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Safety mindfulness: the incorporation of low-dose mindfulness as a leading edge safety intervention

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SAFETY MINDFULNESS: THE INCORPORATION OF LOW-DOSE MINDFULNESS AS A LEADING EDGE SAFETY INTERVENTION

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Abstract

With nearly 2.9 million work related injuries in the United States each year and nearly 5,000 work related deaths, opportunities exist to build on existing safety management interventions to improve workplace safety. In addition to the impact on worker's lives related to workplace safety accidents, workplace related injuries and deaths account for nearly $200 billon in direct costs to U.S. organizations. Current research in the application of workplace mindfulness offers the potential for a leading edge intervention that can lead to increased attention and situational awareness, which could greatly enhance workplace safety. The current study explored the relationship that low-dose mindfulness practice has on workplace safety.

Included in the current study was an examination of current and historical interventions for managing safety as well as a review of mindfulness research, with an emphasis on workplace mindfulness, and finally a review of the limited research that has begun to explore the relationship between mindfulness and workplace safety. A case study was conducted with a lab in a large bio-tech company in Southern California. 16 participants engaged in daily mindfulness training for six weeks. After the six-week trial, participants were interviewed, results were analyzed and organized into results, theoretical implications, and practical implications. The case study concluded with summarizing key themes, surfacing limitations of the study and recommendations for further study were identified. The findings of this study suggest there are great opportunities for low-dose mindfulness to positively impact workplace safety, potentially saving individuals from harm and organizations from costly accidents.

Keywords: Safety, Mindfulness, Workplace Safety, Safety Intervention

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Safety Mindfulness:

The Incorporation of Low-Dose Mindfulness as a Leading Edge Safety Intervention

The Occupational Safety and Health Administration (OSHA) reported over 2.9 million work related injuries in 2013. Using cost figures from the National Safety Congress, each occupational workplace injury is estimated to cost in excess of $39,000 (Herriott, 2013). This figure only accounts for estimates of wage loss, medical expenses, administrative expenses and employer related injury costs. As financially impactful as the direct costs are, the indirect costs further demonstrate the economic impact of a lost time injury. Though more challenging to quantify, indirect costs include lost productivity, associated human resources costs (hiring/training of new employees), increased insurance premiums, and impact to morale and are estimated at 3-10 times the direct cost of an incident (Gagne, 2011). As a point of reference, worker related injuries and illness have been estimated at a cost equivalent to nearly 3% of GDP (Leigh, 2011). In 2012, occupational workplace injuries and deaths were estimated to cost society nearly $200 billion (Herriott, 2013). The result of injuries to our society is immense both in terms of the impact to the individual's health as well as the economic impact to the organization.

With the financial costs demonstrated (Herriott, 2013; Leigh, 2011), and the human consequence of nearly three million people injured each year and over four thousand killed (OSHA), the adage "safety makes good business" holds true. When looking strictly through the lens of business strategy, case studies demonstrate the positive impacts of investing in safety. Companies such as Schneider Electric (France) and Alcoa (United States) have made worker safety a strategic business initiative. The strategy of investing heavily in safety not only resulted in dramatically reducing the numbers of employees injured, it also resulted in $15 million in

annual savings for Schneider while the stock price of Alcoa increased over 600% in the five years CEO Paul O'Neil made safety the organizations top priority (Herriott, 2013).

Managing Safety

Strategies to protect workers has been evolving rapidly in the United States since the early 20th century. Largely in response to workers' compensation laws established in the early 1900s, organizations first begin taking steps to increase worker safety through the adoption of engineering solutions to safety hazards. Examples of engineering solutions include machine guarding and providing personal protective equipment (e.g., safety goggles). The first generation of safety management aimed at creating physical protections between the worker and the potential hazards (Goetsch, 2014).

Following the adoption of engineering solutions to safety, organizations attempted to create consistency in worker behavior through clearly established policies and procedures (Goetsch, 2014). Known in safety circles as enforcement, this generation of safety management attempted to provide clear expectations for safe working behavior. With the creation of policies came disciplinary processes for when policies were not followed. Furthermore, increased technology in the workplace and more detailed policies and procedures, organizations saw a need to provide more education for their workforces. Education initiatives included increased training on machinery, safety procedures, and injury prevention (Goetsch, 2014).

Though these methods for managing safety have significantly contributed to increased safe working conditions, dropping the workplace fatality rate by over 90% since the early 1900s (NCSE, 1997), organizations are now looking for alternative work strategies and interventions to ensure that workers are safe and the environment is less dangerous. Though there is much debate in safety circles whether accidents are a result of individual error, a symptom of the

culture where the injury occurred, or a combination of the two, increased attention is being placed on leading edge solutions to safety problems. Leading edge indicators include hazard identification systems, near miss reporting, or a host of other tools designed to increase awareness and communication to prevent an accident before it happens. These strategies for leading edge safety management is further supported with an understanding that many hazardous activities take place in unsupervised groups where some traditional strategies (policies and procedures) are not easily enforced (Reason, Parker, & Lawton, 1998). Lagging indicators include incident investigations and other tools that are utilized after an accident or injury has occurred in hopes of gaining information that will prevent future accidents. There are many challenges in addressing worker safety such as stress, fatigue, cognitive fixation, automation surprise (a machine acts in a non-routine manner), and lapse's in attention (Dekker, 2013; Huber, Hill, & Merritt, 2015) which can put workers at risk for serious injury. In pursuit of additional strategies for further reducing the number of workers injured from the leading edge, a growing body of research looks to investigate the potential for mindfulness as part of a strategy to increase worker safety (Huber et al., 2015).

Mindfulness

Mindfulness has become a broad term often used to describe a present-centered state. There is an eastern-based version associated with meditation and a western version that is not associated with meditation. The distinctions and similarities of these two view will be explored below.

Mindfulness has grown from a practice associated with Buddhist teachings, incorporating meditation as a practice to become more mindful, to a more secularly accepted practice with a variety of applications. In the clinical context, mindfulness has been used to create programs

like Mindfulness-Based Stressed Reduction (MBSR), and therapeutic interventions like Mindfulness-Based Cognitive Behavioral Therapy (MBCT). It has been used widely in the support sleep therapy, and as part of treatment plans for anxiety and depression. Mindfulness has gained attention outside of medical applications including popularity in such diverse areas as athlete performance (Birrer, 2012), entertainment, literature, self-help, as well as successful applications with our military personnel in both preparing for and returning from combat deployment (Jha, 2015).

Interest in mindfulness has grown dramatically in recent years in both popular culture and academic study. At the time of this writing, a search for mindfulness-related books in Amazon.com will generate 16,000 hits, over 6,000 specifically related to mindfulness meditation. This trend extends beyond the databases of Amazon to areas of academic study with thousands of articles written on subjects related to mindfulness (Good et al., 2016; Hyland, Lee, & Mills, 2015). Although thousands of research studies have been focused on mindfulness, only a fraction of these studies have examined the role of mindfulness in the workplace. Further, of the studies which examine mindfulness in the workplace, none were found that attempted to examine the relationship between the incorporation of daily mindfulness practice and workplace safety.

As mentioned previously, workplace injuries are often correlated to human errors that can be attributed to attention, fatigue, and stress (Dekker, 2006; Huber et al., 2015; Kaplan & Tetrick, 2011; Reason et al., 1998; Weick, 2006). Research has shown positive results of mindfulness practices in the domains of stress reduction, depression, anxiety, sleep quality, and attention (Good et al., 2016; Huber et al., 2015; Hülsheger et al., 2014; Hyland et al., 2015) . The demonstrated benefits of mindfulness to underlying causes of workplace injuries suggests the

possibility for a positive relationship between mindfulness practices and a decrease in workplace injuries.

Research Purpose

The current study attempted to explore the impact of daily mindfulness practices on workplace safety. The mindfulness practices include training and implementation of both formal (breath focused) and informal (meaningful pauses) mindfulness practices with frontline workers. The limited research found in the application of mindfulness to workplace safety has restricted the implementation of a practice that has potentially positive benefits to workplace settings of all types.

The development of strategies that may have the ability to increase attention and awareness in complex and hazardous work environments has the potential to save countless workers from injury or death. The benefits of mindfulness will no longer be reserved for those who have specific job classifications, levels of education, or past experience with mindfulness. The goal of this research was to explore the relationship between mindfulness practice and safety performance in the hope of developing an intervention that will increase workplace safety.

Chapter 2: Literature Review

This chapter provides the current impact of occupational accidents and fatalities while providing additional information regarding the way in which occupational safety is currently managed in the United States. This will provide more detailed information on current strategies for enhanced safety. Next, this review will provide an overview of the mindfulness construct, including its known and potential benefits to the workplace. Included in this section will be a distinction between Eastern and Western forms of mindfulness. This will set the foundation for the primary question in this study: can an intervention adapted from a mindfulness meditation

