CRITICAL SUCCESS FACTORS FOR BEHAVIOR-BASED SAFETY

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SIGNIFICANT FINDINGS

Overall, the results of this research demonstrated the effectiveness of behavior-based safety (BBS) interventions for increasing safe work behaviors and reducing injuries. Without exception, organizations participating in our research realized an improvement in their safety records after implementing a BBS process. Such success, however, was not always easily achieved. This helped identify a number of factors critical to the success of an organization's BBS efforts.

The effectiveness of BBS was clearly demonstrated in Study 1 and Study 3. In Study 1, we manipulated level of employee involvement during BBS training and implementation. The strongest finding was a significant and dramatic decrease in the number of lost work days and severity of injuries after BBS training and implementation. Lost days decreased from a mean of 10.9 per month prior to the safety process to a low of 1.5 lost days per the 18 months after BBS was initiated. The results obtained from Study 3 provided additional support for the effectiveness of BBS interventions. Specifically, using both specific and global feedback to target a number of safety-related behaviors, the target organization not only increased frequencies of safe behaviors, but it also enjoyed a drop in injury rate by more than 50% over the 18-month intervention period.

Acknowledging the power of BBS methods for increasing employee safety, the focus of this research was to identify factors critical to BBS success. Study 1 and Study 5 demonstrated the crucial roles of personal control, interpersonal trust, management support, and BBS training. In Study 1, safety facilitators who were involved in making implementation decisions made more interpersonal audits of hearing protection use, the target behavior they selected than did those assigned their BBS procedures. For only the empowerment or choice condition, did use of hearing protection increase significantly as a function of the observation and feedback process.

Study 5 revealed that organizations opting to make their BBS process mandatory are not necessarily sacrificing employee perceptions of empowerment and personal control. In other words, an organization can build choice into the BBS process that allows employees to experience control. For example, organizations can empower employees to choose when they perform observations, how often observations are performed, and who does the observation. In fact, Study 5 revealed that employees in organization with a mandatory process reported significantly higher levels of trust in management (both abilities and intentions), trust in coworkers abilities and intentions, and satisfaction with training.

Study 5 was also informative regarding variables that increase the likelihood of employee involvement in a BBS process. Five variables were predictive of an employee's self-reported involvement in a BBS process: a) perceived effectiveness of the BBS training, b) trust in management abilities, c) whether safety performance is used in performance appraisals, d) whether an employee received BBS training, and e) tenure with the organization. These variables accounted for 41% of the variance in self-reported involvement in a BBS process.

Finally, the current research led to the development of a "Flow of Behavior Change" model proposed to assist occupational safety and health professionals in designing interventions within their unique safety environments (see Geller, 1998a). This model hypothesizes three types of behavior, four stages of behavioral competency, and four intervention categories.

We propose there are three types of behavior: other-directed, self-directed, and automatic behavior. Whenever people learn new behaviors, these behaviors are initially *other-directed*. In other words, contingencies are externally established to director or instruct a new target behavior. This is considered an *instructional* intervention. Once the newly acquired behavior is practiced, the individual no longer requires external direction or even motivation, only peer support from *supportive* interventions. When individuals set their own contingencies, the behavior then becomes *self-directed* (cf. Watson & Tharp, 1981, 1993?). Thus, self-directed people use *self-management* interventions to guide and motivate their own behavior. After a behavior is successfully repeated over a period of time, it may become *automatic* (or habitual) where the behavior is performed without conscience thought.

We also hypothesize that individuals transition through four stages or levels of behavioral competence (unconsciously incompetent, consciously incompetent, consciously competent, and unconsciously competent) when moving from an *at-risk* habit to a *safe* habit. People in the *unconsciously incompetent* stage are hypothesized to not be aware of the risky behavior they are performing. If individuals are aware they are engaging in a risky behavior and continue regardless of this knowledge, they are classified in the *consciously incompetent* stage. Movement from this stage usually requires *motivational* intervention.

People are considered *consciously competent* when they willingly perform the desired safe behavior, but they still need to consciously think about it. They are not fluent, and need a *supportive* or *self-management* intervention to reach the fluency stage. When individuals no longer need to consciously think about performing safe behaviors, they are considered *unconsciously competent.*

The "Flow of Behavior Change" model (see Figure 1 on the next page), integrates the four stages of competence with the four types of intervention: instructional, motivational, supportive, and self-management. When willing learners are first acquiring new behaviors, teachers typically rely on instructional interventions that use activator strategies (Geller, 1996; Geller, 1998a) to move people from the unconsciously incompetent stage to the consciously competent stage. Instructional interventions can be any antecedent event that directs

behavior. In industrial settings, for example, education/training sessions, training videos, or new safety policies are often used to direct new safety-related behaviors.

Some people might understand the information given during the instructional intervention, but they may not believe the information pertinent or the behavior worth the effort. For example, employees take calculated risks or shortcuts to accomplish a job faster (like not locking-out a piece of machinery). The model refers to this person as consciously incompetent. To move individuals from conscious incompetence (meaning they know what to do but do not do it) to conscious competence, the model illustrates the need for motivational intervention. Since the consciously incompetent individuals know the correct behavior, an activator strategy alone will have minimal impact (Geller et al., 1990). Using a consequence strategy along with an activator strategy is presumed to be the intervention method of choice here (Geller, 1996; 1998b).

Once individuals are performing a desired safe behavior (because of either self- or other-directions), supportive interventions can help people move from the consciously competent stage to the unconsciously competent stage (i.e., a good habit). Supportive interventions mostly involve consequence strategies that reinforce and support desired behaviors. Supportive interventions include behavior-based recognition, interpersonal praise, and peer encouragement. Furthermore, if a person is consciously competent and self-directed, a self-management intervention is hypothesized to facilitate movement to a safe-habit (i.e., unconsciously competent). This proposed "Flow of Behavior Change" model is the only occupational safety and health model that specifies the type of intervention safety professionals or managers should use as a function of employee's competency level with regard to a certain safety-related behavior.

In sum, our findings provided a wealth of information relevant for the implementation of BBS in industrial settings. The studies reported here add to both the theoretical and practical literature in the domain of occupational health and safety. For example, researchers will find the Flow of Behavior Change model useful in planning intervention strategies and predicting their impact. And hopefully, this model will both direct and motivate follow-up research. Safety consultants and practitioners can use the success factors we've uncovered to increase the effectiveness of industry-based BBS process.

USEFULNESS OF FINDINGS

1) A popular perception for industrial safety professionals as well as safety consultants is that BBS processes should be voluntary. The arguments advanced by proponents of this perspective is that making such a process mandatory will result in resistance or even retaliatory behaviors from employees who resent a loss in their perceptions of personal control. Our research indicates this is not necessarily the case. Employees involved in mandatory BBS processes reported more participation and greater levels of interpersonal trust. In addition, these employees reported as much satisfaction with BBS as did individuals participating in a voluntary process.
2) Effective BBS training as well as perceptions of personal control appear to be critical variables for positive employee reaction to a BBS process. In particular, mandatory processes that allow employees opportunities to customize their BBS process are likely to experience more success than organizations that do not allow for employee control.
3) It is beneficial to pay attention to possible unintended side-effects of a behavior-change intervention. For example, in Study 2, the organizational interventions targeting safety-belt use had an unwanted side-effect on turn-signal use. Turn-signal use decreased steadily

throughout the course of the study, ending at a low of 34%, 16 percentage points below the baseline mean of 50%. These data, in concert with the modest increase in safety-belt use, support risk compensation theory (Peltzman, 1975).

4) Study 4 documented a wide array of opinions on the topic of BBS, including a lack of appropriate approaches toward evaluating BBS programs. This implies a need for more attention to dissemination. Over the two years of this grant, we contributed significantly to this need by writing several articles, books, and training manuals and presenting numerous conference presentations, seminars and workshops. Please refer to **Appendix A** for a list of professional activities that disseminated the results of this research.

5) The "Flow of Behavior Change" model developed from this research (see **Figure 1** on page 4) can be used to plan intervention strategies and predict success of existing intervention programs.

BACKGROUND AND SIGNIFICANCE

The leading the causes of death for people under the age of 38 is not heart disease or cancer, but something as common as injuries. Injuries kill more than 93,000 Americans and require an estimated 478 billion dollars in total costs each year. This averages to two people dying and over 370 people sustaining a disabling injury every 10 minutes (National Safety Council, 1998). Of the 96 million visits to the emergency room, 37% were injury related. The most common cause for people visiting the emergency room is for accidental falls (7.7 million), followed by motor vehicle crashes(4.4 million), and accidental cuts (3 million). 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.

