IMPROVING OCCUPATIONAL SAFETY & HEALTH INTERVENTIONS: A COMPARISON OF SAFETY SELF-EFFICACY & SAFETY STAGES OF CHANGE

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(ABSTRACT)

For people aged 44 and under, the primary cause of loss of life in the U.S. is not due to heart disease or cancer, but to something as common as injuries (U. S. Bureau of Labor Statistics, 1998). As such, injuries kill more than 142,000 Americans and require an estimated 62.5 billion dollars in medical attention each year (U. S. Bureau of Labor Statistics, 1998).

Although there have been numerous studies in the field of worksite health promotion, less research has focused on developing guidelines on improving the effectiveness of industrial safety. Many studies have demonstrated how to increase particular safety-related behaviors like using hearing protection, how organizational factors lead to occupational injuries, and how conceptual frameworks can prevent injuries. However, little research provides the safety practitioner with guidelines on how to increasing the effectiveness of an occupational safety intervention.

This study contributes to the safety literature by addressing the current void of intervention effectiveness research by: a) adapting two safety perception instruments based on widely used theories/models (i.e., self-efficacy and stages of change), b) assessing the surveys' predictive validity in estimating employee involvement in a behavior-based safety process, and c) suggesting strategies for improving intervention effectiveness.

The safety surveys created had respectable reliability, strong face validity, and some predictive utility. Suggestions regarding predictive validity were supported in that each scale (safety self-efficacy, safety outcome expectancy, and safety stages of change) separately predicted a significant proportion of variance in the involvement variables (i.e., participation and number of observations). Multiple regression analyses were performed to assess which scales accounted for most variance in employee involvement (i.e., employee participation and number of observations). The results of the regression analyses suggested that safety stages of change was more predictive and accounted for more unique variance in the employee involvement variables than either safety self-efficacy or safety outcome expectancy. Limitations and suggestions for further research are discussed.

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A COMPARISON OF SAFETY SELF-EFFICACY & SAFETY STAGES OF CHANGE

"To your discretion, therefore, must be left the degree of danger you may risk, and the point at which you decline, only saying, we wish you to err on the side of your safety, and to bring back your party safe, even if it be with less information."

First recorded top-down U.S. governmental safety initiative:
– Thomas Jefferson to the Lewis and Clark expedition, 1804

For people aged 44 and under, the primary cause of loss of life in the U.S. is not due to heart disease or cancer, but to something as common as injuries (U. S. Bureau of Labor Statistics, 1998). As such, injuries kill an average of 142,000 Americans and require an estimated 62.5 billion dollars in medical attention each year (U. S. Bureau of Labor Statistics, 1998). This is close to three people dying and over 170 people sustaining a disabling injury every 10 minutes (National Safety Council, 1999). Every year more than 80,000 Americans are permanently disabled as a result of injury to the brain or spinal cord. Thus, unintentional injury represents a serious public health concern, and a theory-driven community, school, and organizational injury prevention technology is needed to improve the health and safety of individuals.

THE IMPACT OF OCCUPATIONAL INJURIES

Due to the frequency and severity of injuries, the U.S. Department of Health and Human Services has identified injury prevention as a priority for attaining the goals outlined in *Healthy People 2000: National Health Promotion and Disease Prevention Objectives* (1990). Baker, Conroy, and Johnston (1992) found that injuries occurring on the job due to unsafe (or *at-risk*) work behaviors remain a significant problem in the U.S. and are a leading cause of unnecessary morbidity. Every day, an estimated 36,000 employees are injured and 16 are killed (NIOSH, 1998). Moreover, an estimated 7,000 to 11,000 workers die annually with 2.5 to 11.3 million employees suffering non-fatal injuries (Leigh, 1995; Miller, 1997).

INTANGIBLE EFFECTS

Occupational injuries result in 250,000 potential productive years of life lost annually – more than cancer and cardiovascular disease combined (Baker, et al., 1992; Leigh, 1995). Over and above the traumatic personal consequences experienced by employees and their friends and families due to unexpected industrial injuries and mortalities, there are also critical social and economic consequences to consider. Although pain and suffering caused by these misfortunes cannot be quantified, the social and economic costs can be estimated. The overall liability of work-related injuries in 1992 has been estimated at $116 billion (National Safety Council, 1993). This figure is an increase from the 1989 estimate of $89 billion and is dramatically larger than the 1985 estimate of $34.6 billion (Leigh, 1995). These costs include lost wages, medical expenses, insurance claims, production delays, lost time of coworkers, equipment damage, fire losses, and indirect costs (Miller, 1997; National Safety Council, 1998).

Even though all of these estimates are enormous, the numbers also indicate that the liabilities of industrial injuries are increasing at an alarming rate. Today's estimates show that each year employers pay approximately $200 billion in direct costs associated with injuries both on and off the job. Occupational injuries account for three-quarters of this total or nearly $155 billion annually. This amounts to over $1,400 per work-related injury. The majority of these losses are in the form of insurance premiums for workers and their families and workers' compensation for days lost from work (Miller, 1997).

It is noteworthy, however, that these loss figures likely underestimate the true impact of industrial injuries. Many occupational injuries go unreported and the Occupational Health and

Safety Administration (OSHA) does not use transportation deaths, suicides or homicides (an estimated 50% of all job-related traumatic deaths) to calculate their estimates (Baker et al., 1992; Leigh, 1995; Miller, 1997; National Committee for Injury Prevention and Control, 1989; Weddle, 1996; Wilson, 1985).

The manner in which employees are hurt varies dramatically, and prevention strategies need to address a myriad of environment, behavior and person factors that contribute to each injury (Geller, 1996; Heinrich, 1959; Petersen, 1996; U. S. Bureau of Labor Statistics, 1997). Thus, critically examining and redefining industrial safety research to improve long-term and broad-based impact has important implications for reducing morbidity and mortality and increasing the quality of life among industrial workers.

In order to better understand occupational safety and health and to investigate strategies for improving the effectiveness of industrial interventions for increasing safety-related behaviors, the primary purposes of this research is to compare self-efficacy theory (Bandura, 1997) and the stages of change model (Prochaska, Redding, & Evers, 1997) as a determinant of safety-related behaviors and the impact of a behavior-based safety improvement process. Thus, the goals of this research were to:

1) Develop and evaluate questionnaires to assess employees’ safety self-efficacy and safety stages of change.
2) Administer the newly developed surveys in an industrial setting.
3) Provide the surveyed organization with behavior-based safety (BBS) education/training.
4) Measure employees’ levels of involvement in the BBS process.

5) Compare the predictive effectiveness of self-efficacy vs. stages of change based on the survey results and involvement information.

HISTORY OF OCCUPATIONAL SAFETY AND HEALTH

The study of occupational safety and health has been in existence for as long as there have been structured work environments. Hippocrates (460-377 BC), for example, wrote of the harmful effects of an unhealthy workplace on slaves, and Caesar (100–40 BC) was reported to have an officer in charge of the safety of his legions (Pease, 1985; Weaver, 1980). This section traces the history of the various interventions developed to improve workplace safety. The history of occupational safety and health is vast and diverse, and therefore a comprehensive review is beyond the scope of this paper (see Geller, 1996; Guarnieri, 1992; Heinrich, 1959; Heinrich, Petersen, & Roos, 1980; Margolis & Kroes, 1975; Weindling, 1985 for more comprehensive reviews). However, this section will focus on the major influences (i.e., government, insurance, engineering and psychology) and pertinent legislation that have shaped occupational safety and health intervention research.

THE BEGINNING OF OCCUPATIONAL SAFETY & HEALTH

In the midst of the Middle Ages, George Bauer (1492-1555) wrote several books on mining/metallurgy describing several innovative approaches for improving ventilation for workers in mining shafts (Raouf & Dhillon, 1994). And Bernadino Ramazzini (1633-1714), the father of occupational safety and health, also wrote on the safety aspects of mining as well as glass working, painting, grinding, and weaving. In *De Morbis Artificum*, or the *Disease of Workers*, Ramazzini (1713) was the first to document the deleterious effects of working conditions on employees' health and studied the injury and death rates of many different occupations. Appreciative of the social importance of the progress and economical development of these occupations, Ramazzini discussed and suggested several preventive strategies for reducing occupational disease and injury (Pease, 1985; Pheasant, 1991; Raouf & Dhillon, 1994; Tayyari & Smith, 1997). Although these early safety *engineers* did not focus their energies on implementing intervention strategies in the workplace, they certainly laid the foundation for current approaches to reduce occupational illness and injury.

As the *machine age* dawned with James Watt and Eli Whitney during the late 1700s, employers accepted industrial injuries and deaths as part of the working conditions without considering the economical ramifications. Employees were seen as volunteers, and were plentiful and replaceable (Leigh, 1998). Although the conditions in the early factories were horrendous, with two thirds of the employees being women and children working 12-hour days, people would risk disease, dismemberment and death for employment and a method for providing food for their families. Even if an employee suffered an illness or injury, they would seldom report the sickness because serious or frequent illnesses were cause for dismissal (Heinrich, 1959; Weindling, 1985).

Governmental Influence

As industrial centers grew, the degradation of living conditions increased and the death rate grew. In England, for instance, the first attempt of governmental intervention (1933) began with federally run factory inspections. Table 1 reviews significant milestones toward intervention development in occupational safety and health. The results of the scrutiny by governmental inspectors (most of whom were physicians) had little impact on the health and safety of employees until the mid 1800's when the Great Factory Act was initiated.

Insert Table 1 About Here

The Great Factory Act of 1844 improved England's factory conditions somewhat, but employers still saw no economic impact of an unhealthy or a risky workplace. In fact, the families of employees who died on the job had little legal recourse. At most they had their funeral expenses covered by the employer (Heinrich, et al, 1980). In 1880, England passed the Employers' Liability Act that made it possible for employees, or their families, to sue an employer for damages. This act made the employers more cognizant of the costs of not addressing the safety of their working conditions. However, the family still had the difficult task of proving the employee (or a fellow employee) was not the cause of his own death, was not aware of the hazard, or that the employer was negligent. Factory inspections and the current laws increased employers' awareness of occupational safety, but it was not until the worker compensation laws were passed that industry owners finally began to realize the costs associated with occupation injuries.

Worker compensation laws covered employee injury regardless of fault; but employees could no longer sue their employers under common law (third party lawsuits were still legal). Seemingly, the worker compensation laws were passed to protect employees. However, they were actually passed to control the number of large lawsuits against employers, and thus enabling a "predictable cost of doing business" (Leigh, 1998, p. 254).

Hence, up to this point the most effective interventions for improving occupational safety and health appeared to be implementation of top-down governmental regulations. As Heinrich, et al. (1980) point out, "Legislation is one process by which government affects safety. Judicial process is another. Together they change the impetus for safety or create a new impetus, and the impetus is defined as time, money and effort" (p.361). Thus, regulations finally made it cost effective for employers to attend to working conditions that adversely effect employees' health and safety, though they were not always in the best interest of the employee (Heinrich, 1959; Heinrich, et al., 1980; Petersen, 1989; Weindling, 1985; Wilson, 1985).

INSURANCE COMPANIES: THE FIRST SAFETY CONSULTANTS

Figure 1 depicts the many historical influences of occupational safety and health interventions. As the worker compensation laws created a need for industries to invest in additional insurance, insurance companies needed to assess their clients' risks to assign proper rates. Thus, in the early 1900s, insurance companies created inspection departments (see Figure 1 for a historical flow chart of occupational safety and health). The inspectors would visit their policy holders to assess workplace hazards and assign the proper rate (i.e., *underwriting*). As these insurance inspectors gained valuable experience in looking for hazards in various industries, these *safety consultants* became the major impetus in organizational safety and health. During an inspection, for instance, if the insurance representative found a hazardous situation, he would make suggestions on how the organization could remedy the safety hazard and obtain a lower premium (also to control the insurance companies' losses).

Insert Figure 1 About Here

The insurance companies were serving the employer while at the same time trying to control their own losses. Consequently, the only safety concerns addressed by the insurance inspectors were ones currently covered by Worker Compensation laws. Furthermore, once the insurance agent assigns coverage rates, there were several self-serving mechanisms to motivate employers to improve the safety of their workplace. Merit rating schemes (i.e., *scheduled rating*), for example, rewarded loss control and penalized high worker compensation claims. The scheduled rating system may have motivated many companies to *cover-up* or not report certain claims to insurance companies in order to avoid a penalty or keep their current coverage rate (Geller, 1996; Miller, 1997).

Whereas it seemed the early insurance companies were striving for a safer workplace, they were instead trying to control their own loss and motivate employers to address only hazards covered by Worker Compensation (Heinrich, et al., 1980). If fact, most of the insurance inspector's time and safety materials went to the larger companies who paid massive premiums, leaving out the mid-sized to smaller organizations. Insurance companies did develop safety guidelines and training materials that made an impact on health and safety. Nevertheless these interventions were guided by current governmental regulations and the need to control loss and not for the safety of employees.

TRADITIONAL SAFETY & HEALTH INTERVENTIONS: THREE "E"S OF SAFETY

From the early 1900s to the present time, employers and safety practitioners adopted the philosophy of the *three E's* (engineering, education, and enforcement) to guide their safety-related interventions (Geller, 1996; Guastello 1993; Heinrich, et al., 1980; Petersen, 1996; Wilde, 1998). To make a difference in the health and safety of employees, the three Es of safety focus on: 1) developing *engineering* strategies that decrease the probability of an employee engaging in at-risk behaviors; 2) *educating* and training employees regarding equipment, environmental hazards, policies and procedures; and 3) *enforcing* the policies and procedures related to operating equipment, wearing proper personal protective equipment, and handling specific hazardous substances.

ENGINEERING/HUMAN FACTORS

The Great Factory Act was passed in Briton in 1844 and by 1850, industrial engineers were improving the physical working conditions by increasing ventilation, improving lighting, and providing guarding for dangerous moving machinery (Grether, 1975; Heinrich, 1959). Industrial safety engineering research has suggested that injuries occur as the result of excess energy between the body and the work environment (Haddon, 1963, 1968, 1980). The pioneering work of William Haddon during the mid-1900s hypothesized that engineering modifications would make the largest impact and achieve the greatest long-term reductions in injuries. Haddon became the first director of the National Highway Safety Bureau (which later became the National Highway Traffic Safety Administration). He was the impetus behind automotive safety devices like airbags, head rests, collapsible steering wheels, and padded dashboards that lead to an estimated 28,000 lives saved (Guarnieri, 1992). Most relevant to occupational safety and health, Haddon's engineering philosophies helped develop personal protective equipment (e.g., ear plugs, hard hats, gloves, safety glasses, steel-tipped boots) for occupational safety.

Throughout the next century, engineers made great contributions to safety by designing safer machinery, using better quality materials, and advancing the design of personal protective equipment the employee would have to endure while operating hazardous equipment (cf. Casali, 1990). However, many engineers tried to completely eliminate the human element by automating many hazardous jobs.

Some engineers considered workers "irredeemably flawed and so to be removed from the process" (Hale & Glendon, 1987, p. 2). With an estimated 88% of all industrial accidents being attributed to the at-risk behavior of the employee, this assumption may seem well-founded (Heinrich, 1931). However, a subdiscipline of engineering, human factors (termed ergonomics in the UK), considers the interaction between the human, machine, and their work environment to be of the greatest importance in causing and preventing injury (Kroemer, & Grandjean, 1997; Roughton, 1996; Tayyari & Smith, 1997).

Since the World War II, the discipline of human factors/ergonomics has been gaining prominence in the U.S. as a way to reduce occupational injuries in numerous settings. Ergonomic (or the *natural law* of *work*) is the study of the human-machine interface or the science of designing the workplace to fit the employee, and thus reducing the potential for excess energy exchange between the person and their work environment.

Guidelines developed by human factors research were originally concerned with increasing human performance or efficiency, with an increase in safety considered a byproduct (Grether, 1975). Current human factors research focuses not only on productivity, but also on cumulative trauma disorders (including back strain), work spaces, workload, workplace layout, automation, and other physical factors (including temperature, noise, vibration, illumination) that affect workers' safety and health (Haddon, 1968; Kroemer, & Grandjean, 1997; National Committee for Injury Prevention and Control, 1989; Office of Technology Assessment, 1985; Roughton, 1996; Tayyari & Smith, 1997).

Typical human factors programs begin with developing a task force of representatives from various levels and specialties in an organization (e.g., management, supervisor, engineer, safety professional, employee). Then, this team or committee develops an occupational hazard survey or some other type of specific environmental audit for assessing the interaction between the employee and his or her work environment (Geller, 1998c; Guastello, 1993). Once the audits are complete, specific recommendations from ergonomic/human factor resources are used for reducing or eliminating the hazard or at-risk behavior (Guastello, 1993; Kroemer, & Grandjean, 1997; Pheasant, 1991; Roughton, 1996; Tayyari & Smith, 1997).

As an occupational safety intervention, human factors programs have been quite successful, with one reviewer estimating an average reduction of 52% in occupational injuries (Guastello, 1993). However, human behavior plays a major role in every safety-related process. Heinrich, et al. (1980) estimate that 98% of all injuries are preventable, with 88% caused by at-risk behaviors of employees and 10% originating from the hazardous mechanical or physical conditions of the workplace. Thus, human factors programs and engineering modifications have made an impact on the 10% of the hazards in the workplace. However, the remaining 88% of the at-risk behaviors are not being addressed. In other words, engineering and human factors interventions can produce a safer workplace, but "it is difficult to provide a safe work environment solely through safety engineering" (Hoyos & Ruppert, 1995, p. 107).

EDUCATION/TRAINING

A common method (or reflexive action) to encourage safe work-related behavior is for organizations to create or purchase an education and/or training program (Jewell, 1998; McAfee & Winn, 1989). In one survey, the majority of organizations (96%) responding indicated that they offered safety training, while another questionnaire found that 46% provided some form of safety training as part of their regular occupational safety efforts (Lee, 1987; McAfee & Winn, 1989). Furthermore, a 1996 survey of over 1200 readers of *Industrial Safety and Hygiene News* revealed industrial education and training in safety to be a top priority for 1997 (Johnson, 1996).

Educational safety programs focus on increasing peoples' knowledge by giving them a background on theories, principles and techniques for improving their future problem-solving abilities. In the *Psychology of Safety*, Geller (1996) stresses the need for safety-related processes to begin with theory and build from solid psychological principles. Geller also emphasizes the importance of training. Training compliments education by providing employees opportunities to apply the knowledge provided by the education. Thus, the purpose of an education/training procedure “is to provide an environment for the acquisition of attitudes, knowledge or skills, so that newly acquired behaviors may be transferred to the job setting” (Goldstein, 1975, p. 97). A successful education/training program can impact workers’ safety by giving them the tools and knowledge to use when faced with a novel emergency on or off the job.

Viscusi (1983) hypothesizes an alternate motivation for occupational safety and health education/training. In his book, *Risk by Choice,* Viscusi (1983) examines the motivation behind adopting various types of education/training programs and criticizes the content of such programs. Although employers never provide prospective employees the average annual death risk or chance of acquiring an injury, when workers begin a job they have some general idea of the risks they face. However, once they gain experience on the job, their risk perception changes.

From a sample of 6,000 employees, Viscusi (1983) found that when workers’ risk perceptions increase, their propensity to quit also increases by 35%. Since hiring new employees is costly (due to retraining and loss of experience), the content of education/training programs “is not intended to enable workers to assess the risk more accurately…it is directed at lowering workers’ assessment of the risk” (Viscusi, 1983, p. 71). Consequently, the information given to employees in education/training sessions reduces the perceived risk of their job and avoids costly turnover.

Furthermore, results of education/training efforts have been inconclusive, since intervention research seldom solely relies on education/training alone. (Petersen, 1996; Hale & Glendon, 1987). Petersen (1996) states that “safety training historically has involved more preachments than real teaching of skills to achieve results" (p. 12). However, Fiedler, Bell, Chemers, and Patrick (1984) found significant improvement in lost-time injuries and number of Mining Safety and Health Administration (MSHA) citations received following a management education/training safety program. Moreover, Zohar (1980) surveyed 20 industries (four from metal fabrication, food processing, chemical, and textile) and found that perceived safety importance was significantly related to the organizational safety climate (i.e., workers' perceptions of structure, system, goal direction, and management leadership style). Clearly, more research is needed to ascertain the effectiveness of education/training for reducing industrial injuries.

Although widespread, education/training programs are rarely systematically evaluated in any type of industrial application (Goldstein, 1975; McAfee & Winn, 1989; Vojtecky & Schmitz, 1986). Evaluative research in occupational safety is seldom initiated because of methodological and design constraints that prohibit many types of teaching methods from being evaluated (U.S. Department of Health and Human Services and Public Health Services, 1990). For instance, in a survey given to individuals involved in the evaluation of safety and health programs ($n = 124$), 40% of these safety professionals were dissatisfied with their attempts to demonstrate the beneficial impact of their safety education/training (Vojtecky & Schmitz, 1986).

Due to inconclusive findings, occupational safety research needs to address the "longer-term benefit of educational/training programs and how these approaches can be combined with others to accelerate behavior change" (Institute of Medicine, 1988, p. 11). Additional research is also required to identify the conditions under which employees are most likely to participate willingly in the development and implementation of methods to increase the occurrence of safe work behaviors among themselves and others. Finally, if education and training methodologies are combined (Geller, 1996), implemented in good faith (Viscusi, 1983), and evaluated systematically to assess the transfer of knowledge (Goldstein, 1975), education/training programs have great potential to make a difference in the safety and health of many employees.

ENFORCEMENT

The final E in the *three Es of safety* is enforcement. There are two types of enforcement in occupational safety and health: enforcement within the industry (referred to as *discipline*) and enforcement by governmental agencies (referred to as *compliance*). Within industry, the company imposes safety rules or policy and procedures as guidelines for employees to follow. When employees do not follow these guidelines, there is a possibility of disciplinary action (e.g., verbal warning, written warning, time off work, job termination).

Governmental agencies establish laws or regulations for organizations to follow. When employers do not comply, they receive citations with accompanying fines. For occupational safety and health, it is very common for employees and employers to be held accountable for their actions (Geller, 1998b). There is considerable debate, however, regarding the effectiveness of discipline and compliance as a motivating intervention for safe behavior (Hale & Glendon, 1987; Geller, 1998b, 1996; Petersen, 1996; Wilson, 1985).

Discipline

One of the most common techniques used to reduce at-risk behavior within the workplace is to introduce stricter rules, increase supervision of the target behavior or increase the number of reprimands given out for failure to comply with the companies' policy and procedures (Geller, 1996, 1998b; Hale & Glendon, 1987; Harms-Ringdahl, 1993; McSween, 1995). The introduction of new safety rules followed by discipline for not following those rules can be an effective intervention if delivered correctly. However, discipline is seldom implemented correctly and has several other negative effects (e.g., escape behavior, aggression, apathy, countercontrol). In an industrial setting, there are even more barriers in administering discipline (or punishment) in an effective manner.

To have the greatest impact, discipline needs to be given in close temporal proximity to the at-risk behavior. It also needs to be given every time the at-risk behavior occurs. Also, the negative consequences should be sizable (as in severe and aversive) to the employee (Azrin & Holz, 1966; Geller, 1996; Harms-Ringdahl, 1993; Hineline, 1984; Kasdin & Wilson, 1978; McIntire & White, 1975). In the workplace, it is very difficult to give discipline in a soon, certain, and sizable manner. The threat of discipline can suppress behavior, but typically only while the supervisor is observing the employee or until the disciplinary "phase" passes.

Pirani and Reynolds (1976) compared the effectiveness of common safety interventions (i.e., safety posters, safety films, fear posters, discussion, role-playing, and discipline) on the use of personal protective equipment (i.e., hard hat, gloves, safety glasses, and proper footwear). Table 2 was adapted from the results of the Pirani and Reynolds (1976) study where the intervention (Int) percentages represent the percent *change* over the baseline period, followed by percent *change* from baseline to a four-month withdrawal (Wdr) period. Discipline did show a moderate increase across all types of personal protective equipment (+39%), but achieved the worst long-term effects, falling an average of 7% below the original baseline periods. Whereas discipline can be an effective means of altering employees' safety behavior, it does not seem probable that it can be carried out in an effective manner and may even, in some cases, decrease compliance following its removal (Baldwin, 1992; Geller, 1996; Pirani & Reynolds, 1976).

Insert Table 2 About Here

Compliance

Organizations encounter many outside safety-related influences that motivate their safety interventions (e.g., government agencies, union, and professional societies). Due to space, this section will only briefly cover one of the major governmental interventions that use compliance as a motivational technique – Occupational Safety and Health Administration. During the 1960s, there was a rapid increase in recorded industrial injuries (referred to as delayed progress in Table 1), and by 1967, President Johnson proposed the Occupational Safety and Health (OSH) Act.

The OSH Act was finally approved by 1970 with the "purpose of assuring safe and healthy working conditions" (Pease, 1985, p. xiv). This Act created two major institutions that have had a substantial impact on how occupational safety and health interventions are implemented. The National Institute for Occupational Safety and Health (NIOSH) was established to research possible hazards in industry and suggest methods for reducing exposure to these hazards. And OSHA, was created within the Department of Labor to enact regulations and standards to ensure the safety and health of all employees (Viscusi, 1983).

Beyond imposing an average of 45 new regulations/standards every six months (Petersen, 1996), OSHA investigates fatalities and employee complaints, as well as regional programmed inspections. During inspections, the OSHA representative determines if the company is complying with the current standards. If the company fails to meet these standards, they may be fined between $300 and $1,000 with a $10,000 fine (and $1,000 per day until the condition is under compliance) for repeated or willful violations (Petersen, 1996; Viscusi, 1983). Under the General Duty Clause, however, fines from OSHA can range anywhere from $3 to $5 million dollars (Petersen, 1996). On average, OSHA inspectors conduct 60 thousand announced inspections per year. With an average of 4 million workplaces, OSHA inspectors can only sample approximately 1.5% of all industries per year (Pease, 1985).

With the inspection being announced, relatively low cost for violations and the extremely low probability of being randomly inspected, the OSHA inspection does not appear to be much of a motivational impetus for occupational safety (Viscusi, 1983). This is not to say OSHA has not had an impact on occupational safety and health. In fact, many companies have placed their whole safety emphasis on the physical aspects the workplace (Petersen, 1996), with the major emphasis placed on performing safety for OSHA, rather than for the safety and health of their employees (Geller, 1996). Whereas OSHA may affect a companies' safety professional, it has little impact on the day-to-day interventions used to impact safety in the typical workplace (for a critical review of OSHA and its impact, see Oi, 1975 or Viscusi, 1983).

PSYCHOLOGICAL MODELS OF OCCUPATIONAL SAFETY & HEALTH

The diversity, intensity, and scope of safety and health education and promotion are immense. There are many target areas (from reducing cigarette smoking to increasing exercise) and governmental objectives (from lowering infant mortality rates to getting 85% of all drivers to buckle-up by 2000) that health professionals or governmental agencies focus on to improve the quality of life for individuals. Some of these areas receive relatively broad study, funding, and promotion (such as reducing drug use among children). Other areas have a smaller, more specific scope (like getting Amish farmers to place reflective triangles on their wagons).

Some of these problem areas and issues are guided by nationally set objectives, as outlined in *Healthy People* (U.S. Department of Health, Education, and Welfare, 1979) and *Healthy People 2000* (U.S. Department of Health and Human Services, 1990). Currently, *Healthy People 2000* has 22 priority areas, 300 health objectives, and three overarching aims: 1) increase the span of healthy life, 2) decrease the incongruity in health between distinct populations, and 3) provide universal access to preventive services.

In accordance with the *Healthy People 2000* objectives, health psychologists have made significant progress in achieving the proposed goals by expanding the impact of their interventions across many areas (including home, school, community, work), by using interdisciplinary teams (including sociology, anthropology, communication, marketing, medicine) to synthesize diverse research findings and by developing comprehensive programs to apply results for large-scale behavior change.

Health psychologists also study numerous health issues (including smoking cessation, exercise, nutrition, weight control, stress), and they investigate the most effective ways of bringing about change in people's health-related behaviors (Bennett, Weinman, & Spurgeon, 1990; Elder, Geller, Hovell, & Mayer, 1994; Glanz, Lewis, & Rimer, 1997; Resnick & Rozensky, 1996; Winett, 1998; Winett, King, & Altman, 1989). One specific area of health psychology that addresses issues in occupational health, is *a wellness/worksite health program* (Cataldo & Coates, 1986; Kerr, Griffiths, & Cox, 1996; McPartland, 1993; Opatz, 1994).

OCCUPATIONAL SAFETY AND HEALTH VERSES WORKSITE HEALTH PROMOTION

Within the industrial safety literature, there are *research lines* drawn between occupational safety, occupational health, and worksite health (Baker, Israel, & Schurman, 1996; Heinrich, et al., 1980; Opatz, 1994; Tayyari & Smith, 1997). In fact, there is some debate over whether research in industry should be referred to as occupational *health* and *safety* (see Baker, et al., 1996; Goldenhar & Schulte, 1994) or occupational *safety* and *health* (e.g., NIOSH, OSHA). Occupational *safety* research looks at injury prevention, engineering/human factors, education/training, discipline/compliance, and property damage (for a review of property damage see Bird & Germain, 1997).

