Concurrent Session

CRITICAL SUCCESS FACTORS FOR BEHAVIOR BASED SAFETY PROGRAMS

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CRITICAL SUCCESS FACTORS FOR BEHAVIOR-BASED SAFETY. E. Scott Geller, Ph.D., Jason DePasquale, M.S., Chuck Pettinger, M.S., C.B.A., and Josh Williams, M.S., Safety Performance Solutions and Virginia Tech, Center for Applied Behavior Systems, 5100 Derring Hall, Blacksburg, VA. 24061-0436

This paper reviews the methodology and preliminary findings of a two-year research grant that combines the technology of applied behavior analysis with theories of motivation, learning, and social influence to determine critical factors for the successful implementation of behavior-based (BB) safety. The research has both practical and theoretical objectives. From a practical perspective, the field studies, industrial interviews and focus groups, and large-scale surveys were designed to: a) develop flexible procedures for implementing an employee-driven process to reduce at-risk work behaviors and increase safe work practices; b) derive guidelines to increase employee involvement in a long-term BB safety improvement process; c) examine both short and long-term effects of a BB safety process on work practices, attitudes, person states, and injuries; d) determine the relative effectiveness of group versus individual feedback procedures to reduce at-risk behaviors and increase safe behaviors; e) study whether targeting certain work behaviors for an intervention process will influence other safety-related behaviors; and f) assess the extent to which line workers can implement an objective and reliable behavior-monitoring process as an integral aspect of their job assignments.

From a theoretical perspective, this research: a) compared hypotheses derived from basic learning theory (i.e., response generalization) with those from danger compensation or risk homeostasis theory; and b) studied the role of certain individual factors (i.e., self-esteem, self-efficacy, personal control, optimism, and belongingness) derived from personality/social theory as predictors of involvement in a safety process, and as person states hypothesized to change as a function of involvement in an intervention process. Consequently, the overarching purpose of this research is not only to develop a set of guidelines for designing a practical long-term intervention process to reduce the risk of unintentional injury in the workplace, but also to develop theory and principles for maximizing the cost effectiveness, ecological validity, and potential for organizational institutionalization of injury-prevention countermeasures.

BACKGROUND AND SIGNIFICANCE

Injury is the principle cause of lost-person years of productive life in the U.S. and accounts for more years of lost potential than cancer and cardiovascular disease combined (Waller, 1987). Each year, injuries kill more than 142,000 Americans and require an estimated 62.5 million dollars in medical attention (U. S. Bureau of Labor Statistics, 1997). In fact, injuries are the leading cause of death to individuals aged 44 and less in the U. S., with persons aged 15 to 24 experiencing a disproportionate number of injuries (Baker, Conroy, & Johnston, 1992). Thus, unintentional injuries represent a serious public health problem. Cost-effective community, school, and industry-based injury prevention interventions are urgently needed to reduce injury rates.

Each year between 2.5 to 11.3 million employees suffer from non-fatal injuries (Office of Technology Assessment, 1985) and 7,000 to 11,000 workers are killed. Most of these workers are in the prime of their lives (Baker, Conroy, Johnston et al., 1992). In addition to these sobering figures are those which estimate that every 10 minutes in the U.S. two persons are killed and 170 people will sustain a disabling injury either on or off the job (National Safety Council, 1986). In sum, approximately 250,000 potential productive years of life are lost because of premature death due to a work-related injury (Baker, Conroy, Johnston et al., 1992).

In 1979, the Surgeon General identified people and their behavior as the major contributor to poor health, injuries, and death (Califano, 1979). This theme of improved health and reduced injuries through behavior change has been emphasized in government reports (Harris, 1980, 1981), journal articles (Roberts, 1987; Sleet, Hollenbach, & Hovell, 1987), conference proceedings (Geller, 1988; Tolsma, 1987), and throughout entire journal issues (Geller, 1991; Lawson, Sleet, & Amoni, 1984; Roberts & Brooks, 1987). "What people *do* influences the quality of life, and people *doing* is the realm of psychology, the science of behavior" (Roberts, Fanurick, & Layfield, 1987, p. 105). In other words, unhealthy or injury-prone lifestyles result from excessive unhealthy and unsafe behaviors, and from deficits in healthy and safe behaviors (Gelfand & Hartman, 1984).

Applied Behavior Analysis

Behavior-based approaches to injury control have a number of advantages over other approaches, including: a) they can be administered by individuals with minimal professional training; b) they can reach people in the setting where a problem occurs (e.g., community, school, workplace); and c) the leaders in these settings can be taught the BB techniques most likely to work under specific circumstances (Baer, Wolf, & Risley, 1968, 1987; Daniels, 1989; Geller, 1997). Research has also shown this approach to be cost effective, primarily because BB techniques are straightforward and relatively easy to administer, and because intervention progress can be readily assessed by indigenous personnel monitoring target behaviors (e.g., Daniels, 1989; Geller, 1996; Geller, Winett, & Everett, 1982; Rudd & Geller, 1985; Sulzer-Azaroff & De Santamaria, 1980).

The activator-behavior-consequence model of applied behavior analysis has been applied frequently and successfully in recent years to prevent occupational injuries (e.g., Alavosius & Sulzer-Azaroff, 1986; Komaki, Barwick, & Scott, 1978; Streff, Kalsher, & Geller, 1993). For example, behavioral scientists have demonstrated the cost-effectiveness of: a) *participative education* to increase safety-belt use (Kello, Geller, Rice, & Bryant, 1988) and the acquisition of fire emergency skills, b) *incentives/rewards* to increase safety-belt use (e.g., Geller, 1984; Geller & Hahn, 1984; Roberts et al., 1988), c) *behavioral feedback* to increase sanitation behaviors during food preparation (Geller, Eason, Phillips, & Pierson, 1980) and reduce driving speed (Van Houten & Nau, 1983), and d) *pledge-card commitment* strategies to increase use of personal protective equipment (Streff, Kalsher, & Geller, 1993).

Behavior-based approaches to safety focus on systematically studying the effects of various interventions on target behaviors, first by defining the target behavior in a directly observable and recordable way, and second by observing and recording it in its natural setting. When a stable baseline measure of the frequency, rate, or duration of behavior is obtained, an intervention is implemented to change the behavior in beneficial directions. Interventions typically involve modifying or changing the antecedents and/or consequences of specified target behavior(s). To determine intervention effectiveness, the frequency, duration, or rate of the target behavior is recorded during and/or after the intervention and compared to baseline measures of behavior (Daniels, 1989; Geller, 1996,1997).

REVIEW OF BEHAVIOR-BASED SAFETY INTERVENTION IN INDUSTRY

Table 1 on the following 5 pages summarizes key aspects of 23 rigorous evaluations of BB safety in work settings. While not exhaustive, this review is complete enough to convey the nature of BB intervention for occupational safety, including their short- and long-term effects. For a study to be included in Table 1, three criteria had to be met: a) the intervention was implemented in an occupational setting; b) the intervention focused on directly changing safety-related work practices; and c) the behavior-change data were obtained from reliable direct observation.

Subjects/Settings

As indicated in Table 1, BB safety interventions have been applied in a variety of industrial/organizational settings. The majority of participants were males in blue-collar jobs. The number of participants per study varied widely, ranging from 4 to 1,107. Eleven publications reported observations from more than 100 subjects.