Due to the frequency and severity of injuries, the U.S. Department of Health and Human Services has identified injury prevention as a priority for attaining the goals outlined in Healthy People 2000: National Health Promotion and Disease Prevention Objectives (1990). Every day, an estimated 10,000 to 36,000 U.S. employees are injured and 14 are killed. Moreover, an estimated 5,000 to 11,000 workers die and 2.5 to 11.3 million employees suffer non-fatal injuries (Leigh, 1995; Miller, 1997; Nation Institute for Occupational Safety and Health, 1998; National Safety Council, 1998; U. S. Bureau of Labor Statistics, 1997). In sum, approximately 250,000 potential productive years of life are lost annually because of premature death due to work-related injuries (Baker et al., 1992).

According to the U. S. Bureau of Labor Statistics (1998), the highest incidence rate of non-fatal occupational injuries and illnesses among goods-producing industries occur in manufacturing. The 1997 incidence rate of 12 per 100 full-time employees was followed closely by incidence rates in the wholesale and retail trades (11.9). Of the nearly two million injuries and illnesses in 1996 resulting in lost workdays, the majority were caused from overexertion (28%) and contacts with objects/equipment (26%). Although the overall 1997 rate of 3.7 lost days per 100 full-time employees has dropped since 1990, work-related injuries remain a problem.

SOCIAL AND ECONOMIC RAMIFICATIONS

Over and above the traumatic personal consequences experienced by employees and their friends and families due to unexpected industrial injuries and mortalities, there are also critical social and economic consequences to consider. Although pain and suffering caused by these misfortunes cannot be quantified, the social and economic costs can be estimated. The overall liability of work-related injuries in 1997 has been estimated at $128 billion (National Safety Council, 1998). This figure is an increase from the 1989 estimate of $89 billion, and is dramatically larger than the 1985 estimate of $34.6 billion (Leigh, 1995). These costs include lost wages, medical expenses, insurance claims, production delays, lost time of coworkers, equipment damage, fire losses, and indirect costs (Miller, 1997; National Safety Council, 1988).

All of these estimates are staggering and indicate the cost of industrial injuries is increasing at an alarming rate. Today it is estimated that each year employers pay approximately $200 billion in direct costs associated with injuries both on and off the job. Occupational injuries account for two-thirds of this total or nearly $128 billion annually. This amounts to over $28,000 per work-related injury and close to one million dollars per employee death. The majority of these current costs are in the form of insurance premiums for workers and their families, and workers' compensation for days lost from work (Miller, 1997; National Safety Council, 1998). It is also noteworthy that these estimates may be underestimating the true impact of industrial injuries due to problems with current surveillance techniques and the fact that many injuries are not reported (Leigh, 1995; Miller, 1997; National Committee for Injury Prevention and Control, 1989; Weddle, 1996; Wilson, 1985).

Because the manner in which employees are hurt differs so dramatically, prevention strategies need to address a myriad of different circumstances (Geller, 1996; Heinrich, 1959; Petersen, 1996; U. S. Bureau of Labor Statistics, 1997). Thus, critically examining and redefining industrial safety research to improve long-term and broad-based impact has important implications for reducing morbidity and mortality, and increasing the quality of life among American workers. As such, relevant theories of behavior analysis and social cognitive psychology were used in the research reported here to critically evaluate the long-term impact of interventions designed to improve safety-related behavior.

INJURY CONTROL STRATEGIES

Although the overall injury and morbidity rates in industry are high, many experts believe techniques are available to prevent most injuries, whether acute or chronic. These techniques include: a) instituting a drug screening program; b) developing ergonomic and engineering strategies that decrease the probability of an employee engaging in at-risk behaviors; c) understanding the characteristics of workers most at risk for unintentional injury; d) educating and training employees regarding equipment, environmental hazards, and at-risk work practices; and e) motivating safe work behaviors through behavior-based observation and feedback. We investigated the latter in this NIOSH-funded research project. A summary of our findings is provided below in **Research Findings,** with more complete documentation of each project included in an appendix as submitted for professional publication**.**

Applied Behavior Analysis

Applied behavior analysis has made substantial contributions to the domain of health promotion and injury control by researching the determinants of at-risk behaviors, directing the development of effective behavior change interventions, and applying these interventions in a variety of settings like behavioral medicine (Cataldo & Coates, 1986), safety performance (Geller, 1996; Petersen, 1996), health behavior (Elder, Geller, Hovell, & Mayer, 1994), traffic safety (Geller, 1998c), environmental protection (Geller, Winett, & Everett, 1982), child safety (Roberts, Fanurik, & Layfield, 1987), and health psychology (Winett, King, & Altman, 1989).

Behavior-based approaches to injury control have a number of advantages over other approaches, including: a) they can be administered without extensive professional training; b) they can reach people in the setting where a problem occurs (e.g., community, school, workplace); and c) leaders in various settings can be taught the behavioral techniques most likely to work under relevant circumstances (Baer, Wolf, & Risley, 1968; Daniels, 1989; Geller, 1996, 1998b; d).

In occupational safety and health the application of applied behavior analysis principles referred to as behavior-based safety (BBS). For the past twenty years, BBS has been used successfully in the prevention of occupational injuries (e.g., Alavosius & Sulzer-Azaroff, 1986; Geller, Davis, & Spicer, 1983; Geller, & Hahn, 1984; Komaki, Barwick, & Scott, 1978; Reber, & Wallin, 1983, 1984; Roberts & Geller, 1995; Smith, Anger, & Ulsan, 1978; Streff, Kalsher, & Geller, 1993). In fact, Guastello (1993) found by systematically reviewing 53 occupational safety and health studies since 1977, that BBS had the highest average reduction (59.6%) of injury rate. Most of these studies, however, were simply demonstrations of techniques that had already been effective in other settings. Researchers made little procedural comparisons to guide the improvement of future intervention designs.

The antecedent-behavior-consequence model of applied behavior analysis has been applied frequently and successfully over recent years to prevent injuries. Behavior analysis has a great deal to offer the field of injury control by enhancing the understanding of the determinants of at-risk behavior, and guiding the development of effective behavior change strategies (Elder et al., 1994; Geller, 1988; Geller et al., 1989; Krause, Hidley, & Hodson, 1996; Petersen, 1989). For example, scientists have demonstrated the cost-effectiveness of: a) *participative education* to increase safety-belt use (Kello, Geller, Rice, & Bryant, 1988), b) *incentives/rewards* to increase safety-belt use (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 by first defining the target behavior in a directly observable and recordable way. The behavior is then observed and recorded in its natural setting. When a stable baseline measure of the frequency, duration, or rate of behavior is obtained, an intervention is implemented to change the behavior in beneficial directions. This intervention typically involves changing the salience of 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, 1998b). Changes in the desired direction indicate acquisition of the target behaviors.

Behavioral Feedback

One of the primary tools used to influence behavior in a BBS process is observation and feedback. Feedback can be based on individual or group performance. It can be given publicly or privately, and it is often combined with an education or training program (e.g., Zohar, Cohen, & Azar, 1980). The behavior change literature has shown consistent benefits of posting or communicating information regarding at-risk behaviors for individuals, groups, and entire communities.

Van Houten and his colleagues (Van Houten & Nau, 1983; Van Houten, Nau, & Marini, 1980) found decreased speeding following the road display of daily percentages of drivers exceeding the posted speed limit. Similarly, Jonah (1989) and Geller (1996) reported significant increases in safety-belt use following the use of roadway signs to post “percentage of drivers wearing safety belts yesterday.” More recently, Ludwig and Geller (1997) used behavior-based feedback in conjunction with goal-setting to increase complete stopping at intersections by the pizza deliverers at two separate pizza stores. Although it is generally agreed that feedback is a viable method for improving individual as well as group performance, there remains some controversy regarding the form feedback should take. Specifically, while some argue feedback is most effective when presented in a global fashion (Bandura, 1986, 1997), others maintain feedback needs to be behaviorally specific for optimal effectiveness (Frederiksen, Richter, Johnson, & Solomon 1982).

Those who claim feedback is most effective as a global score presume such a presentation will result in feedback receivers being more cognizant of all potential behaviors being targeted. Due to this generalized awareness, they will adjust all behaviors, and demonstrate greater and longer-lasting improvement (Baer, Wolf, & Risley, 1968, 1987; Boyce & Geller, 1998). In contrast, individuals supportive of specific feedback maintain that individuals cannot improve their performance unless they are aware of exactly what is being observed (Frederiksen et al., 1982). Our NIOSH-funded research addressed the global versus specific feedback question by comparing the relative effects of both in an industrial setting (see Study 3 and **Appendix E**).