Occupational Health

Occupational *health* focuses on controlling employees' exposure to occupational disease (e.g., black lung, TNT poisoning, *phossy* jaw), while *worksite health* programs concentrate on individuals' lifestyles and health-related behaviors (or habits) that may occur on or off the job (Heinrich, et al., 1980; Kerr, et al., 1996; McPartland, 1993; Opatz, 1994). See Table 3 for the nine most common worksite health promotion activities. In terms of safety-related interventions within the workplace, there is considerable overlap of effort between occupational safety, occupational health, and worksite health promotion. Occupational safety and health and worksite health promotion all focus on *health behavior*, but there is little theoretical overlap in terms of intervention research.

Insert Table 3 About Here

Health behavior refers to the behaviors of individuals, groups, organizations, communities, and institutions and how those behaviors relate to staying healthy and safe, seeking help when an illness is perceived, and following the appropriate medical advise when sick (Glanz, et al., 1997; Gochman, 1988, 1997; Winett, 1998). Specifically, Gochman (1997) defines health behavior as:

> *those personal attributes such as beliefs, expectations, motives, values, perceptions, and other cognitive elements; personality characteristics, including affective and emotional states and traits; and overt behavior patterns, actions and*

> *habits that relate to health maintenance, to health restoration and to health improvement.* (p. 3)

There are three categories of health behavior: preventive health behavior, illness behavior, and sick-role behavior. Kasl and Cobb (1966a, 1966b) define preventive health behavior as any proactive response taken to maintain a healthy lifestyle (e.g., buckling safety belts, using PPE, following policy and procedures, see Geller, 1996, 1998a). The other categories (i.e., illness behavior and sick-role behavior) focus on individuals when they have already been hurt or injured. Since the targets for most occupational safety and health interventions are proactive or *primary* in nature (referred to as *timing* in Winett, 1995), the definition of preventive health behaviors obviously overlaps with the targets of occupational safety and health.

Since there is an overlap between occupational safety and health and worksite health promotion, it is surprising there are few health psychologist who expand their intervention focus to occupational safety and health and vise versa (Baker, et al., 1996; DeJoy, 1996). A prime objective of this paper is to tie together occupational safety and health and worksite health promotion into a model for increasing the effectiveness of interventions to improve both occupational safety and health. Thus, from this point on, behaviors targeted by occupational safety and health interventions and worksite health promotions (i.e., any proactive behavior taken to maintain a healthy lifestyle) are collectively referred to as health behavior (excluding the engineering/human factors research of occupational safety).

Occupational Safety

Applied behavior analysis has made substantial contributions to the field of occupational safety by documenting the determinants of at-risk behaviors, directing the development of effective behavior change interventions and applying these interventions in a variety of domains, including behavioral medicine (Cataldo, & Coates, 1986), safety management performance (Daniels, 1989), health behavior (Elder, et al., 1994), traffic safety (Geller, 1998a), behavior-based safety (Geller, 1998f; Krause, Hidley, & Hodson, 1996), environmental protection (Geller, Winett, & Everett, 1982), safety management (Petersen, 1996), child safety (Roberts, Fanurik, & Layfield, 1987), and health psychology (Winett, et al., 1989). Applied behavior analysis focuses on behavior and "what people *do* influences the quality of life, and people *doing* is the realm of psychology, the science of behavior" (Roberts, et al., 1987, p. 105).

In occupational safety and health, there has been a strong application of applied behavior analysis principles referred to as behavior-based safety (BBS). For the past twenty years, BBS has been used successfully in the prevention of occupational injuries (e.g., Alavosius & Sulzer-Azaroff, 1986; Geller, Davis, & Spicer, 1983; Geller, Eason, Philips, & Pierson, 1980; Geller, Roberts & Gilmore, 1995; Komaki, Barwick, & Scott, 1978; Komaki, Heinzmann, and Lawson, 1980; Pettinger, Boyce, & Geller, in press; Reber & Wallin, 1983, 1984; Roberts & Geller, 1995; Reber, Wallin, & Chokar, 1990; Smith, Anger, & Ulsan, 1978; Streff, Kalsher, & Geller, 1993; Williams & Geller, in press).

Table 4 summarizes the findings of a review of 53 occupational safety and health interventions since 1977. In his systematic review, Guastello (1993) discovered that BBS has the highest average reduction (59.6%) of injury rate (see Table 4) compared to other occupational safety intervention strategies.

Insert Table 4 About Here

Although BBS approaches differ in various ways, they all focus on systematically studying the effects of employees using an observation and feedback process to assess their organization's safe and at-risk work related behaviors. Using this information, employees then design interventions to target critical at-risk behaviors and decrease their occurrence. Typically, BBS techniques accomplish this by first having the employees define target behaviors in an observable, recordable and trackable manner, and then observe and record them in a typical work setting.

Following a relatively stable baseline measure of the frequency, rate, or duration of a target behavior, employees introduce an intervention to change the targeted behavior. Interventions typically involve adding or changing antecedents and/or consequences of the target behavior(s). To determine intervention effectiveness, baseline frequency, duration, or rate of the target behavior is compared to post-intervention measures (e.g., Daniels, 1989; Geller, 1996, 1998f; Komaki, & Jensen, 1986; McIntire, & White, 1975; McSween, 1995; Raouf, & Dhillon, 1994).

The BBS approaches to occupational safety and health have reported a number of advantages over other industrial safety techniques, including the ability: 1) to be administered by employees with a minimal professional safety background, 2) to reach people in the setting where a safety problems occur, and 3) to be readily customized for application in a specific safety-related work culture (Daniels, 1989; Geller, 1998e, 1998f; McSween, 1995; Roberts & Geller, 1994).

Previous research has also shown the BBS approach to be cost effective, relatively easy to administer, and straightforward enough to be assessed by employees who track the target behaviors (e.g., Daniels, 1989; Geller, 1996, 1998f; Pettinger, et al., 1999; Sulzer-Azaroff & De Santamaria, 1980; Sulzer-Azaroff, Loafman, Merante, & Hlavacek, 1990).

Another advantage claimed by Geller is when delivered correctly, BBS can motivate employees to *actively care* for their fellow coworkers. Actively caring is described by Geller (1991) as going beyond the call of duty for the safety and health of others by taking personal action to correct hazardous conditions, increase safe behavior, or decrease at-risk behavior (Geller, 1996; Geller, Roberts, & Gilmore, 1996; Roberts & Geller, 1995).

Consequently, BBS has become such a force in occupational safety and health that a variety of other safety disciplines are supplementing their approaches with behavior analysis techniques. For example, many safety management techniques now incorporate behavioral observations (Pybus, 1996; Yandrick, 1996), or combine successful management techniques like “Systems Management” (Waring, 1996), “Total Quality Management” (Weinstein, 1997), and “Management by Objectives” (Petersen, 1996) with a BBS focus.

Actively Caring

Actively caring is a conceptual approach to injury prevention which focuses on identifying individuals who are most likely to take personal action to correct unsafe conditions, increase safe behavior, or decrease at-risk behavior (Geller, 1991, Geller, 1996; Geller, et al., 1996; Roberts & Geller, 1995). In other words, the model of Actively Caring refers to going beyond the call of duty for the safety and health of others as opposed to simply caring for the safety of oneself. Thus, by increasing actively caring behaviors, one may affect the culture and in turn influence more people to actively care. The Actively Caring model has been used successfully in industrial settings to predict employees’ willingness to actively care for a coworker's safety (Geller, 1996), and predict who will participate in a safety recognition process (Roberts & Geller, 1995).

Behavior-based safety interventions attempt to motivate employees to observe each other and provide proactive feedback regarding safety, which can be interpreted as "actively caring". Consequently, assessing whether employees feel confident in their abilities to perform the tasks required of them in a BBS process should be important in determining if they will participate in a safety process like BBS. Additionally, if employees actively care on a regular basis and a BBS process is introduced into their organization, those individuals who already look out for safety and health of others (or actively care) would be predicted to participate more than employees who do not typically look out for the safety or health of coworkers. Therefore, from an actively caring perspective, it's important to assess not only how confident employees feel in performing actively caring behaviors, but also to determine their current state of self-esteem, self-efficacy, personal control, optimism, and belonging, factors presumed to be directly related to amount of actively caring (Geller, 1996; Geller, et al., 1995; Roberts & Geller, 1995).

MODELS OF SAFETY & HEALTH

Along with the diversity of safety and health promotion and intervention approaches, many different theories and models address safety and health behavior. In fact, many of the approaches to safety and health intervention are derived from some theory or model of behavior change. In fact, Glanz, et al. (1997) surveyed 24 health behavior journals from 1992 through 1994 and found that out of 1,174 relevant articles, 45% focused on at least one theory or model. In this review, the authors found 66 different theories or models in use. Table 5 provides a list of the 20 most cited theories/models related to health behavior.

Insert Table 5 About Here

From 1990 to 1999, there have been at least 11 publications that proposed or adapted models for improving health behaviors. Many of the models have targeted specific health-related behaviors like increasing earplug use (Lusk, Ronis, & Kerr, 1995), reducing overexertion (Kumar, 1994), or controlling occupational stress (Baker, et al., 1996). Three models focus more on environmental factors that influence safety such as safety management (DeJoy, 1994) and broad organizational factors leading to occupational injuries (DeJoy, 1990; Reason, 1995). Several models focused more on presenting a framework or stage process to achieve the desired health behavior (Andersson, & Menckel, 1995; DeJoy, 1996; DeJoy & Southern, 1993; Geller, 1998d; Geller et al., 1990).

With few exceptions, the models mentioned above fail to provide the safety practitioner with guidelines for increasing the beneficial impact of safety-related intervention. Some authors do suggest content for interventions such as self-efficacy training, supervisor training, videotape training. But most models only provide a conceptual basis for the design and/or implementation of a behavior-change program (Conner & Norman, 1996). In a comprehensive review of occupational safety and health intervention, Goldenhar and Schulte (1994) conclude that research on the application "of etiological knowledge and on ways to conduct occupational safety and health intervention research is sparse" (p. 763).

THEORETICAL BASES FOR PROPOSED RESEARCH

This research compares theoretical constructs from social cognitive theory and other health behavior frameworks. More specifically, this research 1) assessed the potential contributions to health behavior intervention of self-efficacy/outcome expectancy (Bandura, 1997) and the stages of change (Prochaska, et al., 1997), and 2) compared the ability of self-efficacy/outcome expectancy versus stages of change to predict involvement in a behavior-based safety intervention process.

SOCIAL COGNITIVE THEORY

The concept of self-efficacy and outcome expectancy has been widely used in a variety of health-related settings (Bandura, 1997; Maddux, 1995). Even though there are many health related models that have had been used successfully to design interventions to achieve positive results (e.g., health belief model, theory of reasoned action, theory of planned behavior, protection motivation), self-efficacy was chosen because of the many successful applications of the theory in a variety of settings and also due to significant overlap of determinants between social cognitive theory and similar health related theories. Table 6 compares determinants of health behavior by listing five commonly used models, and depicts the significant overlap between social cognitive theory and the others listed.

Insert Table 6 About Here

In a history of social cognitive psychology, Barone, Maddux, and Snyder (1997) traced the American forerunners of the sub-field to such early psychologists as John Dewey (1859-1952), James Baldwin (1861-1934), and George Mead (1863-1931). Although Dewey, Baldwin, and Mead were discussing such things as philosophy, developmental psychology, and sociology, these early psychologists laid the groundwork for two social cognitive theory tenets still used today. The first tenet describes how psychology needs to include the *social context* within the study of human behavior because people are essentially social in nature. The second principle illustrates how we use our cognitions for avenues of thinking and communicating to adapt to social contexts. Thus, "social cognitive psychology construes cognition as a part of social acts" (Barone, et al., 1997, p. 11).

Of the early frames of reference for social cognitive theory (i.e., social gestalt, constructivist, information processing, social learning), this section focuses on self-evaluation/regulation (i.e., control theory, goal-setting theory, self-efficacy). This section is further narrowed to self-efficacy theory (Bandura, 1977, 1986, 1997) in that goal-setting theory (Lock & Latham, 1990) overlaps with self-efficacy theory, and control theory (Carver & Scheier, 1981; Scheier & Carver, 1988) is seen as too limiting or mechanistic to cover the diversity of human behavior (Barone, et al., 1997).

Throughout life, people strive to gain control of the various aspects of their environment. Individuals try to gain control over desired outcomes (or attainments) and achieve control over the undesirable events. From a social cognitive perspective (cf. Bandura 1986; 1997), people are exposed to various interdependent circumstances every day (i.e., reciprocal causation), determine the best approach to these situations, assess their perceived competence (i.e., self-efficacy) to carry out their intentions (i.e., human agency), determine if the behavior they perform will produce the desired outcome (i.e., outcome expectancy), and finally decide the importance of obtaining the outcome (i.e., outcome value).

Self-Efficacy

Self-efficacy, originally defined as a person's belief in his or her ability to perform a specific behavior to produce an outcome (Bandura, 1977), has since been expanded by Bandura (1997) to refer to "beliefs in one's capabilities to organize and execute the courses of action required to produce given attainment" (p. 3). Efficacy beliefs can vary in *level* (increasing difficulty of behavior), *generality* (similarity of behaviors), and *strength* (perseverance).

From Bandura’s perspective (1997; also see Maddux, 1995), people’s self-efficacy influences many aspects of their every-day life. Once an individual’s self-efficacy forms for a particular behavior or set of behaviors, these beliefs guide the person’s aspirations, behaviors, efforts, and reactions. However, these behaviors are seen more as *probabilistic* rather than an *inevitability* through *reciprocal determinism* (Bandura, 1986; also see Geller, 1996, 1998e, 1998f). In other words, three interdependent factors, behavior, person, and environment, influence each other depending upon the situation.

Outcome Expectancies

Outcome expectancies have also played an important role in social cognitive theory. An outcome expectancy is the belief that a particular behavior will result in a certain outcome. Outcome expectations take three different forms: physical, social, and self-evaluative. Physical outcomes of engaging in a behavior can be pleasant or aversive sensory experiences. There can also be positive social outcomes such as interest, praise, and recognition, as well as negative social outcomes like disapproval, rejection, or penalties. People also have certain outcome expectancies about how they view themselves. Whereas outcome expectancies have different forms (i.e., physical, social, and self-evaluative), all of these forms can vary in their importance or value.

Outcome value (Maddux, 1995; Maddux, Norton, & Stoltenberg, 1986) has been recently proposed as another significant predictor variable within self-efficacy theory with its own moderators. Outcome value can vary in dimension, displacement, and velocity. Taylor (1991) proposed that an outcome’s dimension, positive or negative properties, could differentially affect people’s emotions or moods. For example, negative outcomes could produce more cognition, affect, physiology, and behavior in some people than the opposite positive outcomes.

Furthermore, satisfaction with outcomes varies with their displacement from outcome value expectancies to post outcome change (i.e., displacement relation). In addition to displacement relation, Hsee and Abelson (1991) also proposed velocity relation. The authors found that people are not only engaging in a behavior to receive an outcome, they are seeking a greater rate (or velocity) of change in the outcome itself, except if it's negative.

Safety Education and Self-Efficacy/Outcome Expectancy

Safety-related education occurs in industrial settings almost reflexively (Petersen, 1996). From a social cognitive standpoint this can have a variety of effects. For instance, typical safety education sessions focus either on giving employees information regarding hazardous conditions or use scare tactics to warn employees about dangerous safety-related situations. According to Bandura, neither method would alter employees' self-efficacy. To have the greatest impact on employees' self-efficacy (for specific safety-related topics), "a shift in emphasis is required, from trying to scare people into health to providing them with the tools needed to exercise personal control over their health habits" (Bandura, 1997, p. 280).

Therefore, to have an effect on employees' safety self-efficacy, safety education needs to focus on providing employees with training to give them the needed skills to perform their work tasks safely. While a typical safety education session might not impact employees' self-efficacy, it could influence their outcome expectancies. If employees watch a safety video which depicts a finger amputation occurring because an employee failed to turn off the power to a machine (e.g., lock-out/tag-out), a shift in the viewers' outcome expectancies could change toward that *particular type* of injury. The severity of the injury would produce expectancies concerning the physical disability (i.e., a physical outcome expectancy) from the amputation, aversive social reactions from family, friends, and coworkers (i.e., a social outcome expectancy), and if the person held safety as a core value, a negative self-evaluation.

In summary, from a social cognitive view, the combination of safety training *and* safety education could increase employees' self-efficacy and shape their outcome expectancies if they had quality training and believe they can have input in the safety process. Consequently, safety interventions that focus on providing practical tools and methods for improving safety should increase participants' safety self-efficacy regarding injury prevention.

SEGMENTATION TECHNIQUES TO BEHAVIOR CHANGE

Transtheoretical Model of Change

The transtheoretical model was developed out of a comparative analysis of more than three hundred studies of psychotherapy and behavior change (Prochaska, 1979). The analysis identified ten techniques or "processes of change" used in attaining particular health behaviors. Next, DiClemente and Prochaska (1982) compared two groups of individuals (self-treatment vs. professional treatment) trying to quit smoking. The authors assessed how often each group used a specific process of change. From interviewing subjects, Prochaska and DiClemente (1983) discovered that individuals trying to quit smoking used different techniques or "processes" depending upon where they were in the quitting process. Table 7 below lists the stages of change and the ten processes of change with brief descriptions of each.

Insert Table 7 About Here

Prochaska, et al. reported (1997) that on average 40% of current smokers (or other risky health behaviors) were not even considering quitting (i.e., precontemplation), 40% were at least thinking about quitting (i.e., contemplation), and 20% had an actual plan to quit (i.e., preparation). Prochaska and DiClemente then argue that the typical smoking programs, which are “action-oriented” interventions would not be appropriate for individuals in the Precontemplation phase. Rather, health practitioners need to tailor their interventions to the specific stages of their targeted population. Presumably, people performing a risky behavior, go through four stages of change on their way to acquiring and maintaining a safe behavior: precontemplation, contemplation, preparation, action, and maintenance.

The stage of change model, has been criticized by Bandura (1997, p. 413) as a “descriptive device” that “provides no explanation for why [people] do not consider making changes” (cf. Davidson, 1992). Smedslund (1997), however, argues that not all psychological research must have an theoretical base to be useful for producing beneficial behavior change. Although the stages of change may not be considered empirical, the “model can, however, be used to generate empirical research” (Smedslund, 1997, p. 542). Prochaska, DiClemente, Velicer, and Rossi, (1992) address these concerns directly by arguing that the transtheoretical model’s primary purpose is in achieving behavior *change*, not studying behavior *acquisition* (see a review in *Health Education Quarterly* Vol. 19(3), 1992).

DiClemente and Prochaska (1985; DiClemente et al., 1991; Prochaska, DiClemente, & Norcross, 1992) have examined self-efficacy’s role in progressing through the stages of change and found that for addictive behaviors, individuals’ self-efficacy was significantly related to their stages of change. Furthermore, DiClemente, Fairhurst, & Piotrowski (1995) suggest that self-efficacy enhancing strategies should be used for the latter stages (i.e., action and maintenance), while interventions addressing outcome expectancies for motivating decision making are better suited for the early stages of change (precontemplation, contemplation).

Whereas the stages of change model may be viewed by some as only a descriptive tool that does not consider each employee's individual determinants for not performing a particular safe behavior, numerous studies have demonstrated the positive impact of customizing interventions to a recipient's stage of change (DiClemente, et al., 1995; Prochaska, et al., 1997).

Although there have been many applications of the transtheoretical model across numerous types of health behaviors (involving smoking, condom use, exercise, weight control, diet, sunscreen, mammography), there is no application to occupational safety. Some worksite health programs may have used this technique, but none have focused their efforts on safety-related at-risk behaviors. If employees are engaging in at-risk safety-related behaviors, the stages of change can be applied to assess which stage these individuals are at regarding their motivation to change. Thus, by segmenting an employee population in terms of stages of change, the safety leaders in an organization can customize an intervention strategy to target specific safety education/training for individuals at varying levels of change. Since there has been no direct application of the stages of change or the efficacy of the 10 processes of change to occupation safety, additional models of industrial safety intervention need to be consulted.

Safety Stages of Change

One industrial safety model that uses a segmentation methodology similar to the stages of change and suggests industrial safety intervention strategies is the flow of behavior change model. The flow of behavior change model originally conceived by Geller (1998d), assists occupational safety and health professionals design interventions to fit the problem. Geller hypothesized that employees fall into one of four stages with regard to their type of intervention needed. Once an organization's leadership segments their employees into these stages, Geller suggests guidelines for developing safety interventions.

More specifically, Geller proposes three types of behavior: other-directed, self-directed, and automatic behavior. When a behavior is first learned, Geller hypothesizes it is other-directed. With other-directed behaviors, individuals rely on external guidance or motivation to become competent in that particular behavior. Once the person practices the newly acquired behavior, it can then become self-directed (cf. Watson & Tharp, 1993). If the behavior is difficult, undesirable, or the response effort is too great (as when the amount of perceived effort involved in performing the behavior outweighs the perceived benefits), the behavior may never become self-directed and will always need some type of extrinsic incentive or disincentive.

Self-directed behaviors are motivated from within people (i.e., internal). If employees, for example, are wearing steel-toed boots because it is part of the company's safety policy and would not wear them otherwise, that person is other-directed. On the other hand, if employees wear their steel-toed boots because they perceive themselves safe workers and would wear steel-toed boots regardless of the safety policy, that individual would be considered self-directed. Over a period of time, if a behavior is repeated frequently and consistently, it may become a habit (i.e., automatic, see Posner & Snyder, 1975; Schneider, & Shiffrin, 1977; Shiffrin, & Schneider, 1977). Furthermore, if a behavior is not very complex (e.g., connecting a safety-belt), it can move immediately from other-directed to becoming a habit, or from a risky habit to a safe habit.

Pettinger and Geller (1999) expanded Geller's original flow of behavior change model by modifying Prochaska and DiClemente's stages of change model for industrial safety application. Pettinger and Geller's *safety stages of change* (see Figure 2) hypothesizes that individuals transition through four stages or levels of competence (precontemplation, contemplation, action [other-directed or self-directed], and maintenance) when moving from an *at-risk* habit to a *safe* habit. In the new model, employees are not aware they are doing something risky or they don't know the correct safety procedure (i.e., precontemplation), they know the correct procedure but are still engaging in the at-risk behavior (i.e., contemplation), they consistently perform the desired safe behavior but still need to think about the correct procedures (i.e., action), or they no longer have to consciously perform the safe behavior, the individual is at the maintenance stage (i.e., safe habit/automatic behavior). Table 8 below provides definitions for each of the stages hypothesized in the safety stages of change.

Insert Figure 2 About Here

Employees can be in one of two different "action" stages for a particular behavior – action *self*-directed and action *other*-directed. For example, if employees are performing safe behaviors consistently, but need external direction to maintain the behavior (the perception that an external source is setting the contingencies for that behavior), they are at the action stage (other–directed). If employees are performing the safe behavior consistently and no longer require any external motivation (contingencies are internally set by the individual), they are in the action stage (self-directed).

Insert Table 8 About Here

The safety stages of change model suggests four types of behavior-change interventions, depending upon the stage of the target performer: instructional, motivational, supportive and self-management. When willing learners are first acquiring new behaviors, teachers typically rely on instructional interventions that use antecedent strategies (Geller, 1996; Geller, 1998d) to move people from the precontemplation stage to the contemplation stage. Instructional interventions can be any antecedent event that directs behavior. In industrial settings, education/training sessions often use training videos to teach new procedures or demonstrate methods of handling new safety situations. These sessions are designed to be clear and easy to understand in order to facilitate movement to the contemplation stage.

Although some people might understand the information given during the instructional intervention, they may not believe the information to be pertinent or they might receive greater rewards for disregarding the instructions. For example, people may take calculated risks or shortcuts to accomplish a job faster (like changing a light bulb while standing on a chair instead of a ladder). The model would place this individual in the contemplation stage.

To move employees from contemplation (meaning they know what to do but do not do it) to action, the safety stages of change model proposes a motivational intervention, an intervention that uses both antecedent and consequence strategies. Since an employee in the contemplation stage knows the safe behavior, an antecedent strategy alone will have minimal impact (Geller et al., 1990). Using a consequence strategy along with an antecedent strategy is presumed to be the intervention strategy of choice in order to encourage people to engage in the target safe behavior (Geller, 1996; 1998f). Geller and his colleagues, for example, have used many incentive/reward strategies (combining activators and consequences) to motivate individuals to use their safety belts (e.g., Geller et al., 1990).

Once the employee is performing the safe behavior (because of either self- or other-directions), supportive interventions can help people move from the action stage to the maintenance stage (i.e., a safe habit). Supportive interventions mostly involve consequence strategies that reinforce and support desired behaviors. Supportive interventions may include recognition, interpersonal praise, and peer encouragement. Employees in the action *self-direction* stage derive their reinforcement from within the task itself, thus, safety self-management (cf. Mahoney, 1971, 1972) is an intervention that empowers employees to set their own contingencies and provide their own reinforcers.

In summary, the safety stages of change suggests that intervention impact is greatest if the type of intervention method uses the readiness for change stage of each potential participant. In other words, in order for an intervention to have the greatest impact on the safety-related behaviors of employees and facilitate progress to a safe habit, organizations need to segment their employees into the various stages hypothesized by the safety stages of change and design stage-specific safety improvement processes. For example, if an organization wanted to motivate their employees to perform specific safety-related behaviors through a plantwide educational intervention, the safety stages of change would predict the most behavior change to occur for employees in the Precontemplation or Contemplation stages.

RESEARCH OVERVIEW & HYPOTHESES

The primary purpose of this research was to compare self-efficacy theory (Bandura, 1997) and the stages of change model (Prochaska, et al., 1997) as a determinant of safety-related behaviors and amount of involvement in a behavior-based safety process. Additionally, the predictive validity of the actively caring concept combined with the stages of change model, was examined to determine any relationships in participating in a BBS process.

H1: From a social cognitive perspective, the BBS intervention will provide employees with the knowledge and tools to perform the safety-related activities taught.

H1.1: Employees' safety self-efficacy at the start of the intervention phase will predict involvement in the BBS process.

H1.2: Employees' safety outcome expectancy assessed at the start of the intervention phase will predict involvement in the BBS process.

H1.3: Safety perception instruments based on the social cognitive perspective will be the most predictive of employee involvement in a BBS process.

H2: From a safety stages of change perspective, the BBS intervention will differentially effect employee involvement based on their current safety stage.

H2.1: Employees' safety stages of change will predict involvement in the BBS process.

H2.2: Within the safety stages of change, there will be two factors: a *self-directed* safety stages of change and an *actively caring* safety stages of change.

H2.3: The survey designed to place people in certain safety stages of change will be the most predictive in assessing employee involvement in the BBS process.

H3: Safety measures will be differentially employees' safety self-efficacy, safety outcome expectancy, and safety stages of change.

H3.1 An inverse relationship will occur between safety outcome expectancy and injury outcome statistics (i.e., OSHA recordables, lost time injuries).

H3.2 An inverse correlation will occur between safety self-efficacy and injury outcome statistics.

H3.3: An inverse relationship will occur between employees' stage of change and injury statistics.

METHOD

OVERVIEW

To assess the predictive utility of safety self-efficacy and the safety stages of change, the revised Safety Self-Efficacy and Safety Stages of Change surveys were given to two manufacturing facilities prior to implementing a behavior-based safety (BBS) process. Following the organization-wide education/training, involvement measures, as well as other safety statistics over a four-month period were collected for each employee.

PARTICIPANTS & SETTINGS

Over three years, ten industrial sites have contributed to the development and testing of the current research. Preliminary survey development and refinement were conducted with six industrial interview sites and two pilot companies. Following survey development, two additional industrial locations were recruited and served as experimental sites. After administering the revised surveys to the experimental sites, the two organizations received behavior-based safety education/training. Employee involvement in the new safety process was tracked over four months. Injury statistics were acquired from one experimental site.

Industrial Interview Sites

Preliminary survey work conducted with companies in Milwaukee Wisconsin, Chicago Illinois, Elkin North Carolina, Cowpens South Carolina, York Pennsylvania, and Bakersfield California preceded initiation of this research. The interview sites represented small to medium sized facilities ranging from 50-500 employees, across a variety of industries including medium to light manufacturing, maintenance, and power generation.

Pilot Company-A

Participants were 495 employees from a bearing manufacturing facility in the southeast region of the United States. The average age of the workers at the Pilot Company-A is 32 years, 82.5 percent are white, and 58.5 percent are male. The average education level of the hourly workers is a high school diploma.

Pilot Company-B

Participants were 450 employees from a rotary motor manufacturing facility in the southeast region of the United States. The average age of the workers at the Pilot Company-B is 45 years, 88 percent are white, and 56 percent are male. The average education level of the hourly workers is a high school diploma plus one year of college/technical school.

Experimental Site-NP

Participants were 530 employees from a newsprint manufacturing facility (NP) in the northwest region of the United States. The average age of the workers at NP is 40 years, 93 percent are white, and 61 percent are male. The average education level of the hourly workers is a high school diploma plus two years of college/technical school.

Experimental Site-TK

Participants were 350 employees from a rotary bearing manufacturing facility (TK) in the southeastern region of the United States. The average age of the workers at TK is 37 years, 88 percent are white, and 56 percent are male. The average education level of the hourly workers is a high school diploma plus one year of college/technical school.

DEVELOPING SAFETY PERCEPTION INSTRUMENTS

Item Development

Over a two-year period, six industrial sites were visited and unstructured, informal interviews scheduled. These 30-minute interviews took place during an eight-hour safety training class with the group size averaging 9 to 30. The interviews were open-ended, group-focused exercises with the companies' safety administrators, as well as a sample of employees representing various areas of the organization including upper level management, maintenance, operations, engineering, and laboratory technicians. In all, it was estimated that over 800 employees and management participated in these initial interviews. These interviews guided the construction of the initial survey items for both the Safety Self-efficacy and Safety Stages of Change instruments.

