Behavior-Based Safety and Occupational Risk Management

E. SCOTT GELLER
Virginia Polytechnic Institute and State University

The behavior-based approach to managing occupational risk and preventing workplace injuries is reviewed. Unlike the typical top-down control approach to industrial safety, behavior-based safety (BBS) provides tools and procedures workers can use to take personal control of occupational risks. Strategies the author and his colleagues have been using for more than a decade to teach BBS to safety leaders and line workers are presented. In addition, a conceptual model is proposed for matching the awareness and behavior of an individual with a particular BBS intervention technique.

Keywords: *risk management; behavioral safety; injury prevention; organizational behavior management; applied behavior analysis*

Unintentional injury is the leading cause of death to U.S. residents aged 44 and younger (U.S. Bureau of Labor Statistics, 1998), and many of these fatalities occur in the workplace. Every year, an estimated 7,000 to 11,000 U.S. employees are killed at work and 2.5 to 11.3 million are seriously injured (Miller, 1997). This results in 250,000 potential productive years of life lost annually—more than from cancer and cardiovascular disease combined (Leigh, 1995). The overall financial liability of work-related injuries in the United States was estimated at $116 billion in 1992, an increase from the 1989 estimate of $89 billion and dramatically larger than the 1985 estimate of $34.6 billion (Leigh, 1995). Direct costs include lost wages, medical expenses, insurance claims, production delays, lost time of coworkers, equipment damage, and fire losses (Miller, 1997).

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THE BEHAVIOR-BASED APPROACH TO RISK MANAGEMENT

For more than a decade, behavior-based safety (BBS) has been prospering in organizations nationwide and more recently throughout the world. A variety of books detail the principles and procedures of BBS (Geller, 1998b, 2001d, 2001e; Geller & Williams, 2001; Krause, 1995; Krause, Hidley, & Hodson, 1996; McSween, 1995; Sulzer-Azaroff, 1998). In addition, a number of comprehensive reviews of the literature provide objective evidence for the effectiveness of this approach to risk management and injury prevention (Grindle, Dickinson, & Boettcher, 2000; McAfee & Winn, 1989; Petersen, 1989; Sulzer-Azaroff & Austin, 2000; Sulzer-Azaroff, McCann, & Harris, 2001).

The successful applications of BBS generally adhere to the seven key principles described below. Each principle is broad enough to include a variety of practical operations, but narrow enough to instruct the development of cost-effective interventions for managing the human dynamics of occupational risk. The author has proposed these principles in several sources as a map or mission statement for guiding the design of interventions to benefit safety-related behaviors and attitudes in the workplace as well as in homes, neighborhoods, and throughout entire communities (Geller, 1997b, 1998a, 1998b, 2001a, 2001b; Geller & Williams, 2001). All of these presentations of BBS appeared in publications for safety professionals and as a result, most readers of this journal are likely unaware of this popular application of behavior analysis for managing occupational risk.

1. FOCUS INTERVENTION ON OBSERVABLE BEHAVIOR

The BBS approach is founded on behavioral science as conceptualized by B. F. Skinner (1938, 1953, 1974). Experimental behavior analysis, and later applied behavior analysis, emerged from Skinner's research and teaching and laid the foundation for numerous therapies and interventions to improve quality of life (Goldstein & Krasner, 1987; Greene, Winett, Van Houten, Geller, & Iwata, 1987). Whether working one-on-one in a clinical setting or with work teams throughout an industrial site, the intervention process always targets specific behaviors for constructive change. In other words, BBS focuses on what people do, analyzes why they do it, and then applies a research-supported intervention technique to improve behavioral processes.

2. LOOK FOR EXTERNAL FACTORS TO UNDERSTAND AND IMPROVE BEHAVIOR

We obviously do what we do because of factors in both our external and internal worlds. However, given the difficulty in objectively defining internal states or traits, it is far more cost effective to identify environmental conditions that influence behavior and to change these factors when behavior change is needed. This can include identifying inadequate management systems or manager behaviors that promote or inadvertently encourage at-risk work practices. Without the proactive and objective problem-solving perspective fostered by BBS principles, these inadequacies may never be identified (or they might be revealed reactively after a near-miss or injury).

3. DIRECT WITH ACTIVATORS AND MOTIVATE WITH CONSEQUENCES

This principle provides understanding of why behavior occurs and informs the design of interventions to benefit behavior. People usually do what they do because of the consequences they expect to get for doing it. As Dale Carnegie (1936) put it, "Every act you have ever performed since the day you were born was performed because you wanted something" (p. 62). Carnegie cited the research and scholarship of B. F. Skinner as the foundation of this motivation principle.