Intervention Techniques

The average duration of the interventions included in our review was approximately 28 weeks. The exact nature of the intervention strategies applied to increase safe behavior and decrease at-risk behaviors varied substantially across studies, but most interventions included some form of behavioral feedback for individuals, groups, or both. Feedback was delivered through tables, charts, interpersonal communication, or congratulatory notes. Many intervention programs included rewards (e.g., money or tokens for consumer goods) contingent on the occurrence of certain target behaviors or a reduction in injury rate. Goal-setting was often used in conjunction with both feedback and reward strategies. Other intervention techniques included team competition, individual or group praise, and individual commitment through signing a BB promise card (Geller & Lehman, 1991).

Every intervention reviewed combined one or more BB techniques to obtain dramatic improvement in safe work practices. While combining methods almost certainly led to greater impact, such combinations made it impossible to determine independent effects of any one technique (e.g., goal-setting, feedback, incentives/rewards, promise/pledge cards). Although Streff, Kalsher, and Geller (1993) did use only a pledge-card program with no feedback or reward, education was a necessary component of this and all other interventions, if only to explain the rationale of the BB technique.

BEHAVIOR BASED SAFETY PROGRAMS

STUDY	SUBJ/SETTING	INTERVENTION	TOP DOWN/D.V.	DESIGN	FINDINGS	FOLLOW UP	COVARIATION
** Komaki, Barwik, & Scott (1978)	38 makeup and wrapping workers	25 weeks visual demonstration of desired behaviors, goal setting/ group feedback	top down - accident reports used to identify behaviors, only supervisors encouraged to contribute/ % safety behaviors	within subjects multiple baseline w/ reversal	% safety behaviors improved from 70% & 80% to 96% & 99%	not actually done, however department received company reward for safety one year later	none discussed
Geller, Eason, Phillips, & Pierson (1980)	9 kitchen workers	25 day program training, individual feedback	top down/ responses which increase probability of microorg. collection on hands, handwashing following designated responses	A-B-A-C-A-D-A	feedback increased frequency of handwashing only	5 day follow up showed a marked drop in target behavior	none discussed
** Komaki, Heinzmann, & Lawson (1980)	55 employees of a city's vehicle maintenance division	45 weeks training, group feedback	top down/ safe job performance (frequent and proper use of safety equipment, housekeeping)	multiple-baseline with a reversal component	slight increase in safety after training, substantial increase with feedback at least 3 times a week	no clear procedures discussed	none discussed
** Larson, Schnelle, Kirchner, Carr, Domash, & Risley (1980)	224 police vehicles	tachograph recordings, individual feedback, public recognition	top down/ vehicle accidents	multiple baseline within groups	reduction in accidents. outcomes - not based on observed behaviors	18 months after costs due to accidents still down	none discussed

** - Indicates reported decrease in subsequent injury related outcome data (e.g., cost, OSHA recordables, lost time, etc..).

Table 1. Summary of Behavior-Based Industrial Safety Research

STUDY	SUBJ/SETTING	INTERVENTION	TOP DOWN/D.V.	DESIGN	FINDINGS	FOLLOW UP	COVARIATION
Rhoton (1980)	60 coal mine workers	16 months contingent punishment, graphic feedback, periodic observation/ **individual & group**	top down/ # ventilation violations per month	multiple baseline with reversal	violations at 0 after 10 months. **outcomes**- not based on observed behavior	none discussed	none discussed
Sulzer-Azaroff, & De Santamaria (1980)	4 female and 2 male production supervisors	12 weeks **individual** and group feedback	top down/ foocus on environmental physical safety hazards	multiple baseline across subjects	fewer hazard rates	4 month "highly favorable maintenance effect"	none discussed
Zohar, Cohen, & Azar (1980)	160 metal fabrication workers	5 months feedback from audio metric test indicating extent of hearing loss/ **individual** feedback	top down/ use of earplugs	multiple baseline	increase earplug use	5 month follow up showed consistent earplug use	none discussed
** Haynes, Pine, & Fitch (1982)	100 urban transit operators	18 weeks incentive plan, team competition, **individual** and group feedback,	top down/ accident rates	multiple baseline/ within groups reversal	significant reduction in accident rates **outcome** based incentives	18 week follow up demonstrated effect still present	none discussed
Geller, Davis, & Spicer (1983)	approximately 550 employees at an industrial complex (450 hourly, 100 salary)	54 day program **individual** incentive program	top down/ safety belt use	A-B-A	Incentives substantially increased belt use for salaried workers	13 day follow -up behavior returned to baseline	none discussed
Chhokar & Wallin (1984)	58 male workers in a heat exchanger manufacturing plant	41 weeks training, goal setting, & feedback/ **group** feedback	mostly top down - behaviors derived from accident reports - some workers interviewed/ % safe behaviors	reversal/ withdrawal design	goal setting most effective with feedback. - no sig diff in frequency of feedback conditions (1 v 2 weeks)	none discussed	none discussed

** - Indicates reported decrease in subsequent injury related outcome data (e.g., cost, OSHA recordables, lost time, etc..).

Table 1. Summary of Behavior-Based Industrial Safety Research (continued)

STUDY	SUBJ/SETTING	INTERVENTION	TOP DOWN/D.V.	DESIGN	FINDINGS	FOLLOW UP	COVARIATION
** Fellner & Sulzer-Azaroff (1984)	158 employees in a paper mill	6 months posted group feedback	mostly top down - some employees interviewed but not sure which ones and what impact these interviews had/ safe practices, safe working conditions	multiple baseline across classes of behavior	safe practices increased, 50% reduction in injuries	none discussed	none discussed
Geller, & Hahn (1984)	300 - 500 employees at each of two plants	incentive program/ individual rewards for belt use	top down/ safety belt use	A-B-A	increase in safet y belt use	follow up showed marked decrease in target behaviorbut higher than baseline	none discussed
** Reber & Wallin (1984))	105 employees of farm machinery manufacturing plant	56 weeks training and goal setting, group feedback	top down (taken from safety manual)/ % performing safely, frequency of injuries	multiple baseline	improvement in all conditions, most improvement with K.R.	none discussed	none discussed
Alavosius & Sulzer-Azaroff (1986)	6 direct service providers working in a state residential school	written & verbal individual feedback	top down/ transferring of physically disabled clients	multiple baseline across settings and subjects	safe practices increased	7 month check effects maintained	none discussed
Cope, Smith, & Grossnickle (1986)	employees at a pharmaceutical plant	13 weeks feedback signs, Buckle Up Bonanza Game (variable cash incentives)/ individual & group rewards	top down/ safety belt use	A - B	increased safety belt use	decrease in belt use during short term follow up, remained stable for long term, still higher than baseline (32% v 38%)	none discussed

** - Indicates reported decrease in subsequent injury related outcome data (e.g., cost, OSHA recordables, lost time, etc..).

Table 1. Summary of Behavior-Based Industrial Safety Research (continued)

STUDY	SUBJ/SETTING	INTERVENTION	TOP DOWN/D.V.	DESIGN	FINDINGS	FOLLOW UP	COVARIATION
Hopkins, Conrad, Dangel, Fitch, Smith, & Anger (1986)	four plastic workers	praise for correct behaviors reminders for unsafe behaviors/ **individual**	top down/ behaviors to decrease exposure to styrene	multiple baseline	decreases in exposure ranging from 36% - 51%	none discussed	none discussed
** Fox, Hopkins, & Anger (1987)	647 - 1,107 employees from two separate coal mines	still being used at time of report (over ten years) token economy **individual and group** incentives	top down - workers informed of program in company newsletter/ frequency, severity, cost of accidents **outcome based** incentives	multiple baseline	frequency decreased, severity rate decreased, costs due to accidents decreased	only one mine still in business, still using the intervention	none discussed
** Karan & Kopelman (1987)	maintenance and drivers for a packaging & forwarding facility	43 weeks outcome **group** feedback	top down/ vehicle and industrial accidents **outcome based** feedback	A - B	decrease in vehicle and industrial accidents	none discussed	none discussed
Kello, Geller, Rice, & Bryant (1988)	141 employees of an industrial plant	one week-one month- three months: awareness sessions and pledge programs	top down/ safety belt use	A-B-A	Awareness sessions substantially increased safety belt use	13 week follow up showed effect still present	none discussed

** - Indicates reported decrease in subsequent injury related outcome data (e.g., cost, OSHA recordables, lost time, etc..).