During the unstructured focus groups, the primary researcher asked questions assessing safety impediments and challenges faced by employees on a daily basis like "What is holding you back from being safe?" and "If you worked in a Total Safety Culture, what would it be like?" Although the questions were not scripted, they did consistently focus on three safety-related factors: environment (e.g., "what are some environmental things that make it difficult to do your job safely?"), person (e.g., "what are some situations that make you feel less confident in performing your job safely), behavior (e.g., what are things people do to put themselves at-risk for an injury) (see Geller, 1996). Such questions assisted the author in determining what would be relevant safety gradations for creating safety self-efficacy questions. Also, by inquiring what percentage of people comply with the company's safety requirements and asking what are some examples of employees looking out for their coworkers safety (i.e., actively caring), the author was able to create theoretical "safety stages".

Safety Self-Efficacy

The initial 22-item Safety Self-efficacy questionnaire in Appendix A contains both self-efficacy measures, as well as outcome expectancy items. The self-efficacy questions (n=11) were designed to tap into employees' Safety self-efficacy *level* (n=5) and their self-efficacy *strength* (n=6). People's efficacy level reflects the number of steps of increasing difficulty they believe themselves capable of performing (i.e., *Even if a safety procedure is long or complicated, I am able to follow it*). A person's efficacy strength assesses persistence in the face of other barriers to performance (i.e., *I avoid trying to learn new safety procedures when they look difficult for me*).

The outcome expectancy items (n=11) were designed to assess an employee's physical (n=3), social (n=4), and self-evaluative (n=4) expectancies. Physical expectancies are any sensory experiences brought about by engaging in a particular behavior (i.e., *I never follow safety procedures because they take too much time*). Social expectancies are the expected reactions from the employee's social systems (e.g., recognition, status, power, disapproval) resulting from a particular behavior (i.e., *I often skip safety rules when there are large production demands*). Self-evaluative expectancies are reactions to one's own behavior (i.e., *If I skip a safety protocol, I feel disappointed in myself*).

Safety Stages of Change

The Safety Stages of Change survey was designed to place employees into one of four stages: precontemplation, contemplation, action, or maintenance with regard to their use of personal protective equipment (PPE), lifting techniques and lockout/tagout operating procedures. The safety-related behaviors on the Safety Stages of Change survey were chosen based on the preliminary work at the 6 industrial interview sites. These behaviors focused personal safety -related behaviors. Appendix B gives the three questions used to place employees into one of the four safety stages of change for PPE, lifting and lockout/tagout.

PROCEDURE

The procedures for implementing the BBS process were held constant over the two experimental sites NP and TK. The only variables that changed were the number of participants and types of critical safety-related behaviors the sites focused on. All workshops were lead by the author and one other graduate research assistant. At both experimental sites, the BBS process was implemented in three steps: a) form a "safety steering team" b) conduct an intensive safety steering team workshop, and b) provide workshops for all employees.

The safety steering teams consisted of volunteers from representative areas of the organization (e.g., production, maintenance, lab). Experimental site NP had 14 safety steering team members, while site TK had 10 members. At each site, this committee received three eight-hour sessions of BBS education and training to: a) foster the belief that the BBS process is employee driven, b) become the *in-house* experts of the BBS process, c) discuss which behaviors were critical to the safety of their coworkers, e) design a tool to measure their safety-related behaviors, and e) lead area-specific safety meetings in setting goals, discussing the results of their behavioral observations, and celebrating safety achievements. Following the safety steering team workshops, all employees at both experimental sites (including the committee members) received eight hours of BBS training.

Survey Administration

Before the safety steering team and employee workshops began, all participants completed both the Safety Self-efficacy and Safety Stages of Change surveys. The employees were instructed to respond truthfully, and were ensured their responses would be kept strictly confidential. Both experimental sites were concerned with employee anonymity, thus a code number was used to track employees. The code number used at both experimental sites was referred to as an employee’s “clock number.” The clock number was an already established internal tracking system; therefore no participants’ names were recorded on the surveys. On average, the questionnaires took no longer than 30 minutes to complete with very few questions or comments regarding the survey items. The experimental sites, however, required that completing the surveys be voluntary.

Safety Steering Team Workshop

The first two days of the safety steering team workshop focused on the principles, concepts, and critical aspects for implementing and institutionalizing a BBS process. Workshop content and exercises where adapted from Geller 1998e and 1998f. The third day of the workshop focused on site-specific application issues such as what type of work-related behaviors are critical to target, and what the initial critical behavior checklist (CBC) should look like.

During the third day of the workshop, the safety steering teams from NP and TK developed a critical behavior checklist (see Appendix C) to be used by their employees following the site-wide employee BBS training. Once the site specific behaviors were chosen, they were operationally defined to ensure objective information would be collected. For example, “not paying attention while lifting” would be very subjective and open for interpretation, while “did not bend knees when lifting” is much more specific and objective. The CBC is a powerful safety-improvement tool that provides objective information regarding current site-wide safety performance, presents feedback to workers to guide their future safety-related behaviors, and guides safety improvement activities (Geller, 1996, 1998e; Krause, et al., 1996).

Employee Workshop

Following the safety steering team workshop, all employees were given eight hours of BBS training. The information covered in the employee training classes was based on the materials presented to the safety steering team, but in an abbreviated eight-hour interactive workshop. The principles, concepts, and tools presented to the employees were consistent with those covered in the safety steering team classes, however there were fewer exercises and opportunities for employees to provide input concerning safety process design and implementation. During a 30-minute portion of the employee workshops, one member of the safety steering team described the process in which they developed the CBC and illustrated how to conduct a safety observation and provide feedback to their fellow coworkers.

Behavior-Based Safety Intervention

After each experimental site completed their BBS training, everyone who received training was encouraged to use their CBC to conduct safety behavioral observations and give each other feedback regarding safe versus at-risk behaviors they observed. Observations are initiated by employees approaching fellow coworkers and asking if they are willing to participate in the new safety process and be observed using the CBC. It is then that employee's decision to participate in the safety observation process. The employee being observed is kept anonymous to counter the perception that the CBC could be used for punitive consequences. Anonymity increases acceptance of the entire BBS initiative. The name of the observer, however, is recorded to track employee involvement.

Following a completed safety observation, the observer places the CBC in a collection box located in various areas around the organization. Once a week, a safety steering committee member collects the observation forms and enters the data into a safety involvement database. Both experimental sites used a database to track which employees were conducting safety observations. In addition to tracking employee involvement, experimental site NP also recorded number of injuries 24 months prior to initiation of the BBS process.

RESULTS

SURVEY REFINEMENT

Pilot Company-A

To further refine the surveys items, the preliminary versions of the Safety Self-efficacy and Safety Stage of Change surveys were administered to employees (N=495) at Pilot Company-

A. The surveys were given out over a one-month period, area by area, during each group's monthly safety meeting. Results of this pilot research were encouraging. Pilot Company-A provided a 65% return rate for the preliminary versions of the Safety Self-efficacy and the Safety Stages of Change surveys (n=350).

Inter-item correlations were performed following the administration of the Safety Self-efficacy survey (n=287). Using alpha as a measure of internal consistency, the scale produced a score of .88. The sub-scale of self-efficacy had an alpha of .86 with the outcome expectancy sub-scale scoring .79. Follow-up analysis and item reduction were performed using factor analysis. Internal consistency was improved to .90. Following the initial analysis of the preliminary Safety Self-efficacy survey, questions were reworded, added, and the questionnaire was reformatted following the guidelines set by Bandura (1998) for constructing self-efficacy scales (see Appendix D for the refined Safety Self-Efficacy survey).

The items from the Safety Stages of Change survey were 1) combined for an overall behavior score, and 2) categorized to give each employee a safety stage of change score (see Table 9). The responses to the safety stages of change questions are scored by level (precontemplation=1, contemplation=2, action=3, maintenance=4) and totaled. Thus, in the initial Safety Stages of Change survey, an employee could score a minimum of 3 and a maximum of 12.

Insert Table 9 About Here

In addition to the questions included in the preliminary version of the Safety Stages of Change survey, three more items were added to the final version of the survey to reflect topics and techniques taught during the BBS education/training intervention that reflect actively caring for safety. These actively caring questions assessed a respondent's willingness to: a) observe a coworkers safety-related behaviors, b) caution coworkers when they are doing something risky, and c) giving a coworker safety-related feedback.

The refined version of the Safety Stages of Change (see Appendix E) scale also included "preparation" as an additional stage. This stage was added to more closely represent the stages found in the studies reported by Prochaska, DiClemente and colleagues (e.g., 1991, 1992, 1997). The preparation stage represents a "stage" where employees know and may be planning to perform the safe behavior in question, but have not yet engaged in the target safe behavior.

Pilot Company-B

Upon revising the Safety Self-Efficacy and Safety Stages of Change surveys, an additional company was recruited to analyze further the reworded and reformatted questionnaires. Pilot Company-B (n=450) received the revised surveys over a two-day period by the author and the safety director of Pilot Company-B. Again, the response from the surveys was encouraging, with a return rate of 86% (n=385).

In designing the two scales, Safety Self-Efficacy and Safety Stages of Change, it was hypothesized there would be five sub-scales: self-efficacy strength, self-efficacy level (see Table 10), outcome expectancy (see Table 11), stages of change for personal safety and stages of change for actively caring behaviors (See Table 12). A factor analysis was computed using the items from Safety Self-Efficacy and the Safety Stages of Change scales.

To test the assumption there were five underlying variables, a Maximum-Likelihood extraction method was employed using SPSS (version 9.0). Additionally, it was theorized that the two safety-related scales will have some amount of correlation. To allow for this an Oblique rotation method (i.e., Promax) was used to examine the underlying factors. However, before the factor analysis was initiated, the survey items were examined for inter-item correlations. Bartlett's test of sphericity, $\chi^2(46, n=1081) = 9250.80$, $p < .001$, indicates the correlation matrix was not an identity matrix, so it is assumed the data were taken from a multivariate normal population. The Kaiser-Meyer-Olkin measure of sampling adequacy is an additional indicator of strength of relationship between the variables. Since there was no identity matrix and the Kaiser-Meyer-Olkin was very high (.89), the factor analysis was justified.

Insert Table 10, 11, and 12 About Here

The Maximum-Likelihood procedure reported there was a good-fit between the data and the factors, $\chi^2(814, n=1081) = 2210.40$, $p < .001$, and six factors emerged (see Table 13-15). There were two changes in the theorized subscales; self-efficacy level and outcome expectancy were both split into two factors. After examining the two new self-efficacy level factors, it was clear that employees' level of confidence varied between giving people feedback concerning their personal safety (Factor 2: self-efficacy feedback level) and using a checklist to observe their coworkers' safety-related behavior (Factor 3: self-efficacy checklist level).

Outcome expectancy was also broken into two factors: Factor 4, a social/self-evaluative outcome expectancy, and Factor 5, a physical/negative social outcome expectancy. Safety stages of change formed a single factor. Even though the safety stages of change did not reveal the subscales stages of change for personal safety and stages of change for actively caring, the author hypothesized the subscales would be revealed in other analyses. Thus, there were three safety stages of change subscales: safety stages of change (a average of all stages of change items), safety stages of change for personal safety (averaging stages of change questions 3 & 5), and safety stages of change for actively caring (averaging stages of change questions 2, 4 & 6).

Insert Table 13, 14, and 15 About Here

Using the new factors, an inter-item correlation was performed on the Safety Self-Efficacy survey. Using alpha as a measure of internal consistency, the scale produced a score of .91. As shown in Table 16, all the sub-scales of self-efficacy had acceptable alphas of .89, .93, and .94. The two outcome expectancy sub-scales also had acceptable alphas of .76 and .88. The Safety Stages of Change survey had an alpha of .77. The first item of the Safety Stages of Change survey one loaded on several factors and was eliminated from the survey thereby improving the scale's alpha to .79 (See Appendix F for more information on the factor analysis).

Insert Table 16 About Here

RESEARCH VARIABLES

The primary variables of interest in this current research are measures of employee involvement in a new BBS process. There were two indices of involvement: participation (yes or no) and number of observations performed, per employee, within the first four months of BBS implementation. Another dependent variable of interest is number of injuries, per employee, 24 months before initiation of the BBS process. The independent variables investigated in the analyses were self-efficacy (i.e., self-efficacy strength, self-efficacy feedback level, self-efficacy checklist level), outcome expectancy (i.e., social/self-evaluative outcome expectancy and physical/negative outcome expectancy), and stages of change (i.e., safety stages of change, safety stages of change for personal safety, safety stages of change for actively caring). Table 17 summarizes all independent and dependent variables used in the analyses reported.

Insert Table 17 About Here

Sub-Scale Analyses

To further analyze the validity of the subscales, one-way ANOVAs were conducted using the subscales as independent variables with the scale scores as dependent variables. Table 18 displays the mean subscales scores for self-efficacy strength, self-efficacy feedback level, self-efficacy checklist level, social/self-evaluative outcome expectancy, physical/negative outcome expectancy, safety stages of change, safety stages of change for personal safety, safety stages of change for actively caring.

Insert Table 18 About Here

As can be seen in Figure 3, the self-efficacy analysis revealed significant differences, $F(2, 906) = 9.71$, $p < .001$, among the scale scores. More specifically, table 19 shows the multiple comparisons between subscales where significant differences (all p's < .01) were found between self-efficacy strength and both self-efficacy feedback ($M = 84$ vs. $M = 79$) and self-efficacy checklist ($M = 84$ vs. $M = 78$), but not between self-efficacy feedback and self-efficacy checklist.

Figure 4 displays the significant difference, F (1, 600) = 11.37, $p < .01$, found in the outcome expectancy subscales: social/self-evaluative outcome expectancy (M = 65), and physical/negative outcome expectancy (M = 60).

Insert Figures 3, 4 & Table 19 About Here

There were also significant differences found, F (1, 897) = 39.26, $p < .001$, in the stages of change subscales: safety stages of change, safety stages of change for personal safety, safety stages of change for actively caring (See Figure 5).

Table 20 illustrates the multiple comparisons between the stages of change subscales. Significant differences (all p's < .001) were found between stages of change for personal safety and both stages of change (M = 3.99 vs. M = 3.59) and stages of change for actively caring (M = 3.99 vs. M = 3.46), but not between stages of change and stages of change for actively caring (M = 3.59 vs. M = 3.46).

Insert Figure 5 & Table 20 About Here

EMPLOYEE INVOLVEMENT

The two experimental sites have similar operations (i.e., light manufacturing), safety records (1.12 TRIR vs. 1.02 TRIR), and safety issues like motivating people to use the proper personal protective equipment. Therefore, on general safety grounds, the data from the two sites could be combined. However, before combining the data from sites TK and NP, analyses were conducted to assess if there were any site differences. Since employee involvement was a major dependent variable, if there were no site-specific factors influencing involvement, then the data from the two sites could be combined for further analysis

Number of Participants

Of the 350 employees at site TK, 60% volunteered to complete the surveys. As Table 21 also shows, of the 212 employees at TK who finished the surveys, 9% participated (n=20) in the BBS process within the first four months. Of the 530 employees who attended Site NP's safety workshops, 14% of the participants (n=74) volunteered to complete the surveys. Of the employees at NP who finished the questionnaires, 65% (n=48) conducted at least one safety observation within the first four months of BBS implementation. Overall, 6% of the employees from experimental site TK and 9% of the employees from site NP participated within the first four months implementation of the BBS process.

Insert Table 21 About Here

Involvement by Experimental Site

Two levels of involvement were considered: participation and observations. Defining "participation" as conducting at least one safety observation within the first four months of the initiation of the BBS process, there were no significant differences between sites for participation, $\chi^2(1, n=880) = 3.30$, $\underline{p} > .05$. Across both experimental sites, a total of 68 employees participated in the first four months of the BBS initiative.

Defining "observations" as number of safety observations conducted within the first four months of the BBS intervention. Table 21, shows there were no significant differences in the average number of behavioral safety observations completed per employee between sites TK (M = 5.25) and NP (M = 5.98), $F\ (1, 67) = .18$, $p > .05$.

Observations by Gender

Upon visual inspection of the dependent variable observation, there was a possible gender difference (see Table 22). To be able to combine the data from the two sites, this potential confound needed to be assessed. Therefore, a Site (TK vs. NP) by gender ANOVA was performed on number of observations. As displayed in Table 23, there were no significant interactions between site and gender, $F\ (1, 64) = .88$, $p > .05$. As can be seen in Table 24, the main effect for site was not significant, $F\ (1, 64) = .07$, $p > .05$, but there was a significant main effect for gender, $F\ (1, 64) = 5.07$, $p < .05$. On average, the males at both experimental sites performed almost twice as many (M = 6.71, SD = 6.27) safety observations as did the female employees (M = 3.50, SD = 3.44), however experimental site had no influence on the amount of employee observations (see Figure 6).

Insert Figure 6, Tables 22 - 24 About Here

SUBSCALES PREDICTIVE UTILITY

Based on the above analyses, the data from the experimental sites were combined to increase the power for subsequent analyses. To test the general hypotheses (H1.1, H1.2 & H2.1) that each individual safety scale would predict involvement (i.e., participation and observations) in the BBS process, a series of multiple regression analyses were performed with participation and number of observations as the dependent variables and safety self-efficacy, safety outcome expectancy, and safety stages of change as the independent variables. Thus, six separate regression analyses were conducted using the forward method of variable entry to test the general hypotheses.

Safety Self-Efficacy Regression

As can be seen in the correlational matrix in Table 25, many of the scales correlated significantly with other scales and with the dependent variables participation, observations, and injuries. Before any analyses were completed, violations of assumptions of regression were assessed. Tolerance measures were relatively small (.76) implying a low chance of multicollinearity, and upon plotting several factors no violations were diagnosed.

The subscales entered into the regression for self-efficacy were: a) self-efficacy strength, b) self-efficacy feedback level, and c) self-efficacy checklist level. Table 26 summarizes the predictors entered into the regression. The subscale to predict a significant portion of the variance in participation was self-efficacy feedback level, $\underline{R}^2 = .042$, $\underline{p} < .001$. The final model R was significantly different than zero following the forward entry, $\underline{F}$ (1, 301) = 13.27, $\underline{p}$ < 001.

The subscale to predict a significant portion of the variance in number of observations was again self-efficacy feedback level, $\underline{R}^2 = .035$, $\underline{p} < .001$. The final model R was significantly different than zero following the forward entry, $\underline{F}$ (1, 301) = 10.79, $\underline{p}$ < 001.

Insert Table 25 & 26 About Here

Safety Outcome Expectancy Regression

The subscales entered into the regression for outcome expectancy were: a) social/self-evaluative outcome expectancy, and b) physical/negative outcome expectancy. Table 27 summarizes the independent variables entered into the regression. The subscale to predict a significant portion of the variance in participation was physical/negative outcome expectancy, $\underline{R}^2$ = .015, $\underline{p}$ < .001. The final model R was significantly different than zero following the forward entry, $\underline{F}$ (1, 299) = 4.44, $\underline{p}$ < 05.

The subscale to predict a significant portion of the variance in number of observations was physical/negative outcome expectancy, $\underline{R}^2$ = .037, $\underline{p}$ < .01. The final model R was significantly different than zero following the forward entry, $\underline{F}$ (1, 299) = 11.47, $\underline{p}$ < 01.

Insert Table 27 About Here

Safety Stages of Change Regression

The subscales entered into the regression for stages of change were: a) safety stages of change, b) safety stages of change for personal safety, and c) safety stages of change for actively caring. Table 28 summarizes the independent variables entered into the regression. All three subscales predicted significant portions of the variance in participation, Final $\underline{R}^2$ = .26, $\underline{p}$ < .001. The final model R was significantly different than zero following the forward entry, $\underline{F}$ (3, 296) = 16.07, $\underline{p}$ < 001.

All three subscales predicted significant portions of the variance in number of observations, Final $\underline{R}^2$ = .14, $\underline{p}$ < .001. The final model R was significantly different than zero following the forward entry, $\underline{F}$ (3, 296) = 34.07, $\underline{p}$ < 001.

Insert Table 28 About Here

ASSESSING SELF-EFFICACY VERSUS STAGES OF CHANGE

A series of multiple regression analyses were performed with percent participation and number of observations as the criteria. Two sets of analyses were conducted: one to test the competing hypotheses and one for exploratory purposes. The predictor variables were the sub-scales from self-efficacy, outcome expectancy, and stages of change (see Table 17). All the factors subscales were entered into the regression using the forward method of variable entry to test the hypotheses, while the stepwise method was engaged for exploratory post-hoc analyses.

Predicting Employee Participation

The factors entered into the forward regression to predict employee participation were self-efficacy (i.e., self-efficacy strength, self-efficacy feedback level, self-efficacy checklist level), outcome expectancy (i.e., social/self-evaluative outcome expectancy and physical/negative outcome expectancy), and stages of change (i.e., safety stages of change, safety stages of change for personal safety, safety stages of change for actively caring).

Table 29 summarizes the independent variables entered into the regression. All three subscales from the stages of change model were entered into and predicted significant portions of the variance observed in percent participation for a combined $\underline{R}^2 = .255$. The final model R was significantly different than zero following the forward entry, $\underline{F}$ (3, 294) = 33.63, $\underline{p}$ < 001. The regression conducted using the stepwise entry method had identical results.

Insert Table 29 About Here

Predicting Employee Observations

The factors entered into the forward regression to predict employee observations were self-efficacy (i.e., self-efficacy strength, self-efficacy feedback level, self-efficacy checklist level), outcome expectancy (i.e., social/self-evaluative outcome expectancy and physical/negative outcome expectancy), and stages of change (i.e., safety stages of change, safety stages of change for personal safety, safety stages of change for actively caring). Table 30 summarizes the independent variables entered into the regression.

Self-efficacy feedback level was entered into the regression first and captured 3.5% of the variance. All three subscales from the stages of change model were entered into and predicted significant portions of the variance observed in observations for a final R^2 = 14.7%. The final model R was significantly different than zero following the forward entry, F (4, 293) = 145.71, p < 001.

Insert Table 30 About Here

A stepwise regression was also performed with predictors being self-efficacy (i.e., self-efficacy strength, self-efficacy feedback level, self-efficacy checklist level), outcome expectancy (i.e., social/self-evaluative outcome expectancy and physical/negative outcome expectancy), and stages of change (i.e., safety stages of change, safety stages of change for personal safety, safety stages of change for actively caring).

Table 31 summarizes the independent variables that remained in the regression. Self-efficacy feedback level was entered into the regression first and again predicted 3.5% of the variance. All three subscales from the stages of change model were again entered into the equation. During the final step, however, self-efficacy feedback level was removed from the equation reducing the amount of variance predicted ($\underline{R}^2$ = .131), but not significantly, $\underline{F}$ (1, 295) = 2.71, $\underline{p}$ > 05. The final model R was significantly different than zero following the stepwise entry, $\underline{F}$ (3, 294) = 183.88, $\underline{p}$ < 001.

Insert Table 31 About Here

Predicting Employee Injuries

Number of injuries was also assessed. The factors entered into the forward regression to predict employee injuries were self-efficacy (i.e., self-efficacy strength, self-efficacy feedback level, self-efficacy checklist level), outcome expectancy (i.e., social/self-evaluative outcome expectancy and physical/negative outcome expectancy), and stages of change (i.e., safety stages of change, safety stages of change for personal safety, safety stages of change for actively caring). Only experimental site NP could produce injury statistics per individual employees.

Table 32 summarizes the independent variables entered into the regression. The only subscale that entered into the equation and predicted significant portions of the variance observed in injuries was stages of change for personal safety, combined $\underline{R}^2$ = .07. The final model R was significantly different than zero following the forward entry, $\underline{F}$ (1, 69) = 5.19, $\underline{p}$ < 05.

To further assess the relationship between injuries and the self-efficacy subscales, outcome expectancy subscales, and stages of change subscales, a correlational analysis was performed. Table 25 above indicated that the only significant correlation found between the subscales and injuries occurred between self-efficacy checklist level, $\underline{r}^2 = -.27$, $\underline{p} < .05$, and stages of change for personal safety, $\underline{r}^2 = .26$, $\underline{p} < .05$.

Insert Table 32 About Here

SEGMENTATION ANALYSES

A technique to improve intervention effectiveness is to segment your population into different groups depending upon certain criteria, and then target these groups with interventions designed specifically for their various levels. Segmentation analyses were conducted to assess the validity of categorizing employees into three groups for self-efficacy and outcome expectancy (low, medium, and high) and 5 groups (pre-contemplation, contemplation, preparation, action, and maintenance) for the safety stages of change.

For self-efficacy and outcome expectancy, the distribution of employee scale scores were divided into thirds (bottom third=low, second third=medium, and top third=high) and each employee was assigned to a group. The stages of change subscales were segmented into their hypothesized stages. However, before these scales can be used in an applied settings as assessment tools, normative research would need to be completed to set classification criteria for the chosen groups.

Segmenting Safety Self-Efficacy

Table 33 displays the low, medium, and high safety self-efficacy categories for the demographic variables of interest: participation, observations, and injuries. A one-way ANOVA was conducted for each subscale and dependent variable. Figures 7 displays the means for percent participation from three one-way ANOVAs with the three subscales of self-efficacy (self-efficacy strength, self-efficacy feedback level, self-efficacy checklist level) as the independent variables.

Insert Figure 7 & Table 33 About Here

For the subscale self-efficacy strength (see Figure 7), there were significant differences between categories for percentage of participation, F (2, 300) = 8.73, p < 001. Self-efficacy feedback level also showed a significant category main effect for percent participation, F (2, 300) = 5.24, p < .01. Self-efficacy checklist level revealed no significant category main effect for percent participation, F (2, 300) = 2.39, p > .05.

The results of the multiple comparisons (using Bonferroni method) for self-efficacy strength and self-efficacy feedback level for percent participation are given in Table 34. In general, Figure 7 displays a positive trend: as the subscale scores increase, the greater the percent participation. More specifically, for self-efficacy strength, the significant differences occurred between the low SE and high SE and the medium SE and high SE. For self-efficacy feedback level, the differences occurred between low SE and medium SE and low SE and high SE.

Insert Figure 8 and Table 34 About Here

Figures 8 displays the means for number of observations from three one-way ANOVAs with the three subscales of self-efficacy (self-efficacy strength, self-efficacy feedback level, self-efficacy checklist level) as the independent variables. As shown in Figure 8, for the subscale self-efficacy strength, there were significant differences between categories for number of observations, F (2, 300) = 4.29, p < 05. Self-efficacy feedback level also showed a significant category main effect for number of observations, F (2, 300) = 5.23, p < 01. Self-efficacy checklist level revealed no significant category main effect for percent participation, F (2, 300) = 1.84, p > .05.

The results of the multiple comparisons for self-efficacy strength and self-efficacy feedback level for number of observations are given in Table 34. In general, Figure 8 displays a positive trend: as the subscale scores increase, the greater the number of observations completed. More specifically, for self-efficacy strength, the significant differences occurred between the low SE and high SE and the medium SE and high SE. For self-efficacy feedback level, the differences occurred between low SE and medium SE and low SE and high SE.

Figures 9 displays the means for number of lost-time injuries from three one-way ANOVAs with the three subscales of self-efficacy (self-efficacy strength, self-efficacy feedback level, self-efficacy checklist level) as the independent variables. As shown in Figure 9, for the scale safety self-efficacy, there were no significant differences between categories for number of lost-time injuries, all ps > 05. In general, Figure 9 displays a negative trend: as the subscale scores increase, the number of lost-time injuries decrease.

Insert Figure 9 About Here

Segmenting Outcome Expectancy

Table 35 displays the low, medium, and high safety outcome expectancy categories for the demographic variables of interest: participation, observations, and injuries. A one-way

ANOVA was conducted for each subscale and dependent variable. Figures 10 displays the means for percent participation from two one-way ANOVAs with the two subscales of outcome expectancy (social/self-evaluative outcome expectancy, and physical/negative outcome expectancy) as the independent variables.

Insert Figure 10 & Table 35 About Here

For the subscale physical/negative outcome expectancy (see Figure 10), there were significant differences between categories for percentage of participation, $\underline{F}$ (2, 298) = 4.46, $\underline{p}$ < 05. Social/self-evaluative outcome expectancy revealed no significant category main effect for percent participation, $\underline{F}$ (2, 298) = 2.62, $\underline{p}$ > .05.

The results of the multiple comparisons for physical/negative outcome expectancy for percent participation are given in Table 36. In general, Figure 10 displays a positive trend: as the subscale scores increase, the greater the percent participation. More specifically, for physical/negative outcome expectancy, the significant differences occurred between the low OE and high OE.

Insert Table 36 About Here

Figures 11 displays the means for number of behavioral observations from two one-way ANOVAs with the two subscales of outcome expectancy (social/self-evaluative outcome expectancy, and physical/negative outcome expectancy) as the independent variables. For the subscale social/self-evaluative outcome expectancy (see Figure 11), there were significant differences between categories for percentage of participation, F (2, 298) = 4.46, p < 05. Physical/negative outcome expectancy revealed no significant category main effect for number of observations, F (2, 298) = 1.79, p > .05.

Insert Figure 11 About Here

The results of the multiple comparisons for social/self-evaluative outcome expectancy for number of observations taken are given in Table 36. In general, Figure 11 displays a positive trend: as the subscale scores increase, the greater the number of observations. There were no significant differences between the outcome expectancy categories.

