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Mindfulness and Workplace Safety: Implications for Offshore Drilling and Operations in the Gulf of Mexico

November 2020

White Paper Contributors

About the Authors



Dr. Christiane Spitzmueller

Dr. Spitzmueller is a Professor of Industrial and Organizational Psychology at the University of Houston. Dr. Spitzmueller brings her experience as Principal Investigator on a host of energy industry funded research projects (including projects for SaudiAramco, BP, ExxonMobil, Energy Transfer Partners) dedicated to improving the health, well-being, safety and technical skill sets of the energy industry workforce. She has served as the Scientific Advisor to the Interstate Natural Gas Association of America (INGAA)'s Industry Safety Culture Assessment project for the past 8 years.



Dr. Rhona Flin

Dr. Flin is a Professor of Industrial Psychology at Aberdeen Business School, Robert Gordon University (UK). For 30 years, she has managed research projects to develop safety knowledge in higher risk industries and healthcare. She is widely known for her work translating crew resource management safety tools in aviation for use in the energy industry and in surgery. She has also developed survey instruments to measure safety culture in the offshore industry. Dr. Flin serves as a member of the Board of Directors for the SPE Human Factors technical section and is a member of the Board for Step Change in Safety.



Dr. Peggy Lindner

Dr. Lindner is an Assistant Professor in the Department of Information & Logistics Technology at the University of Houston. Peggy has her doctorate through the University of Stuttgart's High Performance Computing Center, and her research is on emerging patterns through data in areas where qualitative and quantitative data sources come together. She is an experienced data scientist with expertise in integrating data across systems and platforms, development of mobile apps for the collection of ESM data, and usability testing for dissemination websites.

White Paper Contributors

Post-doc and Graduate Student Contributors

Dr. Erica Baranski
University of Houston

Zihan Liu
University of Houston

Tanya Smit
University of Houston

Acknowledgments

We would like to thank the National Academies of Science Engineering and Medicine's Gulf Research Program for supporting our initiatives and our industry partners: Baker Hughes and Diamond Offshore Drilling, Inc for aiding in the development of this White Paper by engaging offshore workers as subject matter experts. Our collaborative effort benefited tremendously from their thoughtful leadership, and we have each of them to thank for their value inputs and time.



In supporting a safer, more resilient, and sustainable future for the Gulf and all those who call the region home, the Gulf Research Program uses science, engineering, and medical knowledge to empower its citizens and to enhance offshore energy safety, environmental protection and stewardship, and Gulf health and resilience. Additionally, the GRP believes that to use information to effect real change in the Gulf, evidence-based policies will be supported by Gulf education and engagement, data, data products, and knowledge.



Baker Hughes (NYSE: BKR) is an energy technology company that provides solutions for energy and industrial customers worldwide. Baker Hughes a leader in designing, manufacturing, and servicing transformative technologies in the oil and gas industry.



D I A M O N D
O F F S H O R E

Diamond Offshore traces its beginnings to the earliest days of the offshore drilling industry. Diamond Offshore is a leader in offshore drilling, providing contract drilling services to the energy industry around the globe with a total fleet of 15 offshore drilling rigs, consisting of 11 semisubmersibles, and four dynamically positioned drillships.



TABLE OF CONTENTS

Executive Summary	5
Background: Mindfulness and Workplace Safety in the Gulf of Mexico	6
Mindfulness and Safety	7
The Role of Situation Awareness	10
Methods: Systematic Review of Mindfulness-Safety Literature	11
Results: Quantitative Assessment of Mindfulness-Safety Link	12
Results: Qualitative Review of Mindfulness-Based Interventions	13
Conclusions	17
Implications: Mindfulness Training to Enhance Offshore Safety in the Gulf of Mexico	18
References	19



EXECUTIVE SUMMARY

This White Paper provides a comprehensive summary of the association between mindfulness and workplace safety and gives recommendations for future application of mindfulness techniques in promoting workplace safety. Through this paper, we introduce mindfulness as a pathway to enhance offshore safety. We then introduce easy to use mindfulness techniques that have the potential to contribute to offshore safety in the Gulf of Mexico.

What is Mindfulness and Situation Awareness?

Mindfulness reflects paying attention in the present moment in a non-judgmental manner. Mindfulness is associated with reduced employee stress and promotes employee well-being. Mindfulness is also associated with various benefits in work and life, including more satisfaction with life, more productive performance, and improved abilities to regulate emotions and cope with stress. Situation awareness is a related construct, defined as “knowing what’s going on around you”, focuses on attention and awareness and has been widely applied in industrial safety research.

How Does Mindfulness Increase Workplace Safety?

Employees differ in their tendency to be mindful of the present environment. Individual differences in mindfulness can predict workplace safety. Individuals high in mindfulness tend to follow safety guidelines and detect risk cues in the working environment. In contrast, employees low in mindfulness tend to commit errors and be involved in more accidents and injuries at work.

Mindfulness training has been used to promote workplace safety, primarily among military groups and healthcare professionals. Various mindfulness techniques have been designed and implemented to improve employee cognitive functions and reduce stress. Participation in mindfulness training has led to improved attentional performance in high-demand situations, more compliance with safety rules, and fewer errors, accidents, and injuries.

