Revista Brasileira de Análise do Comportamento / Brazilian Journal of Behavior Analysis, 2005, Vol.1 nº. 2, 187-195

O USO DE FEEDBACK DO SUPERVISOR E FEEDBACK AFIXADO PUBLICAMENTE PARA AUMENTAR A SEGURANÇA EM UM AMBIENTE DE FÁBRICA

USING SUPERVISORY FEEDBACK AND PUBLIC POSTING OF FEEDBACK TO INCREASE SAFETY IN A MANUFACTURING SETTING

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RESUMO

O estudo empregou um delineamento de linha de base entre comportamentos para avaliar os efeitos de feedback do supervisor sobre comportamentos relevantes, relacionados com segurança, em uma fábrica de manufaturas. Durante a linha de base, a segurança do depósito atingiu uma média de 35,3% para os comportamentos e condições do Checklist 1, e 35,0% para comportamentos e condições do Checklist 2. Quando o feedback verbal do supervisor foi implementado, a média da segurança do depósito aumentou para 50,6% para o Checklist 1 e para 75,7% para o Checklist 2. Quando o feedback do supervisor passou a ser afixado como parte do programa de intervenção, a média da segurança do trabalho subiu ainda mais, chegando a 58,0% para a Checklist 1 e 83,3% para a Checklist 2. Esses resultados são consistentes com descobertas anteriores de que o feedback sobre o desempenho pode aumentar comportamentos críticos na situação de trabalho.

Palavras-chave: saúde, prevenção de danos físicos, segurança baseada no comportamento, feedback, acidentes.

ABSTRACT

The effects of safety-related and behaviorally relevant verbal and posted feedback from supervisors in a manufacturing plant were evaluated using a multiple baseline across behaviors design. During baseline, plant safety averaged 35.3% for the behaviors and conditions on Checklist 1, and 35.0% for the behaviors and conditions on Checklist 2. When verbal supervisory feedback was implemented, the plant safety average increased to 50.6% for Checklist 1, and 75.7% for Checklist 2. When posted supervisory feedback was added to the intervention package, the plant safety average further increased to 58.0% for Checklist 1, and 83.3% for Checklist 2. These results are consistent with previous findings that performance feedback can increase critical work behaviors.

Key words: health, injury prevention, behavior-based safety, feedback, accidents.

In 1998 the US manufacturing industry employed approximately 21 million workers. In that year alone, 660 workers were fatally injured in manufacturing settings, and 650,000 incidents resulting in disabling injuries were reported (National Safety Council Research and Statistics Department, 1999). Causes of work-related deaths included employees falling to a lower level, being struck by objects, vehicles, or other mobile equipment, workers being caught in or compressed by equipment or objects, and workers caught in or crushed as a result of collapsing materials. Among non-fatal disabling injuries, 33.8% were the result of contact with objects or equipment, 26.3% involved overexertion, 14.2% resulted from employees being struck by

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objects, and 8.3% were caused by workers being caught in equipment or machines (National Safety Council Research and Statistics Department, 1999).

Injuries, whether fatal or nonfatal, not only harm employees, but also come at a considerable cost to companies. The average total incurred cost per claim for "caught between" injuries was $10,507. Costs for slip and fall type injuries averaged $12,470, whereas overexertion and over-extension type injuries averaged close to $9,000 (National Safety Council Research and Statistics Department, 1999).

Three basic approaches have been suggested to effect hazard reduction in the workplace (Sulzer-Azaroff and Santamaria, 1980): (1) Identify classes of behavior that lead to injuries through continuous monitoring and recording of all worker operations; (2) Record classes of behavior that have in the past been correlated with accidental injury, such as failure to wear protective clothing; (3) Focus on the products of unsafe practices, such as housekeeping (e.g., congested walkways or unstable stacks of materials).

Each of the three methods has advantages and disadvantages. Combinations or variations of the three can also yield desired results in safe behaviors. For example, in a study of occupational safety in a large industrial plant, Sulzer-Azaroff, Loafman, Merante, and Hlavacek (1990) pinpointed classes of behavior that had been correlated with accidents in the past, together with the products of unsafe practices. Komaki, Heinzmann, and Lawson (1980) combined several approaches by examining accident logs and deriving four general categories. These categories included classes of behavior that had in the past been correlated with accidental injury, such as wearing face shields or safety goggles; and the products of unsafe practices such as failure to clean up oil or grease spills in pedestrian aisles.