Figures 12 display the means for number of lost-time injuries from two one-way ANOVAs with the two subscales of outcome expectancy (social/self-evaluative outcome expectancy, and physical/negative outcome expectancy) as the independent variables. For the safety outcome expectancy scale, there were no significant differences between categories for lost-time injuries, all ps > 05.

Insert Figure 12 About Here

Segmenting Safety Stages of Change

Table 37 displays the pre-contemplation, contemplation, preparation, action, and maintenance stages for the demographic variables of interest: participation, observations, and injuries. A one-way ANOVA was conducted for each subscale and dependent variable. Figures 13 display the means for percent participation from three one-way ANOVAs with the three subscales of safety stages of change (safety stages of change, safety stages of change for personal safety, safety stages of change for actively caring) as the independent variables.

Insert Figure 13 & Table 37 About Here

For the subscale safety stages of change for personal safety (see Figure 13), there were significant differences between stages for percentage of participation, $\underline{F}$ (4, 295) 7.65, $\underline{p}$ < 001. The subscales, safety stages of change and safety stages of change for actively caring, revealed no significant category main effect for percent participation, $\underline{p}$s > .05.

The results of the multiple comparisons for the subscale safety stages of change for personal safety for percent participation are given in Table 38 (contemplation=1 – maintenance=5). In general, Figure 13 displays a negative trend for safety stages of change for personal safety: as the stages increase, percent participation drops. More specifically, for safety stages of change for personal safety, the significant differences occurred between 2 and 4, 2 and 5, 3 and 4.

Insert Table 38 About Here

Figures 14 display the means for number of observations from three one-way ANOVAs with the three subscales of safety stages of change (safety stages of change, safety stages of change for personal safety, safety stages of change for actively caring) as the independent variables. As shown in Figure 14, for the subscale safety stages of change for personal safety, there were significant differences between stages for number of observations, F (4, 295) = 4.56, p < 05. The subscales, safety stages of change and safety stages of change for actively caring, revealed no significant category main effect for number of observations, ps > .05.

The results of the multiple comparisons for safety stages of change for personal safety for number of observations are given in Table 38. More specifically, for safety stages of change for personal safety, the significant differences occurred between 2 and 4, and 3 and 4.

Figures 15 display the means for number of lost-time injuries from three one-way ANOVAs with the three subscales of safety stages of change (safety stages of change, safety stages of change for personal safety, safety stages of change for actively caring) as the independent variables. As shown in Figure 15, for the subscales of the safety stages of change, there were no significant differences between stages for number of lost-time injuries, all ps > 05. In general, Figure 15 displays a positive trend for the subscales safety stages of change and safety stages of change for personal safety: as the stages increase, the number of lost-time injuries also increases.

Insert Figure 15 About Here

DISCUSSION

Although there have been numerous studies in the field of worksite health promotion (Opatz, 1994), less research has focused on developing guidelines on improving the effectiveness of industrial safety (Goldenhar & Schulte, 1994). Many studies have demonstrated how to increase particular safety-related behaviors like using hearing protection (Lusk, et al., 1995), how organizational factors lead to occupational injuries (Reason, 1995), and how conceptual frameworks can prevent injuries (Andersson, & Menckel, 1995). However, little research provides the safety practitioner with guidelines on how to increasing the effectiveness of an occupational safety intervention.

This study contributes to the safety literature by addressing the current void of intervention effectiveness research by: a) adapting two safety perception instruments based on widely used theories/models (i.e., self-efficacy and stages of change), b) assessing the surveys' predictive validity in estimating employee involvement in a key process of behavior-based safety (BBS), and c) suggesting strategies for improving intervention effectiveness.

SURVEY DEVELOPMENT

Although self-efficacy and stages of change have been extensively used in the health behavior literature, there have been very few if any applications of these concepts in safety-related research. Since there are no general measures of self-efficacy, a domain specific instrument was created to assess employees' beliefs about performing behaviors required of a BBS process and to assess whether those behaviors will produce certain outcomes. Moreover, the stages of change model is also domain (i.e., safety) specific. Thus, a customized instrument was also needed.

Positive feedback from safety professionals and employees regarding the surveys adapted for this study demonstrated face validity. Internal consistency measures were also very encouraging for the surveys: alphas of .91 for Safety Self-Efficacy and .79 for Safety Stages of Change scales. However, additional applications of the surveys in different industrial settings across different geographical regions are needed to assess further the validity of these new safety scales.

The subscale analyses were useful in that they demonstrated the uniquenesses among the scales. For example, Figure 3 shows a significant difference between the subscale for self-efficacy strength and the subscales measuring self-efficacy level. But, there were no differences between self-efficacy feedback level and self-efficacy checklist level. This is understandable since the subscales are both measuring self-efficacy level. However, discovered through the factor analysis, the scales do measure different behavioral domains.

To be more precise, self-efficacy feedback level estimates employees' confidence in providing safety-related feedback to employees who work in their area, work outside of their area, and who are supervisors (i.e., increasing levels of difficulty). Self-efficacy checklist level, estimates employees' confidence in using a checklist to observe a coworker's behavior: a) in your area, b) outside your area, and c) a supervisors.

It was interesting that safety outcome expectancy factored into two subscales: social/self-evaluative outcome expectancy, and physical/negative outcome expectancy (see Table 14). This difference may point to two safety perceptions: a) a more traditional safety paradigm and b) an actively caring safety perspective (see Geller, 1996). For example, the physical/negative outcome expectancy items deal more with employee safety concerns like how easy a safety procedure is to perform or how shortcuts may save time or make a job more convenient. Other negative social outcomes may be in the form of peer pressure to take shortcuts (e.g., coworkers will think less of me) or ridicule (e.g., they won't care or listen). Actively caring, on the other hand, refers more to an entire organizational culture where employees look out for the safety of their coworkers (e.g., I will reduce the chance my coworker will get hurt), and also take pride in doing their job safely (e.g., It will make me feel good about myself).

There was a significant difference between employees' expectancies regarding social/self-evaluative outcomes and employees' expectancies of acquiring negative physical/negative social outcomes. In practice, the difference between the average scale scores for the social/self-evaluative outcome expectancy and physical/negative outcome expectancy may be prescriptive; if employees are certain they will acquire negative outcomes as a result of performing behaviors required in a BBS process (i.e., a high negative physical/social outcome expectancy), this may point to an unsuccessful implementation of a safety process. Therefore, if employees perceive they will acquire more positive social/self-evaluative outcomes and are less certain they will receive the negative physical/social outcomes, a BBS process should be more readily accepted and successful.

The significant differences in the subscale scores for safety stages of change partially validate the rationale of splitting the Safety Stages of Change scale into the subscales. The significant differences shown in Figure 5 demonstrate differences between safety stages of change for personal safety and for actively caring. Again, if a company was to examine the average scale scores for stages of change for actively caring, for example, and found that the average stage employees were categorized in was precontemplation (i.e., not even thinking about adopting the behavior in question), then an intervention focusing on giving actively caring feedback (e.g., BBS) would hypothetically be less successful.

PREDICTING INVOLVEMENT

It was hypothesized that the safety perception instruments created would predict involvement in a BBS safety process as measured by: a) percentage of employees who completed at least one safety observation, and b) the number of observations made by those who participated. The separate subscale regressions assessed the predictive utility of each instrument. For the Safety Self-Efficacy scale, self-efficacy feedback level was the only factor to predict a significant portion of variance for both participation (4%) and number of observations (4%). Since a BBS process relies on coworkers giving each other feedback, then being confident in delivering that feedback in increasingly more difficult situations (i.e., levels of impediments). For example, employees may perceive providing safety-related feedback to employees who work in their area as not a difficult as providing safety feedback to employees who work outside of their area. Thus, the more confidant employees are in giving feedback in increasingly more difficult situations, the greater the employee involvement.

For safety outcome expectancy, the subscale physical/negative outcome expectancy was the only significant predictor for both participation and number of observations completed per participant explaining 2% and 4% of the variance, respectively. This is intuitive in that if an employee perceives the new safety process to be easy or it does not require too much time to participate, then as employees' certainty increases so does their participation as measured by number of observations completed. Thus, to be effective, safety professionals need to design interventions that employees will perceive they can attain positive social as well as avoid negative physical interactions with their fellow coworkers.

All the safety stages of change factors entered into the regression equation and predicted 26% of the variance in whether the employee would participate in the new safety initiative. Furthermore, the three subscales also accounted for 14% of the variance in the number of observations completed per participant. Thus, employees' safety stage of change directly influenced whether they would participate and also the number of times they observed the safety-related behaviors of their fellow coworkers.

The above analyses supports the hypotheses that each safety scale (i.e., self-efficacy, outcome expectancy, and stages of change) would predict involvement in a BBS process. The scales, Safety Self-Efficacy and Safety Outcome Expectance, both had individual subscales (i.e., self-efficacy feedback level and physical/negative outcome expectancy) that predicted a combined 6% of the variance in percent participation and 8% for the number of employee behavior-based observations. The subscales for the Safety Stages of Change surveys (i.e., safety stages of change, safety stages of change for personal safety, and safety stages of change for actively caring), all significantly contributed to predicting a total of 26% of the variance in percent participation and 14% of the variance in number of BBS observations.

SELF-EFFICACY VERSUS STAGES OF CHANGE

To assess which safety scales (safety self-efficacy or safety stages of change) were most predictive of employee involvement, regression analyses were conducted using all the safety subscales as predictors with percent participation and number of BBS observations as the criteria. The forward method of entering variables into the regression was used for hypotheses testing purposes.

Of the social cognitive factors and stages of change subscales submitted to the forward regression procedure, only the stages of change subscale entered into the equation and predicted 26% of variance in percent participation. The second regression procedure conducted again entered all the subscales and predicted 15% of the variance in number of BBS observation conducted by employees. Self-efficacy feedback level was the only safety self-efficacy subscale entered into the equation that predicted a significant amount of variance (self-efficacy $\underline{R}^2$ = 4%)

in number of employee observations. For the safety stages of change, all three subscales (i.e., safety stages of change, safety stages of change for personal safety, and safety stages of change for actively caring) entered into the equation and each predicted significant portions of variance (see Table 30) in number of employee observations (stages of change combined $\underline{R}^2$ = 11%).

The analysis that examined each safety scale separately suggested safety stages of change accounted for more variance (26% for percent participation and 14% for number of BBS observations) than self-efficacy and outcome expectancy combined (6% for percent participation and 8% for number of BBS observations). Even though self-efficacy feedback level entered into the overall regression first, it contributed the least amount of unique variance (4% out of 15% total)..

To assess the differential effects of safety self-efficacy and safety stages of change further, a post-hoc regressions analysis was conducted using the stepwise entry method. The results were identical to the forward method of extraction (see Table 31); except during the last step, self-efficacy feedback level was removed from the equation decreasing the proportion of variance accounted for.

In summery, the safety stages of change scales accounted for more variance in employee observations than the self-efficacy scales. However, the variance accounted for in employee observations was very small (15%) and there was a low participation rate. Thus there was some support for the hypothesis that stated safety stages of change would be most predictive in assessing employee involvement in a BBS process, but clearly, there needs to be follow-up research to investigate if greater participation would influence the amount of variance explained by the scales.

IMPLICATIONS FOR INDUSTRIAL SAFETY RESEARCH

This research has many applications for improving safety and health interventions in the workplace. For example, if an organization wanted to use a BBS process where employee involvement is crucial, an assessment tool that predicted employee involvement and gave suggestions for a successful implementation would be greatly useful from cost-effectiveness perspective. In this regard, the current research provides useful information.

One way to improve intervention effectiveness is to segment your population into different groups depending upon certain criteria, and then target these groups with interventions designed specifically for their various levels. Segmentation analyses were conducted to assess the validity of categorizing employees into three groups for self-efficacy and outcome expectancy (low, medium, and high) and 5 groups (pre-contemplation, contemplation, preparation, action, and maintenance) for the safety stages of change.

For self-efficacy and outcome expectancy, the distribution of employee scale scores were divided into thirds and each employee was assigned to a group. However, before these scales could be used in an applied settings to function as an assessment tool, normative research would need to be completed to set classification criteria for the chosen groups. Again, these analyses were used to determine if involvement differed across the categories created.

With safety self-efficacy, for instance, the subscales self-efficacy strength and self-efficacy feedback level, the group assignment (low medium or high) influenced the amount of BBS involvement (i.e., percent participation and number of observations conducted). In general, employees in the high self-efficacy strength and high self-efficacy feedback level participated and completed more behavioral observation than employees who fell in the low or medium self-efficacy categories. Thus, for a possible application, safety professionals could administer a safety perception survey like safety self-efficacy and measure how many employees fall in the low and medium categories. Then, the safety professionals could use this information in three ways: a) to assess readiness for a safety initiative like BBS, b) to suggest areas for preparatory training/education for a new safety intervention, or c) to customize their safety approach for each of the groups identified.

For example, by using the Safety Self-Efficacy survey as a readiness measure, safety professionals could estimate how many people would fall in the high classification. If a significant number of the employees were categorized as high self-efficacy, the site's safety professional could expect sufficient involvement in a new safety initiative. On the other hand, if the Safety Self-Efficacy Survey revealed that a majority of employees were categorized as low to medium in self-efficacy feedback level, for example, the safety professional could provide specialized education and training sessions to give employees mastery experiences in giving their coworkers safety-related feedback before starting an organization-wide safety initiative. Another method would be to develop specialized safety education and training classes for self-efficacy each group identified.

PREDICTING INJURIES

Another goal of this research was to be able to predict injury rate. Only experimental site NP could supply their injury data. So, there was only injury data from 72 subjects. Out of those 72 employees, there were only 19 lost-time injuries 24 months prior to the initiation of the BBS process. The regression analysis conducted using the stepwise method of variable entry found only one subscale (stages of change for personal safety) to predict a significant amount of variance ($\underline{R}^2 = .07$) in injury rate. The relationship between stages of change for personal safety and injuries depicted in Figure 15.

Counter to Hypothesis H3.3 an inverse relationship will occur between employees' stage of change and injury statistics, there was a direct relationship between injury rate and stages of change. It was hypothesized that employees not even contemplating safety-related issues, for either personal safety or the safety of others, would have a greater frequency of injuries. However, Hypothesis H3.3 was based on predicting future injuries. Since there were no safety-related incidents within the first four months of the initiation of the BBS process, the data are from past injuries.

The direct relationship between stages of change for personal safety and "past" injuries actually makes intuitive sense. Since occupation injuries occur infrequently, employees rarely come in contact with the aversive consequences that accompany most occupational injuries. As such, the only consequences for taking shortcuts or not following safety procedures are an increase in convenience, comfort and time savings (Geller, 1996). As a result, employees often become habituated to risky situations they encounter on a daily basis. However, when employees suffer a work injury, the aversive consequences are immediate, usually severe, and often have lasting impact. Thus, the employees who have had injuries would be more likely to engage in self-protective behaviors (as measured by stages of change for personal safety) than employees who have never been injured.

LIMITATIONS & FUTURE RESEARCH

Employee Involvement

Future research can improve upon several limitations of the current study. One limitation of the current research was the relatively low percentage of employees involved in the BBS process. Although involvement was low for the two experimental sites (6% and 9%), from the author's experiences with other organizations, this is a common problem following the initial months of BBS implementation. Participation generally increases over time. The lack of initial participation is often due to the top-down enforcement context of standard safety programs.

Most industrial safety programs focus on holding employees accountable for following safety policies and procedures in an enforcement or compliance fashion. For example, safety signs used in industry typically try motivating employees by focusing on compliance with messages similar to “Hearing protection mandatory beyond this point” or “It is a safety violation to be in this area without wearing a hard hat.” The limited success of these enforcement campaigns (Bensley, & Wu, 1991; Guastello, 1993; Pirani & Reynolds, 1976) could be explained by psychological reactance (Brehm, 1966).

In general, people try to preserve their individual freedom or react to regain this sense of freedom. Consequently, when industrial safety programs focus on “top-down” mandates from management, employees may feel their freedom is being threatened and react to try and regain this lost sense of freedom by not participating or trying to sabotage the safety initiative. In point of fact, Roberts and Geller (1995) found psychological reactance to have a significant negative correlation ($\underline{r}^2 = -.38$) with participation in an industrial safety program. Thus, if employees have the perception that a safety process as mandatory and they are being forced to participate, they may feel reactance and not take part in the new safety initiative. They may view a BBS observation and feedback process as a “gotcha” or a “safety spy” program rather than a positive continuous improvement process.

However, a BBS process is designed and implemented by employees to create a sense of ownership interdependency (Geller, 1996; Geller 1998c) that motivates employees to feel responsible for the safety of themselves as well as the safety of their coworkers. Thus, the initial low percentage of employees participating in this current study may be due to reactance from the misperception that the BBS process was mandatory. Typically, once a BBS process is initiated and supported by employees, the percentage of people participating in the new safety process increases as employees realize the process is not a top-down safety initiative. Hence, future studies need to be more long-term and thereby show an increase in participation.

Regression Findings

Another limitation of the current research was the relatively low percentage of variance explained in the regression analyses (26% for employee participation percentage, 14% for number of employee observations, and 7% for number of lost-time injuries). Again, the low variance accounted for by the safety perception scales may be an artifact of low participation due to employees' perceptions that the BBS process was a top-down mandatory safety program.

Self-efficacy, outcome expectancy, and stages of change all focus on individual mastery of a behavioral domain. Most of the worksite health promotion programs, like smoking control and exercise management, focus on giving employees the needed tools to achieve individual behavior change (Opatz, 1994). Industrial safety programs differ in that most safety-related behaviors are dictated by the organization or OSHA, and are enforced by compliance techniques. If employees' primary motivation for participating in the BBS process was driven by external factors (i.e., complying with safety program) as opposed to internal factors (like self-efficacy, outcome expectancy, and their current stage of change), a low percentage of variance accounted for by self-efficacy and stages of change factors would be expected. Future studies should include questions to assess employees' motivation for participating in a safety process. The predictors studied in the present research should be relatively ineffective at accounting for the safety-related behaviors of other-directed employees who perform safety-related behaviors because someone else is holding them accountable. On the other hand, the self-efficacy and stages of change self-directed and responsible employees (Geller, 1998b) should be more predictive of safety-related behaviors and injuries.

SUMMARY & CONCLUSIONS

The current research accomplished two primary goals: 1) to develop questionnaires to measure employees' safety self-efficacy and safety stages of change, and 2) to compare the predictive effectiveness of the self-efficacy safety perception instruments. The safety surveys created had respectable reliability, strong face validity, and some predictive utility. The hypotheses regarding predictive validity were supported in that each scale (safety self-efficacy, safety outcome expectancy, and safety stages of change) separately predicted a significant proportion of variance in the involvement variables (i.e., participation and number of observations).

To accomplish the second goal of this research, multiple regression analyses were performed to assess which scales accounted for most variance in employee involvement (i.e., employee participation and number of observations). The results of the regression analyses suggested that safety stages of change accounted for more unique variance in the employee involvement variables than either safety self-efficacy or safety outcome expectancy. However, the low variance accounted for and the small number of people participating in the BBS intervention limits this conclusion.

In the segmentation analyses, all the scales provided useful trends and some significant results. By addressing some of the limitations, a clearer understanding of which variables are most predictive can be accomplished. The Safety Self-Efficacy, Safety Outcome Expectance, and Safety Stages of Change surveys all provided some initial support for the utility of using these concepts in an applied industrial setting. Future research should focus on validation studies to further assess the usefulness, appropriateness, and meaningfulness of the scales constructed for this research. Thus, by creating a better instrument to measure self-efficacy, outcome expectancy, and stages of change, these constructs can be further applied in the field of industrial safety to understand differential readiness for safety interventions and then to customize intervention approaches accordingly. With increased cost-effectiveness of safety interventions, we can come closer to reaching the ultimate objectives of proactively preventing all employee injuries.

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TABLE 1: MILESTONES IN OCCUPATIONAL SAFETY AND HEALTH

1713	Ramazzini publishes *De Morbis Artificum* (Disease of Workers).
1776	James Watt adapts the steam engine for use as a power source.
1793	Eli Whitney invents the cotton gin (the *Machine Age* begins).
1833	England – Government factory inspections established for industries.
1844	*Great Factory Act* - England enacts a law to provide better working conditions and machine guards for employees.
1867	Massachusetts – Institutes factory inspections.
1869	Germany - Acts pass requiring all employers furnish necessary appliances to safeguard health and life of employees.
1869	Massachusetts – Establishes the first state Bureau of Labor Statistics.
1877	Massachusetts – Law passes requiring guarding of dangerous moving machinery.
1880	England – *Employers' Liability Act* passes allowing families to recover damages for deaths caused by negligence.
1885	Germany – Enacts the first compulsory compensation act for workers. (i.e., worker compensation – but only covers sicknesses)
1885	Alabama – 1st U.S. Employers' Liability Statute passes (modeled after England's Employers' Liability Act)
1892	Illinois – Illinois Steel Company founds first safety department.
1911	Wisconsin – First state Workers' Compensation law passed.
1913	Wisconsin – First meeting of the National Safety Council.
1915	New York – American Society of Safety Engineers founded.
1941	All states (except Mississippi - 1949) have Workers' Compensation law.
1942	WWII contracted industries required to have formal safety programs.
1960	*Delayed Progress* – Noted increase in occupational injuries.
1970	Occupational Safety and Health Act creates OSHA and NIOSH.

Note. Adapted from Heinrich 1959; Heinrich, Petersen, & Roos 1980; Pease, 1985; Petersen, 1978; Raouf & Dhillon, 1994; Weindling, 1985, Wilson, 1985)

TABLE 2: INTERVENTION EFFECTIVENESS ACROSS PPE

Intervention Type →	Safety Poster		Safety Film		Fear Poster		Discussion w/ Leaders		Role Playing		Disciplinary Measures		TOTAL	
PPE for: ↓	**Int**	**Wdr**	**Int**	**Wdr**	**Int**	**Wdr**	**Int**	**Wdr**	**Int**	**Wdr**	**Int**	**Wdr**	**Int**	**Wdr**
Head	63%	23%	80%	16%	39%	2%	12%	-1%	74%	66%	43%	-10%	50%	15%
Hands	31%	1%	31%	10%	10%	5%	1%	-5%	63%	60%	46%	-21%	30%	7%
Eyes	72%	16%	45%	13%	47%	1%	28%	15%	88%	90%	34%	-3%	51%	20%
Feet	48%	8%	19%	7%	-2%	-10%	2%	2%	62%	62%	31%	5%	24%	11%
TOTAL	51%	11%	40%	11%	18%	-2%	9%	2%	71%	68%	39%	-7%	37%	13%

Note. Percent change from baseline (Int = intervention period; Wdr = 4-month withdrawal period) (adapted from Pirani & Reynolds, 1976)

TABLE 3: MOST COMMONLY CITED CATEGORIES OF WORKSITE HEALTH PROMOTION

Program	Prevalence in Industry
1. Smoking control	36%
2. Health risk assessment	29%
3. Back problem prevention and care	28%
4. Stress management	27%
5. Exercise and fitness	22%
6. Off-the-job injury prevention	20%
7. Nutrition education	17%
8. Blood pressure control	16%
9. Weight control	15%

Note. Table adapted from Opatz, 1994

TABLE 4: EFFECTIVENESS ACROSS INTERVENTION STRATEGIES

Safety Approach	Number of Studies	Number of Subjects	Average Reduction
1. Behavior-Based Safety	7	2,444	59.6%
2. Ergonomics	3	na	51.6%
3. Engineering Change	4	na	29.0%
4. Group Problem Solving	1	76	20.0%
5. Government Action (Finland)	2	na	18.3%
6. Management Audits	4	na	17.0%
7. Stress Management	2	1,300	15.0%
8. Poster Campaign	2	6,100	14.0%
9. Personnel Selection	26	19,177	3.7%
10. Near-Miss Reporting	2	na	0.0%

Note: adapted from Guastello, 1993

TABLE 5: MOST COMMONLY USED THEORIES AND MODELS IN 497 ARTICLES FROM 1992 TO 1994

Theory or Model	Number of Articles Using the Theory or Model
1. Health Belief Model	100
2. Social Cognitive Theories/Social Learning Theory	74
3. Self-Efficacy	74
4. Reasoned Action/Planned Behavior	66
5. Community organization	50
6. Stages of Change/Transtheoretical Model of Change	50
7. Social Marketing	44
8. Social Networks & Social Support	37
9. Precede-Proceed Model	28
10. Diffusion of Innovation Theory	27
11. Stress and coping	24
12. Relapse prevention	23
13. Economic models	21
14. Information processing	21
15. Health Locus of Control	21
16. Patient-provider interaction	18
17. Empowerment	17
18. Protection-Motivation Theory	10
19. Behavioral Theory	10
20. Communication theory, persuasive communication	9

Note: Adapted from Glanz, Lewis, & Rimer, 1997

TABLE 6: PSYCHOSOCIAL DETERMINANTS OF HEALTH BEHAVIOR

		Outcome Expectations:			**Goals:**		**Impediments:**	
Theories:	Self-Efficacy	Physical	Social	Self-Evaluative	Proximal	Distal	Personal & Situational	Health System
Social Cognitive Theory	✓	✓	✓	✓	✓	✓	✓	✓
Health Belief Model		✓	✓				✓	✓
Theory Of Reasoned Action		✓	✓		✓			
Theory Of Planned Behavior	✓	✓	✓		✓			
Protective Motivation Theory	✓	✓						

<u>Note:</u> Adapted from Bandura, 1997)

TABLE 7: STAGES AND PROCESSES OF CHANGE

Stages of Change	Description
Precontemplation	- Has no intention to take action within the next 6 months
Contemplation	- Intends to take action within the next 6 months
Preparation	- Intends to take action within the next 30 days and has taken some behavioral steps in this direction
Action	- Has changed overt behavior for less than 6 months
Maintenance	- Has changed overt behavior for more than 6 months

Process of Change	Description
Consciousness raising	- Finding and learning new facts, ideas, and tips that support theı healthy behavioral change
Dramatic relief	- Experiencing the negative emotions (fear, anxiety, worry) that go along with unhealthy behavioral risks
Self-reevaluation	- Realizing that the behavioral change is an important part of one's identity as a person
Environmental reevaluation	- Realizing the negative impact of the unhealthy behavior or the positive impact of the healthy behavior on one's proximal social and physical environment
Self-liberation	- Making a firm commitment to change
Helping relationships	- Seeking and using social support for the healthy behavioral change
Counterconditioning	- Substituting healthier alternative behaviors and cognitions for the unhealthy behaviors
Contingency management	- Increasing the rewards for the positive behavioral change and decreasing the rewards of the unhealthy behavior
Stimulus control	- Removing reminders or cues to engage in the unhealthy behavior and adding cues or reminders to engage in the healthy behavior
Social liberation	- Realizing that the social norms are changing in the direction of supporting the healthy behavioral change

Note: Adapted from Prochaska, Redding, & Evers, 1997

TABLE 8: SAFETY STAGES OF CHANGE

Stages of Change	Description
Precontemplation	- Is not aware of the risky habit (Risky habit/automatic behavior)
Contemplation	- Realizes risk but continues with behavior (irresponsible)
Action other-directed	- No longer performs risky behavior but requires external motivation to maintain safe behavior (accountable)
Action self-directed	- No longer performs risky behavior and is internally motivated to maintain safe behavior (responsible)
Maintenance	- Performs safe behavior habitually (safe habit/automatic behavior)

Note: **A**dapted from Prochaska, Redding, & Evers, 1997)

TABLE 9: RESULTS FROM THE PRELIMINARY VERSION OF THE SAFETY STAGES OF CHANGE

	Safety Stages of Change							
	Precontemplation		Contemplation		Action		Maintenance	
Behavior	M	n	M	n	M	n	M	n
Lockout/Tagout	2%	6	27%	95	15%	53	56%	196
PPE	1%	5	9%	30	12%	42	78%	273
Lifting	6%	20	13%	46	24%	84	57%	200

TABLE 10: HYPOTHESIZED SAFETY SELF-EFFICACY SUBSCALES.

Subscale 1: Safety Self-Efficacy Strength

SE 1. Follow safety procedures when there is a large production demand

SE 2. Identify a risky work behavior of a coworker

SE 3. Skip safety procedures and not get hurt

SE 4. Look out for the safety of myself

SE 5. Wear all of the required personal protective equipment (PPE) consistently

SE 6. Use the correct lifting procedures

SE 7. Keep my work area clean

SE 8. Look out for the safety of my coworkers

SE 9. Keep a safe pace of work and still get the job done on time

SE 10. Follow all safety procedures when others are not

SE 11. Deal with most safety issues

SE 12. Help a coworker do a job more safely

Subscale 2: Self-Efficacy Level

***How confident are you in giving the following people feedback about their personal safety:*

SE 13. A team member in your work area

SE 14. Someone working outside your work area

SE 15. A supervisors/manager

***How confident are you in using a checklist to observe the safety-related behaviors of the following individuals:*

SE 16. A team member in your work area

SE 17. Someone working outside your work area

SE 18. A supervisors/manager

***How confident are you in stopping the following individuals if you think they are doing something risky:*

SE 19. A team member in your work area

SE 20. Someone working outside your work area

SE 21. A supervisors/manager

SE 22. A coworker with more experience on the job than you

TABLE 11: HYPOTHESIZED OUTCOME EXPECTANCY SUBSCALE.