How to Utilize Mindfulness in Improving Offshore Safety in the Gulf of Mexico:

Process and personal safety in the offshore oil and gas industry remain top priorities for companies operating in the Gulf of Mexico. With continued improvements in inspection, regulation, and training, there are still risks of personal and process safety incidents. New techniques for enhancing worker situation awareness, well-being and safety have the potential to advance offshore safety. Mindfulness training is one promising approach for designing and implementing safety-related training.

Mindfulness training offers a flexible and cost-effective approach to promote workplace safety, combining teachings about mindfulness with guidance on mindfulness techniques. Future work conducted by the University of Houston will apply mindfulness training to the offshore oil and gas personnel to explore how the benefits of mindfulness can be applied to exert a positive influence on both safety behaviors and objective safety records.



BACKGROUND

According to the Bureau of Labor Statistics, there were 5,250 fatal work injuries in 2018 in the United States, increasing 2% from the number of fatal work injuries in 2017¹. It is estimated by the International Labor Organization that about 2.3 million employees all over the world succumb to work-related accidents or diseases.²

Offshore Safety in the Gulf of Mexico

The safety of the workforce on offshore oil and gas installations is of particular importance given the operational hazards and remote location of the work sites, as demonstrated by the blowout on the Deepwater Horizon drilling facility in the Gulf of Mexico in 2010, in which 11 workers were killed and an estimated 210 million gallons of oil were spilled into the Gulf of Mexico. **Despite the implementation of a series of measures, there are still oil spills and injuries from offshore operations, which have been on the rise from 2016 to 2019.**³

In an effort to determine fundamental aspects of safety management which could benefit from scientific investigation, a workshop by the National Academies of Science Engineering and Medicine (NASEM, 2018) on the engagement of offshore workers identified a lack of evidence on how culture influences particular behaviors. NASEM subsequently published a report of that workshop outlining applications of engineering, design and operative practice to address the human factors of process safety and worker empowerment.²⁸ The research road map for ocean energy safety (OESI, 2019) confirms that a better understanding of human factors is a central pillar for reducing offshore risks.

As employees are the agent of actions that directly relate to workplace safety, various safety training programs delivered to employees in safety-critical industries are gaining increasing attention, including building safety knowledge and enhancing safety behaviors.⁴

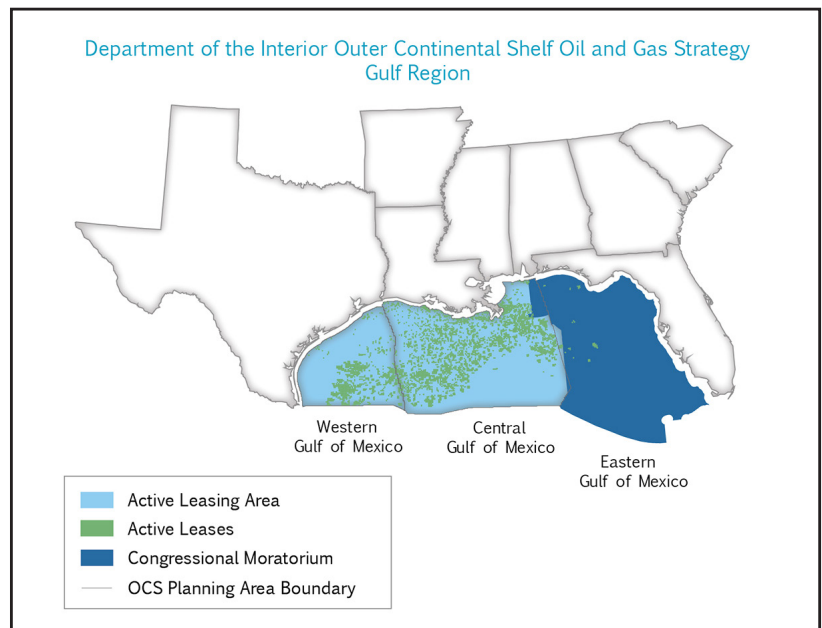
Considering the importance of attention and awareness in promoting workplace safety and reducing accidents, researchers and practitioners have switched the focus to added mindfulness, as another promising way to design and implement employee safety-related training programs.⁵

The Gulf Research Program

This White Paper is part of a research program funded by the NASEM Gulf Research Program and led by a team at the University of Houston (with Robert Gordon University, Diamond Offshore Drilling, Inc., Baker Hughes). **This ambitious research program is designed to examine how mindfulness can contribute to worker well-being and workplace safety.**

We ground preliminary recommendations on the use of mindfulness in offshore settings on two comprehensive reviews on mindfulness and safety: A quantitative assessment of mindfulness and its relationship with safety, and a qualitative review of mindfulness as a safety intervention.

“ Considering the importance of attention and awareness in promoting workplace safety and reducing accidents, researchers and practitioners have switched the focus to mindfulness, as another promising perspective to design and implement employee safety-related training programs. ”



Source: Bureau of Safety and Environmental Enforcement (bsee.gov)



MINDFULNESS AND SAFETY

Mindfulness contributes to a host of positive outcomes for employees, and current research shows it also likely affects safety outcomes. Mindfulness is becoming a popular technique to reduce stress in everyday life. Mindfulness training helps people realize the benefits of being attentive and enjoying the present moment. Numerous courses and websites have emerged to instruct people how to perform mindfulness techniques. Many companies have incorporated mindfulness training as part of employee wellness programs as a preventive measure to sustain high levels of employee well-being and productivity.⁶

Mindfulness contributes to improved cognitive functions. Previous studies on particular components of mindfulness have found that paying attention to the present moment positively relates to heightened levels of sustained attention indicated by better performance on cognitive tasks, while acceptance is positively associated with working memory efficiency, facilitating handling multiple demands at work.⁷



Simulation experiments suggest that mindful people in offshore well-control scenarios can better handle situations where failures or problems are more likely to occur.⁸ In these situations, mindfulness is associated with the correct response in solving safety-relevant issues.