In the studies cited above, authors identified behaviors and practices that were at-risk, and through the use of a process of Performance Management (PM) (Daniels, 1989), reduced these behaviors. Behavioral safety interventions often include visual presentation of examples of safe and at-risk behaviors, along with an explanation for each item, followed by graphic feedback (Komaki, Barwick, & Scott, 1978). Feedback has been shown to favorably impact safety behaviors (Sulzer-Azaroff & Santamaria, 1980), and feedback along with goal setting can be even more effective (Balcazar, Hopkins, & Suarez, 1986; Fellner & Sulzer-Azaroff, 1984). Moreover, studies have shown that, when applied contingent upon goal attainment, tangible rewards and supervisory praise result in safety behavior change (Austin, Kessler, Riccobono, & Bailey, 1996; Sulzer-Azaroff et al., 1990). In short, feedback, goal setting and reinforcement, along with training to clarify safe and at-risk behavior, can dramatically and reliably increase safe behaviors and practices (Chhokar & Wallin, 1984; Lingard & Rowlinson, 1997).

Performance feedback enjoys popularity in organizational research because it is relatively easy to administer and has repeatedly been associated with improvements in targeted behavior. Supervisory monitoring and feedback, in particular, have been useful in changing organizational performance. Supervisory feedback has been preferred over feedback from other sources, because supervisory feedback of course informs the supervisor of employee performance, and because supervisors control many of the consequences that are important to employees

(Daniels, 1989). It has been suggested that supervisory feedback may have direct reinforcing consequences (Komaki et al., 1978), may function as an establishing operation, or have reinforcing consequences because of an association with other reinforcers (Agnew 1998; Duncan, & Bruwelheide, 1985). If the supervisor controls reinforcers such as work scheduling, raises and promotions, positive supervisory feedback can become effective as a conditioned reinforcer.

Balcazar et al. (1985), in a review of feedback research which had been published in *Academy of Management Journal*, *Journal of Applied Behavior Analysis*, *Journal of Applied Psychology*, and *Journal of Organizational Behavior Management* between 1974 and 1984, came to the conclusion that: "...(1) feedback does not uniformly improve performance; (2) adding rewards and/or goal-setting procedures to feedback improves the consistency of its effects; and (3) some characteristics of feedback are more consistently associated with improved performance than others" (p. 65). The review suggested that feedback was most likely to be effective when administered by supervisors, as compared to any other source. Alvero, Bucklin, and Austin (2001) updated the review by Balcazar et al. for articles in the same journals published from 1985 to 1998, and reported similar findings, although they added that in addition to feedback administered by supervisors, feedback delivered by researchers was most closely correlated with intervention effectiveness. Alvero et al. also reported that feedback interventions in their review were more likely to combine feedback with other independent variables, which limited the opportunity to evaluate feedback effectiveness independently.

In the present study, the effects of verbal and graphic supervisory feedback on participants' safety performance were evaluated. Supervisors were first encouraged to collect data on employee performance and give positive feedback when the desired performance was observed. The effects of adding weekly graphed feedback to the intervention package were then evaluated. According to Balcazar et al. (1986), and Alvero et al. (2001), introducing supervisory verbal feedback should result in improvements in safety levels. Adding graphed feedback to supervisory verbal feedback should result in further improvements.

METHOD

Participants and Setting

Thirty-five employees participated in the study. The employees included supervisors, maintenance workers, shipping and receiving personnel, and technicians. The setting of the study was a plastic manufacturing plant located in a small midwestern city in USA. The actual manufacturing workspace was 120,000 square feet. The manufacturing area consisted of a maintenance and tooling sector, a manufacturing sector, and a shipping and receiving sector. Management offices were attached to the plant manufacturing area.