Intrinsic versus Extrinsic Motivation

All complex organizations incorporate some form of external control or accountability system (Dose & Klimoski, 1995). Some investigators (e.g., Deci & Ryan, 1987; Kohn, 1993; Lepper, Greene, & Nisbett, 1973) have reported that external control of behavior through either punishment or reinforcement will undermine an individual's natural desire (sense of responsibility) to engage in a particular behavior. These researchers claim individuals will react against contingencies they perceive as controlling. For example, when people are paid to engage in a particular behavior, they justify their behavior by focusing on the reward they received for engaging in that behavior and not on some internal desire (or responsibility) to make the response.

According to the social psychological principles of discounting and cognitive dissonance (Festinger, 1957), individuals will perceive the target behavior as being less attractive because of the external controlling contingencies, especially if the accountability requirements are perceived as self-serving on the part of management (Dose & Klimoski, 1995). Thus, once the contingencies have been withdrawn, individuals are less likely to engage in the previously reinforced behavior. Perceptions of choice within a safety process could prevent the undermining of intrinsic motivation and thus enhance the probability of behaviors necessary to maintain a safety intervention program.

Because the behaviors needed to sustain a safety process are often inconvenient and uncomfortable, they may require support by some type of extrinsic (or external) intervention. The key is to provide enough external control to support the safety process, but not too much to undermine the internal desire to maintain a safe work culture. This can be accomplished by carefully structuring outcome expectations through role clarification and task specification (Dose & Klimoski, 1995). Such strategies could include participative or mandated goal-setting (Ludwig & Geller, 1997), commitment strategies (Geller & Lehman, 1991; Streff, Kalsher, & Geller, 1993), or consequence procedures, including both reward and punishment techniques.

In a comprehensive review of 28 employer-based programs to motivate safety-belt use, Geller, Rudd, Kalsher, Streff, and Lehman (1987) found reward strategies to be more effective than punishment strategies, and more effective than commitment strategies in the short term. However, commitment strategies were most effective at maintaining long-term behavior change. Thus, it could be speculated that these interventions facilitated workers' sense of responsibility toward the safety process by enhancing personal control and outcome expectancies through self-management.

The research we have performed over the past two years has allowed us to make some comparisons between organizations that mandate some level of performance in their BBS processes versus organizations that rely solely on voluntary participation. As such we have been able to investigate various interpersonal and behavioral consequences associated with both approaches. In addition, our findings have practical implications for individuals or groups planning to implement an industry-based BBS process.

SPECIFIC AIMS OF THE FUNDED RESEARCH

Our specific aims were prompted by our review of the literature summarized above, and have both practical and theoretical ramifications. From a practical perspective, we proposed to: a) develop flexible procedures for implementing an employee-driven BBS process to reduce at-risk work behaviors and increase safe work practices; b) derive guidelines to increase employee involvement in a long-term BBS process; c) demonstrate both short and long-term effects of a BBS process on work practices, attitudes, person states, and injuries; d) study indirect behavioral effects of a behavioral observation and feedback process (i.e., determine whether targeting certain work behaviors for an intervention process will influence other safety-related behaviors); and e) determine 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, we proposed to a) compare hypotheses derived from basic learning theory (i.e., response generalization) with those from danger compensation or risk homeostasis theory; b) study 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; c) compare the validity of intrinsic motivation theory (from cognitive science) versus extrinsic contingencies (from behavioral science) as foundations for a long-term intervention process; and d) develop the construct of empowerment as a feeling state of individuals which is potentially increased by perceptions or expectancies of self-efficacy, personal control, and optimism. Consequently, the overarching purpose of the proposed research was 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.

The results documented here demonstrate we have accomplished most of our specific aims. In addition, we have been able to disseminate much of our findings through presentations, workshops, and professional publications. A list of our professional activities related to this NIOSH-funded research is included in **Appendix A.**

Unfortunately, due to circumstances beyond our control, we were unable to answer some of our research questions. Specifically, a large portion of our survey data was destroyed by the organization responsible for scanning them. In other words, we got employees from 16 organizations to compete a variety of individual difference questionnaires but this data could not be analyzed because of another organizations disastrous error. A letter from this organization explaining the unfortunate destruction of our data can be found in **Appendix B.**

RESEARCH FINDINGS

A more detailed report for each of the studies described in this section can be found in the **Appendices** as the research was documented for professional dissemination.

STUDY 1: THE POWER OF CHOICE: OPTIMIZING INVOLVEMENT IN A BBS PROCESS

See **Appendix C** for a complete report as submitted for publication in *Journal of Safety Research.*

The literature has demonstrated straightforward and unmistakable benefits of a BBS approach to reducing injuries in industry (cf. Guastello, 1993). Most of these studies, however, 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. Research in the area of BBS needs to ask and answer questions regarding the design of more effective and longer-term intervention processes (NIOSH, 1998). This was the prime purpose of Study 1. Specifically, we evaluated the extent that employee involvement increases the impact of a BBS process. We predicted that involving employees in BBS safety training and implementation planning would lead to more beneficial impact of the training and greater participation during the implementation of a BBS process.

Method

Subjects and Setting

Subjects were 476 hourly and salary employees at an engine bearing manufacturing plant in southwest Virginia. The population of employees ranged in age from 19 to 63 years (M = 42), and employee tenure at the facility ranged from six months to more than 25 years (M = 16). The proportion of hourly to salary workers was approximately five to one, and the workforce and hours worked were stable throughout the course of the study.

Procedure

The BBS process began by training volunteer safety facilitators from representative work areas on first shift (n=8) and second shift (n=6) in the basic principles and procedures of this approach. Topics included: a) defining target behaviors, b) developing checklists to record occurrences of target behaviors, c) designing interventions to improve safety-related behaviors, d) charting progress in a time-series, and e) giving effective behavioral feedback. Following two intensive eight-hour education/training sessions for the safety facilitators, the remaining employees across three shifts received a four-hour version of BBS education/training.

Education/Training Manipulation

The format and style of the education/training sessions were manipulated to investigate the impact of employee participation during BBS training. The materials for all sessions, however, were held constant. Four research associates, experienced at conducting safety seminars, presented the sessions in randomized pairs. The material covered in plant-wide training paralleled that provided to the safety facilitators, but in abbreviated form.

Choice Condition

Throughout the course of the two eight-hour safety facilitator and four-hour plant-wide education/training sessions, the safety trainers in the Choice condition asked questions of participants, requested relevant stories, and facilitated discussions and interpersonal involvement with group exercises (n=230 on Shift 1). All sessions were held during the regular shift of the scheduled employees, and concluded with a written test of key safety concepts, principles, and procedures.

Assigned Condition

The training sessions were identical to the *Choice* sessions in every way except for the following manipulated exception. The trainers in the *Assigned* condition presented the safety material in a lecture format without asking questions or facilitating participant input (n=246 on Shifts 2 and 3).

These four-hour training sessions were conducted for 12 *Choice* groups and 14 *Assigned* groups, ranging in size from 7 to 30 individuals (M = 19). 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 key information presented.

Evaluation Procedures

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 key information presented. To assess verbal participation, trained research assistants attended all sessions across both conditions and independently recorded the frequency of all verbal behaviors from the employees directed to the trainers. The verbal behaviors included questions asked, sentence questions answered, and reactive statements. These observations were recorded unobtrusively on a data collection sheet attached to a notebook, giving the impression the observers were taking notes. Questions or comments which were not relevant to the training material or directed to individuals other than the trainer presenting information were not recorded. Interobserver agreement was assessed on a session-by-session basis by dividing the number agreements by number of agreements plus disagreements and multiplying that calculation by 100. Over all education/training sessions, the research assistants agreed on over 90% of their observations. Following the education/training sessions, employees received a questionnaire assessing their satisfaction, perceptions of participation, and knowledge retention. The names of the participants did not appear on any test document or session evaluation.

BBS Implementation

Several involvement manipulations were made to give Shift 1 facilitators (n=8) various opportunities to make key decisions in their BBS process. Specifically, during separate Shift 1 safety meetings, Shift 1 safety facilitators selected: a) the initial safety-related behavior (hearing protection) to be observed plant-wide, b) the design of the checklist used to make the observations of the target behavior, c) the schedule for behavioral observations by facilitator, d) the target number of behavioral observations per week, e) the design and location of group feedback charts displaying on-going measures of plant-wide hearing protection use, f) the protocol for safety slogan contest, and g) the design and color of safety shirts offered plant-wide. The choices made by Shift 1 safety facilitators were yoked to Shift 2 safety facilitators (n=6), in that both shifts implemented the same process customized by Shift 1.

For nine weeks the safety facilitators of the Shift 1 workers (n=230) and Shift 2 workers (n=210) made behavioral observations on hearing protection. These data were graphed and posted on a safety bulletin board located at the highly traveled entrance to the production areas. Facilitator involvement was assessed by the number of observations taken on each shift.