Mindfulness leads to better adjustment. Observing stimuli in a non-judgmental way enables people to pay more attention to the environment.⁹ Moreover, people with high levels of mindfulness are less likely to engage in automatic responses and can better utilize cognitive control resources to adjust to changes in the environment (i.e., response flexibility).¹⁰

In this manner, mindful employees are more likely to “pause before taking verbal or physical action”¹¹ and have a more complete understanding of the context, so that they can alter their behaviors to better fit particular goals and needs.¹²

Mindfulness helps reduce stress and burnout. By instructing individuals to pay attention to the present moment, mindfulness can assist people in more effectively regulating emotions and reducing negative thoughts or persistent rumination about previous events.

Participation in mindfulness techniques can help replenish employees’ psychological resources, facilitating their ability to better handle demands or tasks at work and protecting them from the negative impact of stress and burnout.¹³ This is especially critical to safety performance for people in a safety-critical working environment.¹⁴



“ Simulation experiments suggest that mindful people in offshore well control scenarios can better handle a situation where failures or problems are more likely to occur. ”



Mindfulness-based workplace training

Mindfulness-based training techniques are predominantly designed to improve attention, cognitive capacity and flexibility, emotional regulation, and reduce rumination.¹⁵

For example, the Mindfulness-Based Stress Reduction (MBSR) consists of both focused attention and open monitoring meditation techniques.¹⁶ Studies utilizing the MBSR training demonstrate a decrease in distraction, rumination, perceived stress, and burnout at work.¹⁷ Likewise, the Mindfulness-Based Mind Fitness Training (MMFT)¹⁸, commonly used with military personnel, focuses on attentional control and tolerance of challenging experiences to help increase reactivity and improve resilience from stress.¹⁹

Various important workplace outcomes benefit from mindfulness-based interventions, including improved employee physical health, decreased work stress, and increased employee well-being²⁰. Mindfulness interventions also contribute to enhanced work engagement and work productivity.²¹

Previous research has also examined mindfulness interventions delivered in new formats to enhance its effectiveness in the workplace. Examples include smartphone applications of mindfulness techniques²² and combinations of mindfulness training with interventions on the application of positive personality traits.²³

Previous research has proposed two possible pathways through which mindfulness may contribute to safety:

1. Mindfulness increases attentional processing and helps individuals maintain vigilance while coping with interruption and distraction, a critical factor to safety.⁵
2. Mindfulness enables individuals to regulate emotions and negative thoughts more effectively.¹⁴

COMMONLY USED MINDFULNESS TRAINING TECHNIQUES



Contact Points

Sit comfortably and notice the sensations between your legs or lower back with the chair, your feet with the ground, and your hands on your lap.



Notice 5 Things

Pause for a moment and notice five things you see, hear and feel in contact with your body.



Focused standing

Stand for 3-5 minutes and pay attention to how your legs, arms, and feet feel and take note of anything you see, hear, or smell.



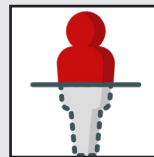
Focused walking

Begin walking. Bring your attention to the movement involved while walking, your pace, and the sights, smells and sounds around you.



Focused Breathing (4-4-8)

Breathe in through your nose for 4 seconds, hold your breath for 4 seconds, release your breath for 8 seconds. Repeat 3-4 times.



Body Scan

As you exhale, have a sense of relaxing deeply, and bring your attention to your body. Notice any sensations you feel in your feet and legs, then back, arms,



The STOP Exercise

Stand up and breathe
Tune into your bodily sensations
Observe your surroundings, consider the possibilities in this moment and in the future.

Are you mindful? Complete the survey below to find out

Mindful Attention Awareness Scale²⁴

Instructions: Below is a collection of statements about your everyday experience. Using the 1-6 scale below, please indicate how frequently or infrequently you currently have each experience.

1	2	3	4	5	6
Almost always	Very frequently	Somewhat frequently	Somewhat infrequently	Very infrequently	Almost Never

- ___ 1. I could be experiencing some emotion and not be conscious of it until some time later.
- ___ 2. I break or spill things because of carelessness, not paying attention, or thinking of something else.
- ___ 3. I find it difficult to stay focused on what's happening in the present.
- ___ 4. I tend to walk quickly to get where I'm going without paying attention to what I experience along the way.
- ___ 5. I tend not to notice feelings of physical tension or discomfort until they really grab my attention.
- ___ 6. I forget a person's name almost as soon as I've been told it for the first time.
- ___ 7. It seems I am "running on automatic," without much awareness of what I'm doing.
- ___ 8. I rush through activities without being really attentive to them.
- ___ 9. I get so focused on the goal I want to achieve that I lose touch with what I'm doing right now to get there.
- ___ 10. I do jobs or tasks automatically, without being aware of what I'm doing.
- ___ 11. I find myself listening to someone with one ear, doing something else at the same time.
- ___ 12. I drive places on 'automatic pilot' and then wonder why I went there.
- ___ 13. I find myself preoccupied with the future or the past.
- ___ 14. I find myself doing things without paying attention.
- ___ 15. I snack without being aware that I'm eating.

