



Protecting the planet *and* its people: How do interventions to promote environmental sustainability and occupational safety and health overlap? ☆

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ABSTRACT

Problem: The challenges of both occupational safety and health and environmental sustainability require large-scale behavior change for meaningful improvements to occur. Environmental sustainability, or the 'green movement' has received far more attention recently, and certain strategies and recommendations from interventions designed for promoting pro-environmental behaviors may inform efforts to intervene on critical behaviors for improving occupational safety and health. **Method:** A survey of the literature regarding behavioral interventions for both environmental sustainability and occupational safety and health was conducted. Several theoretical approaches are reviewed, and successful approaches from each domain are identified, as well as parallel challenges and points for crossover. Recommendations are provided for adapting environmental sustainability intervention approaches for occupational safety and health applications. **Impact on Industry:** Safety and health leaders may achieve sustainable improvements in worker safety and health by harnessing the momentum of the green movement and adapting successful intervention approaches from the environmental sustainability domain.

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1. Introduction

Occupational safety and health and environmental sustainability are parallel challenges. Both the 'green movement' and the focus on occupational safety and health in the United States became important social responsibility issues during the 1970s, and both of these domains require large-scale behavior change for a meaningful impact to be realized. Occupational safety and health (OSH) professionals have worked to promote a number of safety and health-related behaviors in the workplace: the use of personal protective equipment (PPE), adherence to safety checklists, and so forth. Interventions designed to promote environmental sustainability have focused on a number of behaviors, from recycling and reducing litter to taking shorter showers and adjusting thermostats. Both fields have come to recognize the impact that individual behaviors can have on safety and environmental sustainability, as well as the significant challenges of changing individual behavior for a common goal.

Yet currently, the green movement seems to have gained much more attention than occupational safety and health issues, as evidenced by recent political activities (e.g., the Waxman-Markey bill on climate change legislation passed in the House of Representa-

tives in June, 2009) and attention in the mainstream media (e.g., Sept. 28, 2009 *Newsweek* cover story ranking the Greenest companies in America). Additionally, specific "green" job titles have been recognized by the U.S. Department of Labor's Standard Occupational Classification Policy Committee (SOCPC) in their Direct Match Title File (a database for collecting occupation-specific data) including Environmental Economists, Hybrid Vehicle Mechanics, Environmental Communications Specialists, Wind Turbine Erectors, and Wind Turbine Mechanics (U.S. Dept. of Labor, 2009a).

Although it would be advantageous for 'green' to include 'safe,' this is not necessarily the case, much like productivity and safety are not often correlated. For example, wind turbine erectors and mechanics are faced with significant safety challenges such as falls from heights, which continues to be the leading cause of fatalities in the construction sector as a whole (U.S. Dept. of Labor, 2009b). In fact, the disparity between green jobs and safety has gained enough attention to warrant a meeting of national experts to address the issue of better integrating worker health and safety into the current sustainability and green platforms, including issues associated with the Nation's infrastructure (buildings, roads and bridges); energy ("smart grid," solar and wind power); technology (green chemistry and nanotechnology); products and recycling (National Institute for Occupational Safety & Health [NIOSH], 2009).

The behavioral interventions used in these two areas of research have rarely crossed domains to influence each other. Do professionals working in environmental sustainability and occupational safety merely "re-invent the wheel" through trial-and-error methods of

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developing interventions with varying levels of success? Could what environmental psychologists have learned about recycling be useful to the occupational safety manager who is trying to promote the use of fall protection? Could the theoretical models that underlie interventions to reduce energy consumption be applied in efforts to prevent workplace injury?

What follows is a survey of the literature in each field in an attempt to establish a cohesive overview explaining the behavioral interventions that have been used in each, the theories applied in each field, and the parallel successes and failures, with the aim to synthesize what professionals in each field can learn from each other. We begin with examinations of each field independently and then assess areas of overlap. We conclude with recommendations for OSH professionals and outline some future directions for research in adapting techniques across fields.

2. Method

A search of the literature was conducted to locate research relevant to behavioral interventions for promoting safety and sustainability. Initial searches for relevant documents were conducted using Google Scholar. However, the initial search brought so many results as to be impractical (17,300 for the first set of terms). Furthermore, many of the results were on topics completely irrelevant to the current study. Subsequently, two databases were deemed likely to contain documents relevant to the research questions. These were PsycInfo and Sustainability Science Abstracts from CSA, two computerized databases of relevant articles. The following combinations of terms were searched: "marketing" and "green;" "marketing" and "sustainability;" "marketing" and "pro-environmental;" "marketing" and "occupational safety;" "dissemination" and "pro-environmental;" "dissemination" and "green;" "dissemination" and "sustainability;" "dissemination" and "occupational safety;" "promotion" and "green;" "promotion" and "sustainability;" "promotion" and "pro-environmental;" "promotion" and "occupational safety;" "behavior change" and "green;" "behavior change" and "sustainability;" "behavior change" and "pro-environmental;" "behavior change" and "occupational safety;" "applied behavior analysis" and "green;" "applied behavior analysis" and "sustainability;" "applied behavior analysis" and "pro-environmental;" "applied behavior analysis" and "occupational safety;" "occupational safety" and "sustainability;" and "green" and "occupational safety."

Abstracts of the resulting articles, books, chapters, and dissertations were reviewed for relevance. If they appeared relevant, the publication themselves were obtained and further screened for relevance to the current review. For inclusion in this analysis, an article had to be focused on either theory of behavior change or experimental tests of interventions to change behavior. Articles that were heavily directed toward instructing readers how to market a specific product, for example, were not included.

Additionally, the reference section of each publication was reviewed to identify potentially relevant articles. These articles were similarly screened by abstract and then, when applicable, studied in their full version for relevance to the current review. Excluded articles included, for example, those that referred to sustainability in exclusively non-ecological terms, or articles that contained no reference to behavior. Documents selected for relevance included 52 published journal articles, 11 books and book chapters, and 1 unpublished doctoral dissertation.

3. Environmental Sustainability

Research to understand and promote performance of environmentally responsible behaviors (ERBs) has created a significant body of literature, resulting in a variety of theoretical implications and recommendations for successful interventions. A selection of studies

is reviewed below to highlight various approaches to behavior change for promoting environmental sustainability.