The critical point here is that activators (or signals preceding behavior) are only as powerful as the consequences supporting them. That is, activators tell people what to do to receive a consequence, from the ringing of a telephone or doorbell to the instructions from a training seminar or one-on-one coaching session. People follow through with the particular behavior activated (from answering a telephone or door to following a trainer's instructions) to the extent they expect doing so will provide them a pleasant consequence or enable them to avoid an unpleasant consequence.

This principle is commonly referred to as the ABC model or three-term contingency, with *A* for activator (or antecedent), *B* for behavior, and *C* for consequence. The BBS approach applies this ABC principle to design interventions for improving behavior at individual, group, and organizational levels. More than 40 years of research in the behavioral sciences has demonstrated the efficacy of this general approach to directing and motivating behavior change. The next principle provides more specific direction for designing an intervention.

4. FOCUS ON POSITIVE CONSEQUENCES TO MOTIVATE BEHAVIOR

B. F. Skinner's concern for people's feelings and attitudes is reflected in his antipathy toward the use of punishment (or negative consequences) to motivate behavior. "The problem is to free men, not from control, but from certain kinds of control" (Skinner, 1971, p. 41). He goes on to explain why control by negative consequences must be reduced to increase perceptions of personal freedom. Unfortunately, the common metric used to evaluate and rank companies on their safety performance is the total recordable injury rate (or an analogous count of losses) that puts people in a reactive mindset of avoiding failure rather than achieving success. The BBS approach provides proactive measures that employees set goals to achieve to reduce occupational risks and prevent unintentional injury.

5. APPLY THE SCIENTIFIC METHOD TO IMPROVE INTERVENTION?

Behaviors can be objectively observed and measured before and after an intervention process is initiated. This application of the scientific method provides feedback for cultivating improvement. The acronym DO IT (standing for define, observe, intervene, and test), depicted in Figure 1, can be used to teach this principle of BBS to

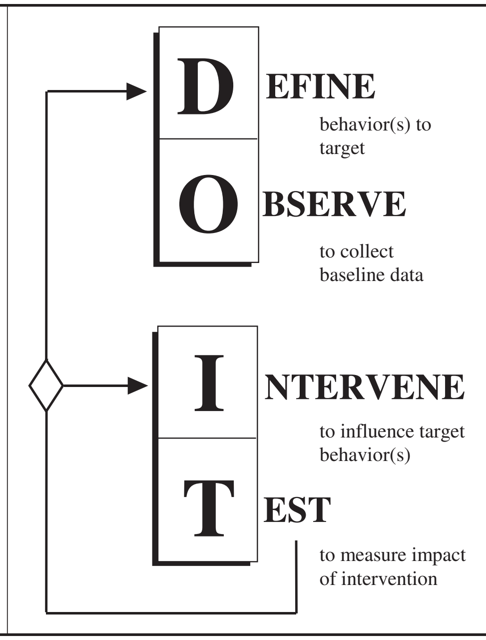


Figure 1. Behavior-based safety is a continuous four-step improvement process.

employees who are empowered to intervene on behalf of their co-workers' safety and want to continuously improve their intervention skills.

D *for define*. The DO IT process begins by defining certain target behaviors. These can be at-risk behaviors that need to occur less often or safe behaviors that need to occur more often. Decreasing the occurrence of at-risk behaviors often requires the occurrence of certain safe behaviors. Therefore, safe behaviors might be targeted to substitute for particular at-risk behaviors. On the other hand, a safe target behavior can be defined independently of an associated at-risk behavior. The definition of a safe behavior might be as basic as using certain personal protective equipment (PPE) or walking within pedestrian walkways. Alternatively, the safe target could be a work practice requiring a particular sequence of safe behaviors, as when lifting or locking-out energy sources.

Deriving a precise definition of a DO IT target is facilitated by considering the various categories of general operating procedures, as

Operating Procedures	Safe Observation	At-Risk Observation
BODY POSITIONING/PROTECTING *Positioning/protecting body parts (e.g., avoiding line of fire, using PPE, equipment guards, barricades, etc.).*		
VISUAL FOCUSING *Eyes and attention devoted to ongoing task(s).*		
COMMUNICATING *Verbal or nonverbal interaction that affects safety.*		
PACING OF WORK *Rate of ongoing work (e.g., spacing breaks appropriately, rushing).*		
MOVING OBJECTS *Body mechanics while lifting, pushing/pulling*.		
COMPLYING WITH LOCKOUT/TAGOUT *Following procedures for lockout/tagout.*		
COMPLYING W/ PERMITS *Obtaining, then complying w/ permit(s).* (e.g., *Confined space entry, hot work, excavation, open line, hot tap, etc.).*		

Figure 2. A tool to facilitate the definition of target behaviors to address in Behavior-Based Safety DO IT process.

exemplified in Figure 2, and then deriving the safe versus at-risk method of performing each relevant work practice. Developing such behavioral definitions provides an invaluable learning experience. When people get involved in deriving a behavioral checklist, they own a training process that can improve human dynamics on both the outside (behaviors) and the inside (feelings and attitudes) of people.

