based on Safety Definitions.
- As soon as you see ONE instance of an unsafe behavior, score that card as “Unsafe”.

**Hand in Safety Checklist**
- Hand in Safety Check cards to unit office at the end of shift, or put it in an envelope in the bakery drawer. Remember: If you note a serious safety hazard, tell your supervisor about it immediately.
- Check cards will be processed by a student assistant to the Director of Dining Services.
- Data will be used to make graphs with safety feedback in kitchen areas. Graphs will be discussed at unit meetings.
Behavior Based Safety
at Western Michigan
University

Results of BBS at WMU Dining
BC and Valleys

January through April  2002  2003
Worker's Comp Injuries  25  15
Lost Days  27  0
Restricted Days  386  93
Worker's Comp Payments  $28,000  $6,500

Back Safety
- Straight back when stationary
- Straight back when reaching
- Repetitive twisting
- Shoulder level
- Lifting: Use legs
- Lifting: Straight back
- Lifting: No Twisting
- Lifting: Load close to body

BBS at WMU Dining
- Is anonymous: Employees observed are anonymous
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- Is positive: safety achievements and improvements are the focus

WMU Dining Services
Safety Check Card

<table>
<thead>
<tr>
<th>Safety Check Card</th>
<th>S / U / X</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lifting: Use legs, Straight back.</td>
<td></td>
</tr>
<tr>
<td>Lifting: No twisting, Load close to body.</td>
<td></td>
</tr>
<tr>
<td>Straight back when stationary, or when reaching.</td>
<td></td>
</tr>
<tr>
<td>Repetitive twisting, Shoulder level.</td>
<td></td>
</tr>
</tbody>
</table>

Straight back when stationary
- Back is straight when employee is working stationary. Back is not bent more than 30 degrees.
**Straight back when reaching**
- Back is bent less than 30 degrees when reaching for items, loading, unloading, pushing carts, etc.

**Repetitive twisting**
- Back is not twisted repeatedly, while engaging in the same task.

**Repetitive twisting, contd.**
- Back is not twisted repeatedly, while engaging in the same task.

**Shoulder level**
- Arms are not raised above shoulder level when working.

**Shoulder level, contd.**
- Arms are not raised above shoulder level when working continuously.

**Lifting: Use legs**
- Legs are bent when heavy items are lifted. An approximately 120 degree angle of the knee is recommended.
Lifting: Straight back
- Spine is bent less than 30 degrees when heavy items are lifted. Back should not be parallel to the floor.

Lifting: No Twisting
- There is no twisting of back when lifting a heavy load.

Lifting: Load close to body
- Load is kept close to torso when lifting.

When to observe
- At a good time for you.
- Devin and Judy can assist you in completing your first check cards.
- As often as you can during the shift. At least 1 observation per day.

How to observe
- Do a quick walkthrough of the work area, observing one student or full-time employee at a time.
- Complete Check Card, based on Safety Definitions.
- As soon as you see ONE instance of an unsafe behavior, score that card as “Unsafe”.

Hand in Safety Checklist
- Hand in Safety Check cards to unit office at the end of shift, or put it in an envelope in the bakery drawer. Remember: If you note a serious safety hazard, tell your supervisor about it immediately.
- Check cards will be processed by a student assistant to the Director of Dining Services.
- Data will be used to make graphs with safety feedback in kitchen areas. Graphs will be discussed at unit meetings.
Appendix D

Full-Time Employee Information Sheet
Dear employee!

A Behavior-Based Safety Process has been developed for Dining Services this semester. The process will continue in the next school year, and also hopefully for years to come. The aim of this process is to reduce the number of injuries to both full-time and student employees.

The safety process in your unit will involve an observer making quick safety observations during the normal course of work. To start with, the observer will be focusing on the safety items listed on this card. The observer will not be able to specifically tell you when he or she might be observing you or the conditions in the work area, but your name will not appear anywhere on the checklist completed by the observer. If you absolutely do not want to be observed at any time, please let the observers know.