3.1. Behavior-Based Applications

Very early research focused on behavior and behavioral approaches to promoting environmentally responsible behaviors (ERBs). Van Liere and Dunlap (1980) reviewed a number of hypotheses to explain the presence or absence of environmental concern. They list the five demographic variables most often cited as relevant to environmental concern: age, social class, residence, political affiliation, and gender. The authors in fact find little support in the experimental research for any of these variables as predictors of environmental concern.

Van Liere and Dunlap (1980) recommend that future research focus on more specific types of environmental concerns as well as factors of cost to the individual. The field as a whole seems to have taken this advice. Indeed, the authors' exclusive consideration of demographic variables highlights the extent to which the research has progressed: current theories, supported by empirical data, focus more on psychological variables as predictors of environmental concern and ERBs.

About a decade later, Geller (1989) proposed an integration of Applied Behavior Analysis (ABA) with social marketing strategies in order to recommend optimal interventions to promote ERBs. Applied Behavior Analysis posits that behaviors are motivated by the consequences they elicit, and an understanding of an individual's expected consequences will enable prediction of the individual's behavior. Essentially, the model suggests that the antecedent-behavior-consequence sequence considered by ABA practitioners should be adapted to target more specific, homogenous populations.

Gardner and Stern's (1996) book, *Environmental problems and human behavior*, provides a useful analysis of ERBs from a behavioral perspective. Especially useful is their taxonomy of behaviors as efficiency behaviors versus curtailment behaviors. Efficiency behaviors are single behaviors that have a significant and long-term impact on the environment, usually through the use of efficient technology. These behaviors may include purchasing energy-efficient vehicles or appliances or orienting a house on a lot to take the best advantage of natural light.

In contrast, curtailment behaviors are those that must be repeated to have a meaningful impact, such as recycling, using mass transit instead of driving, and taking shorter showers. Understanding this difference not only provides a basis for understanding the psychology behind choosing to participate in either type of behavior, but also highlights the potentially maximized benefits from targeting efficiency rather than curtailment behaviors, which must be repeated many times to have significant environmental impact. This distinction is similar to the contrasting approaches in safety of engineering controls versus behavior change. Adapting an engineering control may be a single behavior of altering the environment that will have a lasting impact on risk reduction, while behavior change programs require repeated compliance with a new procedure.

Despite Gardner and Stern's recommendation to focus interventions on efficiency behaviors, Lehman and Geller (2004) found in their review of behavior analysis and ERBs that interventions to promote environmentally responsible behaviors have not tended to emanate from the behavioral subfield of psychology, and resulting publications are sparse in the applied behavior analysis literature. The vast majority of those that were behavior-based targeted curtailment behaviors rather than efficiency behaviors.

An additional problem cited is that research on successful interventions is rarely disseminated to those in institutional settings who could benefit the most from them. The authors review and evaluate behavior-change strategies implemented in the context of applied behavioral analysis. A major recommendation from the

authors is that consequence interventions become institutionalized, making for permanent reward contingencies.

Osbaldiston's (2004) meta-analysis of 62 studies on the promotion of environmentally responsible behaviors, which included 133 effect sizes, examined the types of intervention employed, the behaviors targeted, the potential moderators of successful interventions, and the applicability of various theoretical interpretations. The greatest effect sizes were found in interventions that used making a commitment or goal-setting for their manipulations. Similar to Lehman and Geller (2004), Osbaldiston found that those behaviors targeted were often those easiest to manipulate and measure, rather than those with the greatest potential impact. Behaviors targeted were largely concentrated in two areas: recycling and energy conservation. Osbaldiston makes useful recommendations for future studies: addressing behaviors not previously targeted (i.e., other behaviors than recycling), and using commitment-making and goal-setting interventions, which are not often used despite strong empirical support for their effectiveness. Unlike Lehman and Geller, Osbaldiston found that such strategies were even more effective than reward contingencies.

3.2. Personal Value, Attitude, and Personality links with Behavior

Schwartz (1992) identified two factors along which all values could be placed: self-enhancement versus self-transcendence (the extent to which individuals are motivated by their own interests vs. the welfare of others) and openness versus conservation (the degree to which people are willing to change and challenge themselves vs. their desire to maintain the status quo). To assess the extent to which personal values play a role in environmentally responsible behaviors, Karp (1996) used Schwartz's theory to determine the types of values usually related to ERB. Karp found that values reflecting both self-transcendence and openness were positively correlated with ERBs, whereas values that reflected self-enhancement and conservation were negatively correlated with ERBs. The authors suggest that interventions to promote ERB may be more successful if they target specific values. Despite the finding that values play a role in influencing ERBs, it would be more useful to know how much of a role they play relative to other external factors, such as norms, response cost, convenience, and financial consequences. As such, it is not clear how useful this information could be in developing successful intervention strategies, even when it predicts ERBs with some degree of significance.

Grob (1995) proposed a model linking personal philosophical values, perceived control, environmental awareness, and emotions to environmental behavior. He then tested this model using correlational data. Results of the study provided overall support for the model, with values and emotions having the greatest effect on self-reported ERBs. The authors recommend a replication of the study that measures the dependent variable directly, rather than through self-report. Interestingly, the effect of factual knowledge on ERBs was not significant.

Tribbia (2007), on the other hand, noted the gap between stated environmental attitudes and ERB performance, especially as related to alternative transportation. He proposes five overarching facilitating or limiting factors: (a) inclination (individual characteristics), (b) motivation, (c) information processing and behavioral intent, (d) ability and skill, and (e) external support (peer/community, regulations and laws, and infrastructure). Finally, recommendations are made not only for the design of future interventions, but also for the dissemination of strategies that have proven successful. He states that identifying individuals who are key connections to the body of people designing and implementing interventions is a key first step. He also suggests that scientists should collaborate with designers of interventions to target specific groups of people for relevant behavior change.

Geller's (1995) actively caring model hypothesized that an individual's propensity to actively care mediates the relationship

between certain personality factors (self-esteem, belonging, and personal control) and the performance of ERBs. Actively caring is a construct related to altruism, and describes when an individual is motivated not for personal needs, but for the needs of others and for his or her larger community.