Table 1. Summary of Behavior-Based Industrial Safety Research (continued)

STUDY	SUBJ/SETTING	INTERVENTION	TOP DOWN/D.V.	DESIGN	FINDINGS	FOLLOW UP	COVARIATION
Grant (1990)	approximately 400 employees of a hospital	6 weeks obtrusive monitoring, educational presentation, displays, supportive memos from management, group feedback	top down/ safety belt use	A -B -BC -B -A	increased safety belt use	2 & 4 week follow up showed no decline in safety belt use	none discussed
**Reber, Wallin, & Chhokar (1990)	44 male employees working farm machinery and manufacturing plant	55 weeks training, goal setting, and group feedback	top down/ % safe behaviors, on the job injuries	multiple baseline across departments	intervention most successful when goal setting combined with feedback	none discussed	none discussed
**Sulzer-Azaroff, Loafman, Merante, & Hlavacek (1990)	225 employees in a large industrial plant	6 month package goal setting, individual and group feedback and rewards	mostly top down - some employees included in planning (unclear how)/ % safety achievements	multiple baseline across groups	decrease in lost workday injuries	"Follow up inquiries revealed that January through March was the best quarter ever achieved in the plant."	none discussed
Streff, Kalsher, & Geller (1993)	51 male machinists employed at electronics component firm	focus groups & safety pledge, individual commitment	mostly top down, commit by choice/ safety glasses, ear plugs, and safety glasses	A - B	iinterventions led to increase in use of safety glasses, ear plugs, and saafety belts.	behaviors returned to baseline levels	safety belt increased, was never discussed during focus groups

** - Indicates reported decrease in subsequent injury related outcome data (e.g., cost, OSHA recordables, lost time, etc..).

Table 1. Summary of Behavior-Based Industrial Safety Research (continued)

Top-Down Implementation

Similar to the manner in which many organizations function, the safety programs reviewed in Table 1 were all essentially top-down in nature. Specifically, our literature review indicated essentially two different scenarios. In many cases, the intervention process was implemented and evaluated by an outside researcher who determined which behavior(s) to target, and then designed an intervention process to improve one or more target behaviors. Frequently, management played a role in assisting the researcher. For the rest of the studies, upper management already had determined what behavior(s) they wanted to change in the organization before hiring an outside consultant to design, implement, and evaluate an intervention process. Regardless of the scenario, involvement of the line worker or regular employee (usually the individuals targeted by the intervention) was kept to a minimum.

As shown in Table 1, a few studies did mention some level of employee decision-making in the intervention process (e.g., Chhokar & Wallin, 1984; Fellner & Sulzer-Azaroff, 1984; Streff, Kalsher, & Geller, 1993; Sulzer-Azaroff, Loafman, Merante, & Hlavaceck, 1990), but descriptions of the amount of input from employees and its impact were not given. The research reported here studied the impact of involving line workers in customizing specific aspects of a BB safety process for their site.

Findings

Our literature review demonstrated straightforward and unmistakable benefits of a BB approach to increase safe behaviors and reduce injuries in industry (see also Petersen, 1989). Unfortunately, a majority of the studies were simply demonstrations of techniques that had already been effective in other settings. No significant procedural comparisons were made to guide the improvement of future intervention designs. Furthermore, the studies did not provide information relevant to institutionalizing a BB safety process into the culture of an organization. Research in the area of BB safety needs to ask and answer questions regarding the design of more effective and longer-term intervention processes. This is an important purpose of our research.

Response Generalization

As evidenced by the studies listed in Table 1, a BB intervention process can be dramatically effective in increasing safe behaviors and decreasing at-risk behaviors. A weakness of all but a few of these studies, however, is that they took a rather piecemeal approach when assessing intervention effectiveness. That is, most researchers treated, measured, and evaluated a single target response, and did not consider that a variety of responses might covary as a function of similar reinforcement histories. Such behaviors are said to be clustered in a functional response class (Russo, Cataldo, & Cushing, 1981). When considering such a notion, one can see how behaviors in the workplace may be conceived not as individual responses, but as groups of responses functionally related (as safe work practices). With this conceptualization, intervening to increase one desired behavior can have residual effects on another desired behavior in the same response class. Such a phenomenon has been called response generalization (Bandura, 1969; Carr, 1988) and is likely mediated by the internalization of response-specific rules (Malott, 1992). We have obtained some evidence for such an effect, as described below, but more research of this theory is clearly needed.

Ludwig and Geller (1991) demonstrated that an intervention which targeted only safety-belt use among pizza delivery drivers influenced a significant increase in the use of both safety belts and turn signals. In a subsequent study, Ludwig and Geller (1997) found a similar effect when targeting complete intersection stops among pizza deliverers. A particularly intriguing finding from this research was that response generalization (i.e., concomitant increases in the use of safety belts and turn signals) occurred *only* among subjects who experienced a *participative* goal-setting and feedback intervention. Subjects at another store who were given a mandated goal-setting and feedback intervention increased their percentage of complete intersection stops (the behavior targeted by the intervention process), but actually showed a concomitant decrease in turn-signal and safety-belt use. This effect is consistent with the psychological reactance literature (Brehm & Brehm, 1981) which predicts that controlling measures mandated by managers are met by countercontrol actions from employees reacting against the perceived loss of a work-related freedom (such as the opportunity to drive as one wishes).

Although it is quite possible subjects in the mandated goal condition of Ludwig and Geller (1997) were reacting against management mandates, it is also possible that by making complete intersection stops, these subjects had an increased perception of personal safety, and as a result, felt less need to use their safety belts or turn signals to remain safe. This possibility follows from the theories of risk compensation (Peltzman, 1975) and risk homeostasis (Wilde, 1982).

Risk homeostasis theory (RHT) claims that at any point in time, individuals perceive a certain level of risk in their lives. At the same time, these individuals are willing to accept a certain level of risk. When the perceived and accepted levels of risk are not in equilibrium, a person is presumed to alter his/her behavior in such a manner as to bring the perceived and accepted levels of risk into a homeostatic balance. Although some experiments have been conducted to assess this phenomenon among driving behaviors (McKenna, 1985; O'Neill, Lund, & Ashton, 1985; Streff & Geller, 1988) and in the laboratory (Wilde, Claxton-Oldfield, & Platenius, 1985), the findings have been mixed and inconclusive. Our research evaluates the circumstances under which response generalization versus risk compensation occurs when employees target certain behaviors, while other non-targeted safety-related behaviors are also observed and evaluated (without the employees' knowledge).

In one experimental test of RHT, Streff and Geller (1987) found evidence of risk compensation. Their subjects (n=60) used or did not use a safety belt while driving 30 laps around a dirt track in a 5-hp go-kart. The significant finding was that subjects exposed to a No Safety Belt condition for 15 laps showed an increase in speed when using the safety belt during the subsequent 15 laps which was significantly higher than subjects who used a safety belt for all 30 laps. In addition, changes in subjects perceived risk obtained prior to each run of 15 laps matched their speed differences. Our research was designed to evaluate whether response generalization or risk compensation occurs under various environmental conditions.