Behavioral observations were made on behavioral checklists designed by the Shift 1 facilitators and distributed to Shift 2 facilitators. On each shift, one facilitator was responsible for collecting completed observation cards. These data were collected two times a month at facilitator meetings scheduled and led by either the first or third author.

Results

Participation in Training

Analysis of variance (ANOVA) was used to evaluate differences in the mean number of verbal responses per shift, with Shift 1 in the Choice condition and Shifts 2 and 3 receiving the

Assigned condition. A one-way analysis of variance (ANOVA) on verbal behaviors for training format (Choice vs. Assigned) indicated that participants in the Choice condition exhibited significantly more verbal behaviors than participants in the Assigned condition, F (2, 395) = 38.9, $p < .001$.

Analyses were also conducted on each type of verbal response: questions answered, reactive statements, and questions asked. 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 than participants in the Assigned condition, F (2, 395)= 40.6, $p < .001$. A one-way ANOVA of reactive comments per Shift (Shift 1 vs. Shift 2 vs. Shift 3) indicated that participants in the Choice condition made significantly more comments than participants in the Assigned condition, F (2, 395) = 19.1, $p < .001$. 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 and Assigned conditions, $p > .05$.

The post-session questionnaires included: a) an 18-item knowledge test, b) a 5-item measure of perceived involvement, and c) a one-item measure of satisfaction with the training. One-way ANOVAs by Shift (Shift 1 vs. Shift 2 vs. Shift 3) indicated no significant differences between the knowledge scores of participants in the Choice and Assigned groups, nor the participants' perceptions of involvement, $p > .05$. The ANOVA of participants' self-reported satisfaction with the training process revealed that participants in the Choice condition (i.e., Shift 1) were more satisfied with the training process than Shift 3 participants in the Assigned condition, F (2, 438) = 5.04, $p < .05$. However, the satisfaction rating of Shift 2 participants in the Assigned condition was not significantly different from the Shift 1 participants in the Choice condition, $p > .05$.

Behavioral Observations

Over a nine-week observation and feedback period, Shift 1 facilitators (n = 8) made significantly more observations per week than Shift 2 facilitators (n = 6), $t(16) = 3.05$, $p < .05$. An observation was defined as the single occurrence of recording hearing protection as safe versus at-risk on a critical behavior checklist. Finally, Shift 1 facilitators conducted significantly more observations per person each week than the Shift 2 facilitators, $t(16) = 3.05$, $p < .05$.

Effects on Lost Workdays

Figure 2 depicts a cumulative record of this organization's lost workdays for 18 months prior to (n=197) and 18 months following (n=26) the BBS process. The figure shows a marked decrease in lost days due to injuries following the introduction of BBS education/training, observation/feedback for hearing protection, and several additional intervention processes. A mean of 10.9 lost days per month occurred prior to BB safety; whereas after the intervention, a mean of 1.5 days were lost per month due to injury.

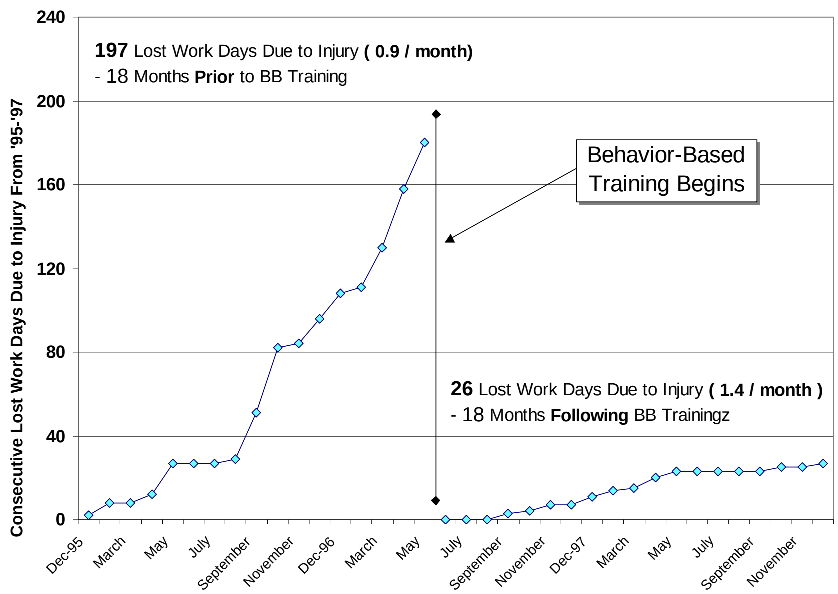

Figure 2: *Cumulative Lost Work Days Due to Injury '95-'97*

Discussion

Our manipulation of involvement was successful during the education/training sessions by getting a significantly greater number of employees to answer questions, make comments, and ask questions. However, results did not support the 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 the 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.

Our results and literature review do suggest, however, it is advantageous to facilitate employee ownership of the BBS process. This was evident in the current research by the impact the Choice condition had on employee observations of the targeted safety-related behavior. Although facilitators in the Choice condition did not report feeling more involved, nor demonstrated greater knowledge of the training material presented, they did make significantly more behavioral observations. Thus, the benefit of the involvement manipulation was manifested during the implementation of a BBS process.

This study manipulated level of employee involvement during BBS education/training and identified at least one factor that may increase the impact of a BBS process. Specifically, when employees are given the opportunity to make key choices in the development and implementation of the safety process, they will contribute more to the process. This would be predicted by the social psychological principle of consistency (Cialdini, 1993).

The reduction in lost-time injuries plantwide strongly suggests the BBS process did much more than increase the use of hearing protection. The plantwide safety training and the regular meetings to discuss the ear protection data probably increased awareness of general safety concerns throughout the facility. The BBS interventions certainly gave the employees the impression that management has increased the priority level of safety. Perceptions of management support, combined with success at performing behavioral observations, may have increased employees' general efficacy regarding safety performance.

Thus, consistent with Bandura (1997), as the workers experienced success making observations on a single target behavior, they stretched the boundaries of their behavioral routines and incorporated the BBS principles beyond simply using hearing protection. Specifically, after the plant-wide safety education/training and the increased focus on using hearing protection, the safety facilitators implemented several other BBS interventions. For example, all employees participated in a plant-wide safety slogan contest with the winning slogan ("Bearings in Mind: Safety First!") being awarded a $50 gift certificate in a public celebration. The employees printed the slogan on a 3-foot by 8-foot banner and displayed it at the entrance to the manufacturing areas.

In addition to the slogan contest, employees on both Shifts 1 and 2 performed distinct interventions in their work areas targeting a behavior they considered critical for improving their safety. With each intervention, the work area met to define the target behavior, develop observation checklists and procedures, and decide how to intervene and test the intervention for impact. This BBS continuous improvement process was a critical aspect of the plant-wide education/training referred to as the DO IT process (i.e., define, observe, intervene, and test, Geller, 1996).

Finally, as a result of the education/training process, plant-wide interventions were implemented to increase safety-belt use. These interventions included written prompts, assigned goals, safety-belt use feedback, promise-card commitments, and incentives to buckle-up. Regardless of intervention strategy, all safety-belt promotions were built around the theme of "Safety is Not Only for the Workplace," a slogan that grew out of the BBS education/training. The safety-belt intervention materials were highly visible, and may have served as additional reminders of the organization's increased commitment to safety.

It is suggested that many occupational injuries go unreported (Leigh, 1995; Miller, 1997; Weddle, 1996; Wilson, 1985). Therefore, using a safety metric that is difficult to hide or cover up, such as lost-time injuries, may provide a better picture of the impact of a safety process. As such, in the current study there was a dramatic decrease in lost workdays (197 to 26) due to injury following the introduction of BBS. Additionally, the great reduction in lost workdays was reported by the organization to save approximately $200,000 in workman's compensation. This figure speaks to the impact on the plant's bottom line of the BBS education/training, subsequent observation and feedback strategies, and employee-driven BB interventions.

The most successful safety processes motivate "employees themselves to apply the techniques throughout their workplace" and thus effective procedures and support systems may vary dramatically across cultures (Geller, 1996, p. 31). This study provides some support for giving employees involvement (i.e., Choice condition) during the design and implementation of a BBS process as opposed to traditional top-down safety approaches (i.e., Assigned condition). Results also support the efficacy of the BBS approach to reducing workplace injuries, and demonstrates the potential benefits for companies to incorporate involvement strategies in their

BBS processes to increase employee participation, institutionalize BB safety, and make a difference in the safety of their employees.