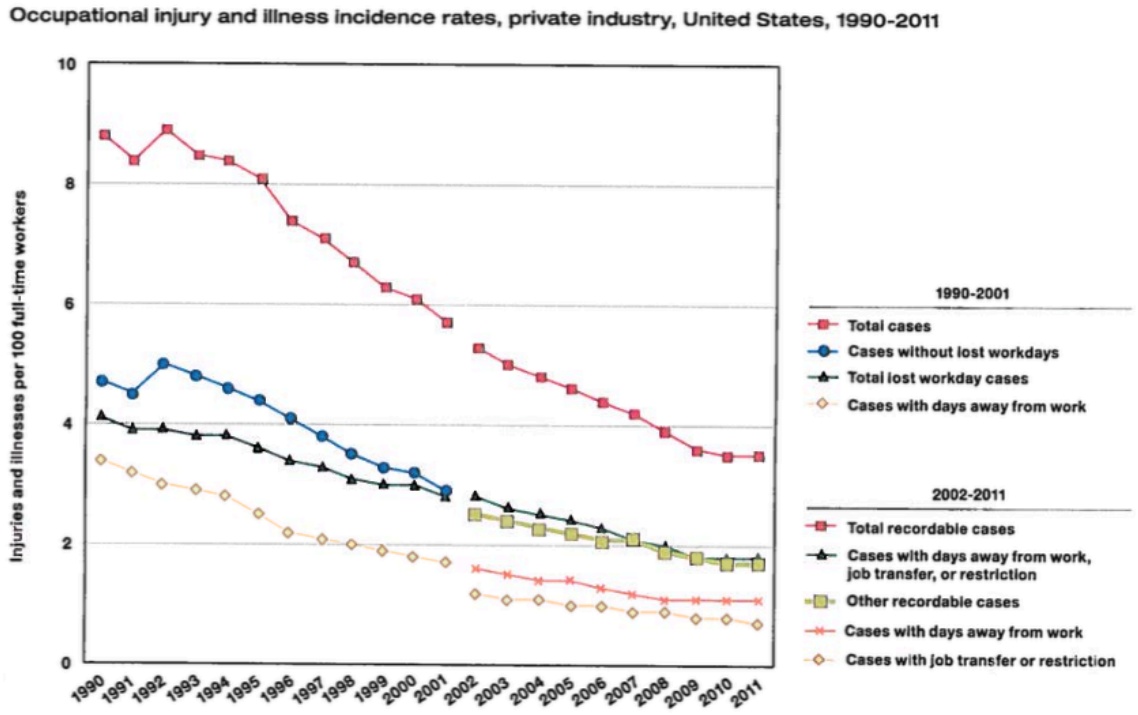
practice positively impact workplace safety and potentially reduce workplace injuries? The very limited research in this area will be presented along with theoretical linkages to support the research in question.

Safety Trends

Though challenging to precisely calculate due to direct and indirect costs, it is estimated that the total cost of workplace injuries and fatalities in the United State are between $250 Billion (Leigh, 2011) and $365 Billion annually (OSHA, 2013). This cost comes with the price of over 3 million nonfatal occupational injuries and illnesses (Bureau of Labor and Statistics (BLS), 2013) and 4,670 worker related fatalities (OSHA, 2013). The impact of worker related injuries places a heavy burden on workers' health as well as the economic health of organizations.

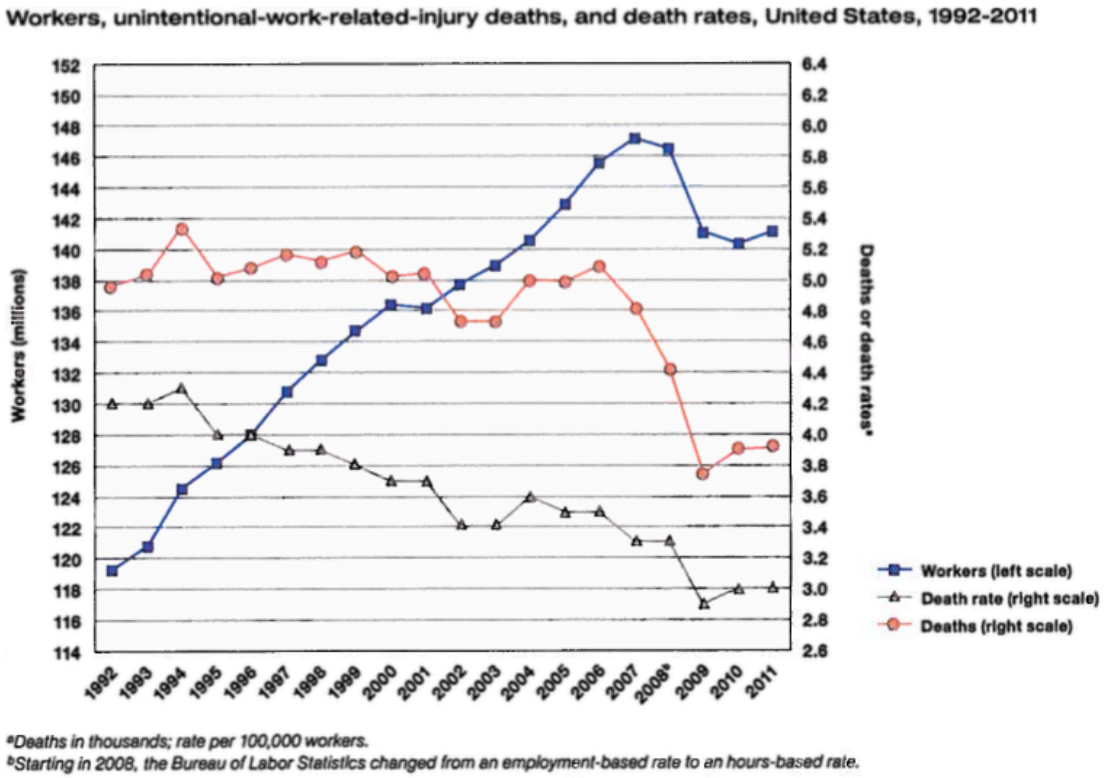
Dramatic progress had been made in workplace safety in the United States over the past one hundred years. The National Safety Council estimates that work related injuries declined 90% from 1933 to 1997 (See Figure 1). More recently, when looking at workplace fatalities and injuries from 1990-2011, there is a continued decrease in both injury and accident rates (See Figure 2) (Council, 2013).

Figure 1. Occupational Injury and Illness Rates, U.S. 1990-2011



Source: Bureau of Labor Statistics.
Note: Beginning with 1992, all rates are for nonfatal cases only.
Changes in OSHA recordkeeping requirements in 2002 affect comparison with earlier years.

Figure 2. Occupational Deaths and Death Rates, U.S. 1992-2011



Though progress has been made in workplace safety, in 2014 there were still 4,500 industrial deaths and over 3 million workers injured (OSHA). With hundreds of billions of dollars spent and thousands of people continuing to be hurt or killed on the job there remains continued exploration for interventions that can focus on continuous improvement when it comes to the area of workplace safety (Carrillo, 2012; Haight, Yorio, Rost, & Willmer, 2014).

Safety Management

Early adoptions in workplace safety focused on the 3E's of safety: Engineering, Enforcement, and Education (Goetsch, 2014). These interventions included many of the traditional and immediately effective solutions to keep workers safe. This involved providing workers with personal protective equipment, machine guarding, and engineering additional solutions to create physical protections between the worker and the machine. Further activities

that fit within the traditional safety and health programs included: safety training, behavioral safety observations, safety meetings, safety inspections, audits, hazard and risk assessments, safety awareness campaigns, and increased work in organizational culture activities (Haight et al., 2014). These safety activities are credited with significantly impacting the positive advancements in safety data.

The advancements that have been made in safety can be correlated to an increase in effective safety programs. However, there remains wide-spread concern in safety circles regarding the effectiveness of using leading versus lagging indicators to further improve workplace safety. Leading indicators reference the quality of an intervention's implementation (Haight et al., 2014) while lagging indicators often review data after an accident has occurred in hopes of making corrective action in the future. Many lagging indicators can be negatively impacted if the culture of the organization does not support honest and candid feedback (Carrillo, 2012). Activities such as incident investigations, which have the desired purpose of learning and initiating change, can be undermined when there is fear of culpability (Garrett & Teizer, 2009). One challenge with relying heavily on lagging indicators is that these incidents are relatively rare, which creates a discontinuous feedback loop. Furthermore, they generally only capture moments of unsafe occurrence rather than the system's overall safety state (Reason et al., 1998). Other systems-based activities that have become traditional safety activities, such as behavior based safety observations, have come under increasing criticism amidst growing data that demonstrates at times these observations are being "pencil whipped," completed with limited or in some cases no actual observation, in order to comply with a company policy but not truly being completed to provide useful feedback that could lead to change (Carrillo, 2012).

In combination with traditional approaches to safety management, current interventions present additional philosophies and systems to be incorporated into the safety arena to make continued progress in preventing workplace incidents. A systems-based approach, referred to as Occupational Health and Safety Management Systems (OHSMS) have become popular with agencies such as OSHA as they attempt to provide increased alignment and uniformity among the various workplace safety programs a company may be utilizing (Haight et al., 2014). The systems approach attempts to offer a uniform solution where policies and procedures are written, communicated, and implemented in a similar fashion.

Trying to define the cause of injuries and accidents is complex, and often requires specific incident analysis. 'Errors' have been defined as "the failure of planned actions to achieve their desired ends" (Reason et al., 1998, p. 291). Dekker (2006) presents a diametrically opposed views of human error that continues to challenge how workplace safety is viewed. In the old view, known as bad apple theory, complex systems would be fine if it were not for erroneous behavior or unreliable people. Dekker (2006) argues this places the blame squarely upon human error (e.g., loss of situational awareness, complacency, negligence). The "new view" is presented as human error being a symptom of deeper trouble (e.g., culture, climate, leadership, pressure, motivation, individual and organizational factors) and connecting people's behavior with the circumstances surrounding them (Neal & Griffin, 2006). These circumstances provide the true sources of the trouble and help to explain the rationale for how individual behavior occurred (Dekker, 2006; Neal & Griffin, 2006; Reason et al., 1998). Those that hold to Dekker's "old view" argue that over 80% of incidents and accidents are caused by human error (Garrett & Teizer, 2009; Shappell & Wiegmann, 2000) while also impacted by organizational climate and culture. Others in the field point to incidents occurring in relation to a broader

cultural set of circumstances that influence the individual behavior (Carrillo, 2012; Dekker, 2006; Neal & Griffin, 2006). In terms of errors associated with violating safety procedures, violations can be categorized by routine violations, optimizing violations, or situational violations (Dierynck, Leroy, Savage, & Choi, 2016; Reason et al., 1998). This categorization supports the duality of human and environmental factors that result in safety violations or accidents.

Mindfulness Approaches

One challenge in the continued exploration of the potential benefits of mindfulness is organizing the various definitions, understandings, and applications of mindfulness. Though originally presented through the lens of Buddhist understanding, variations of mindfulness have been researched and taught. Studies linking western approaches to mindfulness and safety will be examined in this study. However, the clear distinction will be made that the focus of this study is to explore the principles of the Eastern-based understanding of mindfulness, through meditation practice, and its potential to increase worker safety.