AN INDIVIDUAL DIFFERENCE APPROACH: THE ACTIVELY CARING MODEL

A recent individual difference approach to injury prevention focuses on the identification of individual characteristics which predict who is most likely to take personal action to correct hazardous conditions, increase safe behavior, or decrease at-risk behavior (Geller, 1996; Geller, Roberts, & Gilmore, 1996; Roberts & Geller, 1995). The authors have developed a model of "actively caring" (AC) which refers to going beyond the call of duty for the safety and health of others. From social psychology research (Schroeder, Penner, Dovidio, & Piliavin, 1995), they propose that five individual difference factors or "person states" increase the propensity for an individual to actively care for the safety or health of others. Individuals presumed most likely to actively care are those high in self-esteem, self-efficacy, personal control, optimism, and group belongingness or cohesiveness.

Self-esteem is an evaluation people make about their own self-worth. High levels of self-esteem are found in individuals who feel successful, worthy, and capable (Coopersmith, 1967). *Self-efficacy* is a person's perceived ability to mobilize the motivation, cognitive resources, and courses of personal action needed to exercise control over life events (Bandura, 1969, 1977, 1997). *Personal control* (referred to as locus of control in the research literature) reflects the degree to which a person believes most life events are due to internal or personal factors such as, intelligence, desire, and ability versus external uncontrollable factors such as luck, chance, or powerful others (Rotter, 1966). *Optimism* is the degree to which individuals feel positive about their future (Scheier & Carver, 1985). *Belongingness* is analogous to the concepts of group cohesion (Festinger, 1957) and solidarity (Wheeless, Wheeless, & Dickerson-Markman, 1982). It refers to how "close" members of a social group or work team feel toward each other.

Research indicates that persons are more willing to help others when they are high in personal control (Sherrod & Downs, 1974), are more optimistic (Isen & Levin, 1972), and possess a high level of self-esteem (Batson, Bolen, Cross, & Neuringer-Benefiel, 1986). In addition, people are more apt to actively care when believing they will be successful in their efforts. This is self-efficacy and is related to locus of control and past experiences of success (Sherer at al., 1982). Finally, feelings of belongingness have been shown to increase the likelihood an individual will intervene to help another person (Rutkowski, Gruder, & Romer, 1983).

The AC model has been used successfully to predict employees' willingness to actively care for a coworker's safety (Geller et al., 1996), and who will participate in a safety recognition process (Roberts & Geller, 1995). Our research employs a Safety Culture Survey (SCS) which includes scales to measure the AC person states, as well as scales to measure perceptions of management concern for safety, peer support for safety, and personal responsibility for safety. The SCS is used to predict relative participation in a BB safety process, and to assess the cultural impact of a customized intervention process. More details of the SCS are given in the next section.

DEVELOPMENT OF THE PERSON STATES SCALE – PRELIMINARY RESEARCH

This study: a) developed a self-report index of actively caring (RAC) and an Actively Caring Scale (ACS) with five subscales corresponding to the five person states shown to be significantly related to actively caring behaviors (i.e., self-esteem, self-efficacy, personal control, optimism, and belongingness); b) determined the reliability (internal consistency) of the RAC scale; and c) gathered evidence of criterion-related validity for the AC model (as summarized above).

Scale development

The five ACS subscales were developed by adapting other standard measures of these constructs: a) the Self-Esteem Subscale was adapted from Rosenberg's (1965) Self-Esteem Scale, b) the Self-Efficacy Subscale was adapted from the Sherer et al. (1982) Self-Efficacy Scale, c) the Optimism Subscale was adapted from Scheier and Carver's (1985) Life Orientations Scale, d) the Personal Control Subscale was adapted from the Nowicki-Strickland I-E Scale (Nowicki & Duke, 1974; Strickland, 1989), and e) the Belongingness Subscale was adapted from the Wheeless, Wheeless, & Dickson-Markman (1982) Group Cohesion Measure. Five items from the Crowne-Marlow (1960) Social Desirability scale were also included to account for variance in criterion scores resulting from respondents' attempts to present themselves in a favorable light.

The wording for some scale items was revised to fit an industrial setting; the number of items were reduced from the original scales; and the original scale formats were changed (i.e., all scales were changed to a five-point Likert format, 1 = Strongly Disagree, 5 = Strongly Agree). This initial scale contained 115 items, including a 36-item Reported Actively Caring scale (RAC) to measure intentions to actively care for other persons' safety and health.

Method

The ACS and RAC were completed by 816 employees at four industrial sites: one department in a nuclear facility employing 15,000 (n = 245), a polyethylene manufacturing plant (n = 315), and two plants of a large textile manufacturer (n=215 and 281). Scales were completed on opscan forms and computer scored. Surveys from individuals who failed to answer ten or more questions were eliminated. Omitted responses on the remaining surveys were replaced with the average response for that item.

Results and Discussion

Internal consistency analysis (Cronbach's alpha) was used to reduce the number of scale items and estimate the reliability of the resulting ACS subscales. The final ACS was reduced to 52 items and resulted in acceptable alpha's for each subscale (r's ranged from .75 to .88). To determine the criterion-related validity of the AC model, correlations between each subscale and the AC Scale were calculated (see Table 2 on the next page). Results indicated significant relations among each ACS subscale and the RAC, providing evidence for the validity of the AC model. In addition, all Person State correlations among ACS subscales were significant. Further analyses using regression to cross-validate findings across research sites, indicated that the regression model which most closely related to the AC model ($R^2 = .60$, $p < .001$) resulted in the highest cross validation R^2's (.29, .55, and .52, p's < .001). This model included self-efficacy, belongingness, and personal control, and indicated that the ACS subscales are reliable and predict self-reported AC behaviors. Both the correlational and cross-validation analyses indicated that self-efficacy, belongingness, and personal control were the best predictors of self-reported AC behavior, accounting for between 25% and 55% of the variance in AC behaviors.

of the ACS	RAC	SE	SEf	PC	OP
Self-Esteem (SE)	.37				
Self-Efficacy (Sef)	.46	.62			
Personal Control (PC)	.52	.41	.48		
Optimism (OP)	.35	.52	.52	.41	
Belongingness (Bel)	.55	.36	.38	.36	.43

Table 2. Correlations among the Reported Actively Caring (RAC) and separate subscales of the ACS.

PRELIMINARY FINDINGS FROM FOUR RESEARCH PROJECTS

STUDY 1: WHAT DO SAFETY PROFESSIONALS KNOW ABOUT BEHAVIOR-BASED SAFETY?

Safety professionals were solicited for input through a nationwide survey published in *Industrial Safety and Hygiene News (ISHN)*, a monthly magazine for safety professionals with 62,000 company subscribers. The survey was designed to assess readers' knowledge and interest in BB safety, and to explore ideas for improving the communication and implementation of BB principles and procedures for reducing industrial injuries. The survey also allowed us to begin constructing a database of organizations currently active in BB safety efforts.

A total of 162 completed surveys were returned to us by mail or fax. An appreciation of the BB approach was shown by 80% (n=129) of the respondents answering "yes" to the question "Do you believe behavior-based safety is a viable approach for reducing at-risk work behaviors and activities?" (Only 3% responded "no" to this question; the rest said they didn't know). In addition, more participants responded "no" (48%) than "yes" (34%) to the question, "Do you think a safety program should put more direct focus on attitudes than on behaviors?" This is interesting because it not only shows preference for a BB approach, it reflects a shift from the traditional educational approach to injury prevention.