STUDY 2: INCREASING SAFETY-BELT USE IN AN INDUSTRIAL SETTING

(see Appendix D for a compete report as currently under review for publication in *Journal of Organizational Behavior Management*)

The use of shoulder and lap belts is the single most protective behavior that can be conveniently taken to reduce the risk of death or injury in a vehicle crash. It is estimated that vehicle safety belts saved 10,414 lives in 1996 and 90,425 lives since 1975 (National Highway Traffic Safety Administration, 1998). It is predicted that a one percent increase in safety-belt use nationwide would save 200 lives per year (Sleet, 1987), and an increase in nationwide belt use from the current level of 68% to 90% will save 1,500 lives in 1999 (Nichols, 1998). Thus, increasing the use of vehicle safety belts could also save some of the $54.8 million spent annually by employers for on- and off-the-job vehicle crashes.

Intervention Effectiveness

Multiple Intervention Levels

Over two decades of behavior change research at corporate and community sites led to the development of the *multiple intervention level* (MIL) hierarchy depicted in **Figure 3**. This model is used to categorize behavior change approaches and evaluate the cost-effectiveness of successive intervention strategies to alter the behavioral patterns of large numbers of individuals (Geller, 1998a, c; Geller et al., 1990).

Insert Figure 3 about here

A MIL approach to public health has critical implications for evaluating the cost-effectiveness of a behavior-based safety program. According to the MIL, antecedent strategies such as education, training, written prompts, and assigned goals are lower level interventions reaching a maximum number of people. Laws, policies or mandates which threaten a consequence are more intrusive and therefore are higher level interventions. Behavioral goal-setting and feedback as well as incentive/reward programs are considered at the same level as disincentive/penalty programs. This research teseted the utility of the MIL as a heuristic to understand behavior change by sytematically implementing a series of interventions over the course of two years to increase safety-belt use among industry workers.

Method

Subjects and setting

Subjects were 556 hourly and salary employees at an engine bearing manufacturing plant in southwest Virginia. The population of employees ranged in age from 19 to 63 years, and employee tenure at the facility ranged from six months to more than 25 years. The proportion of hourly to salary workers was approximately five to one.

Data collection

Throughout the regular work week, trained research assistants sat in two distinct parking lots of the facility during the first shift arrival, second shift arrival/first shift departure times for hourly workers, and at the arrival and departure times for salary employees. Observers collected data on driver safety-belt and turn-signal use. To assess inter-observer reliability, a second independent observer collected data with the primary observer on 30 percent of all observation sessions. As it was impossible to record data on every vehicle entering or leaving the parking lots, the primary observer identified vehicles to observe by calling out the make and color of the vehicle to be observed (e.g., the red pick-up) as it passed an obvious stationary landmark. Interobserver reliability exceeded 90% for both safety-belt and turn-signal use.

Intervention Techniques

After four weeks of baseline observations, a series of progressively more invasive interventions was implemented at the facility over a two-year period. The interventions were as described below and occurred in the order listed.

Written Prompt.

Attached to the paychecks of all wage employees was a flyer displaying the logo of the industry and a message selected by a safety steering committee of wage workers which read: "*We Buckle-Up Because Safety is Not Only for the Workplace*." Three weeks later the flyer was attached to the paychecks of all salary employees. After ten weeks of individual prompts, the same message was displayed plantwide on table tents in the workers' cafeteria, in bathrooms above hand dryers, and on doors located in strategic places throughout the plant. Damaged and missing flyers were replaced throughout the plantwide Prompt condition. The total duration of the written prompt intervention period was approximately 16 weeks.

Safety Slogan and Celebration

A celebration announcing the winner of a plantwide safety slogan contest was scheduled near the Christmas Holidays. This celebration consisted of rewarding the winner with a $50 gift certificate to a store of his or her choice. At this event, Vince and Larry (the famous "Crash Test Dummies") made an appearance to distribute posters featuring two prominent Virginia Tech football players encouraging safety-belt use. To increase involvement, the celebration occurred after the first workshift and before the second workshift, and included refreshments and photograph sessions with the dummies. The winning slogan ("Bearings in Mind, Safety First!")

was printed on a 3 foot by 8 foot banner and displayed for eight weeks above the main exit from the plant floor.

Assigned Goal

After the Slogan and Celebration intervention and a six-week Withdrawal period, a specific, difficult but attainable goal for plantwide safety-belt use was set. Flyers displaying the plant logo, winning safety slogan, and the goal of 80% safety-belt use were posted on table tents in the cafeteria, in bathrooms above hand dryers, and on doors located in strategic places throughout the plant. These flyers were inspected weekly by research assistants and the plant safety manager for damage and loss. Damaged and missing flyers were replaced throughout this intervention phase. The goal was set approximately 25% above the current percentage of belt use.

Goal Plus Feedback

Sixteen weeks after the Assigned Goal phase, feedback was included on flyers displayed weekly along with a reminder of the plant's belt-use goal. Flyers were posted in the same locations and fashion as in the Assigned Goal intervention described above with one noteworthy exception --feedback on the plantwide safety-belt use from the previous week was included on each flyer. This feedback was updated weekly, and new flyers were posted during the first shift each Monday as during the Assigned Goal phase. After an initial period of feedback, the flyers appeared in bright colors which were changed weekly to attract attention. This phase lasted approximately 16 weeks.

Promise Card

Written buckle-up promise cards (as described in Geller & Lehman, 1991) were distributed to all employees with their paychecks. The promise cards contained the company logo, the winning safety slogan, and a formal statement pledging to use a vehicle safety belt throughout a two-week period. The promise also included a location for the employees to sign, and a box they could check if they would allow their card to be posted in the plant. After the second week of the pledge period, the promise cards with this box checked (n = 200, 82% of the signed promises) were laminated on a 4 foot by 4 foot poster-board and displayed on the plant safety bulletin board.

Blank pledge cards were distributed next to the posted promise cards and labeled "Second-Chance Pledges." The initial pledge period was extended an additional two weeks. New promises (n = 31) were posted (with approval) at the time they were signed. The flyers displaying the safety-belt use goal and behavioral feedback were posted as described above throughout this four-week pledge period.

Promise Plus Incentive/Reward

This intervention was identical to the promise-card commitment described above, except combined with the promise was an incentive to sign the promise and buckle-up during the four-week pledge period. Specifically, it was announced on flyers attached to the paychecks of all employees, on table tents in the workers' cafeteria, and on signs posted in bathrooms above hand dryers and on doors located in strategic places throughout the plant that a cash prize would be awarded to one winner of a random drawing of a signed promise card. The amount of the cash prize was determined by the increase in mean safety-belt use among all plant employees. Specifically, $20 was added to the lottery prize for every percentage point increase in safety-belt use above the pre-promise baseline. The prize was awarded one week following the pledge period in a public drawing conducted by the first author and the plant safety manager. A member of the plant's safety team drew the winning card.

Withdrawal

A withdrawal period marked by removal of all intervention materials occurred after the plant Safety-Slogan Contest, the Promise Card, and Promise Card plus Incentive/Reward interventions. Each withdrawal lasted approximately six weeks.

Results

Safety-Belt Use

Overall, our observations revealed remarkable increases from 1982 in baseline safety-belt use plantwide (52%, n = 1235). Recall that more than a decade earlier, Geller et al. (1983) reported that baseline belt use among hourly and salary workers at this same facility was 3.4 % and 17.4%, respectively.

Figure 4 displays the weekly percentage of safety-belt use for all employees throughout the 24 months of this field study. Vertical lines indicate the introduction of a new intervention or withdrawal as described above. Horizontal lines depict the mean belt-use percentage for each specific phase. The number of observations per phase is indicated within each intervention condition. The month of data collection is provided below the x-axis, and the corresponding year is noted in the body of the figure.

Insert Figure 4 about here

A visual inspection of the data indicates a lack of marked increases in safety-belt use per intervention phase, even as the interventions became more intrusive. A noteworthy exception was the modest increase in plantwide belt use to 68% (n = 1007) as a result of the Promise plus Incentive/Reward intervention. As shown in Figure 4, this effect continued for up to three weeks following the termination of the pledge period. Interestingly, only 213 (38%) promise cards were signed during the Promise plus Incentive/Reward period. Of these, only 88 were signed by employees who had not signed a promise card during the prior Promise-Only intervention.

A close look at the data indicates that another modestly effective intervention was the Safety Slogan contest and Celebration. This intervention resulted in an immediate increase in safety-belt use for six weeks to 53% (n = 601) and a longer-term maintenance of 61% (n =1001) during a subsequent six-week return to baseline. These increases resulted after three attempts to prompt the use of safety belts resulted in a decrease in safety-belt use to 47% (n = 635) during the plantwide Prompt condition.

The only other intervention that had any desired effect was the Promise Card. Two-hundred and forty-four (44%) of the workers signed the buckle-up promise. This strategy increased safety-belt use to 64% (n = 1033) during the two-week Promise period. However, upon posting the promises publicly, use of safety-belts dropped to 57% (n = 632), just below the level obtained during the second Assigned Goal plus Feedback phase (59%, n = 3675).