O *for observe*. When people observe each other for certain safe or at-risk behaviors, they realize everyone performs at-risk behavior, sometimes without even realizing it. The observation stage is not a

Critical Behavior Checklist for Driving

Driver:	Date:	Day:
Observer 1:	Origin:	Start Time:
Observer 2:	Destination:	End Time:
Weather:		
Road Conditions:		

Behavior	**Safe**	**At-Risk**	**Comments**
Safety Belt Use:			
Turn Signal Use:			
Left turn			
Right turn			
Lane change			
Intersection Stop:			
Stop sign			
Red light			
Yellow light			
No activator			
Speed Limits:			
25 mph and under			
30 mph- 45 mph			
55 mph and over			
Passing:			
Two Second Rule:			
Totals:			

% Safe = $\frac{\text{Total Safe Observations}}{\text{Total Safe + At-Risk Observations}}$ X 100% =

Figure 3. A critical behavior checklist (CBC) can be used to increase safe driving.

fault-finding procedure, but is a fact-finding learning process to facilitate the discovery of behaviors and conditions that need to be changed or continued to reduce occupational risk. Thus, no behavioral observation is made without explicit permission from the person being observed. The observer should be open to learning as much (if not more) from the post-observation feedback conversation as he or she expects to teach from completing the behavioral checklist.

A BBS checklist can be specific to a particular task, as is the critical behavior checklist for driving depicted in Figure 3. This is a checklist I used to train my daughter to develop safe driving habits, or at least to demonstrate to me that she knew how to drive safely. We developed the checklist and behavioral definitions together, so there was a sense of ownership on my daughter's part. I increased this perception of ownership by letting my daughter use the checklist on me. In a behavioral healthcare organization this type of checklist could be applied with staff who are responsible for transporting consumers.

At the bottom of the checklist is a formula we used to summarize a driving trial. Note that it is stated in achievement terms (i.e., percentage safe), and it is easy to get a high percentage. This puts the whole process in an achievement mode rather than the typical failure or loss metric used to measure safety performance (e.g., number of injuries or property-damage incidents, and worker compensation costs).

The BBS checklist shown in Figure 4 addresses only one behavior. After defining the safe and at-risk behaviors relevant to each checklist category, a work group can readily use this checklist to hold each other accountable for safe lifting. They do not approach other workers specifically to observe them, as with the use of a job-specific checklist like the one depicted in Figure 3. Instead, members of a work team look for the target behavior to occur. When they see a safe behavior opportunity (SBO), they take out their checklist and complete it. If the target behavior is lifting, for example, observers keep on the lookout for an SBO for lifting. They might observe such an SBO from their work station or while walking through the plant. Or imagine such an application with staff who must lift and reposition consumers who have multiple handicaps and cannot move independently.

It is critical that everyone observed for safe lifting had previously given permission for their lifting to be observed. However, the only name on the checklist is the observer's. This is not a "gotcha" process. Rather it is a way to focus people's attention on a certain work behavior, and identify how well the group performs the behavior. In the case of behaviors with multiple components (as in lifting), the group learns that aspects of a work practice are relatively safe versus at-risk.

Some checklists target multiple behaviors that are generic across various jobs. For example, the checklist presented in Figure 5 is applicable for any job that requires the use of personal protective equipment (PPE). This checklist was designed to conduct several one-on-

Observer: Date:

Target Behavior	Safe	At-Risk
load appropriate		
hold close		
use legs		
move feet - don't twist		
smooth motion - no jerks		
Comments (use back if necessary):		