Allen and Ferrand (1999) tested and expanded this model experimentally by operationalizing actively caring using an existing sympathy scale and developing a comprehensive questionnaire that assessed self-esteem, personal control, belongingness, actively caring, and pro-environmental behaviors while controlling for factors such as social desirability. They found support for Geller's model in that personal control was a strong predictor of ERBs, and that this relationship was mediated by sympathy. They also point out how this model would apply to workplace safety behaviors; propensity to actively care should also mediate the relationship between personality factors and performing safety behaviors that involve demonstrating concern for others, such as making a coworker aware of a safety hazard or reminding them to use PPE. Indeed, this model was developed in the safety domain (Geller, 1996), and is further discussed below.

3.3. Theory of Planned Behavior

Researchers have also applied Ajzen's (1991) Theory of Planned Behavior (TPB) to ERB performance. This theory posits that three main components should be considered in predicting an individual's behavior: attitude toward the behavior, subjective norm, and perceived control. The latter refers to the extent to which a person believes he/she has control over performing or not performing a behavior; it is also called self-efficacy and derived from Bandura's social cognitive theory, (see below). Staats (2003) emphasized the importance of perceived behavioral control, which distinguished TPB from previous theories. He considered the applicability of the theory to pro-environmental attitudes and behaviors by reviewing seven relevant studies and concluded the theory is very successful at both predicting and explaining behavior in this domain.

Bamberg (2003) specifically asserted that TPB could explain the weak relationship between environmental concern and ERBs. The results of his experiment supported the hypothesis that environmental concerns impact ERBs in that they affect the interpretation of specific situations and resulting cognitions. These cognitions, in turn, are better predictors of ERBs. Another interesting finding was that the intentions of highly-concerned participants were closely related to situation-specific cognitions, while the intentions of low-concerned students were closely related to cognitions about social norms. A notable limitation of his study was that it relied on self-report for most of the measures, and the ERB measured was merely a request for additional information (asking for a brochure on green energy), rather than an actual ERB.

In two field studies, Carrus, Passafaro and Bonnes (2008) applied Perugini and Bagozzi's (2001) model of goal-directed behavior, an extension of Ajzen's TPB, to promotion of ERBs. This theory has found empirical support in other domains (e.g., weight management). In order to create and validate a framework that considers the interplay of emotion with cognition and decision-making in the realm of ERBs, the authors evaluated the ability of a number of factors (attitudes, perceived behavioral control, frequency of past behavior, subjective norms, anticipated emotions, and desire) to predict pro-environmental behavioral intention. Both studies collected survey data, one addressing the use of public transportation and the other focusing on household recycling, and the results of both studies results largely supported the model of goal-directed behaviors as being a satisfactory explanation of intention to perform ecological behaviors.

Of relevance to designers of future interventions is the impact of anticipated emotional experiences, which may be affected by, for example, marketing campaigns to associate desired behaviors with

positive emotional experiences. One notable limitation to these studies is that they measure behavioral *intentions* in lieu of actual ERB. It is also worth noting that in each study, a single survey was used to evaluate all the factors in the model, and therefore desire to appear consistent may have influenced responses.

Another study that purported to extend the TPB included self-identity as a predictor of pro-environmental behaviors (Whitmarsh & O'Neill, 2010). Results indicated behavior-specific self-identity (being a 'carbon offsetter') significantly predicted intention to engage in carbon-offsetting behaviors over and above TPB variables, and pro-environmental self-identity significantly predicted certain categories of ERBs. These results suggest the need for priming relevant aspects of identity and targeting particular group identities.

3.4. Self-Determination Theory

Self-Determination Theory (SDT) is a theory of motivation predicated on the notion that we have needs for competency, autonomy, and belongingness, and these needs, although often in competition with each other, direct our behavior (Deci & Ryan, 2002). SDT includes four sub-theories: cognitive evaluation theory, organismic integration theory, causality orientations theory, and basic needs theory. The most relevant one for the current discussion is cognitive evaluation theory (CET), which examines the impact of extrapersonal factors on motivation, and theorizes that what is most important is not necessarily an individual's actual motivation, but his/her *perceptions* of his/her own motivations for behavior (Moller, Deci, & Ryan, 2006).

Although Deci and Ryan initially proposed a dichotomous division of motivation into intrinsic and extrinsic, they expanded the extrinsic category to consider various modes of motivation that represent different levels on the spectrum of autonomy versus control (Moller et al., 2006). Lowest on the scale of autonomy is external regulation. This refers to a person's behavior being driven by fully external reward or punishment contingencies.

Introjected motivation is in place when an individual performs a certain behavior because of socially driven internal consequences, (e.g., in order to feel proud of him/herself or to avoid the shame and guilt of *not* doing the behavior). The most autonomous of the levels of extrinsic motivation is identified motivation, in which an individual performs a behavior because he/she acknowledges its importance or considers it to be consistent with his/her values. Intrinsic motivation, on the other hand, is present when a behavior is satisfying and enjoyable in and of itself, independent of consequences.

De Young (2000) reported on a series of studies focused on the relationship between ERB and intrinsic motives. Three types of intrinsic motives were investigated, including competence, frugality, and participation. While the findings indicated no clear single motive is optimal for promoting ERB, De Young notes the importance of harnessing the human urge toward competence, as each of the types of intrinsic satisfaction investigated can be reframed as issues of competence. This work suggests intervention approaches, which provide individuals a context in which they can feel competent will successfully maintain ERBs, and thus a similar approach would likely carry over to OSH behaviors as well.

Osbaldiston and Sheldon (2003) applied SDT in an experiment assessing the correlation between perceived autonomy and achievement of goals related to environmental sustainability. The authors propose a three-step process that is crucial to the effectiveness of interventions designed to target ERBs, by which individuals first initiate, then maintain, and finally generalize desired behaviors. In order to test a path model asserting that perceived supportiveness led to internalized motivation, and internalized motivation led both directly to future intentions and to future intentions as mediated by goal performance (thus perception of effectiveness), the authors conducted a study in which participants gave information about the

above variables and were later measured on their compliance with a self-generated ERB goal. The results of the study supported the path model proposed. However, two major limitations of the study are the significant amount of variance unexplained by the proposed model and the fact that the data are correlational, as the authors did not manipulate the autonomy (or perceived autonomy) of the participants.