Western Approach to Mindfulness and Safety

The Western approach to mindfulness is non-meditative and emphasizes drawing novel distinctions, resulting in being more present, perceptive, and guided (but not governed) by rules and routines (Djikic, 2014; Langer, 1989). An example of our emphasis on novel distinctions could be the mindset we may adopt when traveling to a new place. When traveling, often we are looking for things that are new, we are actively searching for similarities and differences. The expectation may be that things are going to look new, so we notice. However, in our daily lives we often don't expect things to look different, so we adopt a mindset of expecting things to look the same as they have in the past. This is characterized as mindlessness. From the Western

perspective, the main problem to overcome is this concept of mindlessness (Langer, 1989), which can be described as making bad decisions or no decisions at all by falling victim to our routines, stereotypes, or authority-compliant behaviors (Djikic, 2014). From the Western perspective, people are controlled and prevented from making better choices by the automaticity created by past experiences and controlled environments (Djikic, 2014).-An example that may demonstrate this notion of mindlessness is the feeling of driving on auto pilot. If you have ever arrived at a given location and had a feeling that a portion of the trip is one you cannot remember in detail, this is an example of mindless behavior. A second example of mindlessness may come as a result of repetition. If you conduct an activity so often that it becomes second nature, you may conduct that activity without thinking about it, even though thinking about it may be advantageous to you.

Largely pioneered by Langer (1989), this Western version of mindfulness has some significant distinction from the Eastern approaches. The Western approach emphasizes that mindfulness requires categorizing, judging, questioning, and problem solving activities (Djikic, 2014; Hyland et al., 2015) which contrasts concepts like acceptance and withholding judgment that are prevalent in Eastern understandings (Hyland et al., 2015). Many similarities of Eastern and Western approaches exist, and will be explored later in this review. Langer's approach has been subsequently applied by organizational scholars to the potential impacts of reducing automaticity in the context of high reliability organizations.

Based largely on the Western approach to mindfulness, High Reliability Organizations (HROs) have begun to capture increased attention as models to investigate for increasing overall safety performance(S. Dekker, 2006; K. Weick, Sutcliffe, & Obstfeld, 1999). Examples of HROs include airlines, air traffic control systems, naval aircraft carriers and nuclear power

plants. HROs are organizations that despite very challenging environments have above average safety records and high reliability. HRO theory attempts to describe characteristics of organizations that maintain both their reliability and effectiveness despite operating in complex and dangerous environments (Khorsandi & Aven, 2014). One such characteristic that has surfaced when researching HROs is presences of mindfulness and mindful organizations (Weick, 1999). As safety records of HROs have received increased attention, growing interest has been shown in the relationship between Western-based mindfulness and positive safety performance. Mindfulness has been established as an organizational trait of HROs.

Drawing on the work of Weick, organizations that exhibit positive attributes of high reliability when it comes to safety have developed and intentionally maintained a state of collective mindfulness. In describing collective mindfulness, processes in HROs are distinctive because they focus on five key principles: preoccupation on failure rather than success, reluctance to simplify interpretations, sensitivity to operations, commitment to resilience, and dereference to expertise (Weick, 2006; Weick, Sutcliffe, & Obstfeld, 1999). These processes are tied together by their ability to induce a rich awareness (Weick et al., 1999).

Research into HROs offers a balanced viewpoint on priorities when managing safety with a focus on acting from a leading edge. HROs are constantly measuring and monitoring their systems with an understanding that mechanical breakdowns exist, people become desensitized to risks, and failures happen. Given the dynamic reality of working environments a constant state of awareness and assessment is necessary. This mindset of constant awareness and inquiry are understood by some to be the strongest preventative measures (Weick, 1999).

The Western-based construct of mindfulness has shown a positive relationship with workplace safety. Though the research has been limited, initial evidence suggests positive

correlations from this understanding of mindfulness and workplace safety. Though it has unique characteristics that distinguish it from the Eastern-based approach to mindfulness often achieved through meditative practices, similarities do exist between the approaches. Both approaches propose a present-centered emphasis that seeks to avoid attachment to any one focus of concentration (Djikic, 2014). There is a growing trend by leading proponents on each side to bridge the gap between meditative and non-meditative approaches to mindfulness (Djikic, 2014). Weick (2006) clearly articulates how the associated benefits of Eastern-based mindfulness meditation may enhance the effectiveness of the trait mindfulness associated with HRO's continued pursuit of safety excellence. Of the many benefits outlined, Weick (2006) relates the benefits of attentional stability, vividness associated with the Eastern understanding of mindfulness to the five mindful processes associated with organizing for high reliability. This relationship of Eastern and Western understandings of mindfulness supports the notion of safety being positively influenced by the presence of mindfulness, whether individual or collective. When discussing individual and/or collective mindfulness, research has begun to explore the relationship between levels of mindfulness, individual and collective (Sutcliffe, Sutcliffe, Vogus, & Dane, 2016). The current research attempted to dissect the levels and definitions of mindfulness to further understand the individual and collective benefits obtained through enhanced mindfulness, while exploring the relationship that may exist between increased individual mindfulness to improved collective mindfulness.

To prevent the language of mindfulness or the debate over modern definitions of mindfulness to detract from the focus of this study, Western-based mindfulness will not be further explored here. Instead, this study will focus on the potential of Eastern-based mindfulness to increase individual worker safety.

Mindfulness

A widely-accepted definition of mindfulness is awareness that arises through paying attention, on purpose, in the present moment, non-judgmentally (Kabat-Zinn, 1994). As a state based definition, mindfulness can be enhanced from an Eastern approach through a meditation practice that cultivates present moment awareness while attending to relevant aspects of experience in a nonjudgmental way (Ludwig & Kabat-Zinn, 2014). Dispositional or trait-like mindfulness is simply explained as individuals inherently possessing a personality that lends itself to being more mindful than others (Brown & Ryan, 2003). This stems from the understanding of mindfulness as a nonjudgmental experience of the present moment regardless of whether the moment is positive or negative (Hülsheger, Alberts, Feinholdt, & Lang, 2013). Though state-based mindfulness was once thought to be unique from trait-based, the constructs show a high degree of overlap in related outcomes (Brown & Ryan, 2003; Hülsheger et al., 2013) and research has indicted that heightening state-based mindfulness increases trait mindfulness (Kiken, Garland, Bluth, Palsson, & Gaylord, 2015).

Both state and trait mindfulness have been extensively studied, primarily examining benefits outside the workplace. Historically, mindfulness research has largely focused on health and wellness studies (Khoury, Sharma, Rush, & Fournier, 2015). A small but growing body of research has begun to explore potential benefits of mindfulness in the workplace (Good et al., 2016; Hyland et al., 2015).

Scholars have reviewed the existing literature exploring mindfulness in workplace organizations(Good et al., 2016; Hyland et al., 2015). Good and colleagues (2016) organized the existing literature and potential impacts of mindfulness at work to performance, relationships and wellbeing.

Figure 3. Integrative Framework Relating Mindfulness to Workplace Outcomes

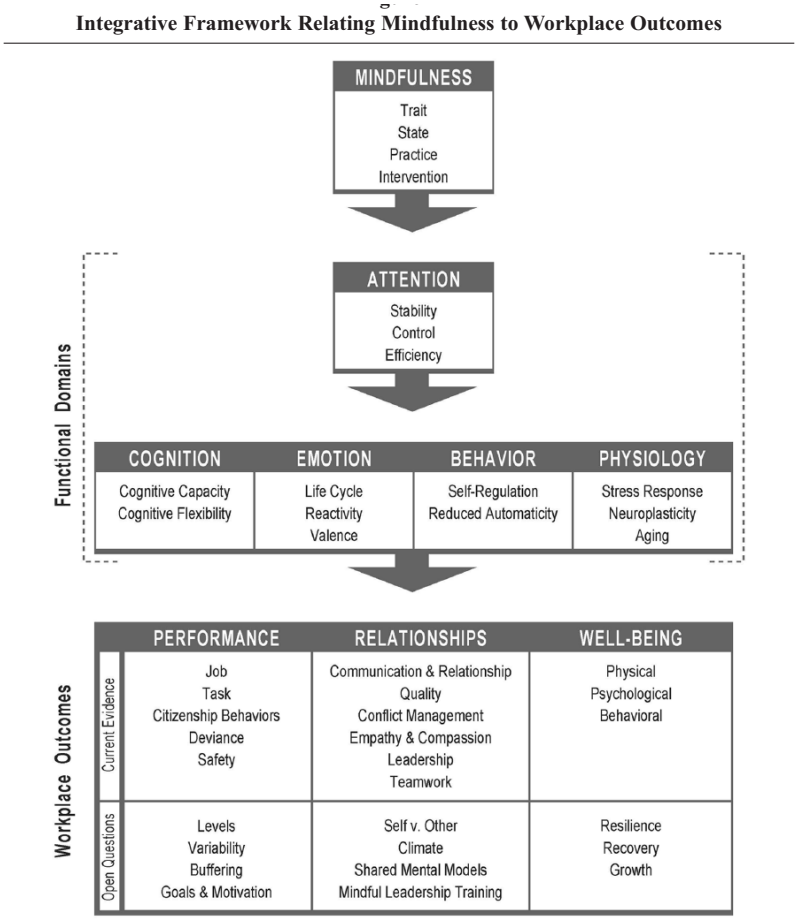


Figure 3 shows how mindfulness can be explained in a linear progression, from practice to workplace outcomes. Mindfulness is perceived to positively impact human functioning through attention, which can lead to enhanced awareness. Mindfulness has been shown to improve three qualities of attention: stability, control, and efficiency (Good, 2016).