When the observer has completed the checklist, it will be dropped off to the unit secretary and put in a sealed envelope. The checklists will be used to make graphs that will display your unit’s safety scores.

Please read this leaflet, and bring it to work every time, so that you can become safer on the job. In addition, we will post this information in your work areas.

WMU Dining Services Safety Committee

1. Slip hazards
   - Walking, not rushing
     Employee is not running, but maintains a walking pace.
   - Organization in dishwashing area
     Employee picks up clean ware at the end of the conveyour belt in dishwashing area, not in the middle of the conveyour belt.
   - Food on floors
     No bits of food are on floors.
   - Dry floors
     No drops of water or grease are on floor.

2. Work surroundings
   - Stacking: 1 foot from top shelf bottom
     Items are not stacked higher than 1 foot on top shelves.
   - Handles inside shelf
     Handles (of e.g., pots and pans) are not sticking outside the edge of shelves.
   - No unattended knives
     No unattended sharp knives anywhere.
   - Uncluttered walkways
     No equipment is left unattended in walkways.

3. Cuts
   - Eyes on task (when cutting or slicing)
     Employee keeps eyes on task when using mechanical slicer or cutting produce.
   - Slicer pick-up
     Back of employee’s hand rests on surface where sliced products fall down from slicer blade OR slicer is turned "Off"
   - Cut away from self
     Employee cuts away from self when preparing food or opening containers.
   - Fingers curled
     All fingers are curled, not straight, when cutting down on cutting board.

   - Uncluttered workspace
     Worker should not have to modify the way in which he/she cuts because of clutter on cutting board.
   - Use spatula for buffalo cutter
     Employee uses spatula, not hands, for all work around buffalo cutter.
   - No cutting into palm. Cutting board used
     No cutting into palm. Cutting board is always used.

4. Back Safety
   - Straight back when stationary
     Back is straight when employee is working stationary. Back is not bent more than 30 degrees.
   - Straight back when reaching
     Back is bent less than 30 degrees when reaching for items, loading, unloading, pushing carts, etc. Instead, employees should walk to the location of the item they are reaching for.
   - Repetitive twisting
     Spine is not twisted repeatedly, while engaging in the same task. Employee should shift weight on legs, and not twist shoulders.
   - Shoulder level
     Arms are not raised above shoulder level when working continuously (stirring in kettles and spraying pots and pans).
   - Lifting: Use legs
     Legs are bent when heavy items are lifted.
   - Lifting: Straight back
     Spine is bent less than 30 degrees when heavy items are lifted.
   - Lifting: No Twisting
     There is no twisting of back when lifting a heavy load.
   - Lifting: Load close to body
     Load is kept close to torso when lifting.
Appendix E

Student Employee Information Sheet
Dear student employee!

A Behavior-Based Safety Process has been developed for Dining Services this semester. The aim of this process is to reduce the number of injuries to both full-time and student employees. This semester, you can expect a full-time employee (observer) to ask you if you want to be observed for safety. If you say "Yes" you will know more about how to do your job safely, and become less likely to get injured. You have the right to say "No" if you are not interested. No names will be recorded during the process.

The observer will be focusing on the safety items listed on this card. When the observer has observed you for safety, he or she will discuss safety with you and show you what was done safely, and what may need improvement.

Please read this leaflet, and bring it to work every time, so that you can become safer on the job. In addition, we will post this information in your work areas.

WMU Dining Services
Safety Committee

If you have any questions about this program, or safety in general, feel free to ask the following employees:

Bernhard Center
Theresa
Sherry
Pam
Kris

Valley 1
Dianne
Marianne

Valley 2
Patrick
Becky

Valley 3
Valerie
Kim

Davis
Jimmy
Pattie

Burnham
Devin
Jan

WMU Dining Services
Behavior Based Safety Process
Student Employee Information
1. Slip hazards
-Organization in dishwashing area
Student employee should pick clean ware up at the end of the conveyor belt in dishwashing area, not in the middle of the conveyor belt.

-Food on floors
No bits of food are on floors. If you see food or garbage on floor, please pick it up.