Pelletier, Green-Demers, Tuson, Noels, and Beaton (1998) constructed and validated a scale to help categorize the reasons people engage in ERBs: the Motivation Toward the Environment Scale (MTES). The scale applies SDT in order to classify motivations along a scale according to the level of self-determination. Interestingly, the authors found that the most relevant element of SDT as it relates to ERBs is its portrayal of how behavioral regulation is internalized. An understanding of the internalization process and ability to assess where participants are within the process would be particularly useful in the development of interventions. The authors provide satisfactory evidence of internal and external validity of their MTES, suggesting that the scale they've developed would be a useful tool in future research.

Pelletier, Dion, Tuson, and Green-Demers (1999) created a similar scale in an attempt to classify and understand environmental amotivation. They developed the Amotivation Toward the Environment Scale (AMTES) to assess the influence of various psychological variables among people who do not engage in ERBs. They hypothesized that failure to act would be related to global helplessness beliefs resulting from a perception that environmental problems are insurmountable, inability to perceive how one's actions could make a difference, and an overall rejection of engaging in ERBs. They further hypothesize that helplessness beliefs could arise from, and be predicted by, strategy beliefs (that certain actions will lead to certain outcomes), effort beliefs (that one can maintain the effort required for certain behaviors), and capacity beliefs (that one is capable of performing a particular behavior). A confirmatory factor analysis supported the proposed four-factor model. Furthermore, it was found that amotivation because of capacity beliefs and because of strategy beliefs predicted helplessness beliefs, but amotivation because of effort beliefs was not a significant predictor of helplessness beliefs. This classification system is useful in understanding a particular individual's reasons for not engaging in ERBs. Interventions could target increasing beliefs that individuals are capable of action, can sustain the effort required for such action, and that individual's actions could have an impact.

Osbaldiston's (2004) meta-analysis of the ERB literature included an examination of results from experiments that tested SDT empirically. Of the four types of motivation included in this theory (external, introjected, identified, and internal), Osbaldiston found that only identified motivation had a significant effect in predicting ERB performance. Given that identified motivation implies an individual performs a behavior because she or he values or identifies with the importance of the behavior, interventionists may benefit from additional research on strategies for increasing individuals' perceptions of the targeted behavior(s)' personal importance.

3.5. Perceived Consumer Effectiveness and Social Marketing

In addition to exploring theoretical contributions from the field of psychology to predicting ERBs, we can find relevant theories in marketing as well. Perceived consumer effectiveness (PCE) is a marketing theory that explains prosocial behavior is determined by the extent of the impact the behavior is believed to have, or how much the consumer thinks that what he or she does will make a difference. Ellen, Wiener, and Cobb-Walgren (1991) attempted to separate, empirically, perceived consumer effectiveness from other constructs of social consciousness. Specifically, they argue that social

consciousness is distinct from environmental concern and makes its own unique contribution to the performance of ERBs.

They conducted a survey of consumers and found that individuals who believe their actions will have an environmental impact are more willing to accept the costs of ERBs. The findings of this study are relevant for future promotion programs, as these results suggest successful interventions should persuade individuals of the potential impact of their behaviors, as well as provide positive feedback regarding the actual results of their ERBs so that desired behaviors are maintained. A notable limitation of this study, as with many of the studies from the marketing field reviewed for this paper, is the reliance on survey and self-report data.

Obermiller (1995) applied PCE theory to an experimental evaluation of two interventions designed to promote ERBs. The “sick baby” approach emphasizes the severity of a problem, whereas the “well baby” approach emphasizes the potential impact of an individual’s behavior to solve the problem. From the marketing standpoint, the well baby approach is theorized to increase perceived consumer effectiveness. The authors found the success of a message depended on the issue – for a highly salient issue, the well baby approach was significantly more effective, whereas for an issue of low salience, the sick baby approach was more effective. A major limitation of the study is that the outcome variable was not actual behavior, but consumer rating of the persuasiveness of a message and importance of an issue. Thus, there is no guarantee these differential impacts would hold at the level of behavior.

Given the consistent finding that merely providing information has been insufficient motivation for people to engage in ERBs, Artz and Cooke (2007) used social marketing techniques, an application of the social influence principles, to develop an e-mail campaign among employees at the Department of Environmental Protection of the state of Maine. More specifically, an advocate within the company sent a series of e-mails requesting commitment, following up, and delivering feedback about four different ERBs. Although the authors did not use a control condition, they used a baseline comparison and found increases in all four target behaviors, with greater changes in those behaviors that were easier to perform and involved no cost to the consumer.

This research also explored the relevance of particular barriers to ERBs that had been identified prior to the study. Barriers such as lack of tangible personal benefit, concern that “green power” was not sufficiently sustainable, requirement of deliberate action to change power source, and low visibility (i.e., lack of social recognition) of the behavior were not barriers this study was deemed to have overcome. However, the design of this study successfully addressed two barriers: (a) lack of information and instructional knowledge, which was addressed by the e-mail newsletter; and (b) the behavior’s failure to achieve social norm status was addressed by the newsletter’s emphasis on other individuals who do purchase green power.

In a series of four studies, Cornelissen, Dewitte, Warlop, and Yzerbyt (2007) tested the hypothesis that pro-environmental behavior could be promoted by “making relevant (pro-environmental) thoughts more accessible at the moment of decision making” (p. 279). They applied a social-labeling technique by delivering a message explicitly describing an individual’s actions as consistent with having high environmental concern. This procedure was intended to induce people to reattribute a behavior that may have been spontaneous or motivated by non-environmental reasons as evidence of their status as an environmentally conscious individual. They found that: (a) social labeling was particularly effective in guiding future choice when processing the label occurred during a distraction task (thus under cognitive load); (b) asking participants to reflect specifically on their motivation following social labeling negated the impact of the labeling on future choice, ostensibly because they were given the chance to “correct” the attribution; (c) social labeling has an effect on decision-making when that distraction occurs during the decision-

making process; and (d) during repeated decision-making (a more externally valid condition), the impact of social labeling increased with successive decisions and the cognitive load likely associated with this task. Thus, future investigators should consider critical situations for delivering social labels in order to lead to future behavior that is consistent with the label given. For example, OSH promotion efforts may benefit from identifying repeated PPE purchases or frequently accessed safety information resources, and delivering positive OSH messages to impact individuals’ attributions of safety behavior.