Stability refers to the ability to stabilize attention in the present as opposed to attentional wandering or daydreaming. Studies have estimated that the human mind spends nearly half its waking hours in the wandering state (Killingsworth & Gilbert, 2010; Mrazek, Franklin, Phillips, Baird, & Schooler, 2013; Smallwood & Schooler, 2015). This stability may stem from the skill to notice when wandering is occurring and the ability to return to present-moment focus (Good et al, 2016). Control refers to the ability to reduce attention to distracting information and has been

supported by neurological evidence of long-time meditators (Good, 2016). Finally, attentional efficiency refers to the efficient use of cognitive resources. As attentional control increases, the amount of cognitive resources spent on off-task thoughts and activities decreases, increasing the efficiency of one's attention. As reported by expert meditators, as well as being visible in fMRI scans, meditators exhaust fewer brain resources linked to increased executive attention (Good, 2016). In general, "attention may always be scarce, but mindfulness may allow more responsible stewardship of this precious cognitive resource," (Good, 2016, p. 133).

As attentional capacity is increased, functional domains of cognition, emotion, behavior, and even one's physiology has been shown to be positively impacted (Good et al., 2016). Cognitive capabilities including working memory, the part of the short-term memory concerned with immediate perceptual and linguistic processing, has been improved with mindfulness training (Roeser et al., 2013). Heightened levels of cognitive flexibility have been associated with mindfulness training, offering benefits such as creativity and innovative problem solving behaviors (Ding et al., 2015; Ostafin & Kassman, 2012).

Mindfulness and mindfulness training have demonstrated several benefits related to one's emotional domain. As one becomes more aware to their own emotional state there appears to be a positive influence connecting mindfulness to the severity and reactivity to stimuli that elicit an emotional response (Arch & Craske, 2010; Davidson, 1998). The ability to be less reactive and emotionally impacted by given stimulus presents further choice in one's behavior.

Behavioral domains positively impacted by mindfulness are related to the superior self-regulation that may occur when attention is increased (Glomb, 2011). In addition to the ability to be in greater control of one's behavior, the ability to reduce automaticity, behavioral patterns conducted with low levels of awareness, has the potential for direct application in the safety

environment. Automaticity is a perceived small, or non-existent, mental gap between a stimulus and a behavioral response. This state of "automatic pilot" results in a condition of mindlessness that can create fixation on a single perspective without awareness that things could be otherwise (Djikic, 2014; Weick et al., 1999). The ability to create more perceived space between stimulus and response provides an enhanced opportunity to make choices based on all available data and not strictly through the filter of past experiences. This ability to recognize and potentially change behavior offers alternatives to the often-held assumption in safety that behavior is done because "I've always done it this way."

Beyond the ability to adjust the way attention is enacted in the present moment, mindfulness training has been associated with changes in the physiology of the brain. Referred to as neuroplasticity, the structural changes that mindfulness practitioners have demonstrated include the shrinking of the amygdala and increasing thickness of the pre-frontal cortex (Good, 2015; Hyland et al., 2015; Taren, Creswell, & Gianaros, 2013). This change in brain structure suggests less reliance on lower-order brain activity associated with the fight or flight functions of the amygdala and enhanced dependence on high-order, pre-frontal cortex regions associated with awareness, concentration, and decision-making. Furthermore, research has shown that meditation increases activity in the area of the brain responsible for self-regulation of attention (Jha, et al., 2007).

The impact mindfulness may have on functional domains can influence workplace outcomes by positively impacting performance, relationships and well-being (Good et al., 2016; Hyland et al., 2015). Workplace performance has been positively impacted by showing mindfulness may help employees better deal with organizational change through a decreased attachment to the current state (Bond & Bunce, 2003). Health care workers with higher levels of

trait mindfulness were also shown to have higher patient ratings of communication and overall quality of care (Beach et al., 2013).

Higher quality relationships in the workplace have been related to mindfulness through the correlation of those with increased mindfulness demonstrating higher levels of emotional intelligence (Chu, 2010). The four components of emotional intelligence are self-awareness, self-management, social awareness, and relationship management. This increase in self and social awareness positively influence relationships both interpersonal behavior as well as working with others. Many of the tangible skills positively impacted include quality of communication and listening (Beckman et al., 2012). Related studies have shown that mindfulness may improve one's relationships because of reduced emotional reactivity (Baer, 2003).

Work related well-being is supported in research correlating mindfulness to positive impacts on one's emotion/mood (Williams, 2006) and reduced work-related emotional exhaustion in studies of those participating in mindfulness training (Hülsheger et al., 2013). As one's overall stress impact and personal well-being may influence their ability to perform at work, it is also possible for the positive benefits related to managing stress and even forms of depression and anxiety may also impact one's work performance (Miller, Fletcher, & Kabat-Zinn, 1995).

Based on the demonstrated benefits mindfulness has on attention through impacting the four domains of human functioning and three workplace outcomes (Good et al., 2016), the intention of this study is to further explore the potential of mindfulness training as an intervention to specifically improve workplace safety. It is hypothesized that benefits of mindfulness will lead to increased occupational safety for front-line workers, which includes

increases to stabilizing and controlling attention while enhancing cognitive flexibility. These benefits have the potential to enable employees most in danger, with an increased level of dexterity in responding to environmental turbulence or automation surprise (Dekker, 2006; Good, 2015).

Mindfulness and Workplace Safety

Through the approach of dispositional mindfulness, a pair of studies by Zhang and colleagues (2013, 2014) explored the relationship between dispositional mindfulness and worker safety. These studies explored the potential benefits of sustained attention, cognitive flexibility, control of risk behavior, and interpersonal relationships on safety performance in high risk industries. This research specifically examined the relationship between dispositional mindfulness and task performance with operators at a nuclear power plant. With a focus on the link between dispositional mindfulness and task performance, Zhang and colleagues (2013) found that the presence factor of dispositional mindfulness had a significant positive influence on task and safety performance for those who held jobs with high levels of complexity (e.g., power plant control room operators). However, those with a high level of dispositional mindfulness had a negative impact on task performance and a non-significant impact on safety performance for those that were classified in low-task complexity jobs (e.g., field operators) (Zhang, Ding, Li, & Wu, 2013). The current study suggests that there is a positive interaction between dispositional mindfulness and task as well as safety performance but also suggests boundary conditions of task complexity may influence the associated impact of mindfulness on safety performance.

Zhang and colleagues (2013, 2014) acknowledged many limitations in their research. First, the research did not warrant a causal relationship between dispositional mindfulness and performance (Zhang et al., 2013). Further investigation is suggested to explore whether a third

variable, such as increased training, would increase both mindful practice and performance (Zhang et al., 2013). Further questions surfaced such as the self-identification of trait mindfulness and questions related to the evaluation of safety and task performance solely based on supervisors scoring of surveys.

In another study, which investigated the relationship between dispositional mindfulness and safety behavior (Zhang & Wu, 2014), Zhang examined the benefits of dispositional mindfulness through the lens of a dual process perspective of human behavior incorporating two basic cognitive systems. The first cognitive system was an unconscious "automatic" system and the second system was a controlled "conscious" system that was more cognitive in nature. The premise was that mindfulness would improve the more autonomous functions associated with one's automatic system by being more aware. This was presumed to improve situational awareness and decrease the likelihood of risky behaviors. The potential benefits to the conscious system presented was supported by research that mindful people are reluctant to simplify perceptions, causing more intentional awareness and thorough investigations into potential risks (Zhang & Wu, 2014). Additional suggested benefits to the conscious system were based on the potential for increased efficiency of cognitive resources. Identifying potential benefits, the study focused on experienced control room operators in Chinese nuclear power plants. Surveys were administered to assess self-reported levels of perceived dispositional mindfulness and safety behavior as well as cognitive tests to gauge the impact of intelligence.

Zhang and Wu (2014) proposed four hypotheses. First, that dispositional mindfulness would be positively related to safety behavior. Second, dispositional mindfulness would add more explanatory power in predicting safety behaviors after controlling for conscientiousness. Third, the relationship between mindfulness and safety behavior would be stronger for more

experienced operators. Finally, the relationship between mindfulness and safety behaviors would be stronger among more intelligent operators. The relationship between mindfulness and intelligence was explored based on a presumption that one's intelligence is a measurement of the ability to use the second, "conscious," cognitive system. A person's level of intelligence was used as the moderator of the mindfulness-performance relationship (Zhang & Wu, 2014). The third and fourth hypotheses, experience and intelligence, were used as boundary conditions.

Zhang and Wu (2014) demonstrated benefits of mindfulness as related to workplace safety. Of the four hypotheses that were offered, each was supported although the effect sizes were small to medium in size. Dispositional mindfulness was positively correlated to positive safety behaviors and the effect was more meaningful for those with higher levels of intelligence and greater experience. The correlation between mindfulness and intelligence in operators suggests that intelligence may be a boundary condition of mindfulness (Zhang & Wu, 2014).

Additional studies have found similar correlations between levels of dispositional mindfulness and safety. One study found a correlation between levels of dispositional mindfulness and food safety practices (Betts & Hisz, 2015). As a result of this finding, Betts and Hisz (2015) called for an investigation of state-mindfulness achieved through meditation and its potential impact on food safety.

Dierynck and colleagues (2016) explored the role of both individual and collective mindfulness has on promoting workplace safety in healthcare. By measuring individual and collective mindfulness alongside self-reported work-around (short-cuts) rates and safety failures with over 500 nurses, the authors demonstrated a relationship between enhanced levels of mindfulness and safe behavior. In their research, a linear model of evidence suggests that high levels of mindfulness leads to less workarounds, which results in increased worker safety

(Dierynck et al., 2016). Dierynck and colleagues (2016) added that one way to increase individual mindfulness, and in doing so impacting overall safety performance, is to offer mindfulness training.

The growing research exploring the relationship between mindfulness and safety has demonstrated mindfulness has a positive influence on worker safety (Betts & Hinsz, 2015; Dierynck et al., 2016; Huber et al., 2015; Zhang et al., 2013; Zhang & Wu, 2014). This research has focused on assessing mindfulness from a dispositional perspective without the presence of mindfulness training. In response to Huber's (2015) call for action, as well as limitations and opportunities surfaced in other studies (Betts & Hinsz, 2015; Dierynck et al., 2016; Zhang et al., 2013; Zhang & Wu, 2014), the current research attempts to closely explore the relationship between the incorporation of a mindfulness meditation practice (mindfulness training) and worker safety. The current study hope to fill a gap by exploring the impact of mindfulness training to individual mindfulness and safety performance.