Overall, the gain in safety-belt use over the course of two years was approximately 15 percentage points or approximately 30 percent above the initial baseline level of 52% (n = 1235 observations) to 67% (n = 1193) through the first three weeks of the Follow-Up. The six week follow-up mean was 65% (n = 1407), 25 percent above the baseline two years earlier.

Turn-Signal Use

Figure 5 displays the weekly percentage of turn-signal use for all employees throughout the 24 months of this field study. Vertical lines indicate the introduction of a new intervention to increase safety-belt use or a return to baseline, and horizontal lines represent the mean turn-signal use percentage for each specific phase of the research. The number of observations per phase is indicated within each intervention condition. The month of data collection is provided below the x-axis and the corresponding year is noted in the body of the figure.

Insert Figure 5 about here

Although not targeted, turn-signal use decreased steadily throughout the course of the research. More precisely, visual inspection of the data indicates that turn-signal use did not deviate markedly in any phase from the baseline mean of 50% (n = 1272), but did trend downward to a low of 34% (n = 1363) during the Incentive/Reward intervention. A Pearson's product moment correlation of turn-signal use with safety-belt use resulted in a significant negative correlation (r = -.28, p <.05) for observations up to Week 75. The correlation from Week 75 through Follow-Up was stronger (r = -.38, p < .05) and is reflected in Figure 5 by an eight percentage point decrease in turn-signal use and a ten percentage point increase in safety-belt use from Week 80 through the first half of Follow-Up.

Discussion

Overall, these data support the MIL hierarchy (Geller, 1998a, c; Geller et al., 1990). That is, one could argue that the antecedent strategies used to motivate safety-belt use in the current research are all first level interventions, less powerful than Virginia's BUL. As such it follows that the hard-core resisters, not influenced by the BUL, would not be influenced by repeated applications of lower-level interventions. As suggested by the MIL, the modest improvements seen in the use of safety belts may have been, in part, due to the involvement of belt users as supportive intervention agents to get some part-time users to buckle-up more consistently.

Modeling appropriate behavior has been shown to increase the likelihood of others emitting the desired response by: a) demonstrating the ease at which it can be done; b) making more salient the costs versus benefits of the target behavior; and c) changing cultural norms regarding the behavior (Bandura, 1997). Indeed, the results of the current research indicate that the interventions requiring at least minimal individual involvement (i.e., Slogan Contest, Promise Card, and Promise Card plus Incentive/Reward) were most effective at increasing the use of safety belts.

Fifteen years ago a similar behavioral intervention at this same facility increased safety-belt use from 17.4% to 50.6% among salary workers, and from 3.4% to 5.5% for hourly workers. As there was no safety-belt use law in 1982, the incentive was enough to provide the motivation to produce some desired behavior change. The baseline level of 52% belt use in the current study was only slightly higher than the intervention levels obtained in 1982. This suggests that those workers not motivated to avoid the improbable fine of $25 were not likely to buckle up for the remote probability of winning the raffle drawing. These individuals need more intrusive and intensive interventions to motivate them to change. This is as predicted by the MIL hierarchy proposed by Geller et al. (1990) and refined by Geller (1998c?).

In Conclusion

The failure of the various behavioral interventions to increase vehicle safety-belt use at an industrial site can be explained by considering the state of those workers not currently buckling up. The employees at this facility have been informed many times about the value of safety belts, and they know how to buckle up. In fact, given that a safety-belt use law has been in effect in Virginia since 1989, vehicle occupants are willfully taking two calculated risks when they don't buckle up. They risk a $25 fine and the likelihood of being more seriously injured in a vehicle crash.

To increase safety-belt use among those who know what to do but don't, a behavioral intervention needs to be motivational. And the motivational contingencies need to be more powerful (soon, certain, and significant) than any other intervention currently in place to increase the safe behavior. Thus, it can be argued that our various instructional interventions were irrelevant, and for most non-users of safety belts, the consequences of our motivational intervention were not significant enough. The incentive/reward program was no more intrusive than the current BUL in Virginia, and thus did not involve a higher level of the MIL hierarchy (Geller, 1998c?).

STUDY 3: SPECIFIC VS. GLOBAL FEEDBACK: COMPARING RELATIVE EFFECTIVENESS

(see **Appendix __** for a complete report as included in an accepted proposal for a Ph.D. dissertation)

The beneficial impact of feedback on organizational safety performance is well established. Improvements in safety-related behaviors following BBS feedback have been demonstrated in a number of organizational settings including: a plastics manufacturing plant (Sulzer-Azaroff & De Santamaria, 1980), a metal fabrications plant (Zohar, Cohen & Azar, 1980), a bakery (Komaki, Barwick & Scott, 1978), a public work's department (Komaki, Heinzmann & Lawson, 1980), a university chemical laboratory (Sulzer-Azaroff, 1978), and a university cafeteria (Geller, Eason, Phillips, & Pierson, 1980). As researchers point out, "Informational feedback on performance has been shown to be a simple, effective, and durable method for promoting safety" (Fellner & Sulzer-Azaroff, 1984, p. 7).

Two common factors influencing the successful use of behavioral feedback in applied settings are global and specific feedback. However, the relative impact of global *versus* specific feedback has not been addressed in the safety literature. This study represents the first empirical test of global versus specific safety feedback on safety performance.

Method

Participants were 40 front-line workers at a soft-drink bottling plant in Southeastern Virginia. The employees were observed by trained behavioral observers from a large Southeastern University using a critical observation checklist. The observations occurred twice a day (once per shift) and each observation period lasted approximately one hour. The checklist included: personal protective gear, lifting, fork truck driving, and general safety (e.g., cutting away from body). For each behavioral category, trained observers marked either “safe” or “at risk” for the safety-related behaviors performed by the employees. At the end of each week, an overall “percent safe” score (total safe observations/total observations X 100) for the week was tallied for the group. This served as the dependent variable. Reliability estimates for inter-rater agreement between observers was calculated each week and was above 85% for all behaviors observed.

For 15 weeks, a baseline period was established to determine percent safe scores for the targeted behaviors. This baseline period was followed by an intervention period in which participants were made aware of the specific behaviors that were being observed with the CBC. They were observed for ten weeks following this ‘awareness intervention.’ After this period, the first ‘feedback intervention’ was introduced. Shift 1 participants received global feedback (aggregated across behaviors), whereas Shift 2 received specific behavioral feedback for each CBC category (with no global feedback).

This CBC feedback was provided in weekly meetings and took the form of graphs that showed weekly changes in percent safe scores. For the Global Feedback condition, a single graph was provided each week. For the Specific Feedback condition, four graphs (one for each behavior) were provided each week. Behavioral observations with the first feedback intervention lasted six weeks. Following this, the second feedback intervention was introduced.

With the second feedback intervention, Shift 1 participants received specific behavioral feedback and Shift 2 participants received global behavioral feedback. In other words, the feedback conditions for the two shifts were reversed for the second feedback intervention. The second feedback intervention lasted 6 weeks. Next, the Withdrawal phase of the experiment consisted of 17 weeks in which observations were made following the removal of BBS performance feedback with both shifts. Finally, after a six month period without observations, the eight week follow-up phase was implemented.

Analysis

The current study used a 2 Feedback Level (global, specific feedback) X 6 Phase (baseline, awareness, intervention 1, intervention 2, withdrawal, follow-up) repeated measures ANOVA to determine the relative impact of global versus specific behavior-based feedback on safety performance.

Results

Behavior-based safety awareness and feedback lead to more frequent safe behavior occurrences over baseline for Shift 2, but not Shift 1. For Shift 2, percent safe scores were higher for the specific versus global feedback condition. No other significant differences were found and no evidence of response generalization was demonstrated. Descriptive statistics are provided below.

Shift 1

Phase	Mean Percent Safe Score Across All Behaviors	Standard Deviation
1 (Baseline)	80.2	9.4
2 (Awareness)	81.0	6.1
3 (Global Feedback)	85.5	4.3
4 (Specific Feedback)	82.2	7.2
5 (Withdrawal)	79.1	7.7
6 (Follow-Up)	78.5	10.0

Shift 2

Phase	Mean Percent Safe Score Across All Behaviors	Standard Deviation
1 (Baseline)	67.9	4.8
2 (Awareness)	81.3	6.1
3 (Global Feedback)	81.5	10.1
4 (Specific Feedback)	74.8	6.1
5 (Withdrawal)	77.1	6.0
6 (Follow-Up)	77.8	12.0

Discussion

Clear distinctions regarding the relative effectiveness of global versus specific feedback were not found. This may be due to several factors. First, participants did not receive BBS training prior to the experiment. This may have limited participants' understanding of behavioral observation and feedback and their overall 'buy-in' into the process. Comprehensive BBS training prior to the experimental manipulation would have likely led to stronger results. Also, assessing 'specific' feedback at the specific behavioral level may be more appropriate than at the response class level. Finally, global and specific feedback may simply work equally well in influencing safety performance. Overall, global and specific feedback worked equally well and improved performance beyond baseline levels for Shift 2. For 18 months prior to and 18 months during the study, the overall frequency of recordable injuries at this facility fell by more than 50%.