In a similar series of experiments, Cornelissen, Pandelaere, Warlop, and Dewitte (2008) noted that both an individual’s level of attention to his/her own behaviors and the overall prevalence of a behavior can impact his/her performance of other ERBs. They demonstrated that when an ERB is relatively commonplace (e.g., not littering), an individual may not consider this as evidence that he/she is environmentally conscious. Directing his/her attention to these behaviors may cause him/her to see him/herself as an environmentally conscious individual and to perform other ERBs. On the other hand, emphasizing uncommon pro-environmental behaviors often led to a less environmentally responsible choice than the choice made by a control group. The results suggest those developing interventions should consider that emphasizing the behaviors a person probably already does regularly is likely to increase consistent behavior, be it pro-safety or pro-environmental, but emphasizing uncommon behaviors, as many promotion campaigns do, may in fact be detrimental by making non-compliance a salient factor that impacts a person’s self-image.

As McKenzie-Mohr (2000) notes, the ubiquitous “information-intensive” interventions to promote ERBs rarely offer a substantial return on investment. McKenzie-Mohr advocates for a community-based social marketing approach to promoting ERBs. The four steps involved in such a process include uncovering barriers to behavior and selecting a behavior to promote, designing a program to overcome these identified barriers and promote the specific behavior, piloting the program, and evaluating the broadly-implemented program. Additionally, the author suggests an interesting approach to identifying barriers: compare a person who is performing the target behavior to one who isn’t.

3.6. Theory Integration

Stern (2000) provided an overview of the literature pertaining to promoting ERBs and attempted to provide a coherent theory to encompass these findings. He first defined and classified ERBs, then discussed the relationship between environmental attitudes and behaviors, various theoretical approaches to understanding ERBs, the factors most relevant to behaviors (thus those to target with interventions), and ended by providing recommendations for intervention design as well as for future research where data are lacking.

Stern explains his value-belief-norm theory of environmentalism and describes a model of the psychological factors involved. Of particular note and potential use in the safety domain is Stern’s identification of four variables that cause ERBs: attitudes, contextual forces, personal capabilities, and habit/routine. Stern’s theory that multiple causes contribute to ERB performance is supported by consistent research findings that the most effective interventions are those that combine a number of approaches, and Stern urges that this combined approach be used in future interventions.

Osbaldeston (2004) also tested Stern’s integrative theory in his meta-analysis, although he dropped the habit/routine factor, as coders could not agree on a meaningful definition, and the author viewed this variable as not readily lending itself to manipulation as here it refers to past behavioral patterns. Attitude was the only factor with a significant positive correlation to ERBs. The relationship of capability with ERBs was non-significant, and context actually correlated negatively. The omission of habit/routine is regrettable, as behavioral

research suggests this factor should be easiest to influence. However, the approach described here lacks the capability of experimental manipulation.

3.7. Limitations and Persistent Challenges

A pervasive problem with environmental sustainability research is that the behaviors chosen for study are rarely those with the greatest environmental impact, but rather those that lend themselves to easy manipulation, observation, and measurement (Lehman & Geller, 2004; Osbaldiston, 2004). Additional problems the field face are failure of dissemination of successful interventions and a lack of focus on behaviors while overemphasizing attitudes (Geller, 1989; Lehman & Geller, 2004). Recent reviews have attempted to remediate this problem by synthesizing the literature and providing summaries of outcomes. An additional problem is the continued prevalence of informational campaigns, despite the finding that factual knowledge is not a significant predictor of ERBs (Grob, 1995).

3.8. Summary and Recommendations

Overall, results of the studies examined offer a number of promising methods to improve the effectiveness of future interventions that may be relevant for OSH promotion efforts. The following emerge as the elements of successful interventions to promote ERBs: (a) identifying key community members to serve as agents of change (Tribbia, 2007), (b) associating the target behaviors with positive emotional experiences (Carrus et al., 2008), (c) supporting the process of initiation, maintenance, and generalization required for internalization (Osbaldiston & Sheldon, 2003), (d) tailoring the intervention to targeted individuals of low concern (using social norms) or high concern (using situational cognitions; Bamberg, 2003), (e) applying social labeling techniques (Cornelissen et al., 2007, 2008), and (f) highlighting the impact of individual behavior (Ellen et al., 1991). Additionally, the recommendation for targeting efficiency behaviors in lieu of curtailment behaviors is certainly germane to the safety domain, as behavioral interventionists may have a greater impact on reducing the burden of injury and illness by focusing on behaviors related to adopting engineering solutions rather than curtailment behaviors. With these recommendations in mind, an examination of existing OSH behavioral intervention research follows.

4. Occupational Safety and Health

Outside of the realm of behavior-based safety (BBS) research, most of the studies examined with respect to safety behaviors involved collecting survey data and using correlational statistics to test theoretical models that could then be applied to the design of interventions. While BBS studies often tested various intervention approaches, very few studies were found that used randomized, experimental methods to compare intervention techniques.

4.1. Social Cognitive Theory

Cheung and Chan (2000) applied Bandura's (1997) social cognitive model, which explains the input of social learning and beliefs of self-efficacy on behavior, to a natural experiment to assess the effectiveness of a campaign by Hong Kong's Occupational Safety and Health Council to reduce injuries and accidents in the workplace. In this particular study, 668 working people responded to a phone survey designed to evaluate the intervention's impact on both Bandura's hypothesized constructs and safety-relevant behavior. The authors found that the campaign was moderately effective, although not particularly strong, and that individuals working in targeted industries reported engaging in more safe behaviors than individuals in

non-targeted industries. They also found that the relationship between promotional activities and reported behavioral change was modified by three constructs: exposure, learning, and development of efficacy beliefs. Of particular relevance was their finding that the impact of a single exposure was small to moderate, but the reported frequency of the safety behavior increased with the number of exposures to the campaign. A notable limitation is, of course, the reliance on self-report data and the lack of a randomly assigned control group.