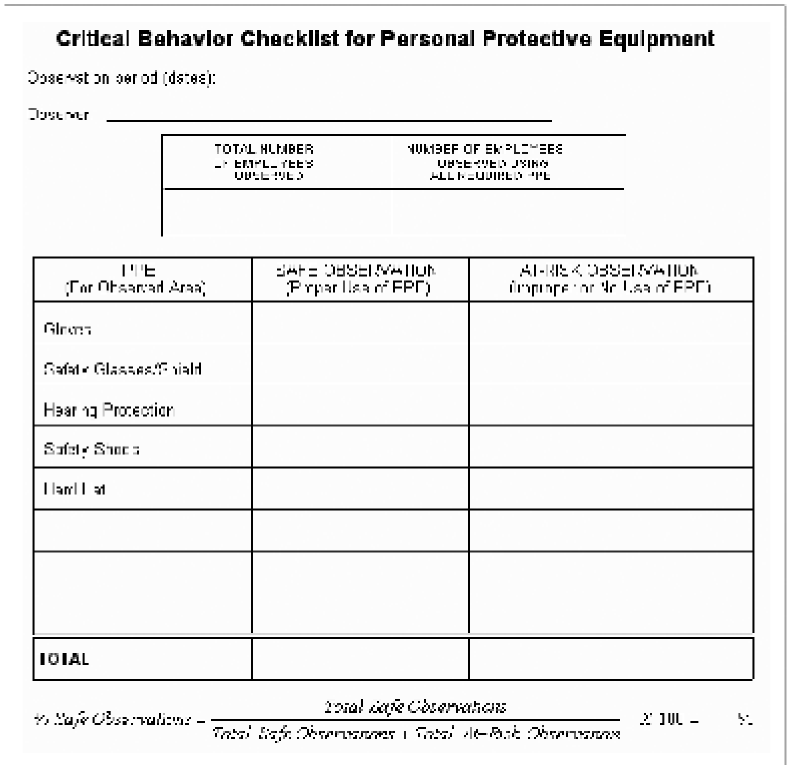
% Safe Observations:

$$\frac{\text{Total Safe Observations}}{\text{Total Safe Observations + At-Risk Observations}} \text{ X } 100 = \_\_\_\_\_ \%$$

Figure 4. A critical behavior checklist (CBC) can be used to increase safe lifting.

one behavioral audits during a particular time period. Each time observers perform an observation, they place a checkmark in the top left box (for total number of employees observed). If the worker was using all PPE required in the particular work area, a check would be placed in the right-hand box. From these entries, the overall percentage of safe employees can be monitored.

The percentage of safe behavior per each PPE category can also be assessed by dividing the total number of safe checks per each PPE category by the total safe and at risk checks. This allows for the calculation of the percentage of safe behavior for each PPE category. The resultant feedback regarding the relative use of various devices to protect employees might suggest a need to make certain PPE more com-



Critical Behavior Checklist for Personal Protective Equipment

Observation period (dates):

Observer ________________________________

TOTAL NUMBER OF EMPLOYEES OBSERVED	NUMBER OF EMPLOYEES OBSERVED USING ALL REQUIRED PPE

PPE (For Observed Area)	SAFE OBSERVATION (Proper Use of PPE)	AT-RISK OBSERVATION (Improper or No Use of PPE)
Gloves Safety Glasses/Shield Hearing Protection		
Safety Shoes		
Hard Hat		
TOTAL		

% Safe Observations = Total Safe Observations / (Total Safe Observations + Total At-Risk Observations) X 100 = ____ %

Figure 5. A critical behavior checklist (CBC) can be used to increase the use of personal protective equipment (PPE).

fortable or convenient to use. It might also suggest the need for special intervention, which is the next step of the DO IT process.

I *for intervene*. During this stage, interventions are designed and implemented in an attempt to increase the occurrence of safe behavior or decrease the frequency of at-risk behavior. As reflected in Principle 2, intervention means changing external conditions of the system to make safe behavior more likely than at-risk behavior. When designing interventions, Principle 3 is critical. Specifically, the most motivating consequences are soon, certain, and sizable; and positive consequences are preferable to negative consequences.

The process of observing and recording the frequency of safe and at-risk behavior on a checklist provides an opportunity to give people valuable behavior-based feedback. When the results of a behavioral observation are shown to individuals or groups, they receive the kind of information that enables practice to improve performance. Much research has demonstrated the cost-effectiveness of providing workers with feedback regarding their ongoing behavior. See, for example, the important analysis of the Hawthorne Effect by Parsons (1974), and comprehensive reviews by Alvero, Bucklin, and Austin (2001), and Balcazar, Hopkins, and Suarez (1986). Furthermore, occupational safety has significantly improved following the public display of workers' percentages of safe versus at-risk behavior (e.g., Austin, Kessler, Riccobono, & Bailey, 1996; Sulzer-Azaroff & de Santamaria, 1980; Williams & Geller, 2000; Zohar, Cohen, & Azar, 1980).