Scoring: To see how mindful you are, add up your answers and divide by 15.

Scores from 1-3: Low level of mindfulness

Scores from 3-5: Moderate levels of mindfulness

Scores from 5-6: High levels of mindfulness

THE ROLE OF SITUATION AWARENESS

Although few researchers study the direct relationship between mindfulness and workplace safety, there has been a considerable effort to understand the relation between a related construct, situation awareness, and safety. Situation awareness, defined as “knowing what’s going on around you”, focuses on the attention and awareness and has been widely applied in industrial safety research.²⁵

Like with mindfulness, employees can differ in their ability to maintain awareness of the working environment. Previous research has found that people with high levels of situation awareness tend to concentrate on the task at hand, and keep track of ongoing events. Further, these individuals are also less likely to be distracted or bored at work or act without conscious intention when performing routine or complex tasks.²⁶

Several aspects of situation awareness overlap with mindfulness. Specifically, both constructs assess increased attention to the present moment and acting with awareness. Considering this conceptual overlap, we argue that integrating the two in this review will demonstrate the strength of their shared attributes in predicting workplace safety. **See Figure 1 below for a visual representation of the conceptual overlap between mindfulness and situation awareness.**

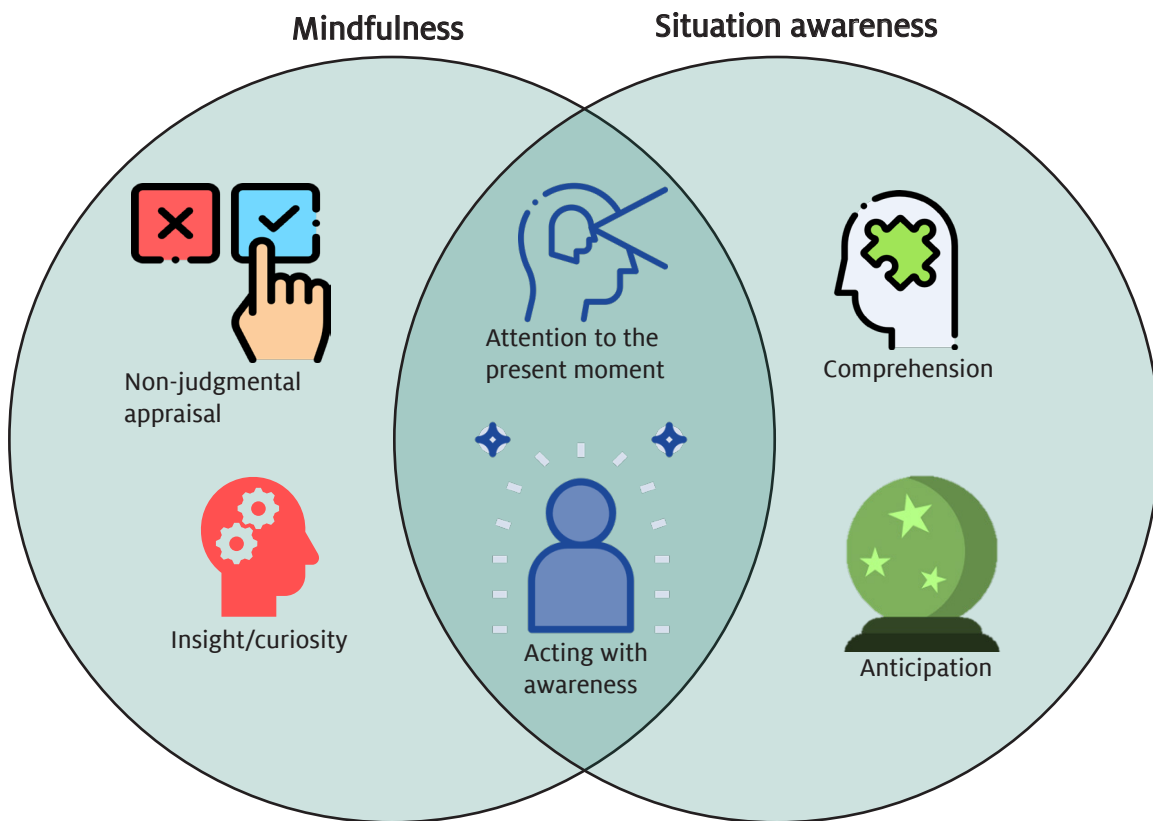
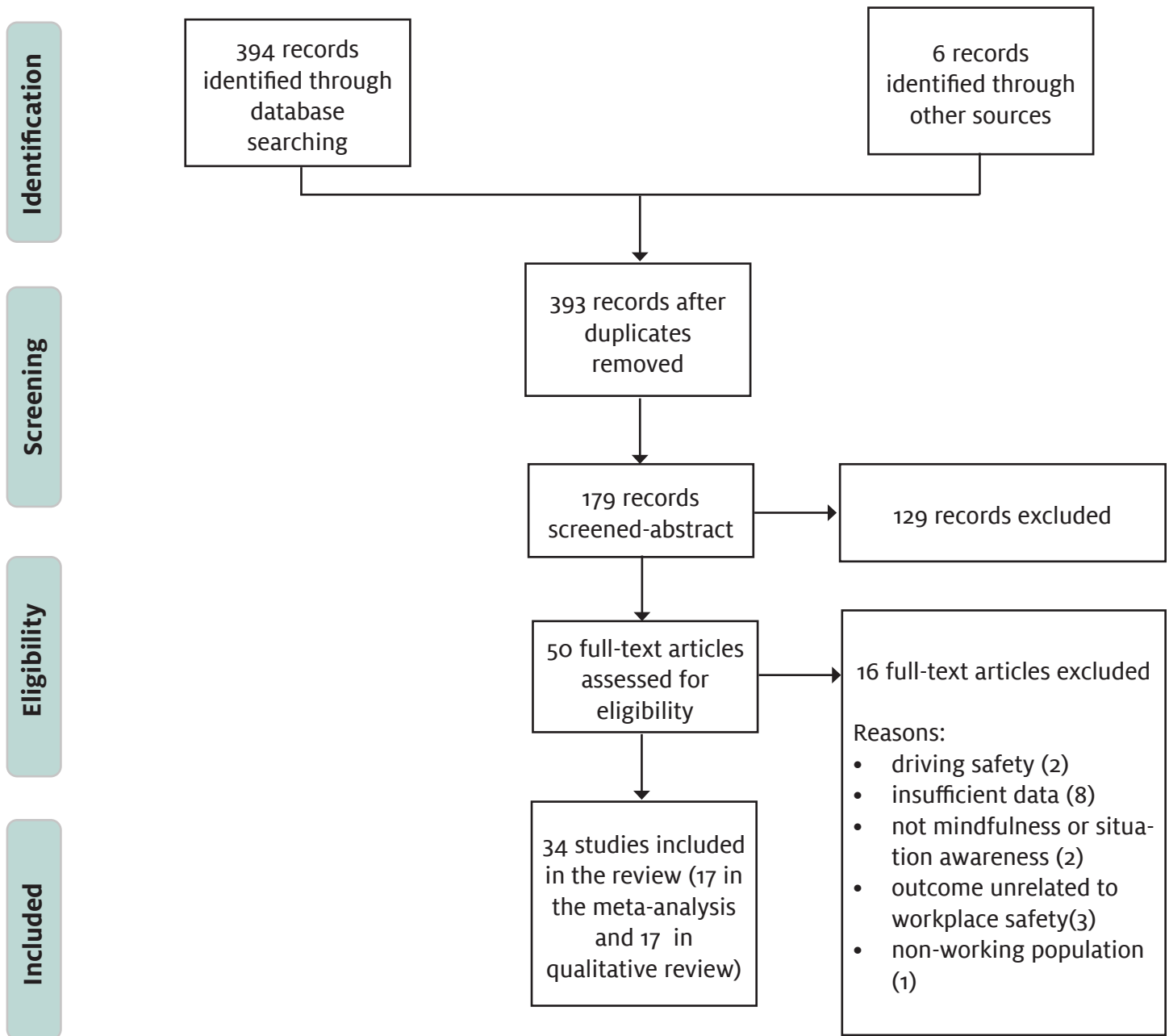