4.2. Theory of Planned Behavior

Two studies were found that evaluated safety-related behavior through the lens of Azjen's (1991) theory of planned behavior (TPB). Colemont and Van den Broucke (2008) examined farmers' performance of safe and healthy occupational behaviors. They developed a self-report instrument to assess attitudes, subjective norms, perceived control, and self-reported performance of four categories of safe/healthy behaviors. They found limited support for their model. More specifically, attitudes and subjective norms were predictive of intention to perform all safety and health behaviors assessed. Perceived behavioral control was less of a consistent predictor, and was significant only in relation to intentions to perform certain behaviors related to safe use of machinery and pesticides.

Petrea (2001) applied TPB to study the use of respiratory protection in pork farming in order to identify strengths and limitations of the theory's applicability. He found that attitudes toward behavior and subjective norms were significant predictors of intentions to perform behavior, while control perception was not. Additionally, there was a significant amount of variance left unexplained by the constructs involved in TPB. This theory remains a useful tool for assessment conducted before designing an intervention as it allows practitioners to identify constructs with the greatest influence on intentions toward target behaviors. However, both independent and dependent variables are defined by surveys or verbal reports rather than real-world events.

4.3. Regulatory Focus

Regulatory focus theory allows one to make distinctions in the way people orient themselves to outcomes: either toward the positive (promotion focus) or away from the negative (prevention focus; Higgins, 1997). Wallace, Little, and Shull (2008) attempted to clarify the role of task complexity in moderating the effect of regulatory focus on performance, both in terms of safety and of production. Complex tasks are those that require application of a variety of cognitive elements; whereas simple tasks do not place great demands on cognitive resources. For example, the complex task used here was a military-style computer game that involved a variety of moving targets in unclear surroundings, whereas the simple task was the same game played on a simulated flat terrain with clear visibility and a single, stable target.

The authors found, across conditions, having a promotion focus relates positively to productivity and prevention relates positively to safety. Additionally, they found support for the predicted moderating effect of task complexity: when a task is complex, promotion and safety are negatively correlated, as are prevention and productivity in the same situation; when a task is simple, though, these relationships are both positive. These authors note the primary limitation for application of their findings is that research on how an employee's regulatory focus can be manipulated is limited. However, the study described simply *measured* regulatory focus as a stable personality variable; manipulations that alter the context and other temporary conditions may affect temporary regulatory focus states in target individuals. As the authors note, "certain powerful contextual variables such as group norms, leadership climate, and task

characteristics may override chronic tendencies and significantly influence behavior” (p. 97).

4.4. Workplace Health Promotion

A number of studies conducted in relation to workplace-based health promotion provide sufficiently significant overlap with safety behaviors to be considered in the current review. Lusk, Ronis, and Hogan (1997) used Pender's (1987) Health Promotion Model, which assesses cognitive and perceptual factors that influence choice to perform health related behaviors (e.g., importance of health, perceived control of health, perceived self-efficacy, definition of health, perceived health status, and perceived benefits and barriers) to predict use of hearing protection among construction workers. The best predictors were found to be behavior-specific: self-efficacy, value of use, and barriers to use. These three factors would be useful targets for interventions targeting health and safety behaviors.

A series of experiments conducted by Menon, Block, and Ramanathan (2002) has clear implications for promoting safety-related behaviors, though they were conducted specifically in reference to health-risk behaviors. The researchers examined the impact of the self-positivity bias (i.e., the belief that one is invincible to disease) on an individual's processing of messages about disease-related risk behavior. Thus, an intervention's objective would be to increase a person's self-risk perception in order to promote target behaviors that reduce risk exposure. They also found that increasing the quantity of information communicated could at times decrease the likelihood of behavior change when referring to an uncommon behavior. They ultimately suggest two ways to optimize the effects of providing information on behavior change: providing a long list of common risk behaviors, or a shorter list of uncommon risk behaviors.

Tetric, Quick, and Quick (2005) suggest that the workplace should be considered the locus of not merely occupational health and safety, but overall health promotion. Two models of healthy workplace development are proposed: the public health model, which integrates both a population-based and at-risk individual approach, and the preventive management model, which focuses on risk factors. Finally, they draw connections to the nascent field of positive psychology and its understanding of health as something beyond the absence of health problems. This article is more relevant to management's approach to health promotion than to individual safety-related behaviors, but the models provided offer an intriguing perspective on including positive psychology approaches to interventions by not only focusing on decreasing unsafe, unhealthy behaviors, but also on increasing safe, healthy behaviors in order to integrate safety into a comprehensive model of health behavior. That is, integrating the positive psychology approach means pursuing interventions aimed at leading indicators of safety such as near-miss reporting, or increased safety engagement, rather than focusing on problem solving or responding to lagging indicators of safety. Indeed, this has been the focus of BBS research for more than 20 years, which is addressed next.

4.5. Behavioral Intervention

Applied behavior analysis has also contributed to the occupational safety domain, mainly with research on BBS intervention programs. These programs are characterized by basic training of employees regarding certain safe and at-risk behaviors, systematic observation and recording of targeted behaviors, and feedback to workers regarding the frequency of safe versus at-risk behavior (Geller, 1996). Many of these programs have also included goal-setting and/or incentive components to encourage participation.

McAfee and Winn (1989) reviewed 24 studies that used positive reinforcement and feedback intervention strategies to increase safety behaviors and/or improve safety outcomes. While their findings

indicated incentives and feedback enhanced safety and/or reduced workplace injuries in every study, they also raise several points regarding limitations of the behavioral approach, including lack of clear evidence for sustained impact and lack of an answer to whether some incentives are more effective than others. A subsequent study by Krause, Seymour, and Sloat (1999) aimed to provide long-term impact data with a longitudinal evaluation of 73 facilities that had implemented BBS programs. Although these authors admit their own potential bias, as participating facilities were clients of the authors' consulting firm, results indicated average reductions in injuries at baseline ranging from 26% after one year, to 69% after five years.