STUDY 4: A NATIONWIDE SURVEY OF SAFETY PROFESSIONALS

(see Appendix E for a complete report as published in the Proceedings of the Professional Development Conference of the American Society of Safety Engineers, June 1998.)

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 BBS, and to explore ideas for improving the communication and implementation of BBS principles and procedures for reducing industrial injuries. The survey also allowed us to begin constructing a database of organizations currently active in BBS efforts.

A total of 162 completed surveys were returned to us by mail or fax. An appreciation of the BBS 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 BBS 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 BBS approach. The survey was presented within the context of research aimed at discovering how to make the BBS 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 an on-site evaluation of factors contributing to the impact of a BBS process. Thus, compared to the average reader of *ISHN*, those who answered the questions and returned our survey were probably more informed about BBS and had higher confidence in the effectiveness of BBS. Even with this positive bias, however, the survey revealed some misperceptions about BBS 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 BBS 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 BBS, but there were a few notable exceptions.

The three items selected most often as representing BBS 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 BBS to be relevant. Specifically, only 42 of the 162 respondents considered BBS an approach useful for investigating injuries. Only 88 respondents (54%) felt BBS is useful for evaluating safety achievement, and 99 respondents (61%) considered BBS an intervention approach for decreasing at-risk behavior.

It is likely people have a rather narrow viewpoint regarding BBS. This limited perspective is also reflected in numerous safety articles, sales pitches from safety consultants, and presentations at safety conferences. In fact, BBS 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 71% of the respondents.

Principle versus Application

Most survey respondents were aware that BBS focuses on positive consequences to influence behavior change, since only four individuals indicated that BBS 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 BBS principles. For example, the most cost-effective BBS approaches to improve safety are behavioral 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, however, 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 measures 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 BBS survey published in *ISHN* reflected appreciation for a BBS approach to injury prevention, but they also demonstrated substantial misunderstanding and misapplication. A majority of respondents, for example, perceived BBS as an observation and feedback tool rather than a general approach to improving the human dynamics of safety, relevant for ergonomics, injury analysis, and the design of incentive/reward programs.

Even with substantial appreciation for behavioral 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 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 5: A NATIONWIDE ANALYSIS OF BBS PROCESSES

(see **Appendix __** for a complete report as current under review for publication in Journal of Safety Research, and an accepted Ph.D. dissertation based on this research).

For this study, it was originally proposed that ten companies reporting exemplary success implementing a BB safety process and ten companies reporting unsuccessful implementation of a BB safety process be selected for site visits. We quickly found that distinguishing between an effective BB safety process and an ineffective BB safety process was not simple. The majority of organizations returning surveys reported a decrease in incident and injury rate. And companies with a poor safety record were not apt to volunteer for a safety visit. As an alternative approach, we decided to approach site visits with the perspective of identifying themes or patterns of factors related to success vs. failure.

Although BBS methods are consistently effective at increasing the occurrence of safe behaviors, they can only work if used throughout an organization. In other words, if employees do not "buy-in" to BBS process, participate actively in observation and feedback sessions, and help to implement BBS intervention procedures, any research describing the impact of this approach is academic (pun intended). Therefore, a primary objective of the current research was to begin the process of identifying organizational and interpersonal variables that inhibit versus facilitate employee involvement in a BBS process.

Subjects and Setting

Participation was solicited through survey research conducted in a professional safety journal, as well as through attendance at professional safety conferences and workshops. The participants were employees working at 20 different industrial sites. From these 20 organizations, 245 employees (221 male, 24 female) participated in 31 focus-group sessions.

About 80% of these participants were male, a male to female ratio that paralleled to workforce. All 20 of the sites visited were involved in an employee-driven BBS process that was at least one year old. Each BBS process included interpersonal observation and feedback with a checklist of specific safe and at-risk behaviors.

Procedures

During scheduled site visits to all 20 participating organizations, data were collected by two researchers via two distinct methods: focus group discussions and perception surveys. Focus groups were performed with each site visited. One focus group involved only members of the safety steering committee the other involved a random selection of hourly employees. While this should have resulted in 40 focus group sessions, 9 of the sites visited did not have an intact safety committee. Therefore a total of 31 focus groups were performed (20 with hourly employees, 11 with safety-committee members). Focus groups ranged in size from four to 22.

The focus group sessions lasted approximately 90 minutes, during which time employees were asked a series of questions designed to solicit their opinions regarding the necessary ingredients for an effective employee-driven BBS process. These questions asked of all groups are listed in the Results Section with a summary of the responses. All responses were simultaneously recorded on data collection sheets by both researchers.

After completing both focus groups, researchers left a perception survey with each organization. The contact person at each organization was instructed to get as many employees as possible to complete the surveys. If it was not possible to survey all employees, the contact person was asked to obtain a representative sample of every work area. When completed, the surveys were mailed directly to the researchers for analysis.

Results

Focus Group Results

Two steps were used to analyze information gathered during focus-groups. First researchers looked at the employee responses for all questions as recorded by both focus-group facilitators. Only those responses that appeared on both of the data sheets were retained for analysis. Second, for the first five questions each response was classified as a positive, negative, or neutral statement by two researchers. Neither researcher was aware of how the other was classifying any of the responses. Only if a statement was classified as positive, negative, or neutral by both researchers was it retained. Agreement was very high and only 12 responses were eliminated as a result of this process.

For questions 6-8 the responses were categorized as a behavior-based factor, a person-based factor, or an environment-based factor. The classification was performed by two subject-matter experts and consensus was reached on each item. The results obtained from focus groups are reported separately for each question.

Question 1

How do you feel about the observation and feedback process used in your behavior-based safety process? A total of 104 comments (56 positive, 37 negative, 11 neutral) were recorded. The most frequent positive comments indicated a perception that observation and feedback is beneficial because it increases one's awareness of safe and at-risk behaviors (17 comments, 15 focus groups, 14 organizations). The second most frequent response implied the observation and feedback process facilitated positive attitudes among employees (8 comments, 6 focus groups, 5 organizations). Specifically, employees indicated it has resulted in increases in trust, comfort with coworkers, and even pride. A smaller number of responses indicated that such a process increased individual accountability (3 comments, 3 focus groups, 2 organizations).

The most frequent negative comment revealed a perception that ulterior motives are behind the observation and feedback process (15 comments, 9 focus groups, 8 organizations). For example some of these comments indicated employees only participate in the process to “rat” on other employees (7 comments, 5 focus groups, 5 organizations) or as an excuse to give negative feedback to someone they did not like (4 comments, 4 focus groups, 4 organizations). This was reflected in 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.” A few other negative comments implied employees participating in the process are simply looking for overtime (2 comments, 2 focus groups, 2 organizations), trips to conferences (1 comment, 1 focus group, 1 organization), or just trying to make themselves look good (1 comment, 1 focus group, 1 organization). Other negative comments suggested the observation and feedback process was inconvenient (9 comments, 8 focus groups, 6 organizations). In other words the observation and feedback process was perceived as just one more thing to do on top of all the other responsibilities.

Question 2

Is participation in the observation and feedback process mandatory or voluntary? The workers interviewed at 12 organizations indicated their process was voluntary, whereas those at 8 organizations indicated participation was either "expected" or mandatory. For each organization, a "positive regard score" was calculated for the observation and feedback process. This was accomplished by subtracting the total number of negative comments made about observation and feedback from the number of positive comments given about this BBS process.

The positive regard scores per organization were then correlated with type of process (mandatory vs. voluntary). The correlation between using voluntary observation processes and positive regard was -.304. Suggesting a trend toward more positive regard for an observation and feedback process that is mandated.

Question 3

What role should management play in your behavior-based safety process? There were 50 total responses obtained (23 positive, 15 negative, 12 neutral) for this question. Content analyses of focus group responses revealed only a few organizations (15%) with more negative than positive comments regarding management involvement in the BBS process. In other words, only three organizations expressed a negative reaction toward any amount of management involvement.

With regard to direct management involvement in the interpersonal observation and feedback process, reactions were mixed. Six employee groups, from six organizations suggested the more management is involved the better (as evidenced by the quote "They should to be involved because a team means everyone."). Nine employee groups, from 8 organizations felt direct management involvement was a bad idea, as reflected in a common statement "Less management involvement is better, support is good if direct involvement is minimal.". These groups pointed to issues of trust as crucial in determining their perceptions. Management involvement should follow successful efforts to build interpersonal trust. It should be noted these organizations stressed the importance of management's role as *supportive* rather than *directive*.