Opportunity for Further Safety Research

In the United States, improvements in safety management have been responsible for dramatically increasing workplace safety as well as significantly lowering the financial impact to organizations. Despite the gains made, thousands continue to be hurt or killed each year and billions of dollars are spent in both direct and indirect costs associated with workplace accidents. Many researchers and safety professionals have begun exploring non-traditional methods to improve workplace safety.

An opportunity exists to increase the small body of research aiming to explore the correlation of mindfulness to workplace safety. By focusing on the impact of increased individual mindfulness, using the widely accepted definition of mindfulness as present-centered

attention and awareness (Good, 2016) the demonstrated benefits on attention (stability, control, efficiency), as well as reduced dependency on behavioral automaticity offer potentially powerful benefits for front-line workers.

Mindfulness has a clear path to workplace outcomes that could improve workplace safety. As mindfulness is developed, improvements to attention occur. As attentional capacity is increased, situational awareness is enhanced. When workers are more aware of their surroundings, behaviors, and cognitive patterns, increased choices become available. Rather than doing things the way they have always done them, workers may begin to question whether working-around a policy to save time is worth the risk. They may become more aware of their own level behavioral automaticity and this heightened presence may enable them to react to their machines acting out of the ordinary or if their environments present a sudden danger. During stressful situations, workers may have strengthened the ability to cope with sudden stresses and while doing so demonstrate enhanced cognitive flexibility, demonstrating problem solving behaviors that take into consideration a wider range of potential risks. The ability to enhance awareness and deal with stress because of increased attention has direct applications to increasing workplace safety.

Previous research has measured the relationship between mindfulness and workplace safety through the lens of dispositional mindfulness and not the incorporation of mindfulness practice(Zhang & Wu, 2014). Despite some skepticism regarding the benefits of low-complexity job functions and mindfulness (Zhang & Wu, 2014), research suggests the attentional qualities of mindfulness may positively impact routine tasks (Good, 2016). Limited research has been conducted to evaluate whether there is a positive correlation on workplace safety after the incorporation of mindfulness training. It is this gap in the current research hopes to explore

through the incorporation of a mindfulness training intervention within an organization to explore the potential benefits of a mindfulness practice on workplace safety.

Chapter 3: Research Methodology and Design

The purpose of this case study was to explore the relationship between mindfulness and workplace safety. Mindfulness has well documented benefits associated with health and wellness outcomes. Workplace benefits of mindfulness are supported (Good et al., 2016; Hülsheger et al., 2014), however, there is limited research exploring the benefits of mindfulness and its potential relationship to workplace safety. There have been calls in recent research studies to move beyond confirming the relationship between mindfulness and safety to conducting experiments that explore the potential benefits of incorporating mindfulness training to workplace safety (Dierynck et al., 2016; Good, 2015; Huber et al., 2015; Zhang et al., 2013). This case study attempts to explore the impact of a low-dose mindfulness training on workplace safety through field research with a client system.

Research Sample

The client group was a single lab within one of the leading companies conducting genetic testing and manufacturing precision laboratory equipment. The specific site has achieved significant safety milestones including being awarded the prestigious Voluntary Protection Program (VPP) certification from OSHA. VPP is a certification given to organizations that excel beyond OSHA standards in implementing an effective safety culture that provides the best possible protection for its employees. Though the company has achieved great success with its current safety programs, contacts within the Environmental Health and Safety (EHS) departments are eager to explore leading edge solutions that may positively impact culture, health and safety. When approached for the experiment, representatives within the EHS

department were excited at the opportunity to pilot a mindfulness training intervention. One challenge at the onset of the intervention was to find the correct setting within the organization that would support the efficacy of a six-week exercise. As the daily mindfulness training takes away from production meetings or time where participants could be completing their daily job function, representatives from the EHS departments were very careful in selecting a lab to pilot the experiment.

A representative from EHS presented the experiment during a site manager meeting. To be equitable, the experiment design was shared and the EHS representative asked if any lab managers were interested in participating in the pilot. Initially a lab had been selected that had several poor safety indicators, including a poor safety record (injury rates) and a self-described negative culture. Though originally thought to be a prime candidate, the lab manager chose not to be involved. Instead, a lab manager that had previous personal experience in mindfulness immediately expressed interest in the study. Though personally familiar with mindfulness, the lab manager abstained from participation in the experiment and removed himself from the daily training in order to avoid impacting subjects' participation.

Participants were lab technicians that worked in genome sequencing. Daily work consisted of detail oriented assembly, including the usage of hazardous chemicals. There were 16 members of the lab that participated. Participants were mixed gender, 9 females and 7 males. Age range varied from early 20's to late 50's, with a mean of 33. Participants were all high school educated. None of the participants had previous experience with mindfulness training or meditation.

Research Protocol

To explore and analyze the relationship between mindfulness and workplace safety, a field research experiment was conducted with a qualitative data approach. Specifically, semi-structured interviews were conducted to foster emergent dialogue, offering greater depth in understanding participant experiences.

Instruments

A mobile application was created to write script for a guided meditation which was to be used throughout the experiment. This guided breathing script has been used with combat veterans to support treatment of PTSD. Some language was modified to support the work environment and the final stanza of the script brought participants attention to their personal safety and the potential risks that exist within their workplace. The full script has been included in the appendices (Appendix 1). Upon completion of the script, the PI contracted the script to be recorded and mixed by contacts that work professionally in the music industry. The recorded meditation was 3 minutes and 14 seconds in duration

Procedure

Participants met with the PI in the lab. The 45-minute training included discussions on the current mindfulness research trends, areas mindfulness was currently being applied, and neuroscience research supporting mindfulness. This training was intended to provide contextual background for the participants and create conditions that would encourage the participants to engage in daily mindfulness practices. Included in the training was an overview of the mindfulness script and the PI led the group through the guided meditation that would be used for daily mindfulness practice.

The second phase of this study involved the implementation of a daily meditation practice. Using the recorded MP3 file, participants were encouraged to use the guided meditation daily. Participants were instructed to use the meditation together as a group during a morning meeting. During the meeting, the lab met as a group within their designed meeting space. They completed their morning stretches, which were already part of their daily routine, then sat together and listened to the guided meditation. The intervention lasted 6 weeks, or 30 work days, resulting in over 90 minutes of mindfulness training.

Source of data

After the six-week experiment, the PI returned to the site to conduct semi-structured interviews with experiment participants. The interviews were designed to allow the PI to ask open-ended questions encouraging participants to describe their experience and any impact they may have noticed of mindfulness practice to their personal safety. The interview script has been in included in the appendices (Appendix 2).

To gain a deeper understanding of the potential impact of the low-dose mindfulness training, the interview was conducted in three sections. The first line of questions was intended to capture participant's general reactions to their experience to their exposure to mindfulness training. The PI then focused follow up questions on the impact mindfulness training may have had on two key areas which may be directly related to potential for improving workplace safety. The first series of follow up questions explored how the mindfulness training may have impacted the participants stress levels or how they responded to stress in their lives differently in the past six-weeks. The second area explored the perceived impact that the mindfulness training may have had on the participant's attention or awareness. The final series of questions, which was

related to the stress and attention series set, asked participants to discuss any connections they experienced in regard to workplace safety.

Of the 16 active participants, 7 agreed to interviews. The remaining participants chose not to be interviewed due to daily work demands. Each face to face interview lasted between 25 and 55 minutes. Interviews were voluntary, as the lab manager set up a private room for interviews and encouraged employees to attend. In discussing interview protocol with lab manager and contact at the organization, it was determined that interviews would not be recorded to ensure honesty. For example, admitting to short-cuts in safety protocol could negatively impact a worker's employment status so it was determined that the PI would take notes confidentially by hand. Interviews were then transcribed and coded.

Chapter 4: Results

The purpose of this case study was to explore the relationship between mindfulness and workplace safety. Though a growing body of research exists which examines that benefits of mindfulness in the workplace (Good et al., 2016; Hülsheger et al., 2013; Hyland et al., 2015), this case study explored the impact a low-dose mindfulness training program could have on workplace safety. By conducting a six-week intervention incorporating a low-dose mindfulness program with a diagnostic laboratory, this case study offered initial evidence of the potential to use mindfulness as proactive tool for increasing workplace safety.

Overall Experience

The first subset of questions asked participants to reflect on their overall experience participating in a six-week mindfulness training program. As the participants expressed no previous experience with mindfulness training or meditation, the initial line of questions was intended to offer an unstructured opportunity for participants to describe any challenges of

benefits related to their experience. In describing their overall experience, responses were clustered around two distinct areas: the daily meditation schedule and unexpected benefits experienced through the six-week trial.

Many respondents confirmed that the duration of the mindfulness training was sufficient for their application, stating that three minutes seemed to be an appropriate entry point for those with no previous exposure to mindfulness. The only objection to the three minute duration was one respondent who described the room where they conducted the training was very loud due to neighboring labs. This person felt that a longer daily practice would have netted better results:

> "*The lab next to us is loud so sometimes it would take me a few minutes to focus on my breath and the words of the meditation.*"

Though this comment was related to the duration of the mediation, the comment brings up further considerations related to noise in the environment of the mindfulness training.

In response to the question of daily practice, all participants reported daily practice as a non-issue. The consistency of making it part of the lab's morning meeting quickly established completing the low-dose mindfulness trainings as a new norm. Though the entire group completed the training together during the morning meeting, the ability to complete a second practice daily was less consistent. Respondents cited a multitude of reasons for their inability to complete a second session daily, including scheduling and production pressures. However, respondents felt strongly that a more structured afternoon session could have yielded more positive results. As one respondent expressed:

> *"Yes (we completed a morning practice), however I would like to make sure we do it at least twice a day. I thought after lunch was great because you start thinking about how many hours you have left in the day and you would get distracted. This meditation helps to focus on what you have to finish the rest of the day."*

One pair of respondents were temporarily transferred to another lab two weeks after the intervention began. When asked if they could maintain their mindfulness training, the participants responded emphatically:

> *"Yes we were able to keep it up daily. We even had to work in the dry ice area (different lab), when we were there (different lab) we were not doing the meditations with everyone else as we were in a different area. We did it everyday anyway. At least two times a day. Other people looked at us a little funny but we didn't care, we even told them they should do it with us. We'd tell them it helps us relax our minds. We think everyone should do this to calm down, relax, and be nice."*

The incorporation of the daily practice into an existing structure supported the initial fidelity of the experiment design. Beyond the initial structural support for the training to occur daily, experienced benefits led to the daily implementation moving beyond the work environment and resulting in unexpected positive impacts.