Data Collection

Data concerning safety behaviors were collected using 2 safety checklists during 10-minute observation sessions conducted three to four times per week over the span of seven weeks (see Table 1 for operational definitions of safety items). The second author assumed

TABLE 1

OPERATIONAL DEFINITIONS OF SAFETY ITEMS

Safety items	Definitions
	Overall Plant Safety 1
Area properly restricted during changeover	The employee(s) conducting the changeover must verbally inform those around the machine that a changeover is in progress
Back Posture	Keep back straight, no bending over
Caught between	Any part of an employee's body gets caught in a machine
Climbing shelves	There is to be no climbing of shelves. A ladder must be used at all levels above floor level (employee must be seen climbing shelves or using ladder to be At-Risk or Safe, otherwise N/A)
Forklift Operation	Any safety violation related to the forklift, i.e.: forks are not all the way down while parked / forklift is loaded, running, and the employee is more than 10 feet away / when forklift comes to a 90 degree corner (blind corner), the occupant must sound horn and continue to do so until corner is cleared and occupant has full vision of surrounding area—their vision is not blocked / if forklift has a high load of at most 2 palette loads, must drive in reverse
Heavy lifting, pushing, and pulling	Items that are 50 lbs. and above are considered heavy, a palette jack should be used, i.e., Gaylord, palettes, etc
Housekeeping	The plant must be free of clutter (aisles are not congested, a pallet should not be left on the floor when there is an open spot for it to be shelved)
Items properly shelved with shelf edge	Items placed on a shelf must not stick out beyond the shelf's edge / items on the shelf should not fall when shaken
Lift with legs	Bend at knees, keep item close to body's midsection—between neck and waist, lift with legs ensuring that the back is straight with no twisting at the waist
Loose clothes or hair	Employees' clothes are worn loosely allowing, for the possibility of them to get caught in the machine. Long hair (beyond shoulder length) needs to be tied up
Machine locked out, tagged out	Whenever an employee enters a machine or the safety guard is removed from the closed position, the machine must be locked and tagged out

TABLE 1 (CONT.)

Open floor	Panels that cover openings in the floor are missing; use a temporary barricade
	Overall Plant Safety 2
Pallets stacked properly	Pallets are laid flat on the floor and not stored in an upright position. Any other items on the floor that have the potential to fall would also be classified as not stacked properly, i.e.: wood, Gaylord, etc.
Purged Resin is disposed of properly	Employee must use gloves or some tool when removing purged resin from the last run. After resin cools (cool to the touch) it should be thrown away
Personal Protective Equipment	Safety glasses, proper shoes (at least tennis shoes), etc. should be worn in designated areas
Slip, trip, and falls	Employees actually engaged in these behaviors or the area is arranged as to permit a slip, trip, or fall (i.e.: hoses are not properly wound or arranged, plastic beads on the floor)
Tool secured	When removing or inserting a tool with a crane, a double-sling must be used (when available) in order to secure the tool. Clamps are to remain on until the crane is secured to the tool and at least two clamps must be used on both sides of tool
Truck trailers chocked (2 wedges under wheels)	Trailers backed up to the building must have two of their back wheels chocked—two triangles under wheels, opposite tires (i.e, if back right tire is chocked then left back tire must also be chocked)
Use ladder to enter machine	There is to be no climbing on the machines. A ladder must be used to enter the machine
Wet floor	Water, oil, or any other liquid that is present on the floor. Diapers should not be left on top of the spill. A left behind diaper is still a wet floor

the position of primary data collector, using a procedure modeled after Komaki et al. (1978). The primary data collector walked a predetermined route through the entire work area and inspected all visible and working employees for each checklist item.

If an item on the checklist was observed, the item was marked either “Safe” or “Unsafe”, in accordance with operational definitions of the safety items. If an item was observed to be both “Safe” and “Unsafe” in different instances during a single session, the item was marked “Unsafe.” If the item was not observed during data collection tour, the item was marked “Not Applicable (N/A).” Checklist items were not marked until after the primary data collector had walked past the area where the behavior was observed, to avoid revealing to employees what particular items were being observed at each time. After the observation session was conducted, a safety percentage was calculated by counting the number of safe items observed divided by the number of items observed in total, and multiplying by 100%.

Reliability

Reliability data were collected every third observation session. During reliability sessions, the lean manufacturing engineer/training coordinator, who served as a reliability data collector, accompanied the primary data collector. Both raters had identical safety checklists as they conducted observation sessions. Reliability percentages were calculated by dividing total agreements by total agreements plus disagreements and multiplying by 100%. Reliability averaged 90% over the course of the study.