Question 4

How do supervisors influence your behavior-based safety process? This question was added after the first four site visits had already been completed. As such focus groups from 16 of the 20 organizations had a chance to respond. From those 16 organizations, only 12 had a position analogous to a front-line supervisor. From these, the employees participating in the focus groups for 11 organizations stressed the importance of the front-line supervisors. At each site it was stated specifically if front-line supervisors do not support the process it will not be effective.

Question 5

What are your perceptions of the behavior-based safety steering committee? A content analysis of the 87 responses (33 positive, 36 negative, 18 neutral) revealed focus group employees at the majority of organizations tended to have overall positive perception of the safety steering committee (16 comments, 15 focus groups, 12 organizations). While some of these comments were general commendations such as “I think there doing a good job (9 comments, 9 focus groups, 8 organizations).” Other remarks in this category revealed employees on the steering committees were viewed as well intentioned and serious about safety (7 comments, 7 focus groups, 7 organizations).

The most common negative responses centered on perceptions that employees on the steering committees tend to be “out of touch” and spend too much time in meetings (8 comments, 7 focus groups, 6 organizations). Another complaint with the safety steering committees was that they were composed of safety "spies" or safety "rats" (4 comments, 4 focus groups, 3 organizations). Finally, it was also commented that employee participation in steering committee meetings was responsible for morale and production problems (4 comments, 3 focus groups, 3 organizations).

Question 6

How would you improve your behavior-based safety process? Of the 103 to this question most were categorized as environment-based side of the triangle (n = 72). The second greatest number of responses were classified as behavior-based (n = 23), and the fewest were classified as person-based (n = 8).

The most common environment-based responses indicated that employees would improve the BBS process by using more and better incentives to motivate participation (11 comments, 11 focus groups, 10 organizations) and making sure everyone had adequate training (11 comments, 9 focus groups, 6 organizations). Additional remarks indicated a need to improve the quality of machinery being used (9 comments, 7 focus groups, 6 organizations). Also, the idea of simplifying the behavioral checklist was given several times (6 comments, 6 focus groups, 6 organizations).

The most common behavior-based suggestion was a need to increase levels of employee participation (8 comments, 8 focus groups, 7 organizations). Other recommendations included increasing the occurrence of positive feedback (2 comments, 2 focus groups, 2 organizations), and firing any at-risk workers (2 comments, 2 focus groups, 2 organizations). All eight responses categorized as person-based focused on ensuring proper employee attitudes. Beyond more effective training, however, employees did not specify how to improve attitudes.

Question 7

What are the biggest obstacles your behavior-based safety process has faced? Of 133 responses recorded, the majority of BBS obstacles were environment-based (n=67). The next highest number of responses were classified as person-based factors (n=47), and the fewest number of responses were classified as behavior-based responses (n=19).

The most common environment-based barrier was lack of management support (22 comments, 20 focus groups, 18 organizations). For some, lack of support meant employees were not given the time to perform observations (8 comments, 8 focus groups, 7 organizations), or there was not enough money to give the process requisite resources (8 comments, 8 focus groups, 7 organizations), or even that management did not show they believed in the process (4 comments, 4 focus groups, 2 organizations). Additional remarks indicated that previous unsuccessful initiatives had made many employees cynical regarding the success of the behavior-based process (10 comments, 10 focus groups, 10 organizations). Also, there was a fairly consistent distaste for the extra paperwork involved (6 comments, 6 focus groups, 6 organizations), especially if the behavioral checklists were complex.

Among the person-based factors, the most frequently mentioned obstacle was a lack of trust (12 comments, 12 focus groups, 12 organizations). According to focus groups at more than 50 percent of the organizations, lack of trust between coworkers, and between line workers and supervisors was perceived as crucial for many of the set backs experienced relevant to the BBS process. Another frequent person-based obstacle was discomfort associated with having another individual observe one's work practices (8 comments, 8 focus groups, 8 organizations). A number of comments also indicated that getting employees to buy-in to the process was a challenge (5 comments, 5 focus groups, 5 organizations). It seems many employees had trouble seeing what was in it for them.

The smallest number of obstacles was classified as behavior-based responses. The most common behavior-based barrier was a lack of participation (5 comments, 4 focus groups, 4 organizations). Other responses in this category targeted poor communication (3 comments, 3 focus groups, 3 organizations), and a tendency to focus on negative as opposed to positive feedback (3 comments, 2 focus groups, 2 organizations).

Question 8

What are the key ingredients for success in a behavior-based safety process? Categorization of 152 responses revealed a majority of BBS key ingredients were person-based factors (n=57), followed by environment-based factors (n=53), and then behavior-based factors (n=42). Individual responses were examined within each of these factors to determine which were most common.

For person-based factors the most frequent key ingredient was interpersonal trust (13 comments, 13 focus groups, 13 organizations). Other responses to this question indicated a BBS process would more likely succeed if employees had a positive attitude (5 comments, 5 focus groups, 5 organizations), and if BBS procedures were approached with an open mind (4 comments, 4 focus groups, 4 organizations).

For behavior-based factors, getting employee participation was the number one response (11 comments, 11 focus groups, 11 organizations), followed by the notion that teamwork was needed for success (6 comments, 6 focus groups, 6 organizations), and then open communication (5 comments, 5 focus groups, 4 organizations).

The most commonly mentioned environment-based factor for success was support (18 comments, 18 focus groups, 18 organizations). Whether time, money, or just a supportive climate, employees indicated that without management support a behavior-based process will fail. Other responses which were repeated included a need for everyone to be properly trained (5 comments, 5 focus groups, 5 organizations), and that participation in the observation and feedback process had to be on a voluntary basis (4 comments, 4 focus groups, 4 organizations).

Three of the latter comments came from organizations with a voluntary process, and one came from an organization with a mandatory process.

Perception Survey Results

701 perception surveys were returned that were acceptable for analysis. These surveys were returned from 15 of the 20 participating organizations (The employees at four organizations failed to complete and return the surveys, and for one organization the returned surveys were completed incorrectly).

Predicting Involvement in the Behavior-Based Process

A forward entry regression analysis was performed to determine variables most predictive of involvement in the safety process. Level of involvement for each employee was determined by summing the three involvement items constructed specifically for this study. Five variables: a) perceptions of the BBS training received, b) trust in management abilities, c) perceptions that safety is used in performance appraisals, d) whether or not the employee was educated in the BBS process, and e) tenure with the organization contributed significantly to predicting self-reported levels of involvement. These variables accounted for 41% of the variance in self-reported involvement in the BBS process.

Participation and Satisfaction in a Voluntary Versus a Mandatory BBS Process

Employees in the mandatory processes reported significantly higher rates for giving and receiving positive behavior-based feedback as well as significantly lower rates for receiving negative behavior-based feedback. In addition, employees in mandatory BBS processes also demonstrated significantly greater levels of trust in management (both abilities and intentions), trust in coworkers (both abilities and intentions), and overall satisfaction with the BBS training received.

Discussion

The tremendous improvements in safety and performance of the companies who have implemented BBS processes has given this approach to safety management credibility and status (Geller, 1998d). Unfortunately, little objective research has been performed to elucidate the organizational factors that can facilitate successful implementation of a BBS approach. Instead, many organizations are left to muddle through the unending case-study literature provided by safety consultants. Although such literature may be enlightening and informative to some degree, it does not adequately inform readers of the underlying organizational processes that lead to successful BBS implementation. The current empirical investigation is a first step in understanding what factors are critical for successful implementation of a BBS process.

Based on the findings of this research we would like to offer a framework for understanding why some BBS processes succeed and others fail. Analogous to the way in which we analyzed the focus group discussions, we propose the BBS Safety Success Triad illustrated in Figure 6. The three sides of this triangle are dynamic and interactive. When one changes the others are influenced.

Insert Figure 6 about here

The BBS Safety Success Triad is based not only on the results from 40 focus groups, but also from the analyses of 720 perception surveys (from 17 organizations). On the person side of the triangle is interpersonal trust; on the environment side of the triangle is management support; and on the behavior side of the triangle is employee participation/involvement. Training is in the middle of the triangle because of its critical role in facilitating all three sides of the triangle.

During training all employees receive the principles, procedures, and tools of a BBS process, and management receives the rationale and the method for supporting BBS. Proper training convinces participants that the process works and the people can implement it. This is necessary for self-efficacy (Bandura, 1997), a person state deemed necessary for any positive change among individuals. A complete description of this study as submitted for publication in the Journal of Safety Research can be found in **Appendix ?.**

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