As respondents began describing their daily use, most participants described that they began experiencing benefits that extended beyond the workplace. When describing their experience, participants described improvements in sleep, memory, and interpersonal relationships. For example, participants described taking the practice home with them and listening to the recorded meditation at night prior to falling asleep. As one respondent articulated:

> *"Nightly practice helped me sleep. My house is loud with people coming in and out all the time. I find my mind racing a lot, especially when I try to fall asleep. I had erratic sleep. After I would listen to the meditation and then found it easier to fall asleep."*

Improvements in one's memory were also described by participants. Improvements in memory were evident to respondents both in their ability to remember things like directions, daily tasks they needed to accomplish, and names. The improvement described in remembering other's names also positively impacted participant's interpersonal relationships. One respondent

described how remembering names and the mindfulness training in general impacted them in social situations:

> *"(The mindfulness training) helped me in social situations as well, if I was meeting new people and getting nervous, I would take a few breaths and then I would be more comfortable speaking with them. I found I would remember their names more. Usually I am really shy and I found I was more at ease and able to speak to people I didn't know without being as nervous."*

Others described how the incorporation of the daily mindfulness practice improved the way they perceived themselves at work. One respondent described in detail being less "snappy" and treating co-workers better and simply being more "pleasant to be around." Others responded that they found that the intensity of anger or frustration they had with another after an argument (both at work and outside of work) dissipated much more quickly than before they began the mindfulness training. Further, there were comments made that described "withholding judgments" about co-workers and the ability to reduce or suspend the judgment of others.

Impact on Stress

Following an unstructured conversation regarding participants experience with a low-dose mindfulness training program, the focus of the interview questions shifted specifically to the participant's ability to manage stress. Respondents were asked a series of questions related to their experience using the three minute daily mindfulness practice.

There was strong consensus from all respondents that the mindfulness training had a significant impact on their ability to manage stress. Participants described a noticeable difference in a decrease in their overall stress level. One participant described this personal shift by saying:

> *"I used to feel like my mind was racing 100 miles an hour. I found that doing this twice a day for the last six weeks, as well as at home, has helped me slow down. I feel it has really helped me stay calm."*

Other respondents supported this theme expanding on how though they were skeptical at the beginning of the study due to not having any previous experience with meditation, the

participation in the daily training has given them a tool that has enabled them to calm down and a healthy way to de-stress. One respondent described being able to "feel the calming words of the meditation" during the daily practice.

This theme of "calming down" was applied directly to the workplace by respondents. Participants described feeling "production pressure" during very busy times in the lab. During times when the amount of orders to get filled created pressure, respondents described stepping away from their work to listen to the recorded meditation. Participants described feeling more energized, focused, and efficient when they returned to their work. Further, respondents described not only feeling the difference in themselves personally ("keeping calm") but as one participant described:

> *"You could feel it in yourself (calming influence) and see how this changed how others interacted with each other."*

A series of comments related to this theme suggest that there were perceived positive impacts on the respondents' abilities to personally manage stress as well as a positive impact on interpersonal communication.

Respondents unanimously reported positive improvements in their ability to manage their personal stress. Participants had no previous experience with meditation and found the low-dose application to be attainable. Despite a low-dose duration of the training, respondents reported benefits consistent with benefits associated with mindfulness training programs of greater intensity (Khoury et al., 2015).

Impact on Awareness/Attention and Connections to workplace safety

Any potential positive impact on participant's awareness or attention was the primary focus of interest to the researcher as potential exists to make advancements in workplace safety when awareness and attention can be enhanced (Dierynck et al., 2016; Weick, 2006; Weick &

Sutcliffe, 2006). After concluding six-weeks of a low-dose mindfulness practice, interviewees reported increases in attention and awareness. Themes emerged and examples were shared of changes in safety behavior such as participants paying closer attention to standard operating procedures and noticing when PPE was not being worn, because of this enhanced awareness, providing evidence of a positive correlation between mindfulness practice and potential for increased worker safety.

As was evident in other sections of the interviews, participants began describing their increased awareness and attention in very general terms. There was a feeling described of "clearing our minds" prior to work beginning. Respondents described how much they enjoyed the morning schedule that was created in the lab. By beginning first with physical stretches, and then transitioning to the mindfulness practice, participants described being more relaxed and less likely to "rush" as the work began. Rather than rushing, participants described taking their time and thinking more vividly about the tasks ahead. A theme emerged of respondents visualizing the work prior to engaging, creating processes that helped slow them down. This ability to "slow down" created a new behavior of prioritizing the day rather than jumping into the work on autopilot. The ability to prioritize tasks while decreasing their tendency to rush into their work contributed to increased safety performance. One respondent stated:

> *"When I was more aware and awake I found myself picturing the day and work I needed to get done. I would see the work rather than just jump into things quickly without thinking about it. I am just more aware."*

This general theme of enhanced awareness created opportunities for participants to notice how this may have a direct relationship to their own safety. For example, one participant described:

> *"I was more aware, just in general. As I'd walk to the bathroom I'd be more aware of what is in the hallways. Some things I had never noticed and it had been here for months. That could have some safety connection as you're seeing things you hadn't paid attention to before."*

This awareness and noticing things one had not noticed prior helped to surface a distinction between their current state, when using the mindfulness practice, and the "auto-pilot" respondents described experiencing in the past. A specific distinction was made as participants cited "seeing" things, like equipment stored in their hallway, that they had never noticed. Participants described being more aware of potential housekeeping issues that could pose safety risks that until now, had gone unnoticed.

This distinction between a "new" way of working because of this enhanced awareness was described by participants with explicit examples of how safety behavior changed because of this awareness. Participants discussed being more aware of their policies and procedures. One participant captured this theme by saying:

> *"I saw new things. I was more aware when reading documents and S.O.P.s (Standard Operating Procedures). As I was looking at the documents more closely, I found I was paying more attention and asking more questions. I was more critical of the procedures and was asking more questions."*

This increased attention to S.O.P.s was emphasized during the interviews as participants described how this increased attention was of great importance due to the hazardous chemicals that they work with on a daily basis. This described enhanced focus gave participants greater confidence in their ability to work safely. One respondent described this new way of working:

> *"I am taking the time to read the chemicals and S.O.P.s more closely than I have in the past. I found that I am being much more careful. Many of these chemicals are very dangerous and I am paying more attention to what I am mixing and the amounts."*

Participants described an overall positive shift in safe working behavior because of this daily practice. Further, participants described how this awareness also informed them of some of the dangerous norms they had developed.

As respondents described a positive shift in safe behavior, this daily practice also resulted in awareness of dangerous habits participants had unknowingly developed. An increased awareness was described of the policies that participants were not currently following with regularity. Participants described examples which included increased awareness of when they, or someone around them, were not wearing the proper Personal Protective Equipment (PPE), such as work boots or safety glasses. This awareness led to participants self-correcting and wearing the required PPE, where in the past they "never really thought about it or recognized it." Awareness was also greatly sharpened in how safely participants perceived that they worked. In our initial training, a conversation occurred regarding participants' reflections on the number of short-cuts (bypassing a safety procedure to get a job done more quickly) they were taking daily. As short-cuts put workers at greater risk for injury, workers are encouraged to put their personal safety above taking short-cuts. Participants described a shift in awareness of how often they were taking short cuts. As one participant described:

> *"After spending the last six weeks doing the meditation, I became way more aware of how often I take short-cuts. I do it everyday and never even thought about it before."*

As was demonstrated with other points of awareness, participants described this awareness of short-cuts being the insight needed to alter their current behavior practices. Respondents described that they now are thinking twice before taking short-cuts, choosing instead to follow the S.O.P. or wear the proper safety equipment despite any impact this choice may have on meeting a perceived production deadline.

In addition to the positive responses that the mindfulness practice had on workplace safety, an additional subtheme emerged of performance being positively influenced by the daily mindfulness practice. Respondents described their enhanced awareness impacting their job

performance in their ability to notice defective components in their work. One respondent mentioned:

> *"After we started doing this (mindfulness practice) I noticed more bad seal tubes than ever before."*

This increased awareness led to the recognition of more failed components, resulting in a higher quality score.

The participation in a low-dose mindfulness training program for a minimum of three minutes a day for six weeks yielded positive workplace outcomes. Participants described benefits and improvements in attention and awareness that resulted in positive changes in well-being, work performance, interpersonal relationships, and workplace safety.

Chapter 5: Discussion

The goal of this research was to explore the relationship between mindfulness practice and safety performance in the hope of developing an intervention that would increase workplace safety. Specifically, this study sought to ask if there would be perceived benefits to workplace safety through the incorporation of a low-dose mindfulness training program?

This final chapter provides a discussion of the study. The first section describes the theoretical implications of this case study. The second section builds on the theoretical implications and offers practical implications of the case study. Limitations of this study are then discussed followed by suggested areas of future study.

Theoretical Implications

The research findings suggest participant experiences to be highly consistent with previous research identifying potential benefits of mindfulness in the workplace (Davis & Bjornberg, 2015; Good et al., 2016). Specifically, using the Integrative Framework Relating

Mindfulness to Workplace Outcomes (Good et al., 2016), respondents demonstrated benefits that are in alignment with the framework.