Figure 1. The conceptual overlap between mindfulness and situation awareness

SYSTEMATIC REVIEW OF MINDFULNESS-SAFETY LITERATURE

To provide a comprehensive foundation of the association between mindfulness and safety, we conducted a systematic review of studies that assess the relation between mindfulness/trait situation awareness and safety at work. This review, outlined below, resulted in 34 relevant studies: 17 test the relationship between trait mindfulness and safety; 17 test the effectiveness of a mindfulness-based intervention in improving workplace safety. See Figure 2 for the flow diagram depicting search and inclusion processes.

Figure 2. Flow diagram of search and inclusion processes for the mindfulness-safety literature review



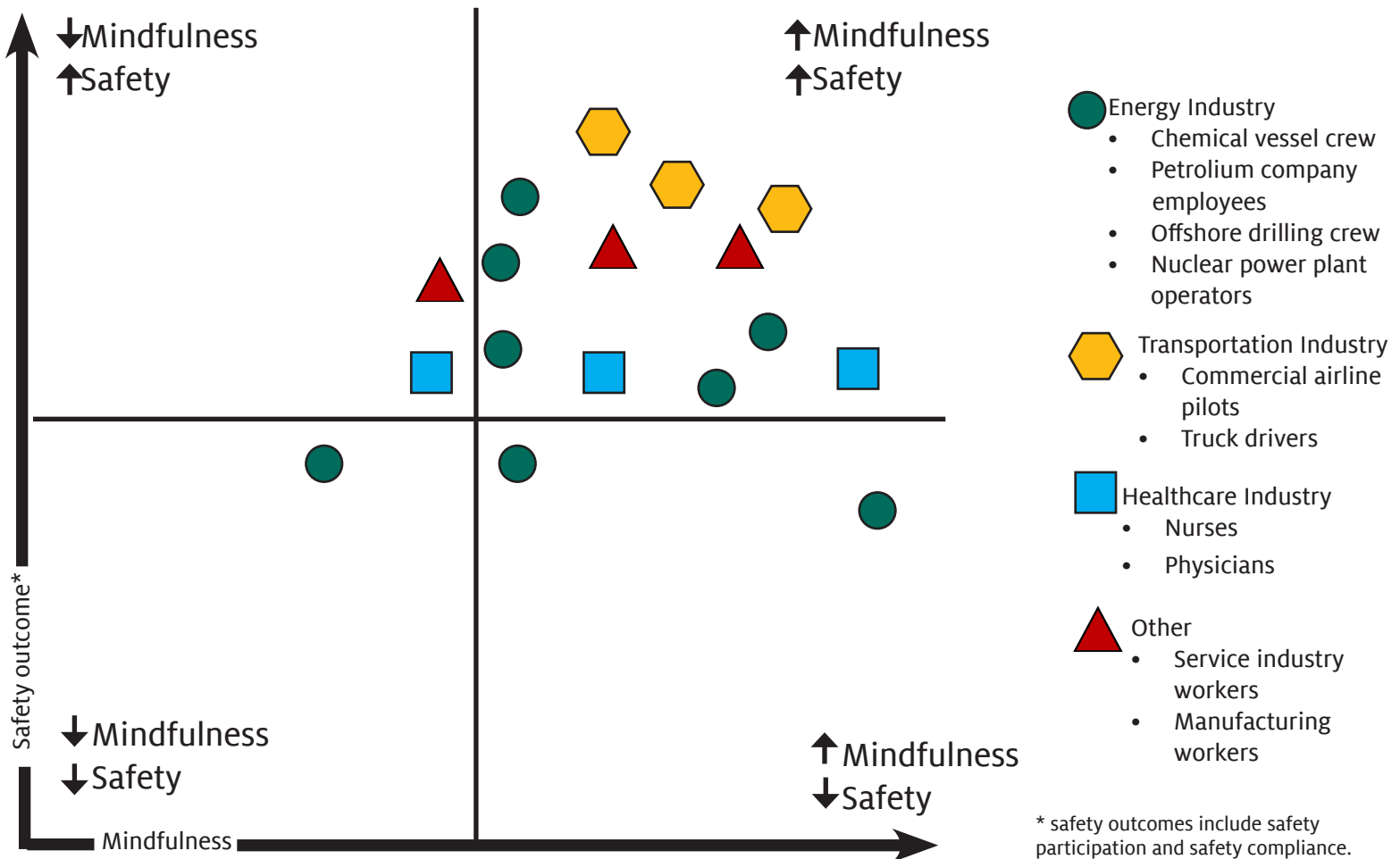
QUANTITATIVE ASSESSMENT OF MINDFULNESS-SAFETY LINK

In 17 studies with a combined 4,846 participants, 94% found positive associations between mindfulness or situation awareness and safety.

Importantly, studies used different operationalizations of safety (e.g., safety events, safety compliance, cognitive failure). **Regardless of the safety construct of interest, the vast majority of the studies included in the review found a strong relationship between mindfulness or situation awareness and safety.** Furthermore, mindfulness is most strongly related to cognitive failure, followed by safety behaviors and safety events.

While we did find a consistently strong relationship between mindfulness/situation awareness and workplace safety, there was significant variation in the strength of this association across different sectors of industry. For instance, results from this assessment suggest that mindfulness and safety are more strongly related in transportation-related occupations, relative to energy industry and healthcare occupations (see a representation of these trends in Figure 3 below).

“In 17 studies with a combined 4,846 participants, 94% found positive associations between mindfulness or situation awareness and safety.”