In addition to behavioral feedback, researchers have found a number of other intervention strategies to be effective at increasing safe work practices. These include worker-designed safety slogans, near-miss and corrective-action reporting, safe behavior promise cards, individual and group goal setting, actively caring thank you cards, BBS coaching, as well as BBS incentive or reward programs for individuals or groups. These are described elsewhere (Geller, 1996, 1997a, 1998b, 2001d, 2001e; McSween, 1995; Petersen, 1989).

T *for test*. The test phase of DO IT provides work teams with the information they need to refine or replace a behavior-change intervention. If observations indicate significant improvement in the target behavior has not occurred, the work team analyzes and discusses the situation, and refines the intervention or chooses another intervention approach. On the other hand, if the target reaches the desired frequency, the participants can turn their attention to another set of behaviors. They might add new critical behaviors to their checklist, thus expanding the domain of their behavioral observations. Alternatively, they might design a new intervention procedure to focus only on the new behaviors.

Each time employees evaluate an intervention approach, they learn more about how to improve safety performance. They have essentially become behavioral scientists, using the DO IT process to (a) diagnose a human factors problem, (b) monitor the impact of a behavior-change intervention, and (c) refine interventions for continuous improvement. The results from such testing provide motivating consequences to support this learning process and keep the workers involved. The systematic evaluation of a number of DO IT processes can lead to a body of knowledge worthy of integration into a theory. This is reflected in the next principle.

6. USE THEORY TO INTEGRATE INFORMATION, NOT TO LIMIT POSSIBILITIES

Although much, if not most, research is theory driven, Skinner (1950) was critical of designing research projects to test theory. Theory-driven research can narrow the perspective of the researcher and limit the extent of findings from the scientific method. In other words, applying the DO IT process to merely test a theory can be like putting blinders on a horse. It can limit the amount of information gained from systematic observation.

Many important findings in behavioral science have resulted from exploratory investigation. That is, systematic observations of behavior occurred before and after an intervention or treatment procedure to answer the question "I wonder what would happen if . . .?", rather than "Is my theory correct?" In these situations, the investigators were not expecting a particular result, but were open to finding anything. Subsequently, they modified their research design or observation process according to their behavioral observations, not a particular theory. In other words, their innovative research was driven by data rather than by theory.

This is an important perspective for safety and health professionals, especially when applying the DO IT process. It is often better to be open to many possibilities for improving safety performance than to be motivated to support a certain process. Numerous intervention procedures are consistent with a BBS approach, and an intervention process that is effective in one setting will not necessarily work in another. Thus, the author and his colleagues teach change agents to make an educated guess about what intervention procedures to use at the start of a BBS process, but to be open to results from a DO IT process and refine procedures accordingly. Of course, Principles 1 to 4 should be used as guides when designing intervention procedures.

After many systematic applications of the DO IT process, consistencies will likely be observed. Certain procedures will work better in some situations than others, with some individuals than others, or with some behaviors than others. Summarizing relationships between intervention impact and specific situational or interpersonal characteristics can lead to the development of a research-based theory of what kind of intervention is most effective under particular circumstances. In this case, theory is used to integrate information obtained from systematic behavioral observations.

7. DESIGN INTERVENTIONS WITH CONSIDERATION OF INTERNAL FEELINGS AND ATTITUDES

As indicated earlier, B. F. Skinner was concerned about unobservable attitudes or feeling states. This is evidenced by his criticism of punishment because of its impact on people's feelings or perceptions. This perspective also reflects a realization that intervention procedures influence feeling states, and these can be pleasant or unpleasant, desirable or undesirable. In other words, internal feelings or attitudes are influenced indirectly by the type of behavior-focused intervention procedure implemented, and such relationships require careful consideration by the developers and managers of a BBS process.

The rationale for using more positive than negative consequences to motivate behavior is based on the differential feeling states provoked by positive reinforcement versus punishment procedures. Similarly, the way we implement an intervention process can increase or decrease feelings of empowerment, build or destroy trust, or cultivate or inhibit a sense of teamwork or belonging (Geller, 2001a, 2001b, 2001c; 2002). Thus, it's important to assess feeling states or perceptions that occur concomitantly with an intervention process. This can be accomplished informally through one-on-one interviews and group discussions, or formally with a perception survey (O'Brien, 2000; Petersen, 2001).

THE FLOW OF BEHAVIOR CHANGE

As reviewed above, an effective BBS approach requires a careful analysis of the context in which desirable and undesirable behaviors occur. Subsequently, behavior change interventions need to be designed, implemented, and evaluated with a DO IT process. In fact, each of the BBS principles summarized here reflects guidelines for developing intervention procedures or assessing intervention impact. In addition, the choice of an intervention process to improve safety-related behavior should depend on whether the target behavior is intentional and whether it is other-directed, self-directed, or automatic (Watson & Tharp, 2002).