As mindfulness was practiced, attention and awareness were described as enhanced by participants. With enhanced attention/awareness participants described benefits in their job and safety performance, clarity of task prioritization, more positive interpersonal relationships with their colleagues, and improvements in their well-being through improvements in their ability to manage stress as well as improvements in sleep quality. Extensive research has demonstrated the benefits associated with mindfulness and its positive impact in managing stress (Khoury et al., 2015). Mindfulness training targeted at stress reduction often follows the basic structures of Mindfulness Based Stress Reduction (MBSR) programs. MBSR programs have been extensively researched to show positive clinical health outcomes such as stress reduction and treatment of depression and anxiety (Khoury et al., 2015). The demonstration of such benefits through the incorporation of a low-dose mindfulness training program further supports the existing research on workplace outcomes of increased mindfulness (Good et al., 2016).

Mindfulness Can Impact Workers With "Low-Complexity" Positions

In some of the limited research exploring mindfulness and safety performance, there exists a hypothesis that low-complexity task holders (front line employees) do not experience the benefits of mindfulness and may actually experience a decrease in task performance when mindfulness is present (Zhang et al., 2013). The current study demonstrated positive impacts associated with mindfulness (e.g., enhanced attention, improved stress response, improvements in interpersonal relationships, increased work performance) with workers that may be classified by some as being in positions of low-complexity. This result offers data that supports the potential for enterprise-wide implementations of mindfulness in the workplace. Though

workplace mindfulness has become popular in leadership development, mindfulness has the potential to benefit the health, well-being, performance, and safety of workers at all levels of an organization. The more levels of an organization that are included in mindfulness training, the greater the potential organization-wide benefits.

Low-Dose Mindfulness Practice Can Positively Impact Workplace Safety

Previous studies have established a connection between safety and mindfulness (Zhang et al., 2013; Zhang & Wu, 2014). This positive trend of increased mindfulness associated with increased safety performance. However, these studies did not measure the impact that mindfulness training may have on increasing one's mindfulness, and in doing so, improving safety performance. Analysis of the daily incorporation of a low-dose mindfulness training program was reported to positively impact workplace safety. Through increased awareness and attention, participants described noticing more unsafe behaviors and shifting their behavior to work more safely. Whether mixing chemicals, following S.O.P.s, working more carefully, slowing down or noticing and correcting lapses in wearing proper safety equipment, participants described at length how the incorporation of this training positively impacted their personal safety behaviors and the behaviors they observed in their colleagues. Building on previous research, this study strengthened the case for the potential for positive improvements in workplace safety through the incorporation of a low-dose mindfulness program. Organizations grappling with challenges surrounding workplace safety or simply looking to become world-class in safety performance may look into incorporating low-dose mindfulness training as a leading edge safety solution.

Though the focus of the study was to explore the connections to workplace safety, the benefits associated with well-being and interpersonal relationships demonstrate the potential

benefits of a low-dose mindfulness practice to extend beyond a singular desired outcome. While confirming and building upon existing workplace mindfulness research, the outcomes of this study also generated practical implications that could further develop the area of workplace mindfulness, specifically related to mindfulness and workplace safety.

Practical Implications: Structure Leads to Fidelity

With safety often falling under EHS departments within organizations, the continued exploration of mindfulness benefits may extend to numerous company-wide initiatives aimed at improving employee health and wellness, including but not limited to workplace safety. Though low-dose mindfulness training may not lead to enlightenment or traditional goals associated with the origins of Eastern-mindfulness practices, the awareness yielded substantial benefits that may be obtained through an enterprise-wide mindfulness training program. When attempting to design a potential mindfulness program, EHS professionals may look to leverage existing structures that may support the implementation of a workplace mindfulness program, such as making mindfulness a part of routine stretching periods.

To create a successful mindfulness training program, organizations could consider implementing low-dose mindfulness programs that include a manageable duration. MBSR programs generally require a minimum of 45 minutes a day of meditation, six days a week for eight-weeks as well as over 30 hours of direct instruction. In this study, the focus was to see if a low-dose mindfulness training (3-6 minutes daily) within the workplace could produce similar benefits to those described in more intensive MBSR programs.

In addition to the duration, it is also suggested that the mindfulness training script include language that is appropriate to the specific work environment. Once duration and language of the training has been established, an opportunity to mitigate resistance may be to couple the daily

mindfulness practice with pre-job stretching. In this experiment, leveraging the current structure to take care of the body and mind together yielded an environment that supported the fidelity of daily mindfulness training. The structure that was created established a new shared norm that mindfulness training was part of the daily routine. This new norm of acceptance to engage in the mindfulness training, as well as management support, may have led to support for the new practice that was aimed at increasing workplace safety. With fidelity, participants experienced many positive impacts consistent with current mindfulness research. EHS professionals attempting to implement a mindfulness training program may wish to leverage existing structure to reduce resistance and increase fidelity.

Train as a Group Rather than Individually

Though there are organized classes and courses designed to support mindfulness training in the group setting, mindfulness training is often a solitary act. The experiment conducted was originally designed to support individual mindfulness training through the development of a recorded MP3 file housed on an existing mobile application. The participants of the study chose instead to incorporate the daily mindfulness training into their morning pre-shift routine. Through the newly established norm, the group reinforced a commitment to the practice, which led to a high degree of fidelity. As mindfulness training becomes more integrated into the workplace, this study offers evidence of the potential positive impact in fidelity and culture by encouraging group, rather than solitary participation.

Limitations

This study has four main limitations. The first limitation was the sample size. A larger sample size, potentially across departments, using the daily incorporation of a low-dose mindfulness practice could have provided deeper insights with more significant conclusions. A

second limitation of this study is the duration of the study. With only a six-week duration, the study could have yielded more extensive findings with a longer study window. A third limitation of this study is that those who participated in the qualitative interviews were voluntary. This may have skewed the data so that only those with positive experiences were willing to discuss their perceptions of the low-dose mindfulness training program. The final limitation of this study involves the actual guided meditation the participants used in the study. Due to recording challenges, the audio quality of the meditation was average. With higher quality equipment and voice actors the quality may have improved, impacting the fidelity or overall experience for participants.

Areas for future study

With research exploring the relationship between workplace safety and mindfulness in its infancy, the current study began to explore the topic yet many relevant questions remain.

The first consideration for further exploration is to expand the study size exploring the connection of a low-dose mindfulness training program to workplace safety outcomes to yield both quantitative and qualitative data sets that are significant. Though the data pool of participants in this study yielded positive results, a more robust sample would greatly enhance this contribution to advancing current research.

Examining the impact of low-dose mindfulness training on workplace safety while using a control group would gain greater insight into the potential benefits compared to other potential interventions. Through the incorporation of a control group in an extended study, results could be more critically analyzed. Control groups could include other interventions including but not limited to journaling daily. Further comparison could greatly enhance the potential benefits of the mindfulness training.

Though this study demonstrated positive effects of mindfulness training through group training, further study comparing the perceived impacts of the mindfulness training in group versus individual would also be worth studying. Further, exploring the impact the environment may have in the perceived effectiveness would also be valuable to explore. One respondent in this study cited a challenge with the noise present in the lab they conducted their daily mindfulness training. There is potential that environment could play a role in the degree of benefits received from mindfulness training.

Opportunity exists to move beyond enhanced intrapersonal awareness to study platforms for sharing insights due to increased awareness. Interviewees revealed powerful insights and shifts experienced by participants. However, others within the organization were less aware of collective benefits associated with the practice. A recommendation for increasing the transformational potential of this intervention would be to create a platform for ongoing conversations based on the increased awareness obtained. This would further the learning associated with increased awareness and changes in safety behavior while integrating the benefits of mindfulness practices into the collective culture.

Conclusion

The potential implications for mindfulness to positively impact workplace safety are abundant. With over three million nonfatal injuries and over 4,600 workplace fatalities occurring each year in the United States (U.S. Department of Labor, 2014/2015) even a modest intervention may yield significant improvements in workplace safety. The current study, as well as other studies (e.g., Huber et al., 2015), are just beginning to explore a potential intervention that could support an evolution of increased safety performance. As the study demonstrated the

benefits could extend beyond safety metrics to include personal well-being and interpersonal relationships while simultaneously improving safety performance.

This demonstrated ability to improve workplace safety through participation in a low-dose mindfulness practices creates great opportunity to enhance workplace safety that is time efficient and negligible cost. The ability to work on leading edge (proactive) safety interventions has the potential to keep countless workers free from potential injury or death. There exists great opportunity to positively influence the human factors (e.g., attention, fatigue) that lead to safety incidents and unsafe behavior (Huber et al., 2015). Respondents overwhelmingly supported the theory that this daily practice can improve workplace safety by reducing anxiety and stress, increasing attention, and improving relationships and communication amongst peers. These benefits can lead to improvements in safety performance as well as creating a culture of learning best practices rather than a culture of blaming through retroactive safety initiatives. Based on this study the potential exists for the incorporation of a low-dose mindfulness program to positively impact safety performance, saving injuries and deaths through a minimally invasive proactive safety intervention.

Appendix

(1) Guided Meditation Scripts

Safety Awareness

Begin by finding a comfortable posture. Lean slightly forward, and back. To one side, and then the other. Find a comfortable balance as you come back to the center.

Close your eyes and rest your hands on your knees. Bring your awareness to the touch of your body on your seat. Feel the weight of your body on your chair.

Take a few deep breaths. While you are breathing deeply, relax your shoulders, your stomach, the muscles in your face, your hands, and your legs. Let go of all the tension in your body.

Now bring your attention back to your breath. Where do you feel it most? In your nose, or your stomach. In the rise and fall of your chest. Just notice where you feel it most and allow your breathing to be natural and relaxed.

Being present with the breath as it goes in, fully present and engaged with the breath as it goes out. Present with what is happening in this moment, with whatever is going on.

When your mind wanders, or if you become distracted, just notice what's going on in your head, and then gently bring your attention back to your breath going in and out. Focus on the sensation of your breath in the foreground, allowing thoughts and feelings to come and go.

Whether you find yourself bringing your attention back to your breath five times or one hundred times... it doesn't matter. The important thing is that you notice you're lost in thought as you gently bring your attention back to your breath.

Now, notice what the breath feels like as it enters through your nose, goes down your throat, filling your lungs, and back out through your nose. Notice your stomach and chest rise and fall with each inhale and exhale, and allow your breathing to be natural and relaxed.