Subscale 3: Outcome Expectancy

***If I skip safety rules:*

OE 1. I will get a reprimand/or be written up

OE 2. People won't respect me

OE 3. It is more convenient or easier to do my job

OE 4. I will feel disappointed in myself

OE 5. I will feel more comfortable

OE 6. I will save time

OE 7. I will be injured

***If I use a checklist to observe the safety-related behaviors of my coworkers:*

OE 8. They will appreciate it

OE 9. I will feel good about myself

OE 10. I will reduce the chance my coworker will get hurt

OE 11. I will feel like I am helping others be safe

OE 12. It will take too long

OE 13. Coworkers will think less of me

***If I give coworkers safety-related feedback:*

OE 14. They won't care or listen to the feedback

OE 15. I will help others remain safe

OE 16. It will take too long

OE 17. They will appreciate the feedback

OE 18. They will get angry with me

OE 19. It will make me feel good about myself

TABLE 12: HYPOTHESIZED SAFETY STAGES OF CHANGE SUBSCALES.

Subscale 4: Safety Stages of Change for Personal Safety
SOC 1.I wear all of my required PPE.

SOC 2.I am concerned about pinch points while working.

SOC 3.I think about the safe methods of lifting.

Subscale 5: Safety Stages of Change for Actively Caring Behaviors
SOC 4.I observe coworkers safety-related behaviors.

SOC 5.I caution my coworkers if they are doing something risky.

SOC 6.I give my coworkers safety-related feedback.

TABLE 13: SAFETY SELF-EFFICACY FACTORS.

Factor 1: Safety Self-Efficacy Strength

SE 1. Follow safety procedures when there is a large production demand

SE 2. Identify a risky work behavior of a coworker

SE 4. Look out for the safety of myself

SE 5. Wear all of the required personal protective equipment (PPE) consistently

SE 6. Use the correct lifting procedures

SE 7. Keep my work area clean

SE 8. Look out for the safety of my coworkers

SE 9. Keep a safe pace of work and still get the job done on time

SE 10. Follow all safety procedures when others are not

SE 11. Deal with most safety issues

SE 12. Help a coworker do a job more safely

***OE 3.** I will get a reprimand if I skip safety rules

Factor 2: Self-Efficacy Feedback Level

**How confident are you in giving the following people feedback about their personal safety:

SE 13. A team member in your work area

SE 14. Someone working outside your work area

SE 15. A supervisors/manager

**How confident are you in stopping the following individuals if you think they are doing something risky:

SE 19. A team member in your work area

SE 20. Someone working outside your work area

SE 21. A supervisors/manager

SE 22. A coworker with more experience on the job than you

Factor 3: Self-Efficacy Checklist Level

**How confident are you in using a checklist to observe the safety-related behaviors of the following individuals:

SE 16. A team member in your work area

SE 17. Someone working outside your work area

SE 18. A supervisors/manager

TABLE 14: OUTCOME EXPECTANCY FACTORS.

Outcome Expectancy

Factor 4: Social/Self-evaluative	**Factor 5: physical/negative social**
****If I skip safety rules:**	
OE 2. People won't respect me OE 4. I will feel disappointed in myself OE 7. I will be injured	OE 3. It is more convenient or easier to do my job OE 5. I will feel more comfortable OE 6. I will save time ***SE 3.** Skip safety procedures and not get hurt
****If I use a checklist to observe the safety-related behaviors of my coworkers:**	
OE 8. They will appreciate it OE 9. I will feel good about myself OE 10. I will reduce the chance my coworker will get hurt OE 11. I will feel like I am helping others be safe	OE 12. It will take too long OE 13. Coworkers will think less of me
****If I give coworkers safety-related feedback:**	
OE 15. I will help others remain safe OE 17. They will appreciate the feedback OE 19. It will make me feel good about myself	OE 14. They won't care or listen to the feedback OE 16. It will take too long OE 18. They will get angry with me

TABLE 15: SAFETY STAGES OF CHANGE FACTOR.

Factor 6: Safety Stages of Change

SOC 1. I wear all of my required PPE. (DELETED)

SOC 2. I am concerned about pinch points while working.

SOC 3. I think about the safe methods of lifting.

SOC 4. I observe coworkers safety-related behaviors.

SOC 5. I caution my coworkers if they are doing something risky.

SOC 6. I give my coworkers safety-related feedback.

TABLE 16: ALPHA SCORES FOR FACTORS.

Factors	Alpha
1. Safety Self-Efficacy Strength	.87
2. Self-Efficacy Feedback Level	.93
3. Self-Efficacy Checklist Level	.94
4. Social/Self-evaluative OE	.88
5. Physical/Negative Social OE	.76
6. Safety Stages of Change	.79

TABLE 17: SUMMARY OF INDEPENDENT AND DEPENDENT VARIABLES.

Independent Variables	Sub-Scales	Score (scale)
Self-Efficacy:	Safety Self-Efficacy Strength	Interval scale assessing confidence from 0 to 100
	Self-Efficacy Feedback Level	Interval scale assessing confidence from 0 to 100
	Self-Efficacy Checklist Level	Interval scale assessing confidence from 0 to 100
Outcome Expectancy:	Social/Self-evaluative OE	Interval scale assessing certainty from 0 to 100
	Physical/Negative Social OE	Interval scale assessing certainty from 0 to 100
Stages of Change:	Safety Stages of Change	Ordinal scale ranging from 1 to 7 reflecting stage of safety
	Safety Stages of Change for Personal Safety	Ordinal scale ranging from 1 to 7 reflecting stage of safety
	Safety Stages of Change for Actively Caring	Ordinal scale ranging from 1 to 7 reflecting stage of safety

Dependent Variable	Definition	Score (scale)
Participation:	An employee turning in at least one safety observation checklist within the first four months of the BBS implementation.	Nominal scale: participated YES or NO
Observations:	Number of safety observation checklists completed and turned into the safety steering team within the first four months of the BBS implementation.	Ratio scale: actual number of observations per employee
Injuries:[a]	A recorded lost-time or OSHA incident.	Ratio scale: actual number of observations per employee

Notes: [a]Only experimental site NP provided injury statistics.

TABLE 18: MEAN RESPONSE FOR EACH SAFETY SUBSCALE.

Subscales	M	SD	n
Self-Efficacy			
SE Strength	83.75	8.70	303
SE Feedback	79.13	17.16	303
SE Checklist	78.08	21.96	303
Outcome Expectancy			
OE Social	64.67	17.23	301
OE Physical	60.09	16.03	301
Stages of Change			
SOC	3.59	0.68	300
SOC Self	3.99	0.78	300
SOC AC	3.46	0.80	300

Note:
SE = self-efficacy
OE = outcome expectancy
SOC Self = safety stages of change for personal safety;
SOC = safety stages of change;
SOC AC = safety stages of change for actively caring.

TABLE 19: MULTIPLE COMPARISONS BETWEEN THE SUBSCALES OF THE SAFETY SELF-EFFICACY SCALE.

(I) SE Subscales	(J) SE Subscales	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
SE Strength	SE Feedback	4.63*	1.37	.002	1.34	7.91
	SE Checkllist	5.67*	1.37	.000	2.38	8.95
SE Feedback	SE Strength	-4.63*	1.37	.002	-7.91	-1.34
	SE Checkllist	1.04	1.37	1.000	-2.24	4.33
SE Checkllist	SE Strength	-5.67*	1.37	.000	-8.95	-2.38
	SE Feedback	-1.04	1.37	1.000	-4.33	2.24

Based on observed means.

*. The mean difference is significant at the .05 level.

Note:
SE = self-efficacy

TABLE 20: MULTIPLE COMPARISONS BETWEEN THE SUBSCALES OF THE SAFETY STAGES OF CHANGE SCALE.

(I) SOC Type	(J) SOC Type	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
SOC	SOC Self	-.40*	6.17E-02	.000	-.54	-.25
	SOC AC	.13	6.17E-02	.115	-2.01E-02	.28
SOC Self	SOC	.40*	6.17E-02	.000	.25	.54
	SOC AC	.52*	6.17E-02	.000	.38	.67
SOC AC	SOC	-.13	6.17E-02	.115	-.28	2.01E-02
	SOC Self	-.52*	6.17E-02	.000	-.67	-.38

Based on observed means.

*. The mean difference is significant at the .05 level.

Note:

SOC = safety stages of change;
SOC Self = safety stages of change for personal safety;
SOC AC = safety stages of change for actively caring.

TABLE 21: PARTICIPATION IN BBS PROCESS BY SITE.

	Participation[a]		Observations[b]	
Site		n	M	SD
TK	Yes	20	5.25	6.67
	No	192		
	Total	212		
NP	Yes	48	5.98	5.39
	No	26		
	Total	74		
Total	Yes	68	5.76	5.75
	No	218		
	Total	285		

[a] defined as completing at least one safety observation
[b] average number of safety observations completed

TABLE 22: AVERAGE NUMBER OF OBSERVATIONS BY GENDER ACROSS SITES.

	Observations		
Gender	n	M	SD
Female	87	.80	2.19
Male	203	1.59	4.16
Total	290	1.35	3.70

TABLE 23: SUMMARY RESULTS FROM A SITE BY GENDER ANOVA FOR OBSERVATIONS.

Source	SS	df	MSE	F	p
Site	2.170	1	2.170	.068	.795
Gender	161.880	1	161.880	5.072	.028
Site * Gender	28.226	1	28.226	.884	.351
Error	2042.684	64	31.917		
Total	4476.000	68			
Corrected Total	2216.235	67			

TABLE 24: AVERAGE NUMBER OF OBSERVATIONS: SITE BY GENDER.

		Participation		Observations	
Site	Gender	Yes/No	n	M	SD
TK	Female	Yes	9	2.44	1.59
		No	62		
		Total	71		
	Male	Yes	11	7.55	8.35
		No	130		
		Total	141		
	Total	Yes	20	5.25	6.67
		No	192		
		Total	212		
NP	Female	Yes	11	4.36	4.32
		No	4		
		Total	15		
	Male	Yes	37	6.46	5.63
		No	22		
		Total	59		
	Total	Yes	48	5.98	5.39
		No	26		
		Total	74		
Total	Female	Yes	20	3.50	3.44
		No	66		
		Total	86		
	Male	Yes	48	6.71	6.27
		No	152		
		Total	200		
	Total	Yes	68	5.76	5.75
		No	218		
		Total	286		

TABLE 25: CORRELATIONS BETWEEN DEPENDENT VARIABLES AND SAFETY SUBSCALES.

	Dependent Variables			Safety Self-Efficacy			Outcome Expectancy		Stages of Change		
	1	2	3	4	5	6	7	8	9	10	11
1. Injuries	–	-.018	-.046	.040	-.156	-.265*	.115	.156	.197	.264*	.057
2. Observations		–	.662**	.148**	.186**	.135*	.113	.121*	.060	-.181**	.108
3. Participation			–	.170**	.205**	.117*	.092	.192**	-.015	-.288**	.039
4. SE for Safety				–	.489**	.464**	.501**	.264**	.282**	.144*	.193**
5. SE Feedback Level					–	.587**	.368**	.297**	.254**	.033	.248**
6. SE Checklist Level						–	.449**	.266**	.124*	.014	.131*
7. OE Social/Eval							–	.246	.296**	.164**	.250**
8. OE Phys/Neg								–	.080	-.008	.042
9. SOC									–	.666**	.864**
10. SOC Self										–	.269**
11. SOC AC											–

<u>Notes:</u> Injuries <u>N</u> = 72; all other items <u>N</u> = 303
SE = self-efficacy
OE = Outcome Expectancy
SOC Self = safety stages of change for personal safety;
SOC = safety stages of change;
SOC AC = safety stages of change for actively caring.
* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).

TABLE 26: REGRESSION SUMMARY WITH SELF-EFFICACY STRENGTH, SELF-EFFICACY FEEDBACK LEVEL, AND SELF-EFFICACY CHECKLIST LEVEL AS THE INDEPENDENT VARIABLES WITH PARTICIPATION AND OBSERVATIONS AS THE DEPENDENT VARIABLES.

Participation

				Change Statistics		
Model	R	R^2	Adj. R^2	R^2	F	p
SE Feedback Level	.205	.042	.039	.042	13.27	.000

Number of Observations

				Change Statistics		
Model	R	R^2	Adj. R^2	R^2	F	p
SE Feedback Level	.186	.035	.031	.035	10.79	.001

SE = self-efficacy

TABLE 27: REGRESSION SUMMARY WITH SOCIAL/SELF-EVALUATIVE OUTCOME EXPECTANCY AND PHYSICAL/NEGATIVE OUTCOME EXPECTANCY AS THE INDEPENDENT VARIABLES WITH PARTICIPATION AND OBSERVATIONS AS THE DEPENDENT VARIABLES.

Participation

				Change Statistics		
Model	R	R^2	Adj. R^2	R^2	F	p
SE Feedback Level	.192	.037	.034	.037	11.47	.001

Number of Observations

				Change Statistics		
Model	R	R^2	Adj. R^2	R^2	F	p
Physical/Negative OE	.121	.015	.011	.015	4.442	.036

OE = Outcome Expectancy

TABLE 28: REGRESSION SUMMARY WITH SAFETY STAGES OF CHANGE, SAFETY STAGES OF CHANGE FOR PERSONAL SAFETY, AND SAFETY STAGES OF CHANGE FOR ACTIVELY CARING AS THE INDEPENDENT VARIABLES WITH OBSERVATIONS AS THE DEPENDENT VARIABLE.

Participation

				Change Statistics		
Model	R	R^2	Adj. R^2	R^2	F	p
SOC Self	.288	.083	.080	.083	26.99	.000
SOC	.373	.139	.133	.056	19.36	.000
SOC AC	.507	.257	.249	.118	46.79	.000

Number of Observations

				Change Statistics		
Model	R	R^2	Adj. R^2	R^2	F	p
SOC Self	.181	.033	.030	.033	10.112	.002
SOC	.302	.091	.085	.058	19.063	.000
SOC AC	.374	.140	.131	.049	16.820	.000

SOC Self = safety stages of change for personal safety;
SOC = safety stages of change;
SOC AC = safety stages of change for actively caring.

TABLE 29: FORWARD REGRESSION SUMMARY WITH SUBSCALES FROM SELF-EFFICACY, OUTCOME EXPECTANCY, AND STAGES OF CHANGE, AS THE INDEPENDENT VARIABLES WITH PARTICIPATION AS THE DEPENDENT VARIABLE.

				Change Statistics		
Model	R	R^2	Adj. R^2	R^2	F	p
SOC Self	.291	.085	.081	.085	27.346	.000
SOC	.291	.141	.135	.056	19.201	.000
SOC AC	.505	.255	.248	.115	45.405	.000

SOC Self = safety stages of change for personal safety;
SOC = safety stages of change;
SOC AC = safety stages of change for actively caring.

TABLE 30: FORWARD REGRESSION SUMMARY WITH SUBSCALES FROM SELF-EFFICACY, OUTCOME EXPECTANCY, AND STAGES OF CHANGE, AS THE INDEPENDENT VARIABLES WITH NUMBER OF OBSERVATIONS AS THE DEPENDENT VARIABLE.

				Change Statistics		
Model	R	R^2	Adj. R^2	R^2	F	p
SE Feedback Level	.187	.035	.032	.035	10.719	.001
SOC Self	.266	.071	.064	.036	11.314	.001
SOC	.327	.107	.098	.036	11.965	.001
SOC AC	.384	.147	.136	.040	13.854	.000

SE = self-efficacy
SOC Self = safety stages of change for personal safety;
SOC = safety stages of change;
SOC AC = safety stages of change for actively caring.

TABLE 31: STEPWISE REGRESSION SUMMARY WITH SUBSCALES FROM SELF-EFFICACY, OUTCOME EXPECTANCY, AND STAGES OF CHANGE, AS THE INDEPENDENT VARIABLES WITH NUMBER OF OBSERVATIONS AS THE DEPENDENT VARIABLE.

				Change Statistics		
Model	R	R^2	Adj. R^2	R^2	F	p
SE Feedback Level	.187	.035	.032	.035	10.719	.001
SOC Self	.266	.071	.064	.036	11.314	.001
SOC	.327	.107	.098	.036	11.965	.001
SOC AC	.384	.147	.136	.040	13.854	.000
(SE Feedback Level)[a]	.373	.139	.131	-.008	2.708	.101

[a]Variable was removed from analysis.
SE = self-efficacy
SOC Self = safety stages of change for personal safety;
SOC = safety stages of change;
SOC AC = safety stages of change for actively caring.

TABLE 32: FORWARD REGRESSION SUMMARY WITH SUBSCALES FROM SELF-EFFICACY, OUTCOME EXPECTANCY, AND STAGES OF CHANGE, AS THE INDEPENDENT VARIABLES WITH INJURIES AS THE DEPENDENT VARIABLE.

				Change Statistics		
Model	R	R^2	Adj. R^2	R^2	F	p
SOC Self	.264	.070	.056	.070	5.186	.026

SOC Self = safety stages of change for personal safety;

TABLE 33: SEGMENTATION RESULTS FROM THE SAFETY SELF-EFFICACY SUBSCALES.

	Self-Efficacy Categories		
Subscale	Low	Med	High
Participation:			
SE Strength			
n	101	101	101
M	0.17	0.15	0.37
SD	0.38	0.36	0.48
SE Feedback			
n	101	109	93
M	0.12	0.28	0.28
SD	0.33	0.45	0.45
SE Checklist			
n	94	117	92
M	0.16	0.23	0.29
SD	0.37	0.42	0.46
Observations:			
SE Strength			
n	101	101	101
M	0.79	0.96	2.15
SD	2.42	3.07	4.83
SE Feedback			
n	101	109	93
M	0.53	1.25	2.19
SD	2.26	2.80	5.19
SE Checklist			
n	94	117	92
M	0.76	1.23	1.95
SD	2.53	3.62	4.44
Injuries:			
SE Strength			
n	19	20	33
M	0.74	0.30	0.48
SD	1.28	0.66	0.87
SE Feedback			
n	16	28	28
M	0.69	0.39	0.50
SD	1.25	0.79	0.92
SE Checklist			
n	19	30	23
M	0.84	0.43	0.30
SD	1.26	0.86	0.70

TABLE 34:
Multiple Comparisons Between the Categories of the Safety Self-Efficacy Scale.

Dependent Variable	(I) SE H-M-L	(J) SE H-M-L	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	Upper Bound
Injuries	Low SE	Med SE	.4368	.3040	.466	-.3091	1.1827
		High SE	.2520	.2733	1.000	-.4185	.9225
	Med SE	Low SE	-.4368	.3040	.466	-1.1827	.3091
		High SE	-.1848	.2689	1.000	-.8446	.4749
	High SE	Low SE	-.2520	.2733	1.000	-.9225	.4185
		Med SE	.1848	.2689	1.000	-.4749	.8446
Observations	Low SE	Med SE	-.17	.50	1.000	-1.38	1.05
		High SE	-1.36*	.50	.023	-2.57	-.14
	Med SE	Low SE	.17	.50	1.000	-1.05	1.38
		High SE	-1.19	.50	.058	-2.40	2.67E-02
	High SE	Low SE	1.36*	.50	.023	.14	2.57
		Med SE	1.19	.50	.058	-2.67E-02	2.40
Participation	Low SE	Med SE	1.98E-02	5.77E-02	1.000	-.12	.16
		High SE	-.20*	5.77E-02	.002	-.34	-5.92E-02
	Med SE	Low SE	-1.98E-02	5.77E-02	1.000	-.16	.12
		High SE	-.22*	5.77E-02	.001	-.36	-7.90E-02
	High SE	Low SE	.20*	5.77E-02	.002	5.92E-02	.34
		Med SE	.22*	5.77E-02	.001	7.90E-02	.36

*. The mean difference is significant at the .05 level.

Note: SE = self-efficacy strength

Dependent Variable	(I) SE Feedback Level	(J) SE Feedback Level	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	Upper Bound
Injuries	Low SE Feedback	Med SE Feedback	.2946	.2997	.987	-.4408	1.0301
		High SE Feedback	.1875	.2997	1.000	-.5480	.9230
	Med SE Feedback	Low SE Feedback	-.2946	.2997	.987	-1.0301	.4408
		High SE Feedback	-.1071	.2556	1.000	-.7343	.5201
	High SE Feedback	Low SE Feedback	-.1875	.2997	1.000	-.9230	.5480
		Med SE Feedback	.1071	.2556	1.000	-.5201	.7343
Observations	Low SE Feedback	Med SE Feedback	-.71	.49	.449	-1.90	.48
		High SE Feedback	-1.66*	.51	.004	-2.90	-.42
	Med SE Feedback	Low SE Feedback	.71	.49	.449	-.48	1.90
		High SE Feedback	-.95	.50	.186	-2.16	.27
	High SE Feedback	Low SE Feedback	1.66*	.51	.004	.42	2.90
		Med SE Feedback	.95	.50	.186	-.27	2.16
Participation	Low SE Feedback	Med SE Feedback	-.17*	5.72E-02	.012	-.30	-2.78E-02
		High SE Feedback	-.16*	5.95E-02	.022	-.30	-1.74E-02
	Med SE Feedback	Low SE Feedback	.17*	5.72E-02	.012	2.78E-02	.30
		High SE Feedback	4.83E-03	5.85E-02	1.000	-.14	.15
	High SE Feedback	Low SE Feedback	.16*	5.95E-02	.022	1.74E-02	.30
		Med SE Feedback	-4.83E-03	5.85E-02	1.000	-.15	.14

*. The mean difference is significant at the .05 level.

Note: SE Feedback= self-efficacy feedback level

TABLE 35: SEGMENTATION RESULTS FROM THE SAFETY OUTCOME EXPECTANCY SUBSCALES.

		Outcome Expectancy Categories	
Subscale	Low	Med	High
Participation:			
OE Social			
n	101	95	105
M	0.19	0.19	0.30
SD	0.39	0.39	0.46
OE Physical			
n	103	98	100
M	0.15	0.22	0.32
SD	0.35	0.42	0.47
Observations:			
OE Social			
n	101	95	105
M	0.94	0.88	2.05
SD	2.82	2.81	4.74
OE Physical			
n	103	98	100
M	0.75	1.31	1.89
SD	2.97	3.55	4.24
Injuries:			
OE Social			
n	26	20	26
M	0.27	0.75	0.54
SD	0.60	1.33	0.86
OE Physical			
n	19	21	32
M	0.53	0.19	0.69
SD	0.90	0.51	1.15

TABLE 36: MULTIPLE COMPARISONS BETWEEN THE SUBCATEGORIES FROM THE SAFETY OUTCOME EXPECTANCY SCALE.

Dependent Variable	(I) OE Physical	(J) OE Physical	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Injuries	Low OE Physical	Med OE Physical	.3358	.2973	.788	-.3937	1.0654
		High OE Physical	-.1612	.2720	1.000	-.8286	.5062
	Med OE Physical	Low OE Physical	-.3358	.2973	.788	-1.0654	.3937
		High OE Physical	-.4970	.2637	.191	-1.1441	.1501
	High OE Physical	Low OE Physical	.1612	.2720	1.000	-.5062	.8286
		Med OE Physical	.4970	.2637	.191	-.1501	1.1441
Observations	Low OE Physical	Med OE Physical	-.56	.51	.824	-1.79	.67
		High OE Physical	-1.14	.51	.076	-2.36	8.00E-02
	Med OE Physical	Low OE Physical	.56	.51	.824	-.67	1.79
		High OE Physical	-.58	.51	.771	-1.82	.65
	High OE Physical	Low OE Physical	1.14	.51	.076	-8.00E-02	2.36
		Med OE Physical	.58	.51	.771	-.65	1.82
Participation	Low OE Physical	Med OE Physical	-7.89E-02	5.87E-02	.541	-.22	6.26E-02
		High OE Physical	-.17*	5.84E-02	.009	-.32	-3.37E-02
	Med OE Physical	Low OE Physical	7.89E-02	5.87E-02	.541	-6.26E-02	.22
		High OE Physical	-9.55E-02	5.92E-02	.323	-.24	4.69E-02
	High OE Physical	Low OE Physical	.17*	5.84E-02	.009	3.37E-02	.32
		Med OE Physical	9.55E-02	5.92E-02	.323	-4.69E-02	.24

*. The mean difference is significant at the .05 level.

Note: OE Physical = physical/negative outcome expectancy

Dependent Variable	(I) OE Social	(J) OE Social	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Injuries	Low OE Social	Med OE Social	-.4808	.2804	.273	-1.1688	.2073
		High OE Social	-.2692	.2615	.920	-.9108	.3724
	Med OE Social	Low OE Social	.4808	.2804	.273	-.2073	1.1688
		High OE Social	.2115	.2804	1.000	-.4765	.8996
	High OE Social	Low OE Social	.2692	.2615	.920	-.3724	.9108
		Med OE Social	-.2115	.2804	1.000	-.8996	.4765
Observations	Low OE Social	Med OE Social	5.64E-02	.52	1.000	-1.18	1.30
		High OE Social	-1.11	.50	.085	-2.32	.10
	Med OE Social	Low OE Social	-5.64E-02	.52	1.000	-1.30	1.18
		High OE Social	-1.16	.51	.070	-2.39	6.61E-02
	High OE Social	Low OE Social	1.11	.50	.085	-.10	2.32
		Med OE Social	1.16	.51	.070	-6.61E-02	2.39
Participation	Low OE Social	Med OE Social	-1.35E-03	5.99E-02	1.000	-.15	.14
		High OE Social	-.12	5.84E-02	.140	-.26	2.39E-02
	Med OE Social	Low OE Social	1.35E-03	5.99E-02	1.000	-.14	.15
		High OE Social	-.12	5.93E-02	.158	-.26	2.75E-02
	High OE Social	Low OE Social	.12	5.84E-02	.140	-2.39E-02	.26
		Med OE Social	.12	5.93E-02	.158	-2.75E-02	.26

Note: OE Social = social/self-evaluative outcome expectancy

TABLE 37: SEGMENTATION RESULTS FROM THE SAFETY STAGES OF CHANGE SUBSCALES.

	Stages of Change				
Subscale	Pre-Contemplation	Contemplation	Preparation	Action	Maintenance
	Participation:				
SOC					
n	3	41	157	91	8
M	0.00	0.24	0.24	0.21	0.25
SD	0.00	0.43	0.43	0.41	0.46
SOC Self					
n	2	36	64	167	31
M	0.50	0.50	0.33	0.14	0.13
SD	0.71	0.51	0.47	0.35	0.34
SOC AC					
n	6	58	138	85	13
M	0.33	0.21	0.22	0.25	0.23
SD	0.52	0.41	0.41	0.43	0.44
	Observations:				
SOC					
n	3	41	157	91	8
M	0.00	1.00	1.33	1.30	2.88
SD	0.00	2.62	3.27	4.23	7.36
SOC Self					
n	2	36	64	167	31
M	1.50	2.97	2.13	0.59	1.52
SD	2.12	4.66	4.72	2.11	5.24
SOC AC					
n	6	58	138	85	13
M	1.00	1.12	1.01	1.65	3.15
SD	1.67	2.93	2.74	4.52	7.30
	Injuries:				
SOC					
n	0	13	47	11	0
M	.	0.15	0.47	1.09	
SD	.	0.38	0.83	1.58	.
SOC Self					
n	1	25	27	18	0
M	0.00	0.32	0.44	0.89	.
SD	0.00	0.69	0.93	1.23	.
SOC AC					
n	2	15	32	21	1
M	0.00	0.47	0.56	0.52	0.00
SD	0.00	0.74	0.98	1.12	0.00

TABLE 38: MULTIPLE COMPARISONS BETWEEN THE SUBCATEGORIES FROM THE SAFETY STAGES OF CHANGE.

Dependent Variable	(I) SOC Self	(J) SOC Self	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Observations	1	2	-1.47	2.58	1.000	-8.78	5.83
		3	-.63	2.55	1.000	-7.85	6.60
		4	.91	2.53	1.000	-6.24	8.07
		5	-1.61E-02	2.59	1.000	-7.35	7.32
	2	1	1.47	2.58	1.000	-5.83	8.78
		3	.85	.74	1.000	-1.25	2.94
		4	2.39*	.65	.003	.54	4.23
		5	1.46	.87	.958	-1.01	3.92
	3	1	.63	2.55	1.000	-6.60	7.85
		2	-.85	.74	1.000	-2.94	1.25
		4	1.54*	.52	.035	5.95E-02	3.02
		5	.61	.78	1.000	-1.59	2.81
	4	1	-.91	2.53	1.000	-8.07	6.24
		2	-2.39*	.65	.003	-4.23	-.54
		3	-1.54*	.52	.035	-3.02	-5.95E-02
		5	-.93	.70	1.000	-2.90	1.04
	5	1	1.61E-02	2.59	1.000	-7.32	7.35
		2	-1.46	.87	.958	-3.92	1.01
		3	-.61	.78	1.000	-2.81	1.59
		4	.93	.70	1.000	-1.04	2.90
Participation	1	2	.00	.29	1.000	-.83	.83
		3	.17	.29	1.000	-.64	.99
		4	.36	.29	1.000	-.45	1.16
		5	.37	.29	1.000	-.46	1.20
	2	1	.00	.29	1.000	-.83	.83
		3	.17	8.37E-02	.410	-6.49E-02	.41
		4	.36*	7.38E-02	.000	.15	.57
		5	.37*	9.85E-02	.002	9.25E-02	.65
	3	1	-.17	.29	1.000	-.99	.64
		2	-.17	8.37E-02	.410	-.41	6.49E-02
		4	.18*	5.91E-02	.020	1.73E-02	.35
		5	.20	8.79E-02	.243	-4.96E-02	.45
	4	1	-.36	.29	1.000	-1.16	.45
		2	-.36*	7.38E-02	.000	-.57	-.15
		3	-.18*	5.91E-02	.020	-.35	-1.73E-02
		5	1.47E-02	7.86E-02	1.000	-.21	.24
	5	1	-.37	.29	1.000	-1.20	.46
		2	-.37*	9.85E-02	.002	-.65	-9.25E-02
		3	-.20	8.79E-02	.243	-.45	4.96E-02
		4	-1.47E-02	7.86E-02	1.000	-.24	.21

*. The mean difference is significant at the .05 level.