The astute reader will note, however, that the sample of surveys we analyzed was not random and was likely biased toward the BB approach. The survey was presented within the context of research aimed at discovering how to make the BB approach more effective. Thus, it's likely most people who took the time to complete and return the survey were at least interested in this particular approach to industrial safety. In fact, several respondents asked specifically to be included in our sample of organizations to visit for the on-site evaluation of factors contributing to the impact of a BB safety process.

Thus, it's likely the results of our survey were biased by sample selectivity. Compared to the average reader of *ISHN*, those who answered the questions and returned our survey were probably more informed about BB safety and had higher confidence in the effectiveness of BB safety. Even with this positive bias, however, the survey revealed some misperceptions about BB safety which can limit its application for safety improvement.

What is Behavior-Based Safety?

The first part of the survey asked respondents to give their impression of BB safety by checking all of the items they believe are true from a list of 16 possible characteristics. In general, the respondents' selections indicated accurate knowledge of BB safety, but there were a few notable exceptions.

The three items selected most often as representing BB safety were: 1) an intervention approach for increasing safe behavior (selected by 143 respondents); 2) an observation and feedback process (n=130); and 3) a tool for managing safety (n=114).

Relatively fewer respondents considered other characteristics of BB safety to be relevant. Specifically, only 42 of the 162 respondents considered BB safety an approach useful for investigating injuries. Only 88 respondents felt BB safety is useful for evaluating safety achievement, and 99 respondents considered BB safety an intervention approach for decreasing unsafe behavior.

I suspect many people have a rather narrow viewpoint regarding BB safety. This limited perspective is also reflected in numerous safety articles, sales pitches from safety consultants, and presentations at safety conferences. But, BB safety is much more than a tool for doing observation and feedback. It is actually "a general philosophy that can be applied to many aspects of safety management." This general definition was actually the most accurate item on our survey checklist, and was checked by 115 of the 162 respondents.

Principle versus Application

Most survey respondents were aware that BB safety focuses on positive consequences to influence behavior change, since only four individuals indicated that BB safety was "an approach focusing on the use of punishment to decrease unsafe behavior." However, a different story emerged when the survey asked respondents to check which techniques were actually used in their plant "to influence safety-related behaviors in the workplace."

Activators (or antecedent strategies) were most popular, with policies (n=149), posted safety signs (n=124), demonstrations (n=108), and lectures (n=102) leading the list. Goal-setting, feedback, and incentive/reward programs were used frequently, but more companies focused on outcome ("accidents or injuries") rather than process ("safety-related behaviors or activities") when setting goals (n=95 vs. 48), when giving group feedback (n=83 vs. 60), when giving individual feedback in coaching sessions (n=96 vs. 74), and when rewarding people for safety improvement (n=72 vs. 56).

The absence of checks for many techniques was quite revealing, and inconsistent with an appreciation for BB safety principles. For example, the most cost-effective BB approaches to improve safety are BB goal-setting and feedback for individuals and groups, yet these intervention approaches were being used at less than half of the sites represented by the survey respondents. It was encouraging that almost two-thirds of the sample (n=102) use safety steering committees to manage their safety programs.

Only 15% (n=24) of the respondents indicated they monitor "percent safe behavior" to assess the success of their safety programs. The traditional outcome metrics were most popular, with 77% (n=125) using OSHA recordables, 75% (n=122) using lost-time accidents, 42% (n=68) using total recordable injury rate, and 44% (n=66) using total recordable rate, including illness. Interestingly, slightly more respondents reported they use attitude or perception surveys (17%) than percent safe behaviors (15%).

Implications

The responses of those who completed and returned our BB safety survey published in *ISHN* reflected appreciation for a BB approach to injury prevention, but also demonstrated substantial misunderstanding and misapplication. A majority of respondents, for example, perceived BB safety as an observation and feedback tool rather than a general approach to improving the human dynamics of safety, relevant for ergonomics, injury investigation, and the design of incentive/reward programs.

Even with substantial appreciation for BB observation and feedback as a way to increase safe behavior, relatively few respondents indicated use of a relevant metric for monitoring the success of a behavior-improvement process. Thus, while safety leaders are increasing their belief in the power of observation and feedback to improve behavior, companies are apparently slow to apply appropriate feedback measures to evaluate and improve their safety programs. This is likely not due to inconsistencies between people's beliefs and behaviors, but rather is due to management system variables that prevent a paradigm shift from an outcome-based and reactive evaluation process to one focused on up-stream process activities that contribute to the prevention of workplace illnesses and injuries.

STUDY 2: DOES EMPLOYEE INVOLVEMENT IMPROVE BEHAVIOR-BASED SAFETY?

This research evaluated certain intervention procedures taught by industrial safety trainers and consultants as part of a BB safety process. More specifically, this research studied the effects of involving employees in the development and implementation of BB safety interventions as opposed to the typical top-down approach to occupational safety.

Training BB Safety

The BB safety process at a large manufacturing plant in Southwest Virginia began by training volunteer safety facilitators from representative areas and then conducting facility-wide training sessions for the remaining employees (n=550). The format of the training sessions was manipulated in order to investigate the impact of employee participation during BB safety training. The materials for all sessions were held constant. However, the safety trainers in the *Choice* condition (n=230 on Shift 1) were instructed to ask questions and facilitate group discussion and involvement with workers. This included group exercises in which workers presented their suggestions for safety enhancement. In contrast, the same trainers in the *Assigned* condition (n=246 on Shifts 2 and 3) presented the safety material in a lecture format without asking questions or facilitating workers' input. Further, group exercises in this condition were "yoked" from the responses of the groups in the *Choice* condition (i.e., Shift 1).

Four-hour training sessions, presented by two trainers, were held for 12 *Choice* groups and 14 *Assigned* groups, ranging in size from 7 to 30 individuals. To assess the impact of the two training approaches, three variables were measured: the amount of verbal participation, participants' reported satisfaction with the training, and the participants' retention of safety training information.

All verbal behaviors from the participants, including questions asked, questions answered, and reactive statements, were evaluated for each training session. Figure 1 depicts the mean number of verbal responses for each shift, with Shift 1 in the *Choice* condition and Shifts 2 and 3 receiving the *Assigned* condition. A one-way analysis of variance (ANOVA) of verbal behavior for training format (*Choice* vs. *Assigned*) indicated that participants in the *Choice* condition made significantly more verbal behaviors (M = 6.48) than participants in the *Assigned* condition (Shift 2: $\underline{M} = 1.09$, Shift 3: $\underline{M} = 1.19$, $\underline{p} < .05$).

Further analyses were conducted on each type of verbal response: questions answered, reactive statements, and questions asked. As shown in Figure 2, a one-way ANOVA of questions answered per Shift (Shift 1 vs. Shift 2 vs. Shift 3) indicated that participants in the *Choice* condition answered significantly more questions (M = 4.02) than participants in the *Assigned* condition (Shift 2: $\underline{M} = .35$, Shift 3: $\underline{M} = .38$, $\underline{p} < .05$). As illustrated in Figure 3, a one-way ANOVA of reactive statements per Shift (Shift 1 vs. Shift 2 vs. Shift 3) indicated that participants in the *Choice* condition made significantly more reactive statements (M = 2.32) than participants in the *Assigned* condition (Shift 2: $\underline{M} = .67$, Shift 3: $\underline{M} = .73$, $\underline{p} < .05$). And as shown in Figure 4, a one-way ANOVA of questions asked per Shift (Shift 1 vs. Shift 2 vs. Shift 3) indicated no significant difference in the average number of questions asked by participants in the *Choice* (M = .14) and *Assigned* conditions (Shift 2: $\underline{M} = .08$, Shift 3: $\underline{M} = .08$, $\underline{p} > .05$). Overall, these findings suggests that participants in the *Choice* condition were significantly more involved in the training process than employees in the *Assigned* condition, but there were no differences in number of questions from participants.