From numerous studies on work-based efforts to promote safety-belt use, Geller (1990) identified the major components that contribute to a successful workplace intervention: management's visible commitment, a well-defined and enforced policy of compliance, and consequence incentives to promote adoption and maintenance of the behavior. Geller (1990) lists five additional components that contribute to successful workplace campaigns, which include: targeting observable behavior, examining influential external factors, directing with activators, focusing on positive consequences as motivators, and application of the scientific method to assess and improve interventions (*for recommendations on intervention implementation, see also Geller, 2006*). Geller also asserts these same principles can be used in developing interventions targeting other behaviors, and gives additional details on how to design a particular intervention. Additional driver safety studies (e.g., Geller & Lehman, 1991; Ludwig & Geller, 1997) indicated the benefit of goal-setting and pledge-card commitment strategies for successful interventions, thus highlighting the value of direction with activators in addition to consequence incentives.

Alavosius, Adams, Ahern, and Follick (2000) list multiple factors that contribute to the performance of safe behaviors in the work environment. Behavior-based systems must consider that, although a worker's own behavior is often blamed for an incident, the behaviors of managers and supervisors as well as the corporate culture contribute to at-risk behaviors and injuries to employees. Behavior-based safety programs are designed to promote the arrangement of contingencies that support safe behaviors and discourage at-risk behaviors. Essentially, what the authors recommend seems to be the standard ABA application to safety behaviors and does not differ significantly from Geller's recommendations for behavior-based and people-based safety systems.

4.6. Additional Relevant Research

Lingard and Holmes (2001) examined risk-related decisions regarding both an immediate consequence (falls) and a long-term consequence (occupational skin disease) among construction workers. The authors discovered the crucial challenge is that, since actual construction is usually done by subcontractors, there is a significant distance between the developers making decisions about worksite safety-related issues and the workers from subcontractors who are actually being put at risk. The responsibility for avoiding risk then becomes an issue of individual (behavioral) decisions rather than systematic (technological) controls. Survey data they collected provide useful information on barriers to implementing safety-promoting technology; the most cited reason was cost-saving measures, given the unique pressures of competition for contracts.

Lingard and Holmes (2001) also identify certain facilitators of safe decision-making named by the workers surveyed, including financial incentives and more frequent inspections (particularly of small-scale worksites) for prevention of falls, and education and training as well as material safety data sheets and warning labels for the prevention of occupational skin disease. Another interesting point is that large work sites will often be overseen by the unions, and are likely to be safer sites than those of smaller projects with non-union workers.

Also noteworthy is a longitudinal study of German businesses' occupational safety and health programs. This study revealed that, although more programs were present in 2003 than in 1997 and companies reported them to be moderately successful, many companies complained of the significant need for institutional support (Ulmer & Groeben, 2005). The primary recommendation from the authors is greater involvement of insurance companies and governmental agencies.

4.7. Limitations and Persistent Challenges

Wirth and Sigurdsson (2008) identified gaps in the literature about behavioral safety and proposed specific research questions for addressing the areas of missing information. The authors indicate a need for (a) information on the prevalence of such behavior-based safety programs, (b) meta-analyses to assess generalizability in particular, and (c) research on best practices. In order to guide the development of best practices, the authors provide a comprehensive list of research questions that must first be addressed. An understanding of the gaps in the literature is useful for the present review, but the recommendations are not especially relevant, as they are for the design of future research, rather than that of specific intervention approaches.

Several methodological problems pervade the literature on workplace safety promotion and limit the generalizability of findings. Of primary importance is that most of the articles reviewed in the occupational safety and health field involved survey data to assess theoretical explanations, and few true experiments were conducted. Additionally, there was a notable reliance on self-reports of behavior. As mentioned above, the field would benefit greatly from randomized, controlled studies that translated theory into intervention designs and then tested these programs empirically and behaviorally. In that regard, it seems that the behavioral research on environmental behaviors is farther along in the process of revealing research-based intervention strategies.

4.8. Summary and Recommendations

The current review uncovered a number of patterns relevant to future research. The theory of planned behavior and social cognitive theory as applied to safety-related behaviors underline the importance of cognitions (e.g., exposure, learning, efficacy beliefs, attitude and subjective norms) as they relate to relevant behaviors, suggesting these may be appropriate targets for interventions.

Regulatory focus theory offers an understanding of how an employee's state of mind, in combination with task complexity, may impact safety-related behaviors. However, the research cited does not suggest how regulatory focus may be manipulated. From the behavioral field, we learn that management's commitment to and enforcement of policy, as well as the provision of behavior-based consequences, is essential.

Moreover, general institutional support is key to successful implementation of programs to promote safety behaviors and decrease at-risk behaviors (Alavosius et al., 2000; Geller, 1990; Lingard & Holmes, 2001; Ulmer & Groeben, 2005). The findings of Lusk et al. (1997) that self-efficacy, value of use, and barriers to use specific to the target behavior were the best predictors of actual behavior, suggest these would be useful constructs to target in an intervention.

5. Existing Parallels

In a brief editorial, Geller (2009) cites a few of the numerous looming ecological crises and the behaviors individuals can perform to preserve the natural environment. He then lists the parallel barriers to safety behavior and pro-environmental behaviors: (a) denial, (b) bad

habits, (c) diffusion of responsibility, (d) belief that individual efforts will not make a difference, and (e) motivation by primarily soon and certain consequences.

Other parallels that emerge include the limited effectiveness of awareness (i.e., informational) campaigns in promoting safe behaviors and sustainable behaviors (Colemont & Van den Broucke, 2006; Grob, 1995), and Osbaldiston's (2004) finding that goal-setting and commitment were the most successful strategies for promoting ERBs clearly carries over into safety behaviors as well as evidenced by Geller and colleagues' (1991) previous research on improving driver safety. Additionally, the sick-baby/well-baby approach advocated by Obermiller (1995) relates to Higgins' regulatory theory of approach/avoidance, which has been applied to safety-related behaviors. Furthermore, self-determination theory has been widely applied in both arenas with mixed results.

6. Potentials for Cross-Over

As the larger body of work on behavioral interventions comes from the field of ERB promotion, there are a number of elements that have been successful in this arena that may be applied to safety-related behaviors. For example, Geller's (1989) model integrating ABA and social marketing could be applied to the safety domain. Osbaldiston's (2004) recommended interventions to increase ERBs clearly translate effectively to safety applications, especially the successful commitment and goal-setting strategies. Additionally, it could be useful to examine the safety literature to ascertain if certain behaviors have been predominately targeted, to the point of neglecting other, more important safety behaviors, as has been the case with ERBs.