Experimental Design

This study employed a combined multiple baseline across checklist behaviors and A-B-C design. Data were collected for two separate baselines containing two different sets of safety behaviors and conditions. Supervisory verbal feedback and supervisory verbal feedback plus posted feedback were subsequently introduced in a temporally staggered multiple baseline fashion to both baselines.

Baseline

Eleven sessions of baseline were conducted at the start of the study. Two separate checklists were then developed. Checklist items were divided by ranking each of the twenty items from highest frequency of at-risk occurrence to lowest frequency of at-risk occurrence, based on the first eleven sessions of baseline data collection. Items with an equal number of at-risk occurrences were arranged alphabetically in the ranking. The next step consisted of pairing the higher frequency at-risk items with the lower frequency at-risk items to form 2 checklists. For example, the highest frequency at-risk item was paired with the lowest frequency at-risk item and added to Checklist 1. The second highest frequency at-risk item was paired with the nineteenth highest frequency at-risk item and added to Checklist 2, and so on. This procedure continued until all items had been paired and added to a checklist. Items ten and eleven were then added to Checklist 2 to balance the number of items on each checklist. The experimenter then reviewed baseline data for each session and calculated the safety percentage for each checklist. The analysis revealed that the checklists had similar mean safety percentages: 35.3% for Checklist 1 and 35% for Checklist 2. Baseline measurements were conducted for five additional sessions for behaviors on Checklist 2 after the first intervention had been applied to behaviors on Checklist 1.

Intervention

A supervisory feedback system was first put into effect to give positive and corrective feedback to employees concerning safety behaviors. The intervention was introduced in a daily shift meeting, in which the safety items on Checklist 1 were targeted.

Supervisors were instructed by the primary data collector and the manufacturing engineer/training coordinator to correct unsafe behaviors/practices by demonstrating to employees a safer way to conduct the tasks. Supervisors were also encouraged to give compliments and praise to those employees who performed tasks in a safe manner. Supervisors were also instructed to conduct daily observation sessions, or spot-checks, once during each shift to collect data on items on Checklist 1. These sheets were to be completed and returned to the manufacturing engineer/training coordinator's factory mailbox by the time the supervisors went home from their shift for the day. The experimenter collected the spot-check data-sheets, and feedback was delivered via electronic mail to the supervisors. The electronic mail informed the supervisor of how many data-sheets were collected, out of total data-sheets due. This feedback consisted of the number of data-sheets returned, and the experimenter's observation session findings. Supervisors were also given praise for completing data sheets.

After 5 sessions of this procedure with Checklist 1 items, baseline measures and results for the intervention phase were shown for Checklist 1 at a shift meeting. The feedback intervention was then carried out for Checklist 2 in the same manner as was done for Checklist 1.

The second experimental phase was also introduced at this time for Checklist 1, consisting of adding publicly posted supervisory feedback to the verbal feedback intervention. Graphs depicting safety performance for all twenty Checklist items were posted weekly above a time clock in an area that employees walked through frequently. The data were presented in the form of bar graphs depicting group safety performance during the past week. After 6 such sessions, with supervisory feedback for both checklists and additional posting of feedback for Checklist 1 only, supervisory feedback and posting of feedback continued for both Checklists for 3 final sessions.

RESULTS

As shown in the graph in Figure 1, the percentage of items on Checklist 1 observed as performed safely rose from 35.3% to 50.6% on average during the supervisory feedback intervention, and the percentage of items on Checklist 2 observed as performed safely rose from 35% to 75.7% on average. When posting of feedback was added to supervisory feedback, percentage of items observed as performed in a safe manner rose further to 58% for behaviors on Checklist 1, and to 83.3% for behaviors on Checklist 2.

DISCUSSION

The results of this study suggest that implementation of supervisory verbal feedback can increase safety behaviors and practices, as safety percentages increased by 15.3% for

Checklist 1 items and 40.7% for items on Checklist 2. Adding public posting of feedback to supervisory feedback resulted in a further increase of 7.4 percentage points for Checklist 1, and an increase of 7.6 percentage points for Checklist 2.