THREE TYPES OF BEHAVIOR

Safety-related behavior in a work setting usually starts out as other-directed, meaning employees follow someone else's instructions. Such direction can come from a policy statement, an operations manual, or a training program. After people learn what to do, essentially by memorizing or internalizing the relevant instructions, their behavior can become self-directed. They talk to themselves or formulate an image of the work practice before performing to activate the appropriate behavior. Sometimes they talk to themselves after emitting a behavior to reassure themselves they performed it correctly. Or, they use self-dialogue to figure out ways to do better next time. At this point, they are usually open to receiving corrective feedback.

When some behaviors occur frequently and consistently during a period of time, they become automatic. A habit is formed. Some habits are desirable, and some are undesirable, depending on their short- and long-term consequences. If implemented correctly, rewards, recognition, and other positive consequences can facilitate the transfer of behavior from the self-directed state to the habit state.

Of course, self-directed behavior is not always desirable. When workers take a calculated risk, for example, they are intentionally choosing to ignore a safety precaution or take a short cut to perform more efficiently or with more comfort or convenience. In this state, people are knowingly at-risk. It is often difficult to change self-directed behavior from at-risk to safe, because such a transition usually requires a relevant change in personal motivation.

Before a bad habit can be changed to a good habit, the target behavior must become self-directed. In other words, people need to become aware of their undesirable habit (as in at-risk behavior) before an adjustment is possible. Then, if people are motivated to improve (perhaps as a result of corrective feedback or an incentive or reward program), their new self-directed behavior can become automatic.

THREE KINDS OF INTERVENTION APPROACHES

The ABC (activator-behavior-consequence) model described in Principle 3 is a framework to analyze why behavior occurs, as well as to develop interventions for benefiting behavior. Consider that activators and consequences are external to the performer (as in the environment), or they can be internal (as in self-instructions or self-recognition). They can be intrinsic or extrinsic to a behavior, meaning they provide direction or motivation naturally as a task is performed (as in a computer game), or they are added to the situation extrinsically to improve performance (as in a salary bonus program). An incentive or reward program is external and extrinsic. It adds an activator (an incentive) and a consequence (a reward) to the situation to direct and motivate desirable behavior (Geller, 1996).

Instructional intervention. An instructional intervention typically uses an activator or antecedent event to get new behavior started or to move behavior from the automatic (habit) stage to the self-directed stage. Or it is used to improve behavior already in the self-directed stage. The aim is to get the participants' attention and instruct them to transition from unknowingly at-risk to knowingly safe. You assume the person wants to improve, so external motivation is not needed—only external and extrinsic direction.

This type of intervention consists primarily of activators, as exemplified by education sessions, training exercises, and directive feedback. Because the purpose is to instruct, the intervention comes before the target behavior and focuses on helping the performer internalize the instructions. This type of intervention is more effective when the instructions are specific and given one-on-one. Role-playing exercises provide instructors opportunities to customize directions specific to individual attempts to improve. They also allow participants the chance to receive rewarding feedback for their achievement.

Supportive intervention. Once a person learns the right way to do something, practice is important so the behavior can become part of a natural routine. Continued practice leads to fluency (i.e., fast and accurate behavior) and in many cases to automatic or habitual behavior. Practice does not come easily, however, and benefits greatly from supportive intervention. People need support to reassure them they are doing the right thing and to encourage them to keep going.

Although instructional intervention consists primarily of activators, supportive intervention focuses on the application of positive consequences. Thus, when receiving rewarding feedback or recognition for particular safe behavior, people feel appreciated and are more likely to perform the behavior again (Allen, 1990; Daniels, 2000, 2001; Geller, 1997a). Each occurrence of the desired behavior facilitates fluency and helps to cultivate a good habit. Note that supportive intervention is typically not preceded by a specific activator. In other words, the support of self-directed behavior does not need an instructional antecedent. The person knows what to do.

Motivational intervention. When people know what to do but don't do it, they require some external encouragement or pressure to change. Instruction alone is obviously insufficient because they are knowingly doing the wrong thing. In safety, this is referred to as a calculated risk. People take calculated risks when they perceive the positive consequences of the at-risk behavior to be more powerful than the negative consequences. The positive consequences of comfort, convenience, and efficiency are immediate and certain, whereas the negative consequence of at-risk behavior (such as an injury) is improbable and seems remote.

In this situation an incentive or reward program is useful. It attempts to motivate a certain target behavior by promising people a positive consequence if they perform it. The promise is the incentive and the consequence is the reward. In safety, this kind of motivational intervention is much less common than a disincentive or penalty program. A disincentive takes the form of a rule, policy, or law that threatens to give people a negative consequence (a penalty) if they fail to comply or take a calculated risk.