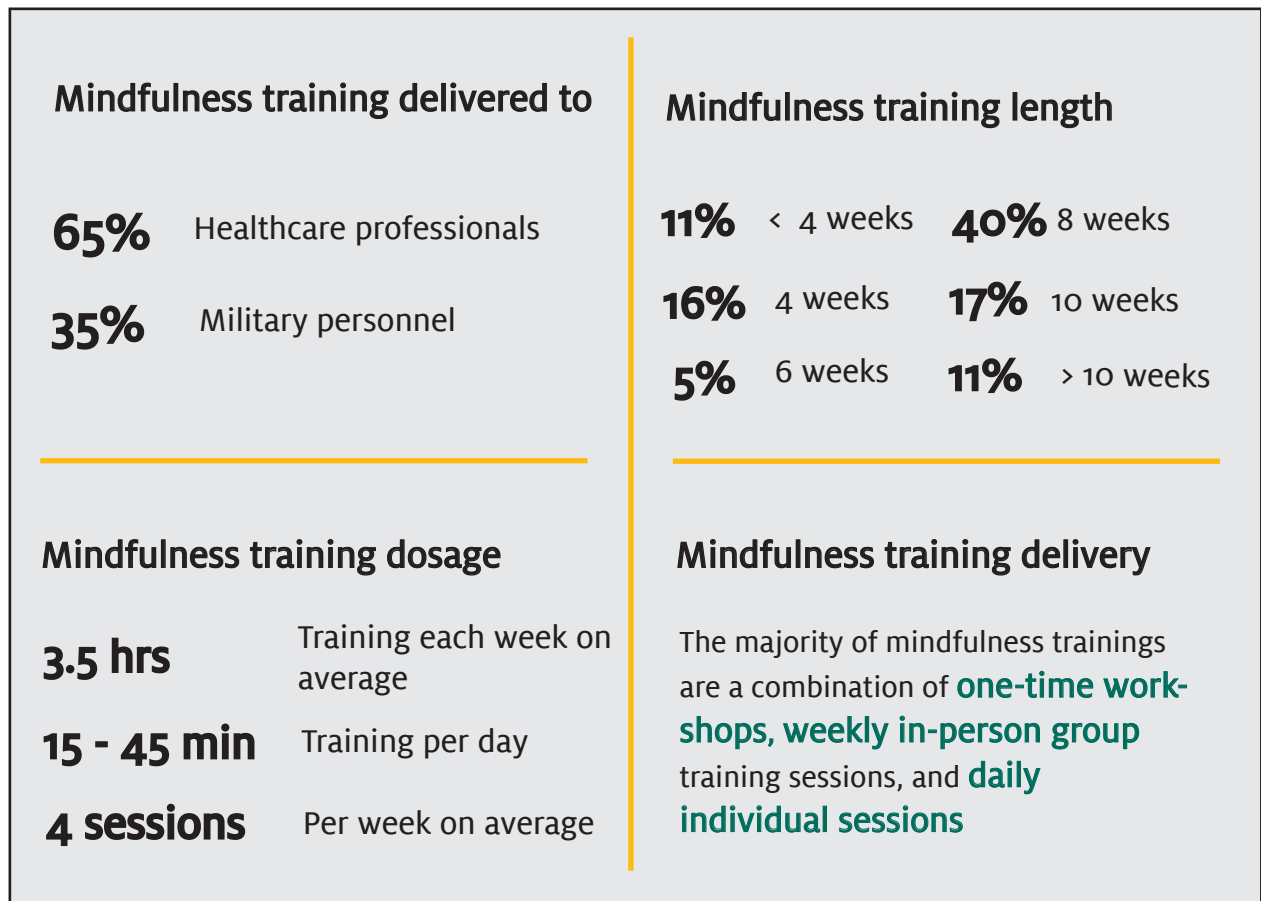
QUALITATIVE REVIEW OF MINDFULNESS-BASED INTERVENTIONS

Of 17 studies with a combined 4,758 participants, 15 found that participation in mindfulness training improves workplace safety.

This review also revealed that several types of mindfulness interventions and techniques, including Mindfulness-Based Stress Reduction (MBSR) and Mindfulness-Based Mind Fitness Training (MMFT), were effective in promoting safety-related outcomes (e.g., safety incidents or accidents, patient safety, safety compliance).




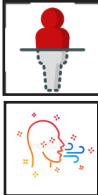



While studies varied in training length, dosage (i.e., daily practice duration and quantity), and delivery method, **the vast majority found their specific training program to be effective in improving workplace safety.** Moreover, successful mindfulness interventions also adapted established mindfulness interventions to specific occupations (i.e., healthcare professionals and military personnel) (see a summary of these trends below).

“Of **17** studies with a combined **4,758** participants, **15** found that participant in mindfulness-based training improves workplace safety.”


















QUALITATIVE REVIEW OF MINDFULNESS-BASED INTERVENTIONS

Below is a complete list of studies investigating the effectiveness of mindfulness-based interventions in improving safety in the workplace. Occupation type, intervention dosage (i.e., quantity and length of training sessions), mindfulness techniques and the study's main findings are outlined for each study.

Study	Occupation	Intervention dosage	Mindfulness technique	Main findings
Brady et al. (2012)	Healthcare professionals	1 hr weekly group training plus 30 min/day for 4 weeks	Individual and group mindfulness practice of focused breathing and contact points. 	Training reduced employee stress, increased self-care, and led to improvements in patient care and satisfaction, and decreases in patient safety events.
Daigle et al. (2018)	Healthcare professionals	2.5 hr weekly group training plus 45 min/day for 8 weeks	Exercises to increase mindfulness and attention: body scan, walking/sitting meditation. 	Training resulted in significant improvements in distress and perceived improvement in reported errors post-treatment.
Gunther (2014)	Healthcare professionals	2 month mindfulness education program		While no significant differences in trait mindfulness levels were found between the experimental and control groups, training did lead to increases in error reporting behaviors.
Hallman et al. (2014)	Healthcare professionals	45 min bi-weekly group training plus 15 min/day for 8 days	Experiential and instructional activities including body scan and refraining from judgment of surroundings. 	Training program effectively decreased stress, increased mindfulness, and improved patient safety and staff safety.
Jha et al. (2015)	Military personnel	2 hr weekly group meeting plus 30 min/day for 8 weeks	Mind Fitness training that emphasized decreasing stress, increasing resilience, and self-regulation. 	Training-focused mindfulness training programs bolster cohorts' attentional performance in high-demanding situations.
Jha et al. (2017)	Military personnel	2 hr weekly group meeting plus 30 min/day for 8 weeks	Mind-fitness training also emphasized mindfulness practices in operational environments. 	Training protected military groups from attentional lapses over time in high-demand situations.
Jha et al. (2020)	Military personnel	1-day workshop, 2 hr weekly group meeting, 30 min/day for 8 weeks		Training delivered by instructors with experience in working with military personnel led to less decline in attentional and working memory performance.