Note: 1=Pre-Contemplation; 2=Contemplation; 3=Preparation; 4=Action; 5=Maintenance.

FIGURE 1: HISTORICAL FLOW CHART OF OCCUPATIONAL SAFETY AND HEALTH

The History of Occupational Safety & Health

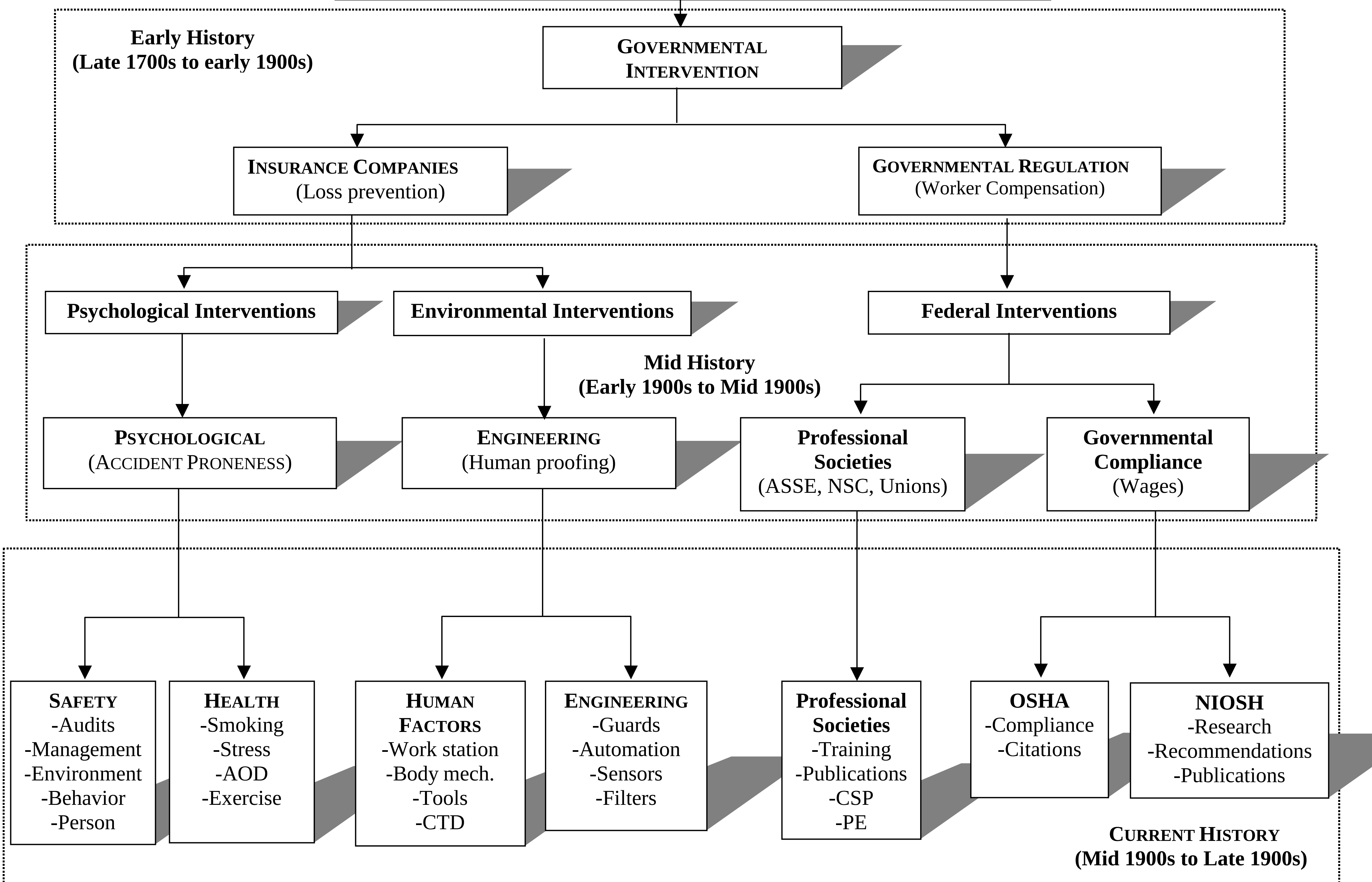


FIGURE 2: THE SAFETY STAGES OF CHANGE

The Safety Stages of Change

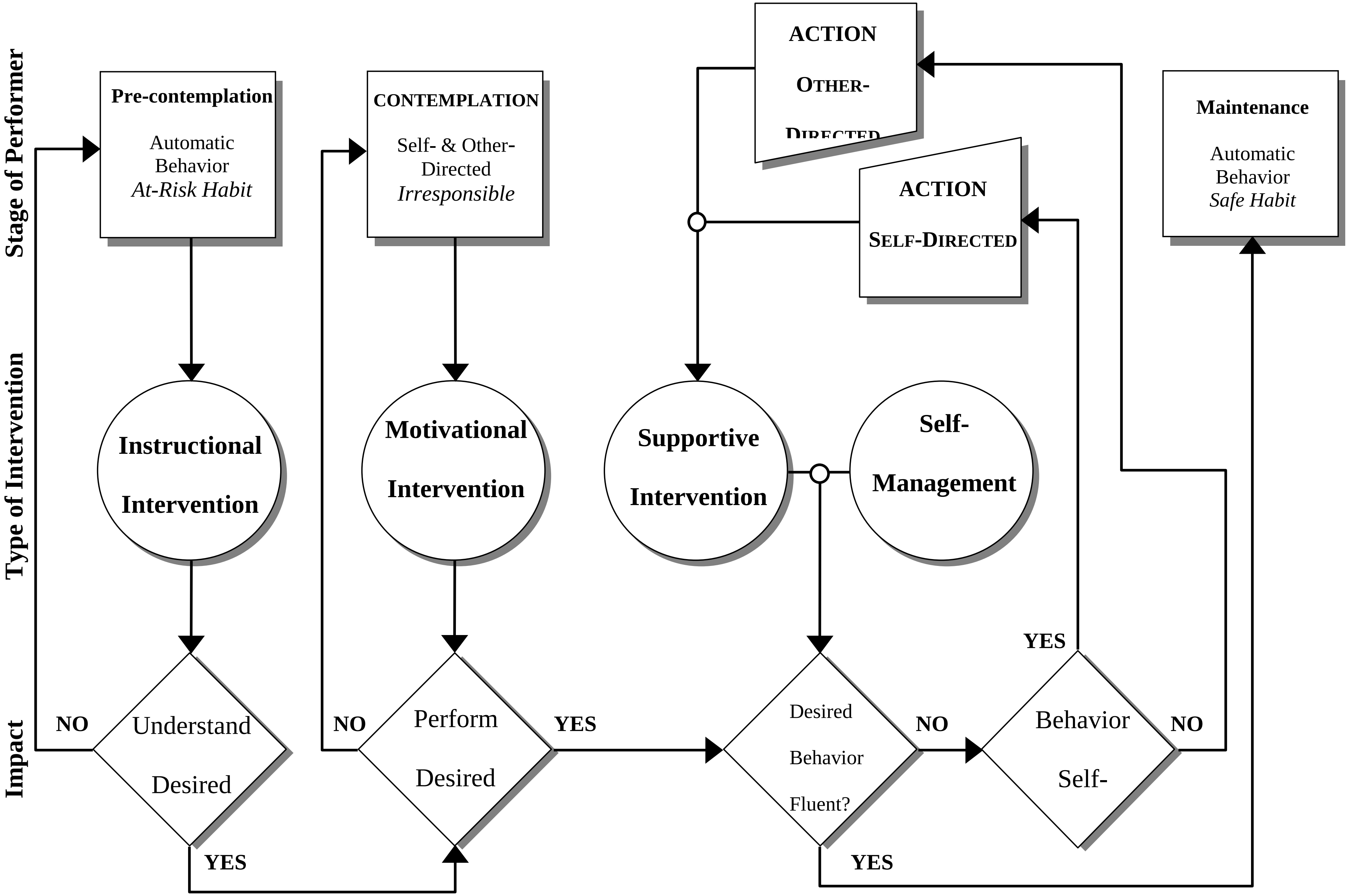


FIGURE 3: MEAN SUBSCALE SCORES FOR SAFETY SELF-EFFICACY

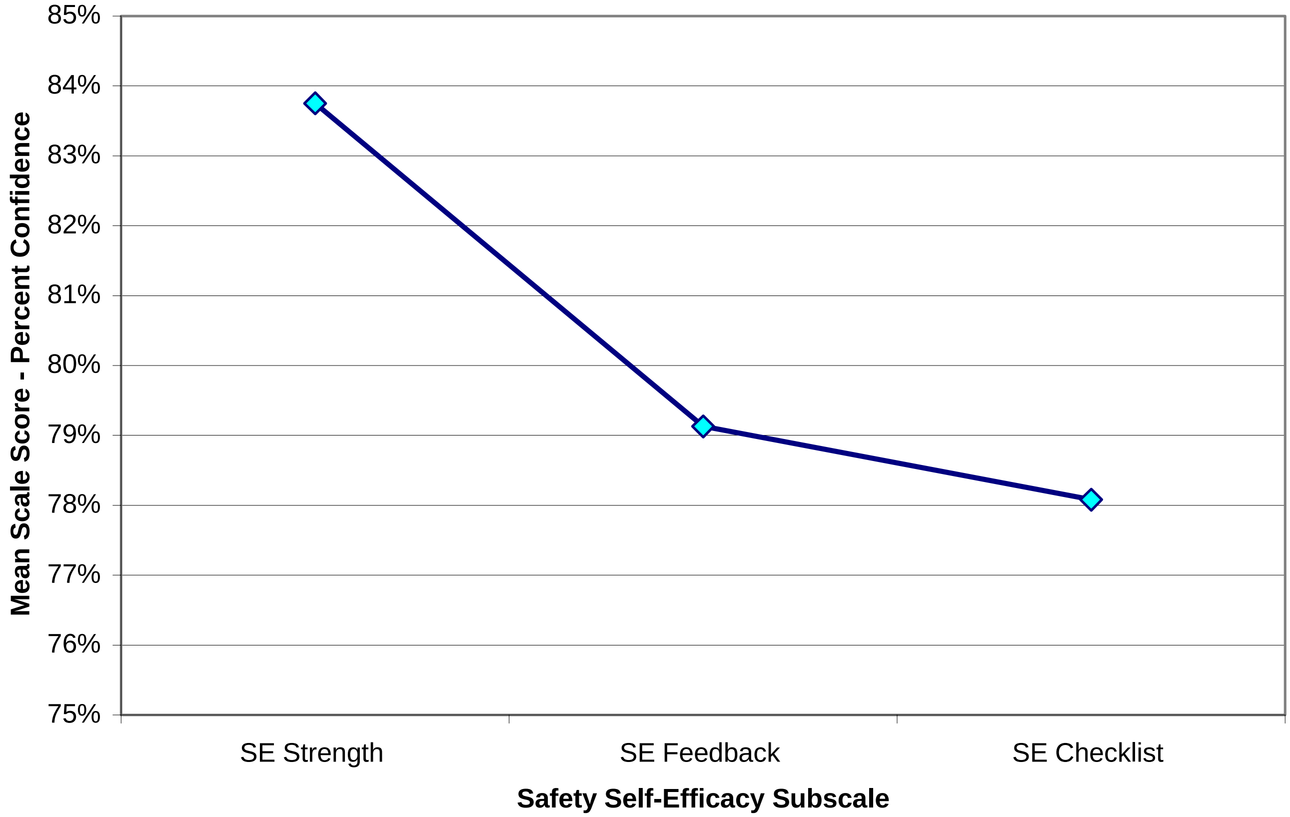

85%
84%
83%
82%
81%
80%
79%
78%
77%
76%
75%
Mean Scale Score - Percent Confidence
SE Strength
SE Feedback
SE Checklist
Safety Self-Efficacy Subscale

FIGURE 4: MEAN SUBSCALE SCORES FOR OUTCOME EXPECTANCY

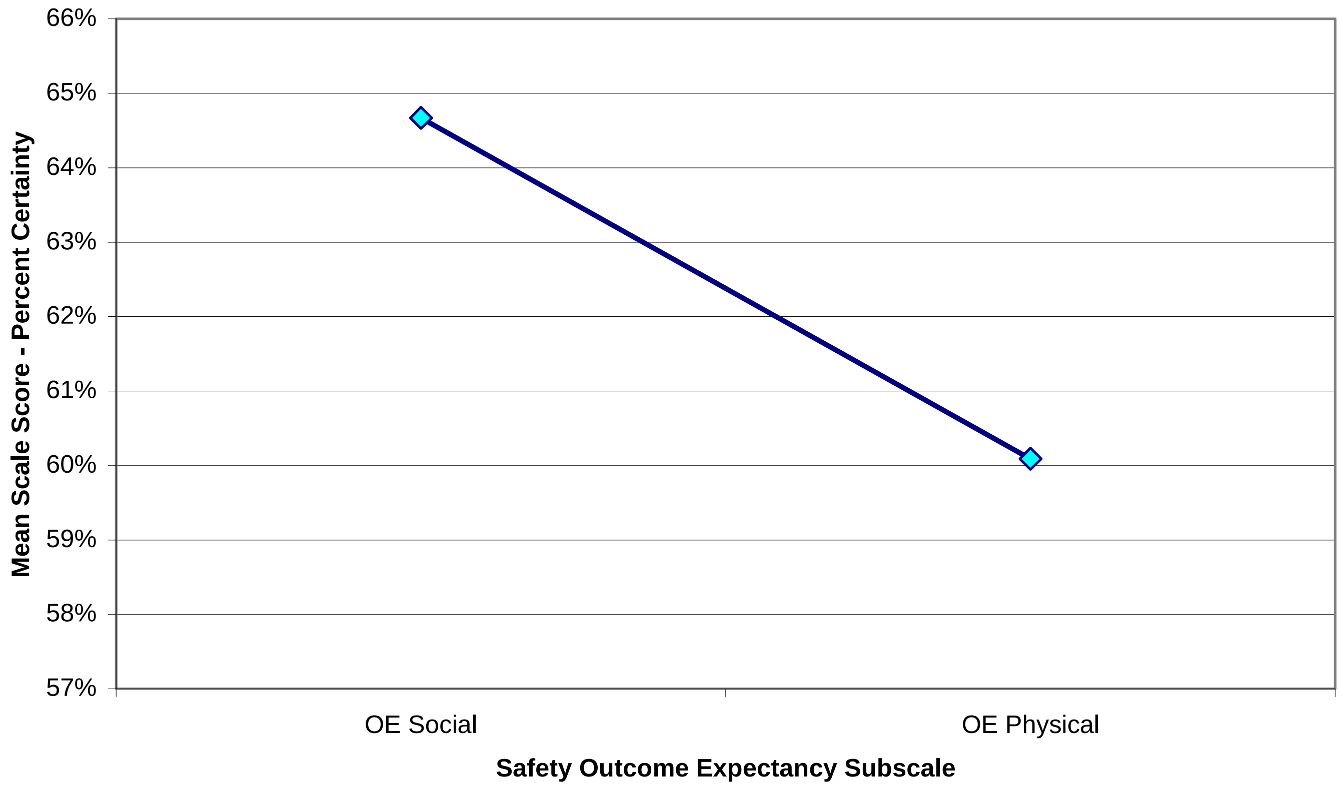

66%
65%
64%
63%
62%
61%
60%
59%
58%
57%
Mean Scale Score - Percent Certainty
OE Social
OE Physical
Safety Outcome Expectancy Subscale

FIGURE 5: MEAN SUBSCALE SCORES FOR SAFETY STAGES OF CHANGE

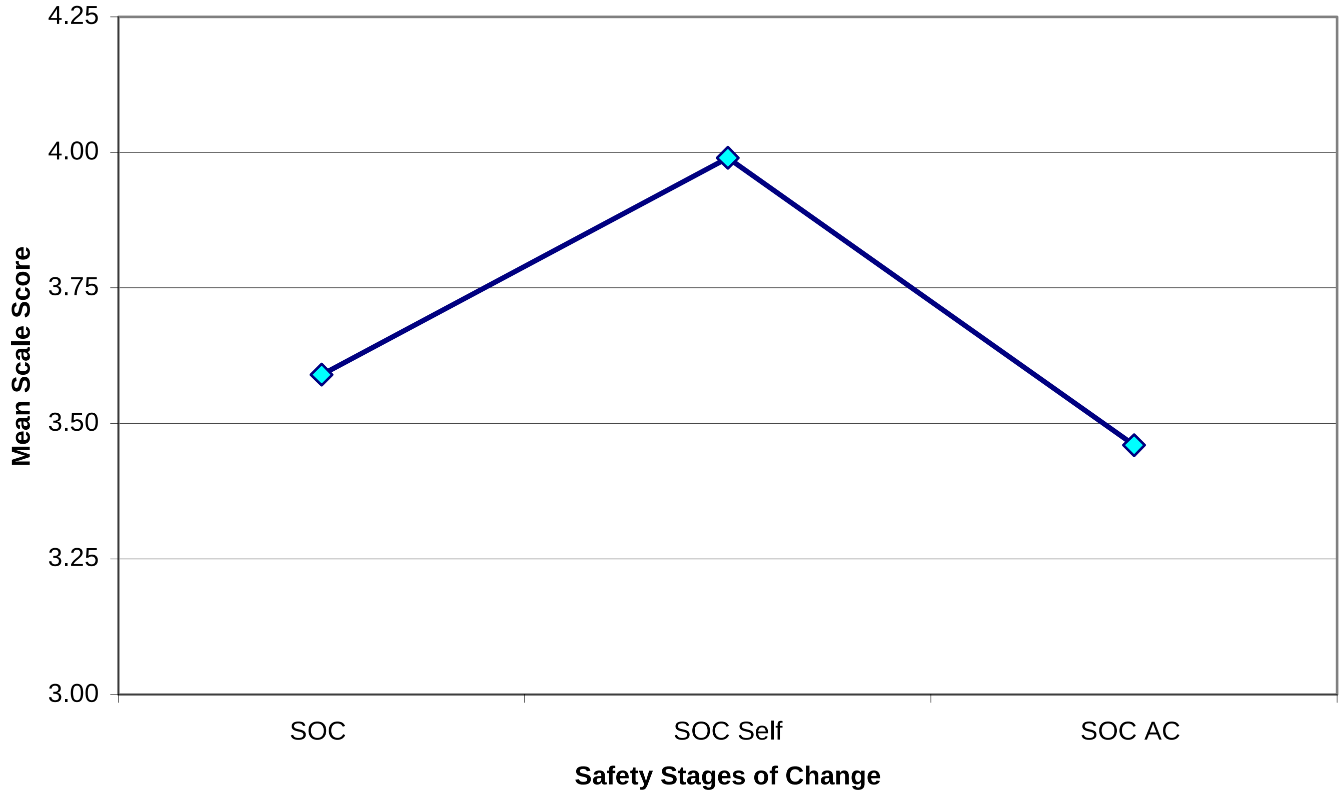

4.25
4.00
3.75
3.50
3.25
3.00
Mean Scale Score
SOC
SOC Self
SOC AC
Safety Stages of Change

FIGURE 6: MAIN EFFECT FOR GENDER FOR EMPLOYEE OBSERVATIONS

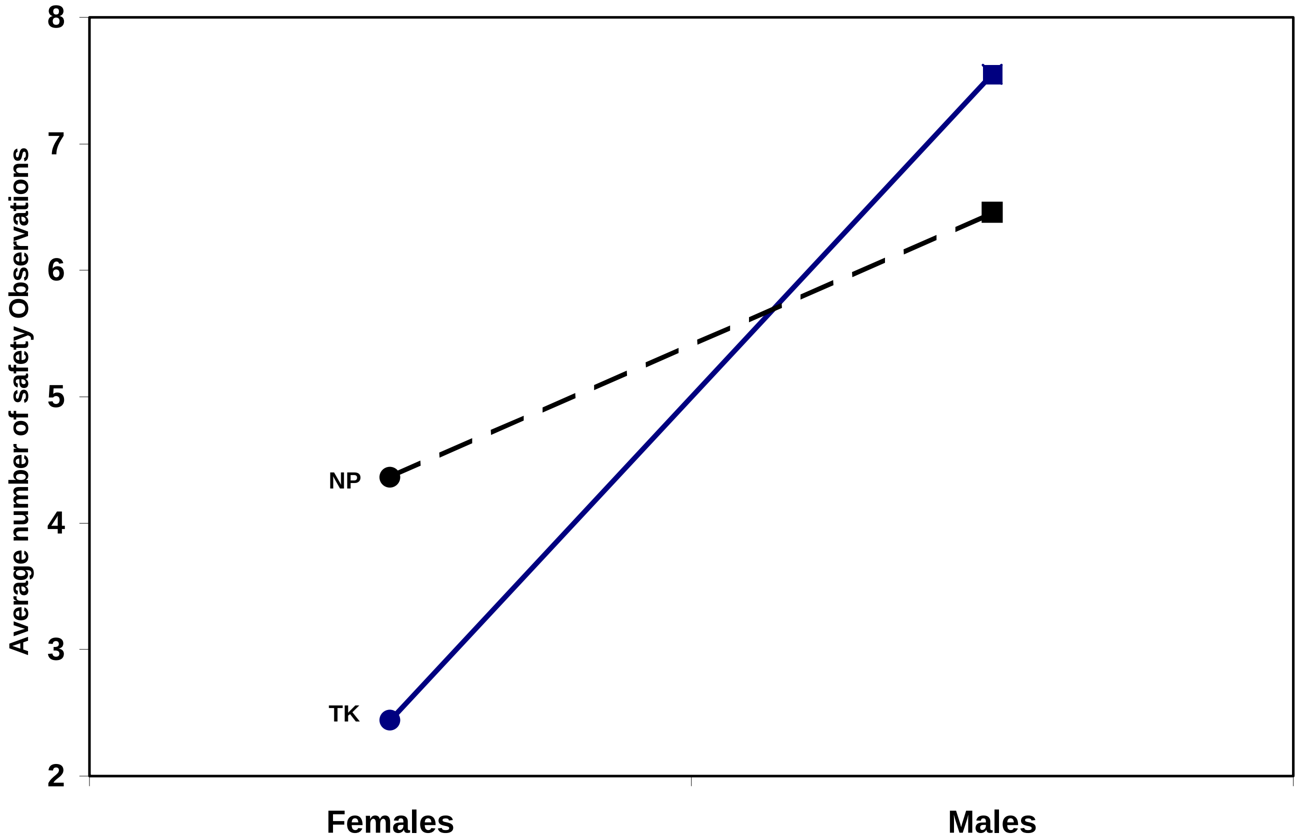

8
7
6
5
4
3
2
Average number of safety Observations
NP
TK
Females
Males

FIGURE 7: SAFETY SELF-EFFICACY BY PARTICIPATION

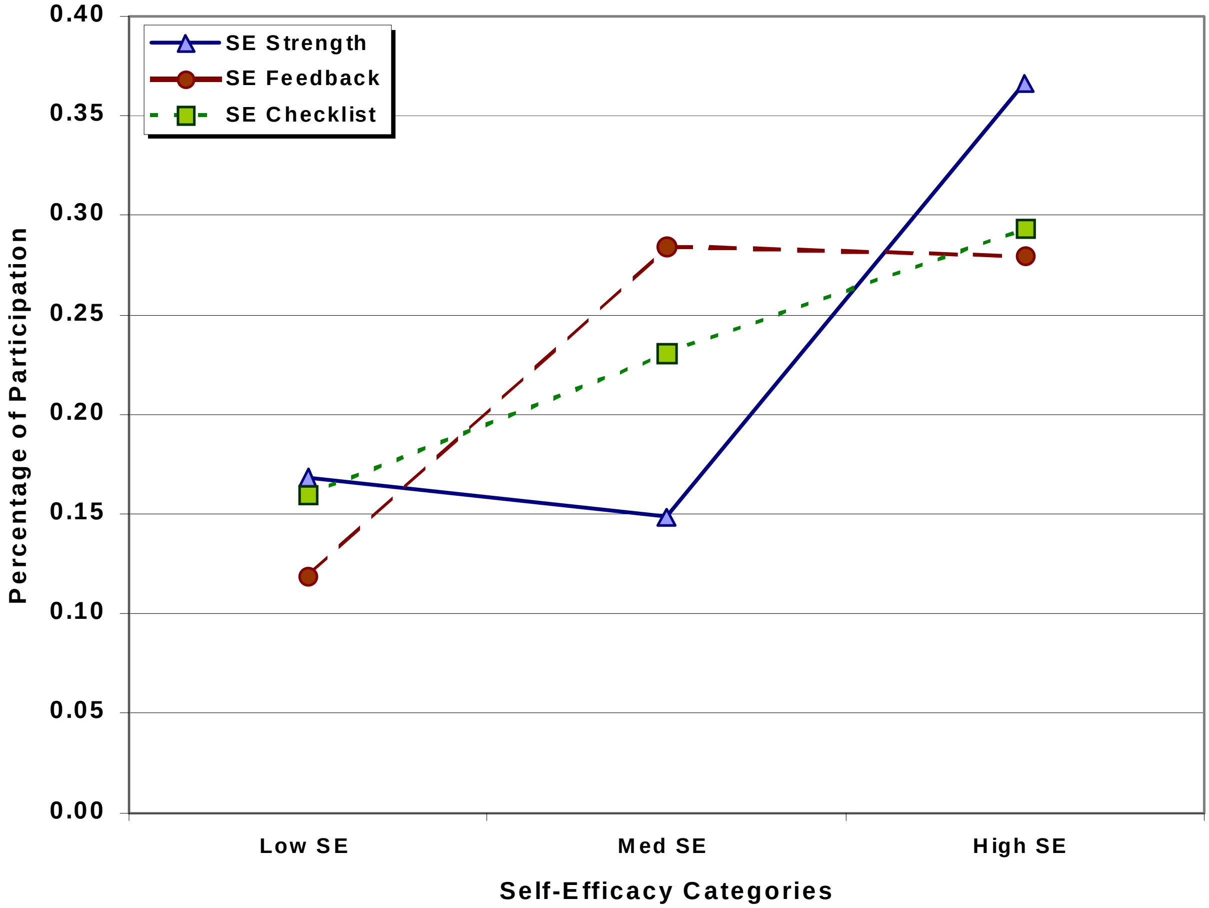
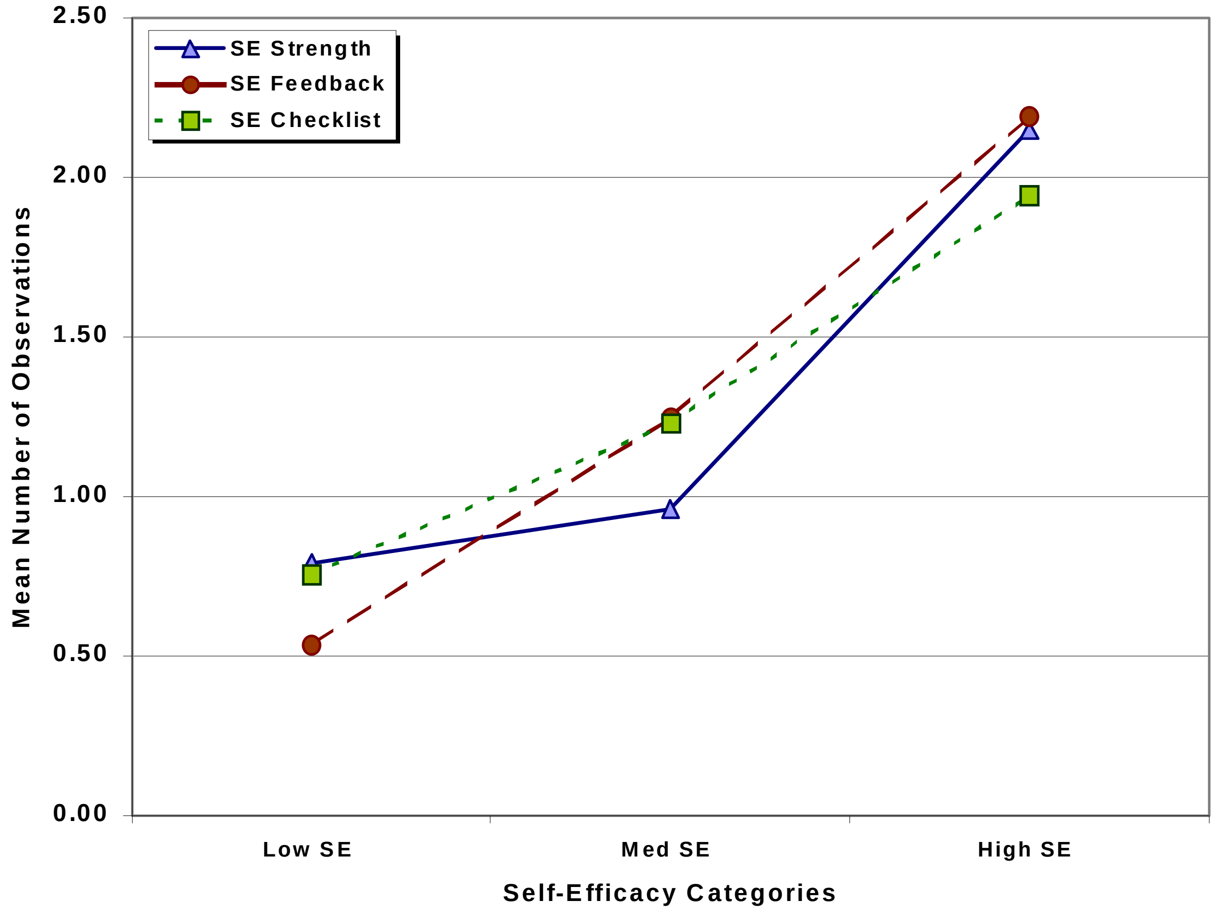