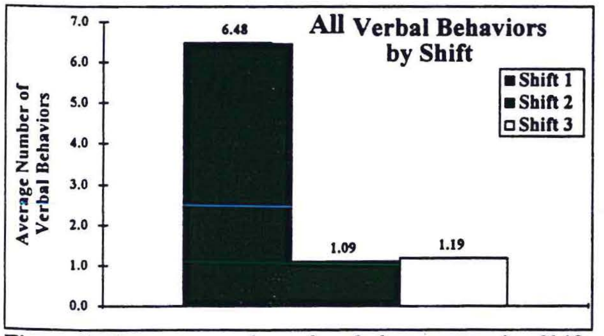

Figure 1. Average number of verbal responses by Shift. Shift 1 received participative training and Shifts 2 and 3 received nonparticipative training.

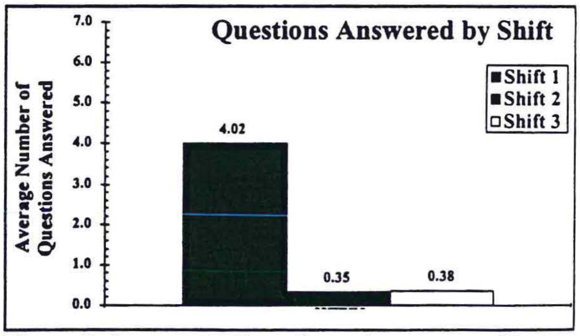

Figure 2. Average number of questions answered by shift. Shift 1 received participative training and shifts 2 and 3 received nonparticipative training.

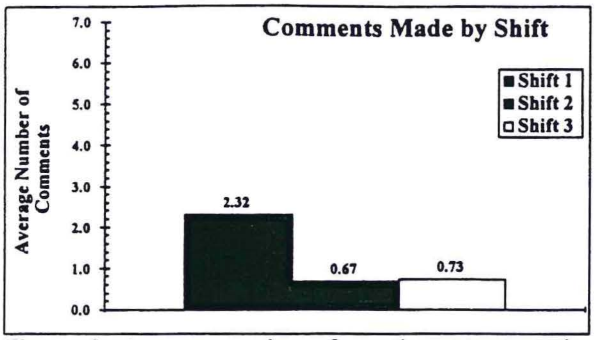

Figure 3. Average number of reactive statements by Shift. Shift 1 received participative training and Shifts 2 and 3 received nonparticipative training.

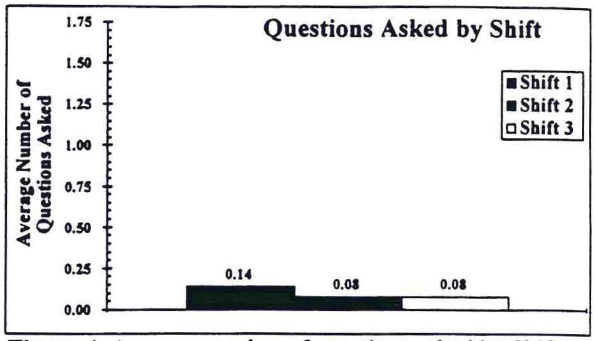

Figure 4. Average number of questions asked by Shift. Shift 1 received participative training and Shifts 2 and 3 received nonparticipative training.

Participants' responses to the following post-training questionnaires were also evaluated: a) an 18-item knowledge test, b) a 5-item measure of involvement, and c) a 1-item measure of satisfaction with the training. As shown in Figure 5, a one-way ANOVA by Shift (Shift 1 vs. Shift 2 vs. Shift 3) indicated no significant differences between the knowledge scores of participants in the *Choice* ($\underline{M}$ = 66.6) and *Assigned* conditions (Shift 2: $\underline{M}$ = 68.9, Shift 3: $\underline{M}$ = 66.5, $\underline{p} > .05$). Analyses of participants' perceptions of involvement using a one-way ANOVA by Shift (Shift 1 vs. Shift 2 vs. Shift 3) indicated no significant difference between the perceived involvement of participants in the *Choice* ($\underline{M}$ = 3.44) and *Assigned* conditions (Shift 2: $\underline{M}$ = 3.58, Shift 3: $\underline{M}$ = 3.70, $\underline{p} > .05$). Finally, analysis of participants' self-report of satisfaction with the training process using a one-way ANOVA by Shift (Shift 1 vs. Shift 2 vs. Shift 3) indicated that participants in the *Choice* condition (i.e., Shift 1) were more satisfied with the training process ($\underline{M}$ = 2.56; 1 = *strongly liked,* 7 = *strongly disliked*) than Shift 3 participants in the *Assigned* condition (Shift 3: $\underline{M}$ = 3.05, $p > .05$). The satisfaction of Shift 2 participants in the *Assigned* condition (Shift 2: $\underline{M}$ = 2.80) was not significantly different from the participants in the *Choice* condition.

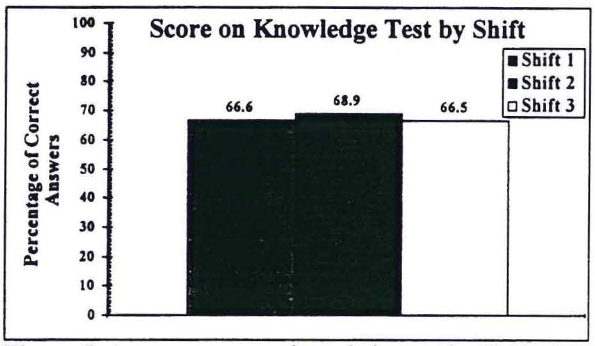

Figure 5. Average score on knowledge test by Shift. Shift 1 received participative training and Shifts 2 and 3 received nonparticipative training.

These results were counter to our hypothesis that participative training would be more effective and appreciated than nonparticipative training. The lack of significant differences between conditions regarding information retention, satisfaction, and involvement suggest that: a) group participation may not be directly measurable by verbal behavior alone, b) the nature of the training material itself may have involved workers regardless of their verbal responses, or c) *Choice* training simply may not be more effective than *Assigned* training in terms of information retention and personal satisfaction.

Implementing BB Safety

Many involvement manipulations were made to give the Shift 1 facilitators (n=8) as many opportunities to make key decisions in the BB safety process as possible. For example, the Shift 1 safety facilitators selected: a) the initial safety-related behavior (hearing protection was chosen) to observe plant-wide, b) the design and location of group feedback prompts, c) the initial plant-wide safety intervention, d) the design of a safety slogan contest, and e) the safety-related behaviors to observe in individual work areas. The choices made by the Shift 1 safety facilitators were assigned (or yoked) to the Shift 2 safety facilitators (n=6), thus limiting Shift 2 input into the BB safety process. This parallels the *Choice* vs. *Assigned* conditions manipulated during training.

For nine weeks the safety facilitators of the Shift 1 (n=230) and Shift 2 (n=210) made behavioral observations on hearing protection. The data were graphed and posted on a safety bulletin board located at the entrance to the production areas for all employees to observe. The dependent measure used to assess facilitator involvement was number of observations taken.