-Dry floors
No drops of water or grease are on floor. If you see drops of water or grease on the floor, please get a mop or towel to clean it up.

2. Work surroundings
-Stacking: 1 foot from top shelf bottom
Items are not stacked higher than 1 foot on top shelves. **Especially pots and pans.**
-Handles inside shelf
Handles (of e.g., pots and pans) are not sticking outside the edge of shelves.
-No unattended knives
No unattended sharp knives anywhere. Sharp knives should be cleaned immediately and put away.
-Unoccupied walkways
No equipment is left unattended in walkways. This includes carts and storage units that are not being used, and are just left alone in the middle of walkways.

3. Cuts
-Eyes on task (when cutting or slicing)
Employee keeps eyes on task when using mechanical slicer or cutting produce.
-Cut away from self
Employee cuts away from self when preparing food or opening containers. Employee should never cut towards torso or hands/
-Fingers curled
All fingers are curled, not straight, when cutting down on cutting board.
-Use spatula for buffalo cutter
Employee should always use a spatula (pot licker), not hands, for all work with buffalo cutter.
-No cutting into palm. Cutting board used
Employee should never cut into palm. A cutting board should always be used.

4. Back Safety
-Straight back when stationary
Back is straight when employee is working stationary. Back is not bent more than 30 degrees.
-Straight back when reaching
Back is bent less than 30 degrees when reaching for items, loading, unloading, pushing carts, etc. Instead, employees should walk to the location of the item they are reaching for.
-Repeatitive twisting
Spine is not twisted repeatedly, while engaging in the same task. Employee should shift weight on legs, and not twist shoulders.
-Shoulder level
Arms are not raised above shoulder level when working continuously (stirring in kettles and spraying pots and pans).
-Lifting: Use legs
Legs are bent when heavy items are lifted.
-Lifting: Straight back
Spine is bent less than 30 degrees when heavy items are lifted.
-Lifting: No Twisting
There is no twisting of back when lifting a heavy load.
-Lifting: Load close to body
Load is kept close to torso when lifting.
Appendix F

Research Protocol Approval
Date: March 31, 2003

To: John Austin, Principal Investigator
   Sigurdur Oli Sigurdsson, Student Investigator for thesis

From: Mary Lagerwey, Chair

Re: HSIRB Project Number 03-03-13

This letter will serve as confirmation that your research project entitled "Examining the Effects of Feedback on Safe Behavior and Critical Safety Conditions" has been approved under the exempt category of review by the Human Subjects Institutional Review Board. The conditions and duration of this approval are specified in the Policies of Western Michigan University. You may now begin to implement the research as described in the application.

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

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

Approval Termination: March 31, 2004
Endnote

Data were originally collected on two back safety variables: straight back while working stationary, and straight back while reaching. The two back safety variables were combined in one "Back safety" variable. Straight back while working stationary was operationally defined as: Back is straight when working stationary with both feet planted on floor. Back is not bent more than 30 degrees. Employee is working continuously at a task that takes place in a workspace measuring approximately 3 feet by 3 feet on a horizontal plane. This item is scored if employee works stationary for more than approximately 10 seconds during a 20 second observation period. Straight back while reaching was operationally defined as: Back is bent less than 30 degrees when reaching for items, loading, unloading, pushing carts, etc. Employee walks to item, instead of reaching for it. If back: reaching, or back: stationary, or both, were scored as unsafe, the combined variable was coded as "unsafe". If both back: reaching and back: stationary were scored as safe, the combined variable was scored as "safe". If either back: reaching, or back: stationary were scored as safe, and the other back safety variable was scored as not applicable, the combined variable was coded as "safe". The combined variable was generated as research assistants had difficulties discriminating between stationary and reaching behaviors, but little difficulty in discriminating when the angle of the spine exceeded 30 degrees. In addition, the original discrimination between stationary and reaching behaviors was not considered important. As injuries related to bad posture accumulate over a long period of time, it appeared meaningless to operationally
define and observe stationary behaviors during a 20 second observation interval.
REFERENCES