0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
SE Strength
SE Feedback
SE Checklist
Percentage of Participation
Low SE
Med SE
High SE
Self-Efficacy Categories

FIGURE 8: SAFETY SELF-EFFICACY BY OBSERVATIONS



SE Strength
SE Feedback
SE Checklist
2.50
2.00
1.50
1.00
0.50
0.00
Mean Number of Observations
Low SE
Med SE
High SE
Self-Efficacy Categories

FIGURE 9: SAFETY SELF-EFFICACY BY INJURIES

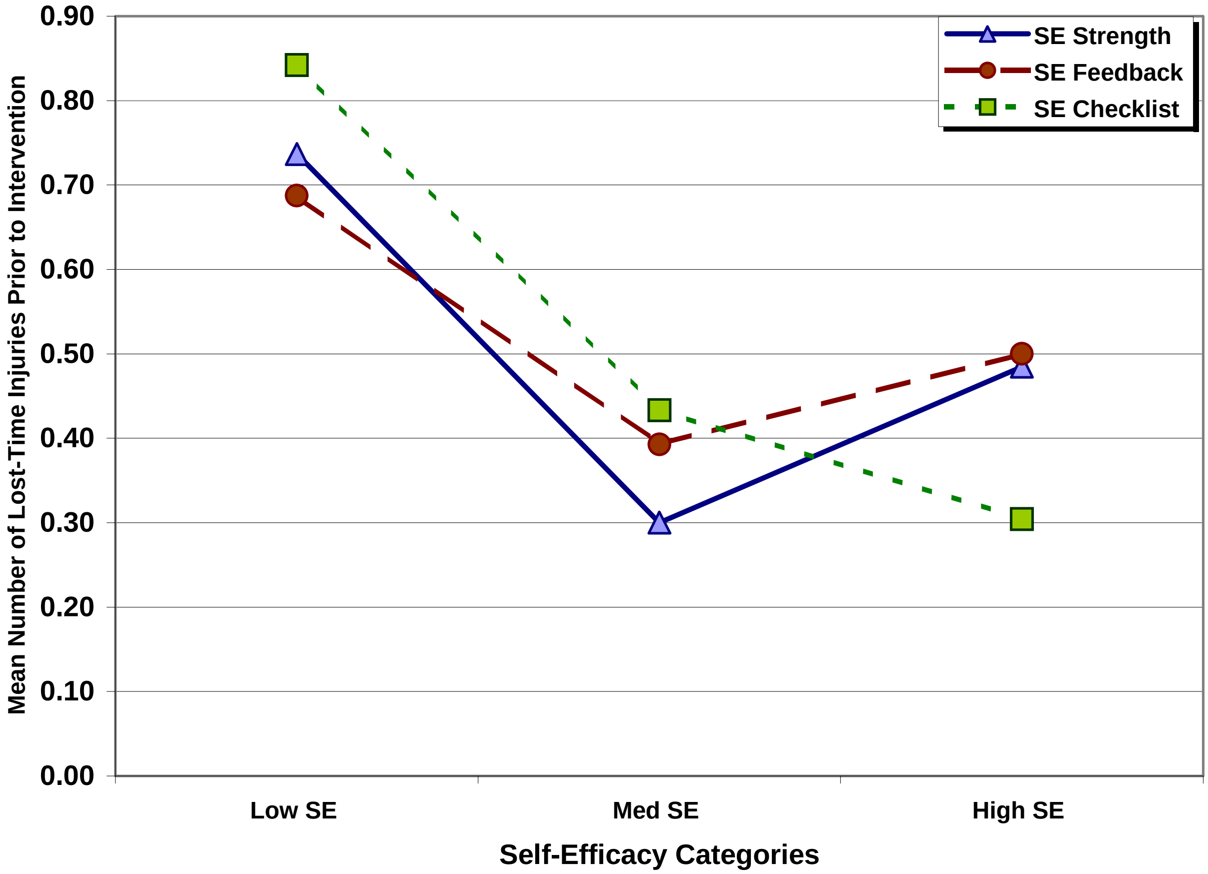

0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
Mean Number of Lost-Time Injuries Prior to Intervention
SE Strength
SE Feedback
SE Checklist
Low SE
Med SE
High SE
Self-Efficacy Categories

FIGURE 10: OUTCOME EXPECTANCY BY PARTICIPATION

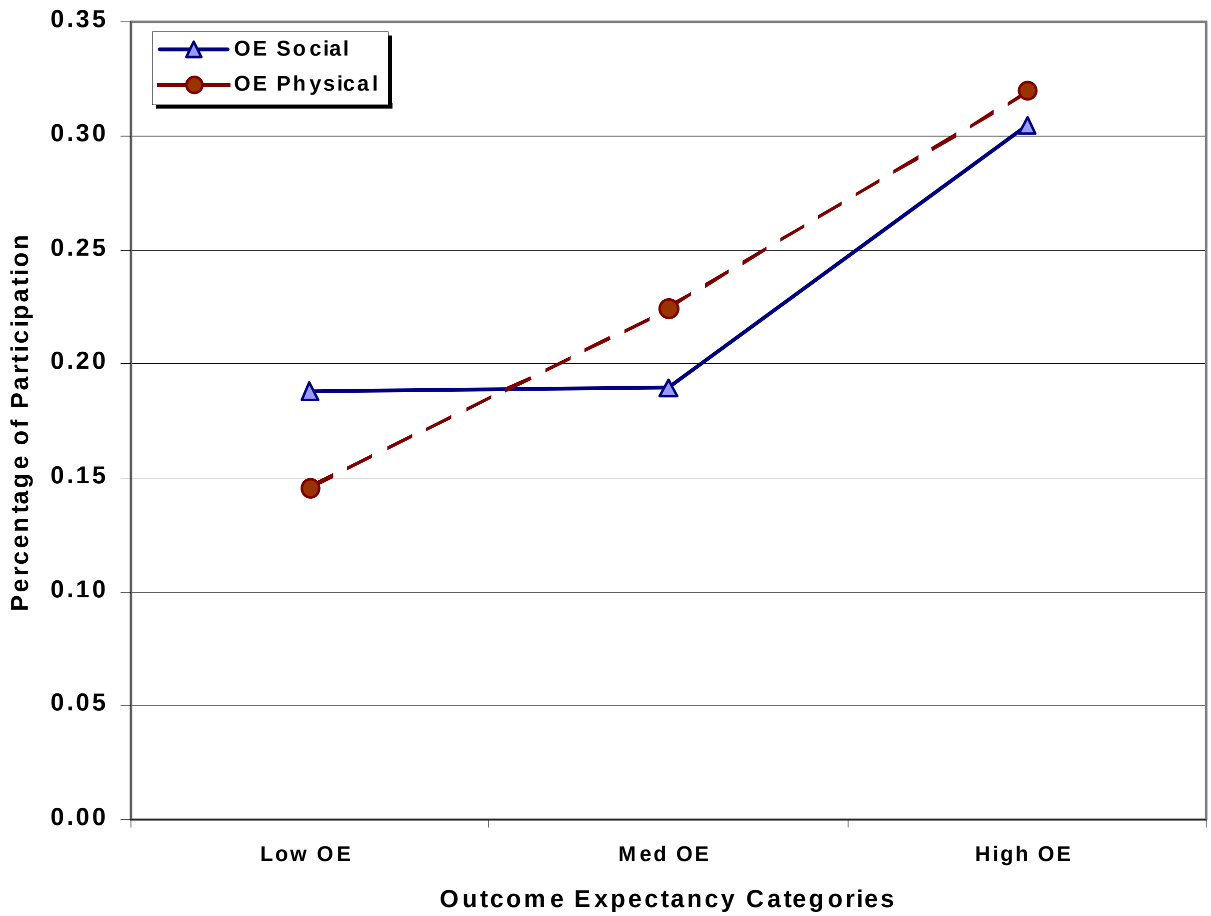

0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
OE Social
OE Physical
Percentage of Participation
Low OE
Med OE
High OE
Outcome Expectancy Categories

FIGURE 11: OUTCOME EXPECTANCY BY OBSERVATIONS

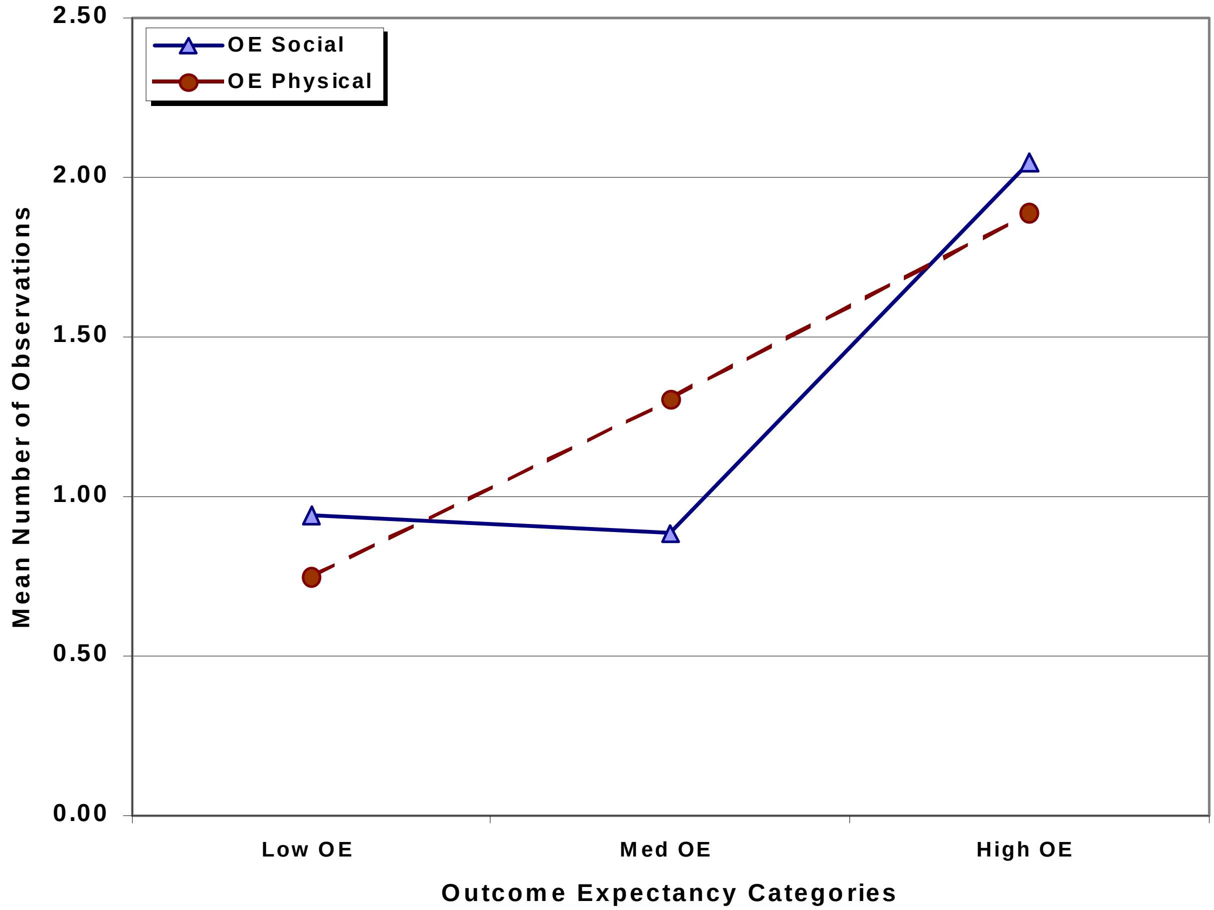

2.50
2.00
1.50
1.00
0.50
0.00
OE Social
OE Physical
Mean Number of Observations
Low OE
Med OE
High OE
Outcome Expectancy Categories

FIGURE 12: OUTCOME EXPECTANCY BY INJURIES

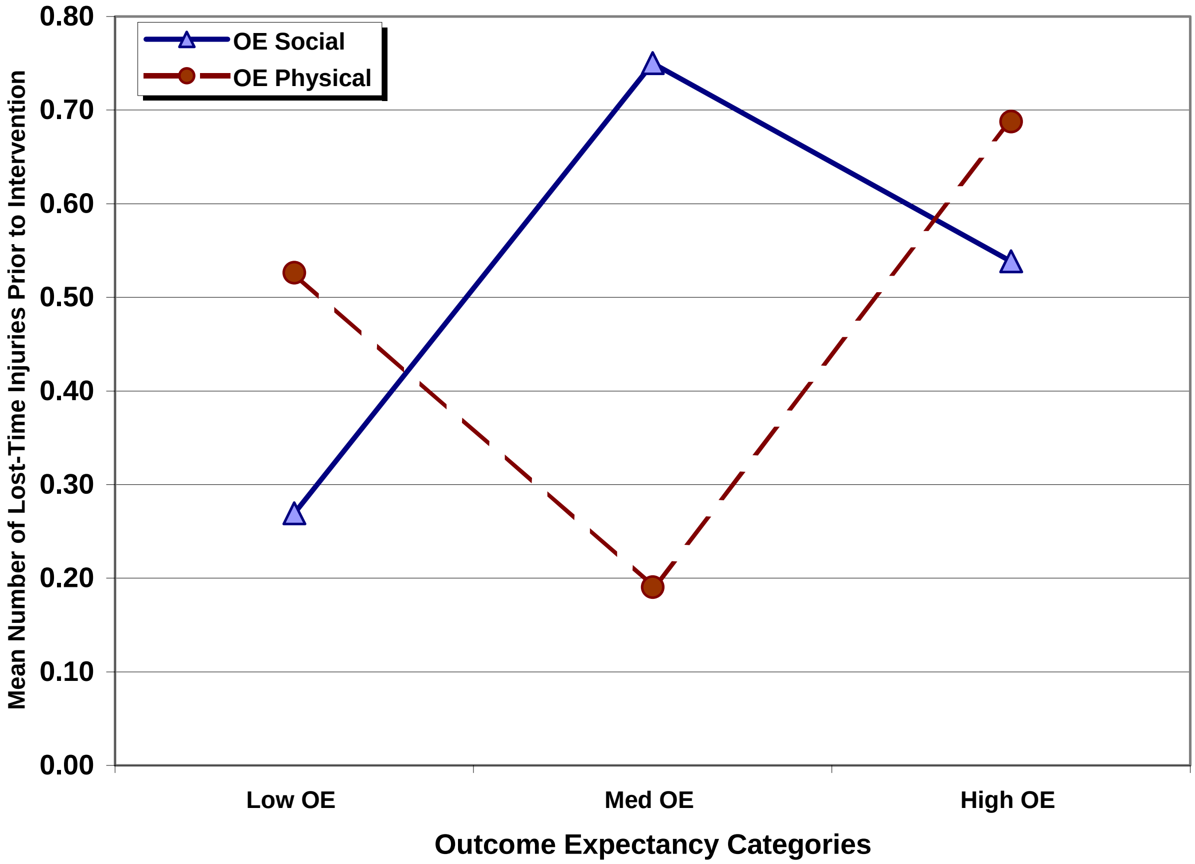

OE Social
OE Physical
Mean Number of Lost-Time Injuries Prior to Intervention
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
Low OE
Med OE
High OE
Outcome Expectancy Categories

FIGURE 13: SAFETY STAGES OF CHANGE BY PARTICIPATION

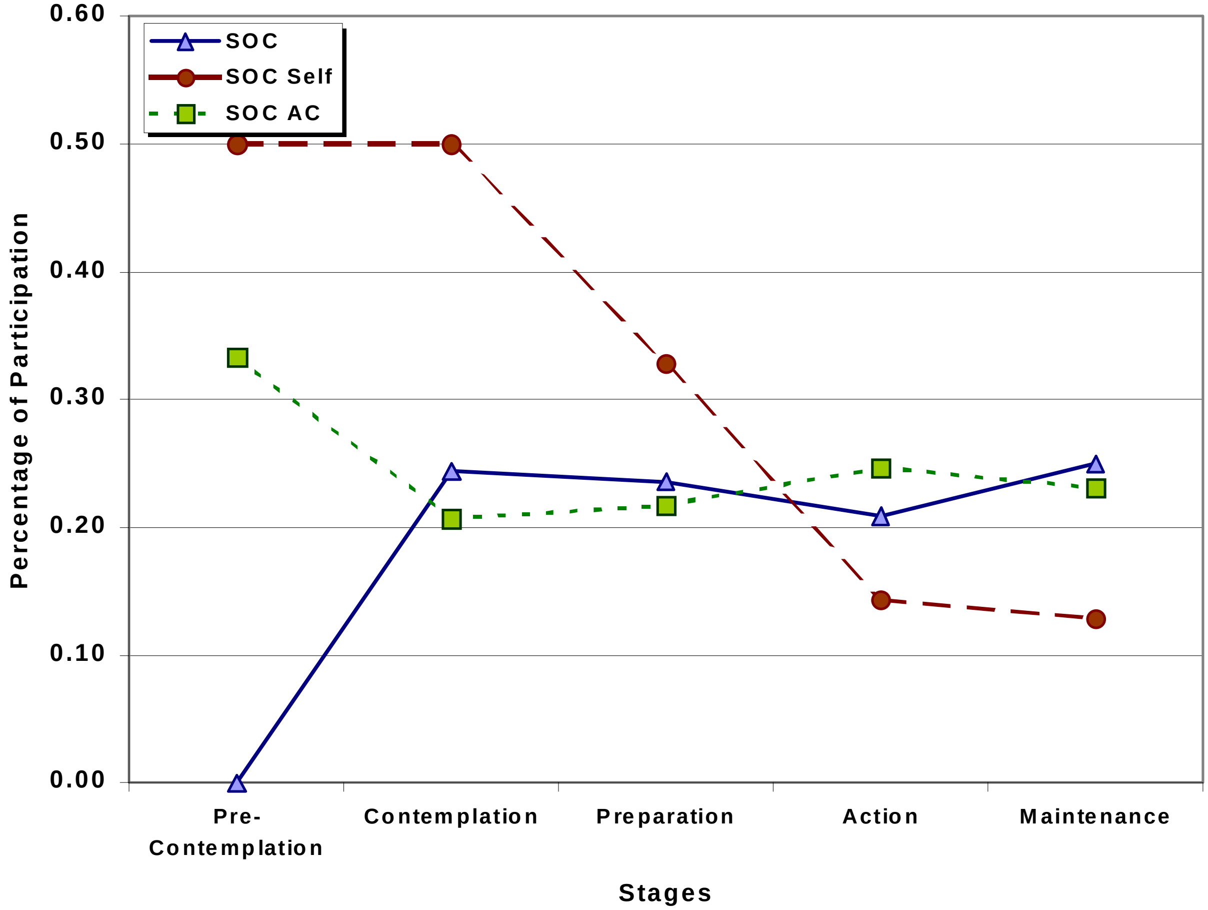

0.60
0.50
0.40
0.30
0.20
0.10
0.00
Percentage of Participation
SOC
SOC Self
SOC AC
Pre-Contemplation
Contemplation
Preparation
Action
Maintenance
Stages

FIGURE 14: SAFETY STAGES OF CHANGE BY OBSERVATIONS

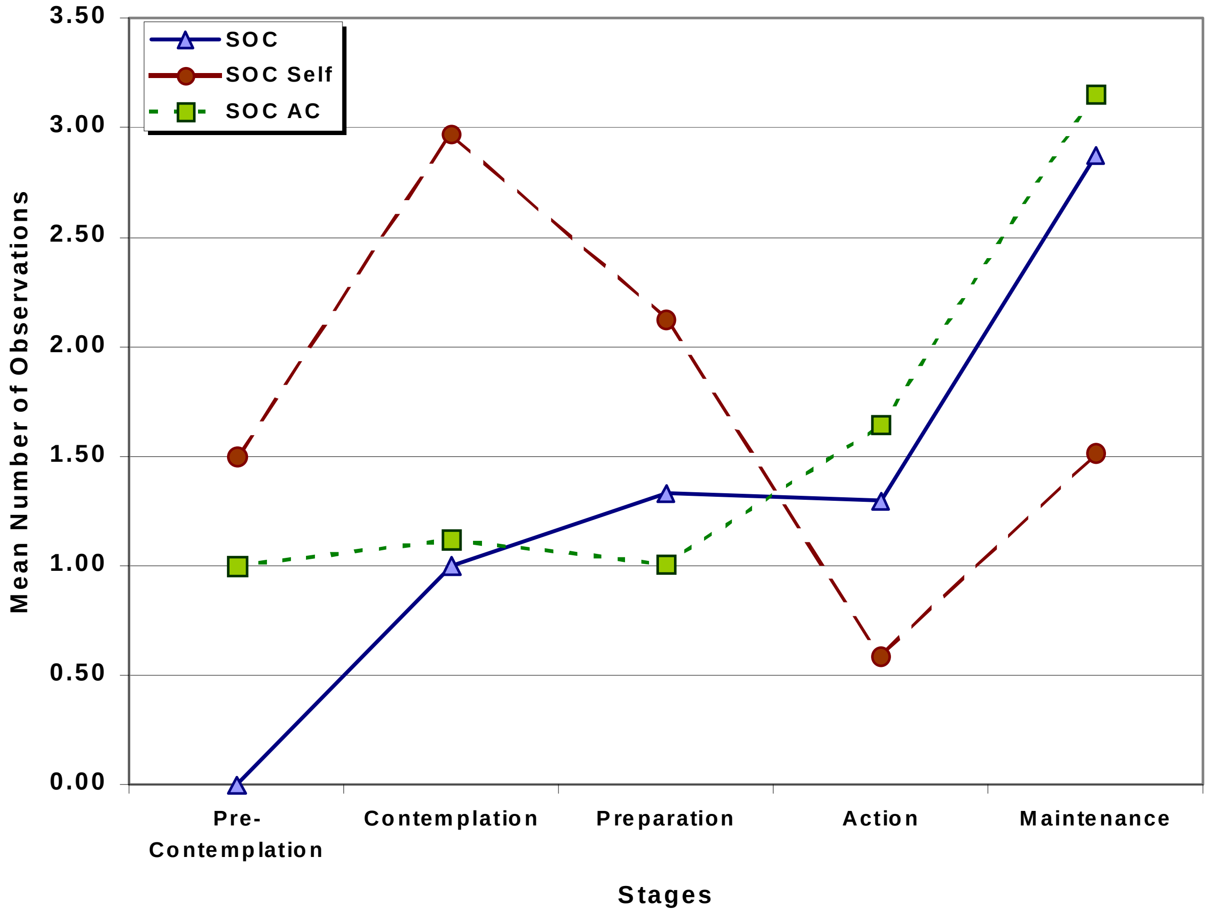
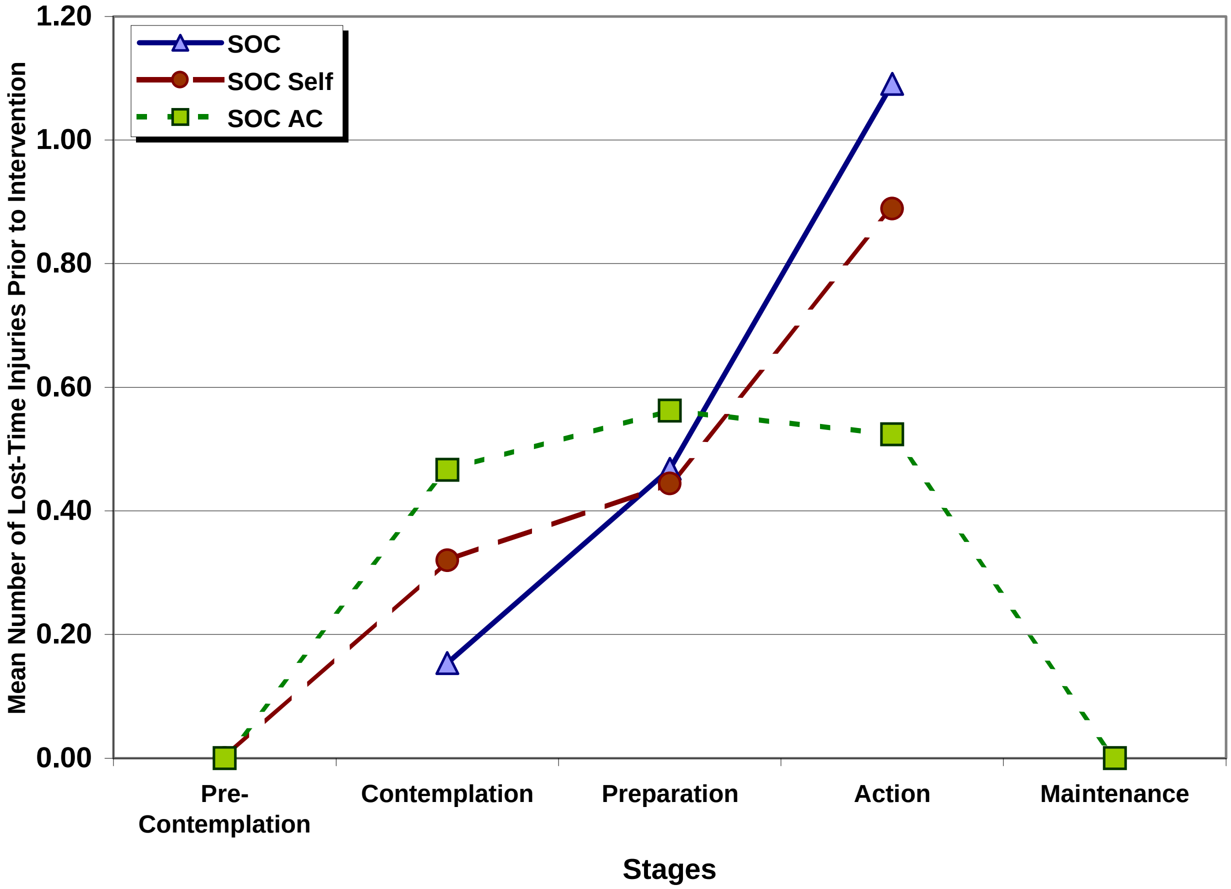

SOC
SOC Self
SOC AC
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Mean Number of Observations
Pre-Contemplation
Contemplation
Preparation
Action
Maintenance
Stages

FIGURE 15: SAFETY STAGES OF CHANGE BY INJURIES


1.20
1.00
0.80
0.60
0.40
0.20
0.00
Mean Number of Lost-Time Injuries Prior to Intervention
SOC
SOC Self
SOC AC
Pre-Contemplation
Contemplation
Preparation
Action
Maintenance
Stages

APPENDICES

APPENDIX A: SAFETY SELF-EFFICACY SURVEY

Please circle the number that best represents your current ***perceptions***.

		Strongly Disagree	Disagree	Mildly Disagree	Neutral	Mildly Agree	Agree	Strongly Agree
1.	**Even if a safety procedure is long or complicated, I am able to follow it.**	1	2	3	4	5	6	7
2.	**Even while following safety procedures, I often feel like giving up and skipping them.**	1	2	3	4	5	6	7
3.	**I never follow safety procedures because they take too much time.**	1	2	3	4	5	6	7
4.	**If my coworkers follow all the safety procedures, I would too.**	1	2	3	4	5	6	7
5.	If I skip a safety protocol, I feel disappointed in myself.	1	2	3	4	5	6	7
6.	There are situations that would make skip safety procedures.	1	2	3	4	5	6	7
7.	**I don't use protective equipment because it is uncomfortable**	1	2	3	4	5	6	7
8.	**I often skip safety rules when there are large production demands**	1	2	3	4	5	6	7
9.	It is against my beliefs to skip safety procedures	1	2	3	4	5	6	7
10.	**When unexpected production problems occur, I can follow safety protocols and still get the job done**	1	2	3	4	5	6	7
11.	I often skip safety procedures because they are inconvenient	1	2	3	4	5	6	7
12.	When I don't follow safety policies, I expect my supervisor to disapprove	1	2	3	4	5	6	7
13.	If I did not follow a safety policy, it would not effect the way I felt about myself	1	2	3	4	5	6	7
14.	**I feel unsure about my ability to use safety procedures**	1	2	3	4	5	6	7
15.	**I avoid trying to learn new safety procedures when they look difficult for me**	1	2	3	4	5	6	7
16.	**When learning a new safety policy, I soon give up if I am not initially successful**	1	2	3	4	5	6	7
17.	I follow safety procedures to avoid penalties or reprimands	1	2	3	4	5	6	7
18.	**I do not feel capable of dealing with most safety issues**	1	2	3	4	5	6	7
19.	I never give up easily on safety-related tasks	1	2	3	4	5	6	7
20.	When I do my job safely I feel a sense of satisfaction	1	2	3	4	5	6	7
21.	Failure just makes me try harder	1	2	3	4	5	6	7
22.	If I can't follow a safety procedure the first time, I feel that I should keep trying until I can.	1	2	3	4	5	6	7

APPENDIX B: SAFETY STAGES OF CHANGE SURVEY

Circle ONE number (1-4) below that best describes your feeling toward each category:

Lockout/Tagout:

1) Locking out my machinery is a habit that I do without having to think about it.
2) I don't lockout the machinery I use because I don't remember or know how to.
3) I know how to lockout my equipment but I rarely do.
4) I always lockout my equipment but I still need to think about how to do it.