Results and Discussion

Over the nine-week period, the Shift 1 facilitators ($n = 8$) made significantly more observations per facilitator per week ($M = 10.57$, $SD = 3.39$) than the Shift 2 facilitators [($n = 6$, $M = 6.13$, $SD = 3.76$, $t\ (16) = 3.1$, $p < .05$]. Also, the Shift 1 facilitators observed a significantly greater [$t\ (8) = 2.6$, $p < .05$] percentage of target behaviors than did the Shift 2 facilitators (37% vs. 23%, respectively). Shift 1 facilitators also took significantly more observations per person each week than the Shift 2 facilitators [$t\ (16) = 3.05$, $p < .05$]. See summary statistics in Table 3.

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Mean	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Observations per facilitator	Equal variances assumed	.030	.864	3.053	16	.008	4.4472	1.4568	1.3590	7.5355
	Equal variances not assumed			3.053	15.357	.008	4.4472	1.4568	1.3484	7.5460

Table 3. Test of significance for mean observations per facilitator per week

These findings show promise regarding the effects of empowerment and involvement on participation in a BB safety process. In addition, a time series tabulation of this plant's injury statistics shows the bottom-line beneficial impact of the BB safety process across all three shifts (see Figure 6). Lost days due to injuries decreased markedly after the BB safety training and observation/feedback programs were put in place (10.9 lost days per month prior to BB safety versus 1.5 lost days per month after the initiation of BB safety).

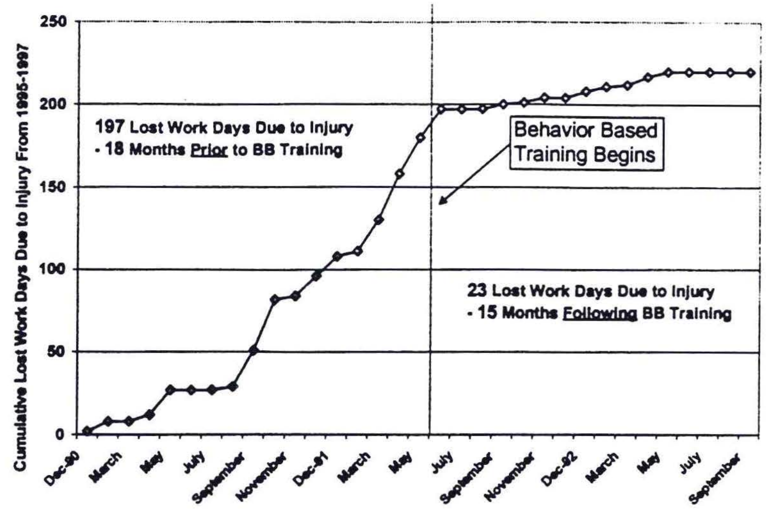

Figure 6. Cumulative Lost Work Days Due to Injury '95-'97

STUDY 3: MUST BEHAVIOR-BASED FEEDBACK BE SPECIFIC?

Although past research demonstrates the practical utility of providing feedback to improve safety performance, less is known about what type of feedback is most effective in improving safety performance. This industry-based study compared general versus specific feedback methods.

A critical behavior checklist (CBC) with corresponding behavioral definitions was designed to target specific work practices. For each behavioral category, trained observers marked either "safe" or "at risk" for a number of safety-related behaviors of employees at a soft-drink bottling plant in Roanoke, VA. At the end of each week, the total percentage of safe behaviors for each category was calculated. An overall "percent safe" for the week was also tallied. Reliability estimates for interrater agreement between observers were calculated each week and were above 85% for all behaviors observed.

Method

Forty employees from a soft-drink bottling facility were observed by trained behavioral observers once a day for two work shifts. For 15 weeks, a baseline period was established to determine the percent safe for the target behaviors before a feedback intervention was initiated. Following baseline, Shift 1 received feedback on overall percent safe (combined across behaviors), whereas Shift 2 received feedback on percent safe for each behavioral category. Feedback was posted weekly for six weeks. Then the intervention methods were reversed for another six weeks. Shift 1 received specific behavioral feedback, and Shift 2 received global behavioral feedback. Feedback graphs were attached to pay stubs and presented at weekly meetings for all 12 weeks of this intervention period.

Results and Discussion

As depicted in Figure 7, the overall percent safe for Shift 1 increased from 72% safe in baseline to 87% safe after the first intervention (*Global* feedback) and fell to 81% after the second intervention (*Specific* feedback). For Shift 2, the overall percent safe increased from 78% safe to 85% safe after the first intervention (*Specific* feedback) and dropped to 75% safe after the second intervention (*Global* feedback).

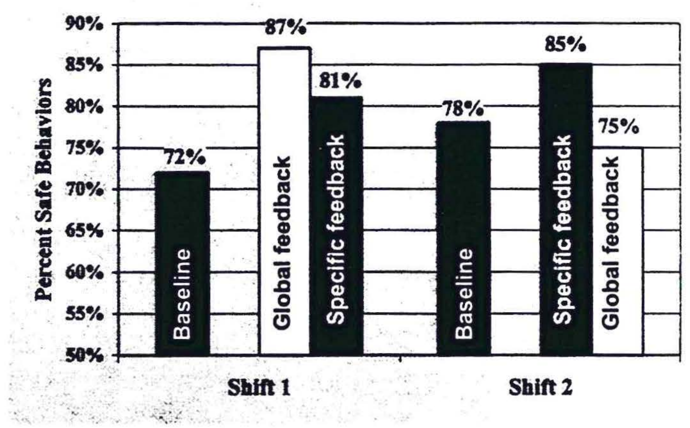

Figure 7. Effects of varying types of feedback on behavior

These results indicate that feedback improved safety performance beyond baseline measures, but no differences were found for type of feedback. However, the observation procedures were accomplished and the feedback graphs presented in the absence of formal education/training regarding BB safety. All employees at this facility are scheduled to receive BB education/training. Follow-up results are expected to demonstrate that teaching employees the principles and rationale behind a BB safety process will enhance the impact of BB observation and feedback.

So far the results suggest that in the absence of formal BB safety training, specific and global behavioral feedback are equally effective at influencing safety performance. Substantial differences were seen with regard to order, with performance increasing over baseline in the first feedback intervention (regardless of feedback type), and trending downward for the second intervention (regardless of feedback type). This suggests workers were initially motivated to improve performance when they first received feedback and then, in the absence of positive consequences associated with improved performance (or appropriate involvement and education/training), safe behavior decreased for the second feedback intervention. It is noteworthy that the overall frequency of recordable injuries at this plant decreased by over 50% following the BB observation and feedback process.

STUDY 4: WHAT FACTORS DISTINGUISH SUCCESSFUL FROM UNSUCCESSFUL BEHAVIOR-BASED SAFETY PROGRAMS?

Ten companies reporting exemplary success implementing and maintaining a BB safety process and ten companies reporting unsuccessful implementation and maintenance of a BB safety process have been selected for site visits. To date, teams of two have conducted eight of the 20 proposed site visits. During these site visits, the teams conduct structured interviews and hold focus-group meetings to discuss reasons for program successes and failures, and to explore strategies for improving the long-term implementation of BB safety principles and procedures.

A separate meeting is held with members of the plant safety steering committee and with a random sample of hourly employees. The survey team also tours the facilities and records any visible signs of support for BB safety (such as slogans, posters, billboards, etc.), and also inquires about program-related articles and promotions in company publications.