Tribbia's (2007) recommendations for dissemination of successful interventions to promote ERBs via identification of and connection to individuals in key decision-making capacities with the power to design and implement interventions may be crucial for improved impact of OSH interventions. Despite regulation enforcement mandates of central governing bodies (The Environmental Protection Agency and Occupational Safety and Health Administration), this process remains an essential consideration, as environmental and OSH challenges persist. Additionally, Tribbia's categorization of five factors may be a useful cross-theoretical way to consider a comprehensive set of factors that contribute to behavioral decisions.

Osbaldiston and Sheldon (2003) identified and found empirical support for a three-step process that is crucial to the effectiveness of interventions designed to target ERBs, by which individuals first initiate, then maintain, and finally generalize desired behaviors. This process, which emerges from self-determination theory, could equally be applied to safety-related behaviors in the hope of maximizing the results of a single intervention.

Another application of SDT to ERB performance is in the Motivation Toward the Environment Scale (Pelletier et al., 1998) and Amotivation Toward the Environment Scale (Pelletier et al., 1999). It could potentially be very useful to create similar measures that apply to the safety domain. Additionally, the promising method of social labeling (Cornelissen et al., 2007) should be useful in promoting safety behaviors as well as sustainable behaviors.

Allen and Ferrand's (1999) application of Geller's Actively Caring Model also translates neatly into safety behaviors, as the constructs measured and assessed are similar to ones often applied in the safety field (e.g., self-efficacy). Indeed, the Actively Caring Model started in safety (Geller, 1996), although tests of the model have not been conducted with the rigor applied by Allen and Ferrand.

McKenzie-Mohr's (2000) social marketing approach should, in theory, apply just as well to occupational safety and health interventions. Additionally, Gardner and Stern's (1996) taxonomy of ERBs into curtailment behaviors and efficiency behaviors has been quite useful in classifying, understanding, and targeting behaviors, and is perhaps the most relevant contribution ERB intervention

research may contribute to the safety domain. It would appear that, were this model applied to safety behaviors, most would fall in the category of curtailment behaviors, but perhaps a more appropriate comparison would be with attempts to modify individual behaviors versus attempts to improve design and engineering for safety purposes. This is a valid research question, and is worth considering if there are one-time behaviors with repeated long-term impact.

7. Conclusions and Impact on Industry

Research aimed at increasing specific ERBs clearly informs OSH improvement efforts. The types of behaviors targeted with interventions should be re-evaluated to maximize overall impact on reducing injury and illness. That is, the field of OSH may benefit from the key lesson from the environmental sustainability realm that the greatest effect in behavior change is often found by targeting the easiest behaviors that are not necessarily associated with a significant impact on the overall problem. That is, much as increasing recycling does not significantly slow climate change, it may also be the case that increasing the use of PPE will not significantly impact overall occupational injury and illness. Instead, much like eliminating reliance on fossil fuels is a difficult task that seems to be gaining some traction, OSH researchers should focus their attention on OSH-‘efficiency’ behaviors, such as incorporating safety concerns into design processes for buildings and manufacturing processes so that the need for repeated curtailment behaviors is reduced.

Sustainability research indicates the most successful interventions apply a combination of approaches, with commitment strategies and consequence interventions that communicate clear rewards for engaging in ERBs showing strong evidence. This further supports the widespread assertion that OSH researchers must always strive to demonstrate the financial cost-savings that result from proactive OSH activities, and suggests gaining owner/manager support is a critical component of successful interventions. OSH interventionists can learn from the sustainability movement's ability to appeal to consumers, and apply these techniques to persuade business owners to engage in meaningful OSH promotion activities. Business owners and managers are the most important consumers of OSH products to target with interventions, as their behavior change should be targeted directly to result in indirect employee OSH-behavior change, since owners' and managers' values will dictate the level of emphasis OSH issues receive in the work environment. Additionally, the role of positive psychology should be further explored by OSH intervention researchers, as this paradigm fits well with the common theme of going beyond minimal compliance to promotion and prevention.

Clearly, improvements in both environmental sustainability and occupational safety and health require individuals to take action above and beyond the status quo. Given the similarities in research efforts to change behaviors that will impact both domains, one might question whether there are similarities among individuals who engage in ERBs and individuals who take action for OSH. And the same kinds of investigations can also be extended to the organizational level. Are ‘green’ businesses more likely to promote OSH for their employees? Clear evidence demonstrating similar motivational factors linked with green and OSH activities would provide a strong foundation for adopting techniques from one domain to the other.

Indeed, the similarities between environmental sustainability and OSH efforts are significant enough that the two may be thought of as major components of the overall concept of sustainability in the workplace. That is, safety should be included as a critical piece of any sustainability effort, and the term sustainability should imply safety as well. This concept is not new, as Hill and Bowen (1997) have suggested sustainable construction must include an element of social justice, and part of this ‘pillar’ of sustainability includes protection and promotion of human health through a healthy and safe working

environment. This means leaders must plan and manage the construction process to reduce the risk of exposures.

Other researchers have proposed including safety within a “Safety-Sustainability Continuum,” where commitment to safety serves as a starting point toward achieving sustainable business practices (Gilding, Hogarth, & Humphries, 2002). These researchers also recognize the commonalities of OSH and environmental sustainability, and suggest using safety as an entry point for operationalizing sustainability for an organization, with a dual emphasis focusing equally on the human benefits and business case of achieving this broader conceptualization of sustainability.

Activist groups interested in both environmental and occupational health issues have recognized the similarities of the goals of OSH and sustainability; this has spawned the formation of labor-environmental alliances across the United States known as ‘blue-green coalitions’ (Mayer, 2009). Leaders in the respective fields of OSH and environmental sustainability should seek partnerships with these coalitions to benefit from their synergistic cooperation and learn techniques for achieving positive changes in sustainability across domains. By harnessing the momentum of the green movement and adapting successful intervention approaches from the environmental sustainability domain, OSH leaders may achieve sustainable improvements in worker safety and health.

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