PPE:

1) I use my personal protective equipment without having to think about how and when I should use it.
2) I don't use personal protective equipment because I have no idea which piece is required or when or how to use it.
3) I usually use my personal protective equipment, but I still have to think about how and when to use it.
4) I know what personal protective equipment is required, when and how to use it, but I rarely do.

Lifting:

1) When lifting, I never think about or don't know the proper lifting techniques.
2) When lifting, I have to think about how to use the proper lifting techniques.
3) When lifting, I use proper lifting techniques without having to think it.
4) Even though I know the proper lifting techniques, I seldom use them.

APPENDIX C: OBSERVATION CHECKLIST

Observer: ______________________________ Date: ______________________________
Department: ______________________________

Behavior	Safe	At-Risk	Comments
Working Under Control - Eyes on path/task - Pace - Communication	☐ -- -- --	☐ -- -- --	
Body Positions/Ergonomics - Reaching/extending - Lifting - Line of fire - Pinch points - Posture	☐ -- -- -- -- --	☐ -- -- -- -- --	
PPE - As required	☐	☐	
Tools and Equipment - Selection - Condition - Use	☐ -- -- --	☐ -- -- --	
Housekeeping - Proper storage - Working surfaces - Trip hazard	☐ -- -- --	☐ -- -- --	
Mobile Equipment - Check Out - Seat belt - Driving - Proper load	☐ -- -- -- --	☐ -- -- -- --	

APPENDIX D: REFINED SAFETY SELF-EFFICACY .

On the following items, please rate your confidence in performing the behaviors described below. Rate your degree of confidence by recording a number between **0** to **100** in each of the spaces in the CONFIDENCE column below. Please use the scale below:

0	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**
Cannot do at all					Moderately certain I can do					I certainly can do

CONFIDENCE
(0 – 100)

________ Follow safety procedures when there is a large production demand
________ Identify a risky work behavior of a coworker
________ Skip safety procedures and not get hurt
________ Look out for the safety of myself
________ Wear all of the required personal protective equipment (PPE) consistently
________ Use the correct lifting procedures
________ Keep my work area clean
________ Look out for the safety of my coworkers
________ Keep a safe pace of work and still get the job done on time
________ Follow all safety procedures when others are not
________ Deal with most safety issues
________ Help a coworker do a job more safely

……. ***How confident are you in giving the following people feedback about their personal safety:***

________ A team member in your work area
________ Someone working outside your work area
________ A supervisors/manager

……. ***How confident are you in using a checklist to observe the safety-related behaviors of the following individuals:***

________ A team member in your work area
________ Someone working outside your work area
________ A supervisors/manager

……. ***How confident are you in stopping the following individuals if you think they are doing something risky:***

________ A team member in your work area
________ Someone working outside your work area
________ A supervisors/manager
________ A coworker with more experience on the job than you

On the following items, please rate how confident you are the following situations will happen. Rate your degree of confidence by recording a number from **0** to **100** in each of the spaces in the CONFIDENCE column below. Please use the scale below:

0	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**
Will not happen					Might happen					Certainly will happen

CONFIDENCE
(0 – 100)

……. *If I skip safety rules:*

_______ I will get a reprimand/or be written up

_______ People won't respect me

_______ It is more convenient or easier to do my job

_______ I will feel disappointed in myself

_______ I will feel more comfortable

_______ I will save time

_______ I will be injured

……. *If I use a checklist to observe the safety-related behaviors of my coworkers:*

_______ They will appreciate it

_______ I will feel good about myself

_______ I will reduce the chance my coworker will get hurt

_______ I will feel like I am helping others be safe

_______ It will take too long

_______ Coworkers will think less of me

……. *If I give coworkers safety-related feedback :*

_______ They won't care or listen to the feedback

_______ I will help others remain safe

_______ It will take too long

_______ They will appreciate the feedback

_______ They will get angry with me

_______ It will make me feel good about myself

APPENDIX E: THE REVISED SAFETY STAGES OF CHANGE

Please read each sentence carefully. Circle **ONE** number in each box below that **best describes your feelings** toward the set of statements.

A. (circle one number in the box below)

1	I seldom wear all of my required PPE.
2	I plan to start wearing all of my required PPE, but I haven't yet.
3	Sometimes I wear all of my required PPE.
4	I usually wear all of my required PPE, but I have to think about using it.
5	Wearing all of my required PPE has become a habit I do automatically.

B. (circle one number in the box below)

1	I am not planning to observe coworkers safety-related behaviors.
2	I plan to observe the safety-related behaviors of my coworkers, but I haven't yet.
3	I sometimes observe the safety-related behaviors of my coworkers.
4	I usually observe coworkers safety-related behavior, but I need to think about doing it.
5	Observing the safety-related behaviors of my coworkers is a habit I do automatically.

C. (circle one number in the box below)

1	I am seldom concerned about pinch points while working.
2	I plan to pay more attention to potential pinch points while working, but I haven't yet.
3	Sometimes I pay attention to potential pinch points while working.
4	I usually pay attention to potential pinch points while working, but still I need to think about it.
5	Paying attention to potential pinch points while working has become a habit I do automatically.

D. (circle one number in the box below)

1	I am not planning to caution my coworkers if they are doing something risky.
2	I plan to caution my coworkers if they are doing something risky, but I haven't yet.
3	Sometimes I caution my coworkers if they are doing something risky.
4	I usually caution my coworkers if they are doing something risky, but I need to think about it.
5	Cautioning my coworkers if they are doing something risky is a habit I do automatically.

E. (circle one number in the box below)

1	I seldom think about the safe methods of lifting.
2	I plan to use the safe methods of lifting, but I haven't yet.
3	Sometimes I use the safe methods of lifting.
4	I usually use the safe methods of lifting, but I need to think about them.
5	Using the safe methods of lifting has become a habit I do automatically.

F. (circle one number in the box below)

1	I am not planning to give my coworkers safety-related feedback.
2	I am planning to give my coworkers safety-related-feedback, but I haven't yet.
3	I sometimes give my coworkers safety-related feedback.
4	I usually give safety-related feedback, but I still need to think about doing it.
5	Giving safety-related feedback has become a habit I do automatically.

APPENDIX F: FACTOR ANALYSIS FOR FINAL SURVEYS

Criteria for Item Removal:

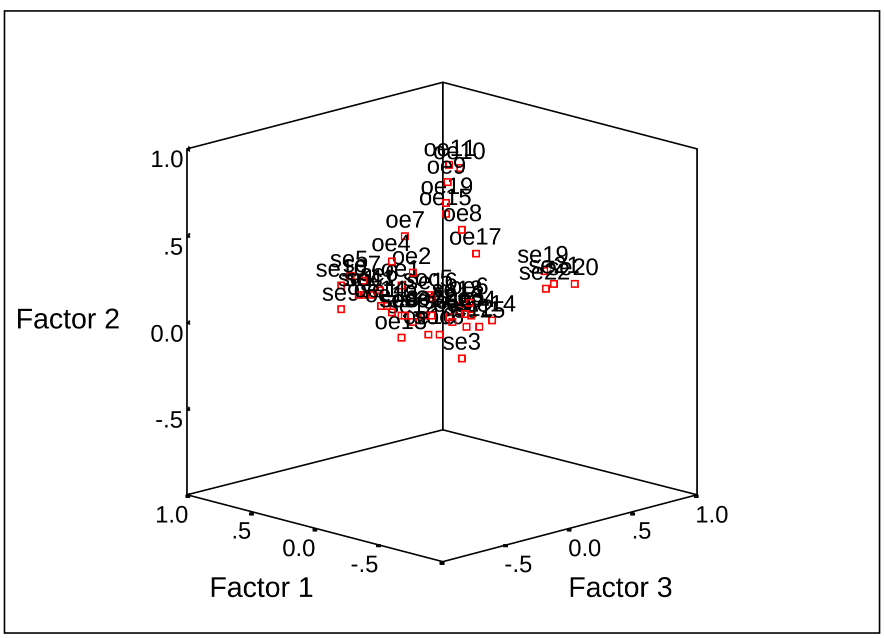
1) **Loadings on more than three variables**
2) **Loading lower than .25**

Factor Correlation Matrix

Factor	1	2	3	4	5	6
1	1.000	.479	.510	.472	-4.016E-02	.474
2	.479	1.000	.489	.492	-4.970E-02	.498
3	.510	.489	1.000	.618	7.692E-02	.648
4	.472	.492	.618	1.000	-7.119E-02	.498
5	-4.016E-02	-4.970E-02	7.692E-02	-7.119E-02	1.000	1.875E-02
6	.474	.498	.648	.498	1.875E-02	1.000

Extraction Method: Maximum Likelihood.
Rotation Method: Promax with Kaiser Normalization.

Factor Plot in Rotated Factor Space



	Factors					
Items	SE	**OE Social**	**SE Feedback**	**SOC**	**OE Physical**	**SE Checklist**
SE10	.835					
SE4	.753					
SE9	.731					
SE1	.663					
SE5	.634					
SE11	.587					
SE6	.565					
SE8	.496					
SE12	.492		.265			
SE7	.491					
*(SOC1)	.328		-.224	.216		
SE2	.322					
OE1	.307					
OE11		.892				
OE10		.852				
OE9		.800				
OE19		.660				
OE15		.576				
OE8		.548				
OE7	.219	.464				
OE17		.370				
OE4		.357	-.218			
OE2		.282			.225	
SE20			.988			
SE19			.945			
SE22			.874			
SE21			.808			
SE14			.412			
SE13	.245		.375			.221
SE15			.330	.239		
SOC6				.894		
SOC2				.725		
SOC4			.205	.695		
SOC3				.592		
SOC5				.373		
OE18			-.207	-.300	.283	
OE3					.718	
OE6					.717	
OE16					.650	
OE5					.592	
OE12					.576	
OE13					.393	
OE14				-.210	.316	
SE3		-.221			.296	
SE17						1.003
SE16						.852
SE18						.827
% Varience	29.91	7.46	6.33	5.42	4.32	3.32
Eigenvalues	14.06	3.50	2.98	2.30	1.56	1.02

Notes: Extraction Method: Maximum Likelihood. Rotation Method: Promax with Kaiser Normalization.
a Rotation converged in 9 iterations. * = Item droped for final survey. SE = self-efficacy OE = outcome expectancy SOC Self = safety stages of change for personal safety; SOC = safety stages of change; SOC AC = safety stages of change for actively caring.

CURRICULUM VITAE

NAME: Charles Blakely Pettinger, Jr.

EDUCATION:
Ph.D. Candidate, Applied/Experimental psychology,
Virginia Tech, degree May 2000.
M.S., Industrial/Organizational Psychology,
Rensselaer Polytechnic Institute, 1994.
B.A., Behavioral Psychology,
University of Florida, 1988.

CERTIFICATION: Certified Behavior Analyst (May 1989).

EXPERIENCE SUMMARY:

EXPERTISE

Chuck's primary areas of expertise are in the design, implementation, and analysis of behavior-based safety and health processes. His major research interests are in the fields of Behavioral/Community Psychology, Applied Behavior Analysis, and Organizational Behavior Management.

PROFESSIONAL HISTORY

Chuck currently functions as Senior Research Scientist for the Center for Applied Behavior Systems. He is involved in most aspects of this center, including management of research projects, recruiting center personnel, leading weekly research meetings, and developing and implementing educational programs for center research assistants.

Chuck has played a key role as a research assistant on several grants, including a grant from the National Institute for Occupational Safety & Health, Virginia Department of Motor Vehicles, Virginia Spinal Cord Injury System, National Institute on Alcohol Abuse and Alcoholism, U.S. Department of Energy, Alcoholic Beverage Medical Research Foundation, and National Collegiate Athletic Association. Additionally, Chuck has served as a consultant with Safety Performance Solutions conducting training seminars for numerous organizations such as Wisconsin Electric, Westinghouse, Pennsylvania Power & Light, Sentry, Federal Mogul, and Coca-Cola.

PROFESSIONAL CONTRIBUTIONS

Chuck has also conducted research in field settings, including the application of the "Actively Caring" model to predict persons who are at increased risk for accident or injury in an industrial setting. His field work also includes the development and validation of new behavioral/cognitive performance tests in organizational settings. Furthermore, Chuck has research interests in validating new sobriety tests and developing programs to prevent incidences of drinking and driving. To date Chuck has co-authored three training/technical manuals and designed and developed numerous training materials for use in industry or government agencies. In addition, he has three publication, five published abstracts and over 25 professional conference presentations.

PROFESSIONAL & TEACHING EXPERIENCE

1/93 to 7/99 – Research Associate for the Center for Applied Behavior Systems. Position benefits include managing, developing, organizing, and analyzing series of research projects investigating the behavioral and environmental influences of various socially valid topics of current interest in industry, community, and college settings.

6/96 to 5/99 - Research Assistant on a two-year grant from the National Institute for Occupational Safety & Health (grant # 1 R01 OH03397-01) looking at techniques to improve safe driving practices of pizza delivery employees.

2/96 to 5/99 - Project Coordinator on a two-year grant from the National Institute for Occupational Safety & Health (grant # 1 R01 OH03374-01) investigating the critical success factors for behavior-based safety in applied industrial settings.

8/96 to 12/96 – Graduate Teaching Assistant for Psychological Measurement Lab PSYC 4294, Virginia Tech, Fall 1997. Opportunities included designing class syllabus, preparing lectures, designing in class assignments, grading assignments, and assigning grades for two sections of classes. Topics covered during classes include PC computer skills, SAS statistical computer program, correlation, regression, reliability/validity, multiple regression and factor analysis.

7/95 to 12/95 - Co-Project Coordinator on a grant from the Virginia Spinal Cord Injury System (grant # 5 R01 AA51062-02) conducting a workshop with the representatives of 1500 Virginia-based EMS, fire fighter, and police personnel. The purpose of the workshop will be to provide these safety individuals with the educational know-how and resources to set up successful spinal cord injury prevention programs at their respective locations.

8/93 to 1/96 - Research Assistant on a two-year grant from the National Institute on Alcohol Abuse and Alcoholism (grant # 5 R01 AA09604-02) investigating college-aged drinkers' propensity to engage in behaviors which minimize the risk of driving while intoxicated.

1/93 to 6/95 - Research Assistant on a two-year grant from the Alcoholic Beverage Medical Research Foundation (grant # 501 4-43628) investigating intervention techniques for preventing DUI among college fraternity and sorority students after university-sanctioned parties.

10/93 to 5/94 - Project Coordinator on a grant from the US Department of Energy (grant # 5 R01 AA34780-02) to conduct a workshop with the employees of the Hanford Nuclear Plant. The purpose of the workshop was to provide the individuals with the educational know-how and resources to set up successful behavior-based safety programs at their facility.

8/93 to 2/94 - Project Coordinator on a grant from the Virginia Department of Motor Vehicles (grant # LE930459004) to conduct a series of seven summer workshops with the representatives of 500 Virginia-based corporations. The purpose of the workshops was to provide these corporate individuals with the educational know-how and resources to set up successful safety belt programs at their respective corporate sites.

5/91 to 5/92 - Research Assistant on a grant from the National Collegiate Athletic Association focusing on using the *Winning Attitudes* program and student athletes to influence children to *say no to drugs* and use team work to achieve their personal goals.

7/90 to 6/91 - Program Consultant for the district wide Behavioral Program Review Committee. Responsibilities included scrutinizing behavioral programming for methodological and theoretical soundness. Additional duties included on-site visits to assess and consult on the environmental/behavioral contingencies for the purpose of developing effective programming.

WORK EXPERIENCE

8/96 to 5/99 - *Associate*, Safety Performance Solutions, Blacksburg, VA. Responsibilities include conducting three day safety seminars, eight hour safety training workshops and coaching hourly employees in the development of safety behavioral programs for use in industrial settings. To Date. chuck has over 800 hours of professional training experience.

8/90 to 6/91 - *Behavioral Program Specialist*, Alachua ARC, Gainesville Florida. Responsibilities included supervising three program administrators, and developing, training, analyzing behavioral programs in a workshop setting for persons with developmental disabilities.

2/89 to 5/90 - *Rehabilitation Therapist*, Tachachallie Rehabilitative Center, Gainesville Florida. Responsibilities included managing and training two Training Assistants. Further duties include developing, monitoring, and analyzing social, behavioral, developmental, and educational programs for persons with developmental disabilities.

COMPUTER SKILLS

Extensive experience running and repairing all PC/Windows based and Macintosh computer systems (through Windows '98 and system 8.02). Expertise in CorelDraw 7, and Microsoft Excel, Word, PowerPoint, and Access (latest versions for both PC/Mac operating systems). Additional knowledge of SuperPaint, SPSS, SAS, StatView, and many other similar software products.

PUBLICATIONS

Geller, E.S., DePasquale, J.P., Pettinger, C.B., and Williams, J.H. (1998). Critical Success Factors For Behavior-Based Safety. American Society for Safety Engineers.

Geller, E.S., Boyce, T.E., Williams, J.H., Pettinger, C.B, DePasquale, J.P., and Clarke, S.W. (1998). Researching Behavior-Based Safety: A Multi-Method Assessment And Evaluation. American Society for Safety Engineers.

Glindemann, K.E., Geller, E.S., Clarke, S.W., Chevallier, C.R., & Pettinger Jr., C.B. (1997). A community-based feedback process for disseminating pedestrian BAC levels. *Journal of Prevention & Intervention in the Community*.

TRAINING MANUALS

Pettinger, C.B., Boyce, T.E., DePasquale, J.P., Williams, J.H., & Geller, E.S., (June, 1996). *Achieving a Total Safety Culture Through Employee Involvement.* Training manual developed for the National Institute for Occupational Safety & Health (for Grant # 1 R01 OH03374-01).

Geller, E.S., Pettinger, Jr., C.B., Roberts, D.S., Glindemann, K.E., Jones, J.P., & Maddox, K.L. (December, 1993). *Achieving a Total Safety Culture: From the Road to the Workplace* (2nd Edition). Training manual developed for the Virginia Department of Motor Vehicles (for Grant # LE930459004).

Geller, E.S., Roberts, D.S., & Pettinger, Jr., C.B. (1993). *Actively Caring Coaching for Continuous Safety Improvement.* Newport, VA: Make-A-Difference, Inc.

TECHNICAL REPORTS

Glindemann ,K.E., Geller, E.S., Fortney, J.N., Pettinger Jr., C.B., DePasquale, J.P., Boyce, T.E., & Clarke, S.W. (1996). *Determinants of Alcohol Intoxication and Social Responsibility for DUI-Risk at University Parties*. Final report for a grant from the Alcoholic Beverage Medical Research Foundation.

Geller, E.S., Glindemann, K.E., Pettinger, JR., C.B., Roberts, D.S., Maddox, K.L., & Jones, III, J.P. (1994). *Achieving a Total Safety Culture: From the Road to the Workplace.* Final report for Grant # LE930459004 from the Virginia Department of Motor Vehicles (192 pages).

PUBLISHED ABSTRACTS

Pettinger, Jr., C.B., Cobb, T., DeYoung, L., & Geller, E.S. (September, 1996). *The "Airline Lifesaver": Twelve Years of Motivating Safety*. Paper presented at the 16th annual convention of the Florida Association for Behavior Analysis, Daytona Beach, FL.

Clarke, S.W., Geller, E.S., Pettinger, Jr., C.B., DePasquale, J.P., & Glindemann, K.E. (September, 1996). *Critical success factors for behavior-based safety*. Poster presented at the 16th annual convention of the Florida Association for Behavior Analysis, Daytona Beach, FL.

Michael, P.G., Pettinger, Jr., C.B., Rowe, M.P., & Brown, P.A. (September, 1996). *Don't be A Stinker, Use Your Blinker!*. Paper presented at the 16th annual convention of the Florida Association for Behavior Analysis, Daytona Beach, FL.

Pettinger, Jr., C.B., Kalsher, M., Roberts, D.S., & Glindemann, K.E. (1994). *Alcohol testing through cognitive behavioral fitness tests*. Published in the Virginia Journal of Science.

Wheeler, J.B., Pettinger, Jr., C.B., Saunders, C., Haskell, I.O., & Shurts, T.E. (1994). *"Actively Caring" and alcohol consumption: A field study of college students*. Published in the Virginia Journal of Science.

PRESENTATIONS

Pettinger, Jr., C. B., Williams, J. H., Ford, D.K., Geller, E. S. (March, 1999). *The history of occupational safety and health: A comparison of techniques used to reduce injuries and fatalities in industrial settings*. Paper to be presented at the annual convention of the Southeastern Psychological Association, Savannah, GA.

Pettinger, C.B., Jr., Michael, P.G., & Buscemi, N.V. (May, 1998*). Critical Success Factors for Behavior-Based Safety: Does Employee Involvement Make a Difference?* Paper presented at the 24th Annual Convention of the Association for Behavior Analysis, Orlando, Florida.

DePasquale, J.P., Williams, J.H., Pettinger, C.B., Jr., Ford, D.K., & Glindemann, K.E. (May, 1998). *In Search of Safety Excellence: A Comparative Analysis of Current Behavior-Based Safety Efforts.* Paper presented at the 24th Annual Convention of the Association for Behavior Analysis, Orlando, Florida.

Pettinger, C. P., DePasquale, J. P. (October, 1997). *Keeping People Safe: A Systematic Examination of Both Training & Feedback Strategies to Get the Job Done for Safety*. Paper Presented at the 2nt Annual Behavior NOW Conference, Houston, TX.

Wallace, M., McPherson, M., Rowe, M.P., Pettinger, C.B., & Glindemann, K.E. (October, 1997). *Evidence of a Disappearing Gender Gap in Alcohol Consumption: You've Come a Long Way Baby*. Poster presented at the 14th Annual Meeting of the Southeastern Association for Behavior Analysis, Chapel Hill, North Carolina.

Pettinger, C. P., DePasquale, J. P., Boyce T. E., Williams, J. H., & Geller, E. S. (April, 1997). *Critical Success Factors for Increasing Safe Work Practices: A Systematic Evaluation of Real-World Application.* Paper Presented at the 12th Annual Convention for the Society for Industrial Organizational Psychologists, St. Louis, Missouri.

Williams, J. H., Pettinger, C. P., Clarke, S. W., & Chevaillier, C. R. (April, 1997). *Participative Versus Non-Participative Approaches to Safety Training: Comparative Impact on Satisfaction and Information Retention.* Paper Presented at the 12th Annual Convention for the Society for Industrial Organizational Psychologists, St. Louis, Missouri.

Pettinger Jr., C.B., Williams, J.H., Boyce, T.E., & Ford, D.K. (April, 1997). *DO IT for Safety: A Process of Continuous Improvement.* Paper presented at the 43rd Annual Convention for the Southeastern Psychological Association, Atlanta, Georgia.

Williams, J.H., Pettinger Jr., C.B., Boyce, T.E., & Fortney, J.N. (April, 1997). *Participative Versus Non-Participative Safety Training: Information Retention Versus Satisfaction.* Paper presented at the 43rd Annual Convention for the Southeastern Psychological Association, Atlanta, Georgia.

DePasquale, J.D., Pettinger Jr., C.B., & Guillaumot, J.J. (March, 1997). *"Up in the Air": Reinforcing Flight Personnel for Encouraging Safety*. Poster presented at the 9th Annual Convention for the Society for Behaviorology, Plymouth, Massachusetts.

Chevaillier, C.R., Williams, J.H., Michael, P.G., Pettinger Jr., C.B., & Boyce, T.E. (May, 1997). *Involve Them and They'll Understand: A Systematic Test of this Training Slogan*. Paper presented at the 23rd Annual Convention for the Association for Behavior Analysis, Chicago, Illinois.

Ford, D.K., Gershenoff, A.B., Pettinger Jr., C.B., Chevaillier, C.R., & Martin, H. (May, 1997*). DO IT on the Job: An Employee-Driven Process to Prevent Workplace Injuries.* Paper presented at the 23rd Annual Convention for the Association for Behavior Analysis, Chicago, Illinois.

Pettinger, Jr., C.B., Depasquale, J.P., Fortney, J. N., Boyce, T.E., & Haskell, I.O. (March, 1996). *A Safe Driving Checklist to Improve Driver Training.* Paper presented at the annual convention of the Southeastern Psychological Association, Norfolk, VA.

Chevaillier, C.R., Glindemann, K.E., Fortney, J. N., Pettinger, Jr., C.B., & Gershenoff, A.B. (March, 1996). *Providing BAC Feedback to University Students: A Longitudinal Study*.

Paper presented at the annual convention of the Southeastern Psychological Association, Norfolk, VA.

Glindemann, K.E., Geller, E.S., Pettinger, Jr., C.B., & Fortney, J. N., (March, 1996). *Intervening With Fraternities to Reduce the Risk of DUI.* Paper presented at the annual convention of the Southeastern Psychological Association, Norfolk, VA.

Paul, S., Cobb, T., DeYoung, L., DePasquale, J., & Pettinger, Jr., C.B., (November, 1995). *"Up in The Air": Activators Vs. Consequences as Motivators of Flight Personnel.* Poster presented at the 12th annual conference of the Southeastern Association for Behavior Analysis, Charleston, SC.

Pettinger, Jr., C.B., Wetzel, B.R., Rasmussen, D., & Boyce, T.E. (May, 1995). *Activator Versus Consequence Approaches to Encourage Participation as an Intervention Agent.* Paper presented at the 21st annual convention of the Association for Behavior Analysis, Washington, D.C.

Roberts, D.S., Pettinger, Jr., C.B., Patarroyo, O., & Geller, E.S. (May, 1995). *Actively Caring for Safety: Interactional Impact of Organizational Support and Perceived Risk.* Paper presented at the 21st annual convention of the Association for Behavior Analysis, Washington, D.C.

Pettinger, Jr., C.B., Fortney, J. N., Boyce, T.E., & Haskell, I.O. (January, 1995). *Activator Versus Consequence Strategies to Encourage "Buckling up" Behaviors.* Poster presented at the 5th semi-annual convention of the Florida Association for Behavior Analysis/Organizational Behavior Management Network, Clearwater Beach, FL.

DePasquale, J.P., Pettinger, Jr., C.B., Kalsher, M.J., & Glindemann, K.E. (January, 1995). *Performance Based Testing: Acceptability and Effectiveness.* Poster presented at the 5th semi-annual convention of the Florida Association for Behavior Analysis/Organizational Behavior Management Network, Clearwater Beach, FL.

Patarroyo, O., Roberts, D.S., Buermeyer, C.M., Pettinger, Jr., C.B., & Gulino, A. (January, 1995). *Comparing Employees' Person States Before and After Actively Caring Training and a Thank-You card Intervention.* Poster presented at the 5th semi-annual convention of the Florida Association for Behavior Analysis/Organizational Behavior Management Network, Clearwater Beach, FL.

Pettinger Jr., C.B., Fortney, J.N., Nuttycombe, K.K., & Geller, E.S. (September, 1994). *Rewarding Use of the "Airline Lifesaver" Cards: An Indirect Intervention to Increase Safety Belt Use*. Paper presented at the 14th annual convention of the Florida Association for Behavior Analysis, Orlando, Florida.

Pettinger Jr., C.B., Jones III, J.P., Gershenoff, A., Shurts, T., & Gallagher, K. (May, 1994). *The Compensatory Tracking Task Battery (CTTB): Using Computer Tasks to Predict Alcohol-Induced Decrements in Psychomotor Performance*. Poster presented at the 20th annual convention of the Association for Behavior Analysis, Atlanta, Georgia.

Pettinger Jr., C.B., Roberts, D.S., Doss, A., Casali, S., & McClintock, M. (May, 1994). *Attempts to Increase Safety at a Nuclear Facility through Behavior Analysis.* Paper presented at the 20th annual convention of the Association for Behavior Analysis, Atlanta, Georgia.

Boyce, T.E., Pettinger Jr., C.B., Maddox, K.L., & Geller, E.S. (May, 1994). *The Effects of Establishing Conditions on Risk Taking Behavior.* Paper presented at the 20th annual convention of the Association for Behavior Analysis, Atlanta, Georgia.

Pettinger, Jr., C.B., Kalsher, M., Roberts, D.S., & Glindemann, K.E. (May, 1994). *Alcohol Testing Through Cognitive Behavioral Fitness Tests*. Paper presented at the 72nd annual meeting of the Virginia Academy of Science, Harrisonburg, Virginia.

Wheeler, J.B., Pettinger, Jr., C.B., Saunders, C., Haskell, I.O., & Shurts, T.E. (May, 1994). *"Actively Caring" and Alcohol Consumption: A Field Study of College Students.* Paper presented at the 72nd annual meeting of the Virginia Academy of Science, Harrisonburg, Virginia.

Pettinger, JR, C.B., Roberts, D.S., Wetzel, B., & Geller, E.S. (April, 1994). *Increasing Safety at a Nuclear Facility through use of Behavioral Interventions.* Paper presented at the Annual meeting of the Virginia Psychological Association, Charlottesville, Virginia.

Pettinger, Jr., C.B., Jones, J.P., Heath, J., & Gershenoff, A. (October, 1993). *The Use of Computer Tasks to Predict Alcohol-Induced Decrements in Psychomotor Performance*. Poster presented at the 10th Annual Meeting of the Southeastern Association for Behavior Analysis, Chapel Hill, North Carolina.