Weaknesses of this study include the lack of assessment of independent variable integrity. The supervisors were never routinely monitored to ensure that they were actually delivering the feedback. Supervisors were responsible for producing safety sheets after every shift, but sheets were returned for only five out of 36 shifts. Data collected by the researcher were used as a basis for feedback when supervisory data were unavailable. The plant was also visited by MIOSHA (Michigan Occupational Safety and Health Administration) between the 15th and 16th observation sessions for a scheduled free safety audit. Prior to the MIOSHA visit, the plant supervisors addressed some equipment and safety concerns. This may have further alerted workers to safety issues, thus accounting for the large difference observed between observations 15 and 16 on Checklist 2.

However, safety behaviors and practices did clearly and consistently increase as a result of the intervention. The increases in safety performance observed in this study are consistent with the idea that supervisory feedback can serve to change employee behavior

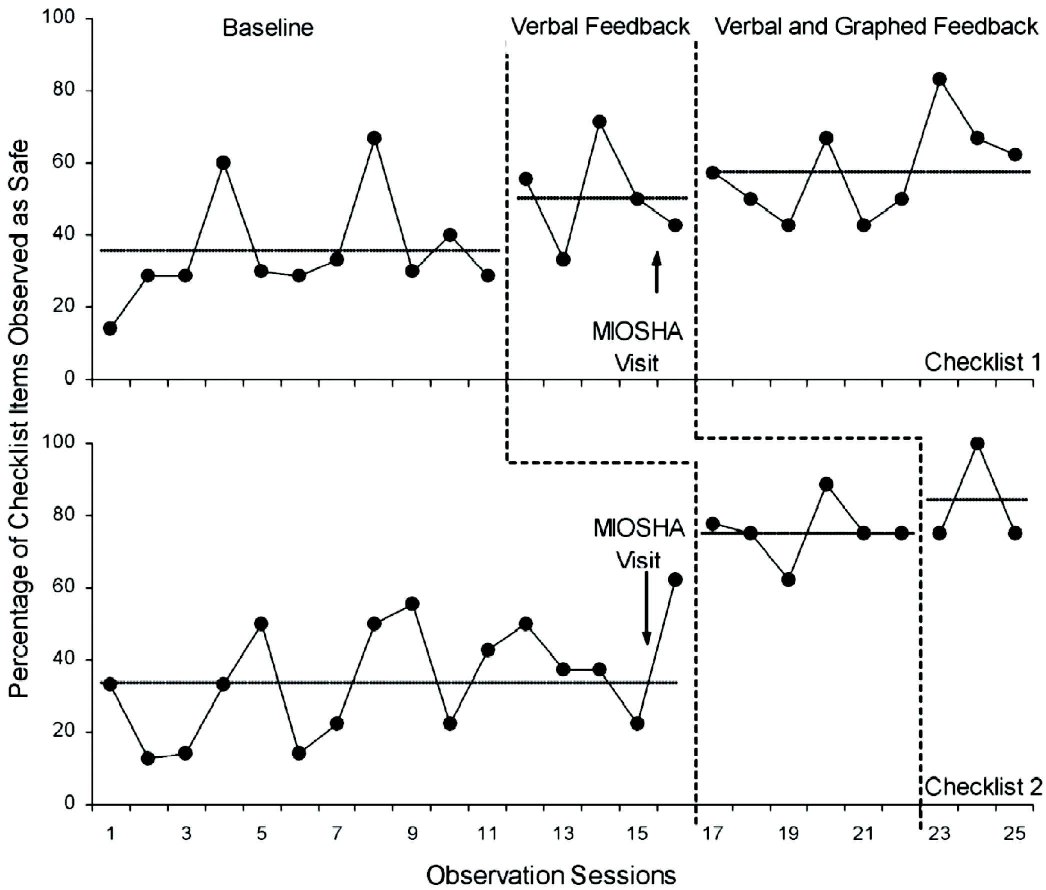

Figure 1. Percentage of checklist items observed as safe for each session.

(Alvero et al., 2001; Balcazar et al., 1986). The performance improvement may have occurred for various reasons. Further research on the effectiveness of feedback is needed to clarify its specific behavioral mechanisms.

The findings of this study confirm that low-cost feedback procedures can be effective in reducing the occurrence of critical at-risk behaviors and conditions. Ultimately, reductions in the frequency of at-risk factors in the workplace should result in a reduced number of injuries. Successful safety feedback interventions can therefore lead to profits for organizations, increase the well-being of workers, and help establish a safety culture in the workplace.

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