Often a disincentive or penalty intervention is ineffective, because like an injury, the negative consequence or penalty seems remote and improbable. The behavioral impact of these enforcement programs are enhanced by increasing the severity of the penalty and punishing more people for taking the calculated risk. However, the large-scale implementation of this kind of intervention can seem inconsistent and unfair. In addition, threats of punishment appear to challenge individual freedom and choice (Skinner, 1971), and therefore this approach to behavior change can backfire and activate more calculated risk-taking, even sabotage, theft, or interpersonal aggression (Sidman, 1989).

Motivational intervention is clearly the most challenging, requiring enough external influence to get the target behavior started without triggering a desire to assert personal freedom (Brehm, 1966, 1972). Powerful external consequences might improve behavior only temporarily, as long as the behavioral intervention is in place. Hence the individual is knowingly safe but the excessive outside control makes the behavior entirely other-directed. Excessive control on the outside of people can limit the amount of personal control or self-direction they develop on the inside (Aronson, 1999; Bem, 1972; Geller, 2001a, 2001c).

Putting it all together. Figure 6 reviews this intervention information by depicting relationships between four competency states (unknowingly at-risk, knowingly at-risk, knowingly safe, and habitually safe) and four intervention approaches (instructional intervention, motivational intervention, supportive intervention, and self-management). When people are unaware of the safe work practice (i.e., they are knowingly at-risk), they need repeated instructional intervention until they understand what to do. Then, as depicted at the far left of Figure 6, the critical question is whether they perform the desired behavior. If they do, the question of behavioral fluency is relevant. A fluent response becomes a habit or part of a regular routine, and thus the individual is habitually safe.

When workers know how to perform a task safely but do not, they are considered knowingly at-risk. This is when an external motivational intervention can be useful, as discussed above. Then when the desired behavior occurs at least once, supportive intervention is needed to get the behavior to a fluent state. Figure 6 also illustrates a distinction between knowingly safe or other-directed and knowingly

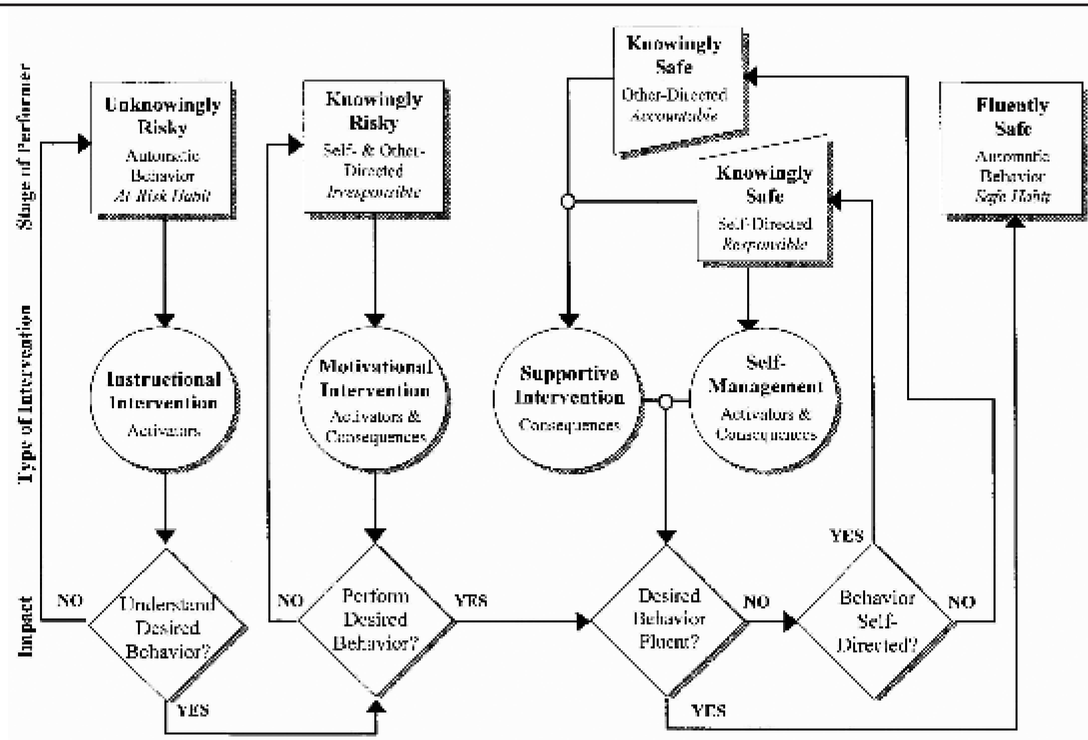


Figure 6. The Flow of Behavior Change model proposed to match awareness (knowingly vs. unknowingly) and safety-related behavior (safe vs. at-risk) with four basic types of intervention (adapted from Geller, 2001e).

safe or self-directed. If a safe work practice is self-directed, the employee is considered responsible and a self-management intervention is relevant. As detailed elsewhere (Watson & Tharp, 2002), the methods and tools of effective self-management are derived from behavioral science research and are perfectly consistent with the principles of BBS.