While keeping your breathing natural and relaxed, bring your awareness to your personal peace and safety. As you move through your day, you can return to your breath during times of stress, allowing the moments necessary to care for yourself and your safety.

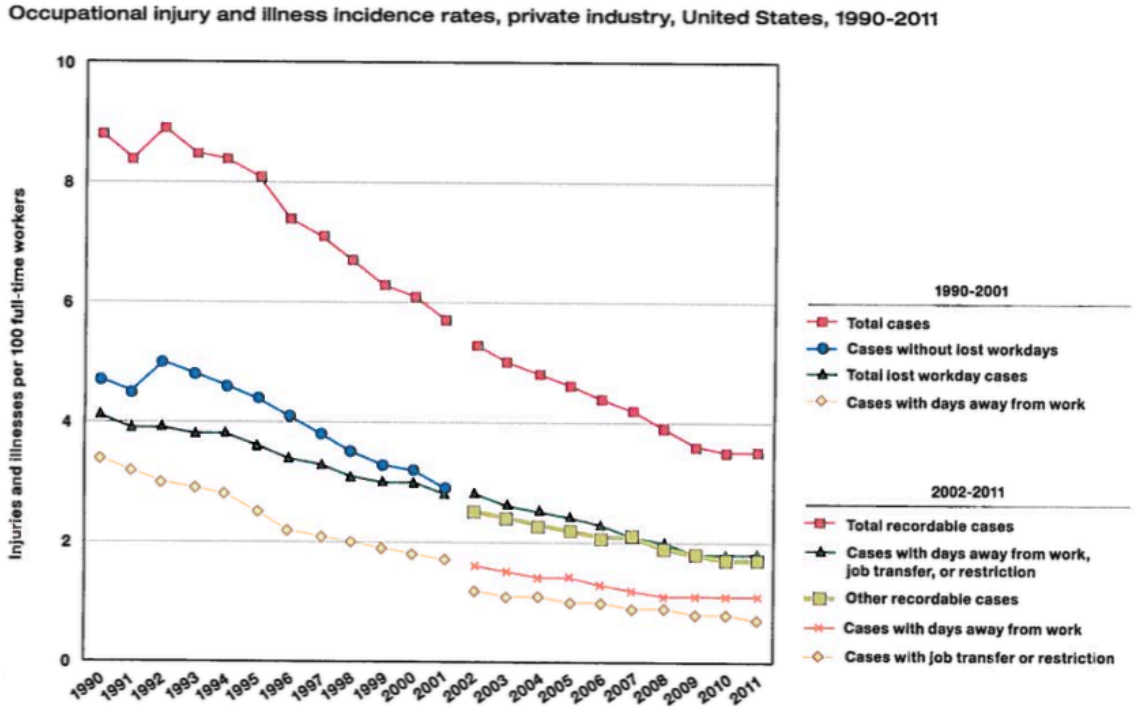
Now gently bring your attention back to the touch of your body on your seat, and open your eyes.

(2) Interview Protocol

Research Questions	Interview Questions
How did participants experience a daily low-dose mindfulness practice?	o How did they perceive the daily meditation practice? o Were you able to maintain a daily practice? o What benefits, if any, did you experience as a result of the daily mindfulness practice? o What challenges did you encounter with the daily practice?
Will the incorporation of a low-dose mindfulness practice increase attention/awareness?	o What did you notice about your awareness as a result of this daily practice? o Where did you find yourself more aware or mindful? o Was there an impact on your attention level as a result of your practice? Please elaborate
Will the incorporation of a low-dose mindfulness practice reduce stress in participants?	o Did you notice any impact to your stress level or the way you perceived stress in your life as a result of the daily mindfulness practice? o Have you noticed any change in your response to stress?
Will the incorporation of a low-dose mindfulness practice increase workplace safety?	o Did you find any changes in your safety behaviors as a result of the daily mindfulness practice? o Did you notice any change in the amount of "workarounds" you were using during the four-week study? o Do you see any benefits of the incorporation of a daily mindfulness practice and increased worker safety? o Did you notice any changes in your safety awareness?

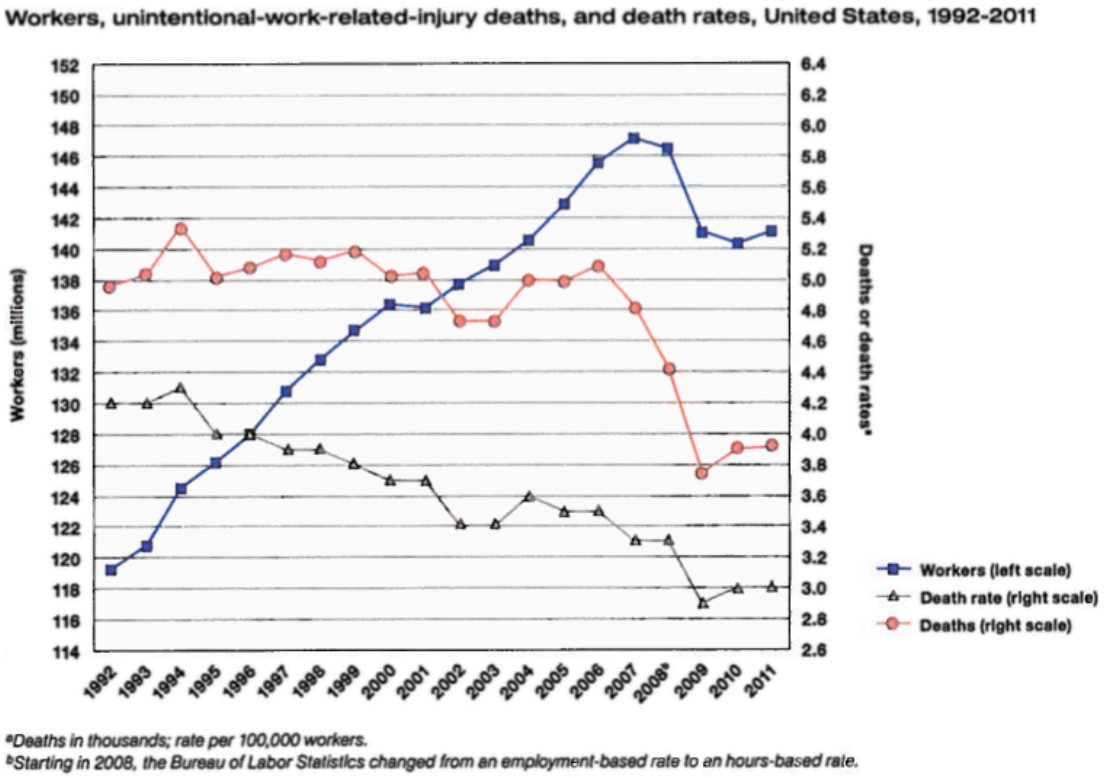
List of Tables and Figures

Figure 1. Occupational Injury and Illness Rates, U.S. 1990-2011.



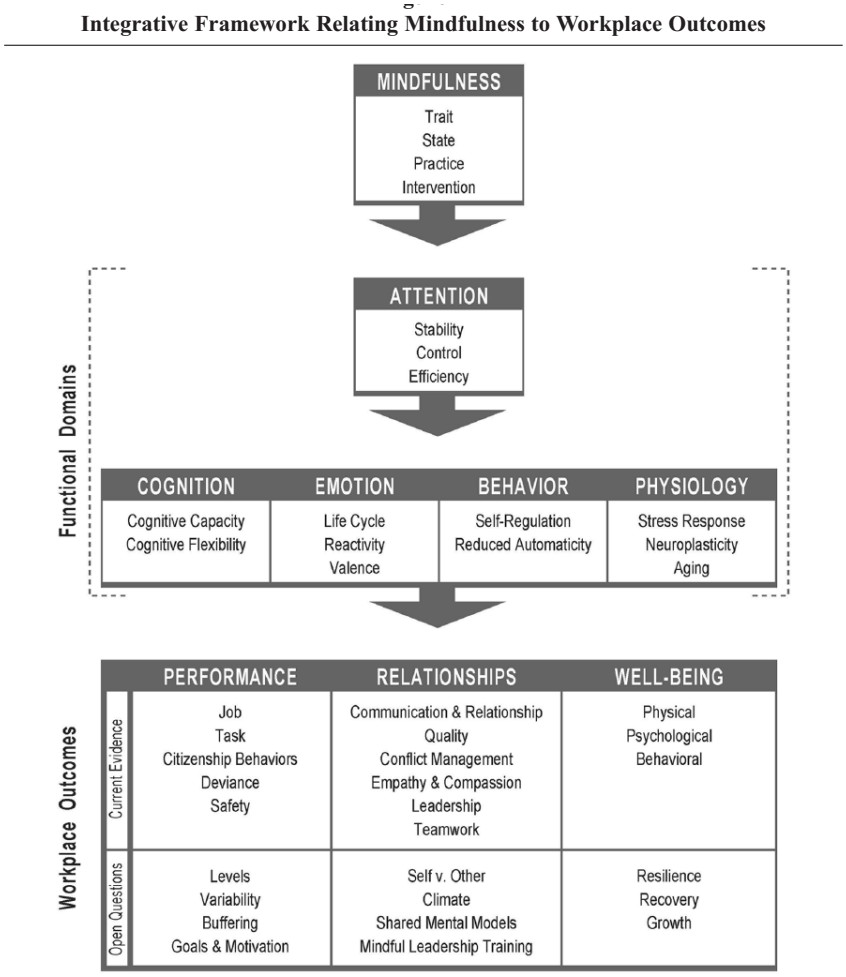
Source: Bureau of Labor Statistics.
Note: Beginning with 1992, all rates are for nonfatal cases only.
Changes in OSHA recordkeeping requirements in 2002 affect comparison with earlier years.

Figure 2. Occupational Deaths and Death Rates, U.S. 1992-2011.



[a]Deaths in thousands; rate per 100,000 workers.
[b]Starting in 2008, the Bureau of Labor Statistics changed from an employment-based rate to an hours-based rate.

Figure 3. Integrative Framework Relating Mindfulness to Workplace Outcomes



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