A Safety Culture Survey of 171 questions is also administered to all employees. The 20 different variables assessed by the Safety Culture Survey are depicted in Table 4. Prior research has shown all of these variables to influence industrial safety. Results obtained in the current research will uncover relations among these variables as they mediate the success or failure of a BB safety process. As of this writing, none of the visited organizations has returned completed surveys. Therefore, results discussed here rely on information gathered during structured interviews and focus groups conducted at only eight sites.

Assertiveness	Reactance	Personal Responsibility for Safety	Frequency of Positive Feedback Given
Belonging	Self-Esteem	Trust in Management	Frequency of Negative Feedback Given
Impulsivity	Self-Efficacy	Trust in Peers	Frequency of Positive Feedback Received
Optimism	Management Support for Safety	Perceptions of Safety Training Received	Frequency of Negative Feedback Received
Personal Control	Peer Support for Safety	Frequency of Observations	Propensity to Actively Care

Table 4. Individual person states assessed by the Safety Culture Survey

Results from Structured Interview and Focus Groups

Site-visit interviews and focus groups have provided a wealth of instructive information. Qualitative data collected so far enable us to begin identifying some patterns and trends. Specifically, responses from employees have helped to uncover factors which appear to act as obstacles to BB safety, as well as factors which facilitate a BB safety process.

First, effective safety efforts require careful selection and grooming of safety champions. Approaches used to determine committee membership vary greatly, from allowing anyone to volunteer to conducting an extensive selection and interview process. The individuals who compose the BB safety steering committee play a critical role in the success or failure of the process. Because of the importance of this team, it is critical an organization be selective in determining committee membership.

A committee which does not have the respect of its coworkers (reflected by comments like "People just want overtime and trips," "I don't even know who is on it," "They're brown-nosers," "Some of those committee members are the most unsafe workers we got. Does that make any sense?") experiences more difficulties in getting employee participation as compared to a committee that commands respect (reflected by comments like "They are dedicated and try hard," "The facilitators really help get things done"). Due to the significance of the BB steering committee, organizations would benefit from selecting employees who are viewed as leaders, and are respected by the workers in their area.

Effective safety efforts focus on the positive. One of the primary tools used to influence behavior in a BB safety program is observation and feedback. If observation and feedback methods are to be successful, the feedback must focus on the positive. When questioned about the observation and feedback process, those employees which were most vocal against the process pointed to the frequency with which negative feedback was occurring (reflected with statements like "Inappropriate feedback is often given," "I give permission to be observed, then I'm made to look bad," "The observers are looking for negatives").

What needs to be made very clear to employees as they are trained in the observation and feedback process is that observers need to make a conscious effort to focus on the positive. The observers in successful programs are respected and feel a sense of pride in their coaching roles (as reflected in words like "We take pride in making observations and providing feedback," "You might be at risk without even knowing it, we provide another set of eyes to protect you"). The bottom line is, if employees use the observations as an opportunity to criticize a fellow employee, the process will meet with substantial resistance.

Employees must be made to realize that nothing negative will come from their being observed. Here trust (of fellow employees and management) becomes a critical factor. In particular, employees must be confident that observations will not be used against them (as indicated by comments like "It's a pimp program, names get involved," "It may not be anonymous" "Sure, no one has gotten in trouble yet, but it's just a matter of time before an observation is used to punish someone"). To the extent trust exists in the organization, the observation and feedback process will be more likely to succeed.

Effective safety efforts require visible supervisory and management support. No surprises here. Employees realize the importance of management support for the success of a BB safety process. And if employees do not perceive such support in their environment, their efforts will likewise be attenuated. For example, when asked to identify the three biggest obstacles to the success of their BB safety process, all of the employee groups identified support from management as critical. Such support could take the form of management providing employees with the time to receive proper training and to conduct observations. Some management of unsuccessful programs showed a reluctance to "turn loose power" to the employees.

With regard to direct management involvement in the process, reactions were very mixed. Some employee groups suggested the more management involvement the better (as evidenced by the quote "They should be involved because a team means everyone"). But other employee groups felt direct management involvement was a bad idea (as reflected in the consensus comment "Less management involvement is better, support is good if direct involvement is minimal"). Those groups which discussed management involvement as a factor which would inhibit BB safety pointed to issues of trust as crucial in determining their perceptions.

In sum, while all those interviewed agreed that management support is a necessity, perceptions regarding degree of direct management involvement in the process were mixed. In deciding the role management should play in the process, an organization would do well to heed employee perceptions on this issue, particularly with regard to trust. If safety has traditionally been top-down in a particular culture as reflected by the slogan, "safety is a condition of employment," then it is probably best to keep direct management involvement in the process to a minimum, at least at first.

Effective safety efforts driven from the bottom facilitate employee ownership. While organizations experiencing success with BB safety have clear support for the process from top management, the critical driving force is found among the hourly employees. Some organizations attempt to facilitate ownership by consistently changing membership on their BB safety steering committee after a specified time period. Other organizations do not rotate committee members and the BB leadership role becomes a permanent position. To date, there are no clear data to indicate which of these two approaches is more likely to lead to long-term success.

Regardless of committee make-up, it is advantageous to find a way to facilitate employee ownership of the BB safety process. In one of the more successful processes we have evaluated to date, perceived employee ownership of the process was readily apparent. Specifically, during focus group sessions we ask the question "What are your perceptions of employees on the safety committee?" At this particular organization, when employees were confronted with this question there was an uncharacteristic moment of silence. The question was posed a second time and a woman responded, "We heard you but we're just not sure what you mean." The woman continued, "All of us here feel like we're members of the safety committee 'cause it's our process, so when you ask us that question we're really not sure who your asking us about." Responses such as this are truly indicative of a process owned by the line workers themselves.

EXECUTIVE SUMARY

Our comprehensive review of the research literature turned up convincing evidence that a BB approach to occupational safety can be extremely effective at reducing at-risk behavior and workplace injuries. A key ingredient of every effective BB intervention was observation and feedback. In other words, participants need a mechanism for learning what to do differently in order to prevent the possibility of personal injury. Little is known, however, about the best way to implement a BB observation and feedback process, nor has there been any systematic study of the organizational factors needed to institutionalize a BB process for improving safety-related work practices. This defines the mission of our research reviewed here.

Our two-year project is still underway, and most of the survey data are not yet analyzed. However, the preliminary research and four experiments described here enable the following conclusions:

- Although appreciation for BB safety is on the rise, BB safety principles are rarely applied in the development of a company-wide accountability system. In other words, outcome numbers (such as total recordable injury rate) rather than process numbers (such as quality and quantity of participation) are used most often to evaluate safety performance, even on the shop floor.

- Involving employees in a BB safety training program did not facilitate knowledge gained nor personal satisfaction in the process. However, involving employees in the development of an intervention tool and protocol had prominent beneficial effects on actual implementation of an observation and feedback process.

- Marked reductions in workplace injuries occured at both study sites immediately after a BB observation and feedback process was put in place.

- Specific feedback and nonspecific global feedback were equally effective at influencing modest improvement in work practices. The observation and feedback process were implemented, however, without prior employee training on BB safety principles. Follow-up research will assess the impact of specific versus global feedback processes after all employees receive a comprehensive training program on BB safety.

- Interviews and focus groups at sites with varying success implementing BB safety indicated key roles of an employee steering committee, visible management support, one or more champions to drive the process, and personal perceptions of program ownership and interpersonal trust. The most successful organizations "do it their own way," and the procedures and support systems vary dramatically across cultures.

- And finally, we realize we have only cracked the surface in determining the critical success factors of BB safety. We will obtain much more information before our grant ends, but then we will have only begun an important discovery process. Much more research is needed in this human factors domain of industrial health and safety.

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