In essence, self-management involves the application of the DO IT process (Principle 5) to one's own behavior. This means (a) defining one or more target behavior(s) to improve, (b) monitoring these behaviors, (c) manipulating relevant activators and consequences to increase desired behavior and decrease undesired behavior, and (d) tracking continual change in the target behavior(s) to determine the impact of the self-management process (Geller, 2001a; Geller & Clarke, 1999).

Accountability versus responsibility. From the perspective of large-scale safety and health promotion, the distinction in Figure 6 between accountable (other-directed) and responsible (self-directed) is critical, implicating one of the greatest challenges in the safety and health professions. When people are held accountable, they are asked to reach a certain objective or goal, often within a designated time period. However, they might not feel responsible to meet the deadline, or they might feel responsible enough to complete the assignment, but that's all. They do only what's required and no more. In this case, accountability is the same as responsibility.

There are times, however, when people extend their responsibility beyond accountability. They do more than what is required. They go beyond the call of duty defined by a particular accountability system. This is often essential when it comes to occupational risk management. To improve safety beyond the current performance plateaus experienced by many organizations, workers need to extend their responsibility for safety beyond that for which they are held accountable. They need to transition from an other-directed state to a self-directed state.

Many jobs are accomplished by a lone worker. There are no supervisors or coworkers around to hold the employee accountable for performing a job safely. So the challenge for safety and health professionals and corporate leaders is to cultivate the kind of work culture that enables or facilitates responsibility or self-accountability for safety. This requires a consideration of psychological theory and research not typically linked to BBS, and is beyond the scope of this article. See, for example, the concepts of self-perception (Bem, 1972) and self-persuasion (Aronson, 1999), and the safety-focused applications described in Geller (2002).

IN CONCLUSION

Industrial safety has been identified as a domain in need of large-scale and long-term behavior change. For this to happen, however, a prominent paradigm shift is required. The standard command-and-control or enforcement approach to industrial safety has limited impact, as witnessed by the safety performance plateaus experienced by numerous organizations. The BBS approach summarized here provides tools and procedures employees can use to take control of their own safety performance, thereby enabling a bottom-up empowerment approach to reducing occupational risks and preventing workplace injuries.

Several consulting firms, as well as the Cambridge Center for Behavioral Studies, sponsor an annual BBS Users Conference that line workers attend in large numbers to learn more about BBS procedures and to network with other users of the principles and procedures reviewed in this article. Unlike the traditional safety conference, the focus is not on compliance with OSHA safety rules, government standards, or company policy, but rather on how to get more people involved in a BBS approach to proactive management of occupational risks. The theme is not on how to reduce such outcome numbers as total recordable injury rate and worker-compensation costs, but instead on what can be done to achieve more quality participation in ongoing injury-prevention programs. The popular safety slogans "Think safety" and "Safety is an attitude" are replaced with "Keep on doing what you're doing and you'll keep on getting what you're getting."

The basic BBS principles and methods that precipitated this paradigm shift in occupational safety were reviewed in this article, including some techniques the author and his colleagues have used for more than a decade to teach BBS to safety leaders and line workers. A conceptual model was presented (see Figure 6) that suggests ways to match the awareness and behavior of an individual with a particular intervention approach. Some research support was provided for this model, but more empirical validation is certainly needed. It is hoped this overview of BBS will prompt the occurrence of additional research to improve and expand applications of behavior analysis to reduce occupational risk and prevent unintentional injury in the workplace and beyond.

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E. Scott Geller, Ph.D. and professor of psychology, is the director of the Center for Applied Behavior Systems at Virginia Polytechnic Institute & State University, where he has been a faculty member since 1969. He is a fellow of the American Psychological Association, the American Psychological Society, and the World Academy of Productivity and Quality. He is a past editor (1989-1992) of Journal of Applied Behavior Analysis and a current associate editor (since 1983) of Environment and Behavior and a consulting editor for Journal of Safety Research and Journal of Organizational Behavior Management.