Study	Occupation	Intervention dosage	Mindfulness technique	Main findings
Jha et al. (2020)	Military personnel	One 4-hr workshop, eight 1 to 2-hr group meeting, 30 min/day for 8 weeks	Mind-fitness training with strategies to promote concentration, body awareness, and monitoring.  	Training protected military personnel from cognitive lapse over time, indicated by less decline in sustained attention performance and working memory.
Meland et al. (2015)	Military personnel	1-day workshop, 3-hr weekly group training, 30 min 2x weekly for 4 months	Info of the benefits of mindfulness and guided practices of body scan, and sitting meditation.   	Training alleviated participants' physiological stress and subjective mental demand of challenging tasks, but did not improve errors in attentional performance.
Mumber (2014)	Healthcare professionals	Mindfulness practice for 6 weeks	Mindfulness training focused on error prevention and patient safety culture. 	Mindfulness interventions contributed to improvements in trait mindfulness and patient safety events.
Singh et al. (2009)	Healthcare professionals	2 hrs in-person training per week for 12 weeks	Info of the benefits of mindfulness and guided practices of body scan, and sitting meditation.   	Mindfulness training led to decreased uses of physical restraints, Stat medications, and staff/peer injuries.
Singh et al. (2015)	Healthcare professionals	Two 1-day workshops, 5-day intensive training, 20 min/day for 10 weeks	Guided practices of focused attention, breathing, and non-judgmental acceptance.  	Training showed significant improvements in reducing the use of physical restraints, redirection, staff stress, turnover rates, and staff/peer injuries.
Singh et al. (2016)	Healthcare professionals	Two 1-day workshops, 5-day intensive training, 30 min/day for 10 weeks	Information of the benefits of mindfulness and guided practices of contact points, compassion meditation, and lovingkindness meditation.	Training led to a reduced need for physical restraints decreased when caring for patients and decreases in staff turnover rates and staff/peer injuries.
Singh et al. (2020)	Healthcare professionals	Two 1-day workshops, 5-day intensive training, 30 min/day for 10 weeks		Mindfulness was more effective in reducing staff/peer injuries, aggressive behavior, and staff turnover compared to Positive Behavior Training alone.
Valley and Stallones (2017)	Healthcare professionals	1 day workshop, 2.5 weekly group training, 1 hr/day for 8 weeks	Group discussions and guided mindfulness practices, such as focusing on breathing and yoga.   	Mindfulness training increased safety compliance and decreased cognitive failures but not safety participation in medical staff.



Study	Occupation	Intervention dosage	Mindfulness technique	Main findings
Wong et al. (2020)	Healthcare professionals	90 min/week group training, 15/day individual training for 8 weeks	Group sharing, in-class activities, guided practices of mindful breathing and communication.	Mindfulness training led to improved sustained attention and decreased subjective energy depletion in cognitive-demanding situations.
Zanesco et al. (2015)	Military personnel	2 hour group training twice a week plus 15-minute daily practice	Introductions on concentration, open monitoring, and body awareness, and guided practice of body scan and mindful sitting.	Mindfulness training led to improvements in attention and working memory outcome measures and decreases in cognitive failures.



CONCLUSIONS

Mindfulness is Related to Increased Workplace Safety

Despite variation in mindfulness training and occupation type, almost all studies from the quantitative and qualitative review summarized above found a positive effect of participation in a mindfulness activity technique on promoting workplace safety. In general, applications of mindfulness-based activities in the working population lead people to perform more safety behaviors, and are involved in fewer attentional lapses and concrete safety events, including injuries and accidents.

Benefits of Low Mindfulness Training Dosage

Training dosage (i.e., the quantity and length of mindfulness training sessions) ranges from three, 45-minute sessions across 8 days to a day-long workshop followed by five daily intensive group training sessions and 30-minute daily individual sessions over 8 weeks. However, regardless of training dosage, almost all studies observed a positive effect of mindfulness-based intervention on workplace safety. Thus, from a practical standpoint, researchers and practitioners alike may benefit from mindfulness techniques that are less time-intensive.

Modified Training for Different Occupations

In our review, the specific mindfulness training used was partially dependent on the study’s population as well as on the criteria variables used to assess safety, suggesting that different types of mindfulness training may have been modified according to the participants and safety-related outcomes of interest.

The Mindfulness-based Stress Reduction program is often applied to healthcare professionals to investigate its influence on patient safety or its impact on healthcare worker compliance with safety rules and participation in safety-promoting activities.²⁷ The Mindfulness-Based Mind Fitness Training and Mindfulness-Based Attention Training are two mindfulness-based cognitive training interventions that have been tested exclusively among military groups to enhance their ability to cope with situations that involve high cognitive demand situations. Many studies using in targeting similar populations emphasized tailoring the mindfulness techniques to a particular population with the changes in the terminology and exercise components.

MODIFIED TRAINING FOR DIFFERENT OCCUPATIONS

MILITARY PERSONNEL

Mindfulness training can be designed to emphasize application of mindfulness practices in the operational environment and delivered by instructors who are familiar with the military culture.



HEALTHCARE PROFESSIONALS

Mindfulness training can be combined with other positive behavior training focused on development of context-specific support strategies and positive behaviors to maximize its benefits to employee well-being and patient care.



OFFSHORE OIL AND GAS WORKERS

Learning from research in military personnel, mindfulness training can include mindfulness practices suitable for the offshore environment and incorporate offshore terminology and cultural references.



MINDFULNESS TRAINING TO ENHANCE OFFSHORE SAFETY IN THE GULF OF MEXICO

Despite the call for more evidence-based safety culture work, there are still very few studies directly testing the effectiveness of mindfulness training on safety. Further, the prerequisite partnerships between companies and academic researchers are scarce, especially in the offshore drilling and service sectors.

The Offshore Mindfulness and Safety Initiative, led by a research team out of the University of Houston, is part of the Gulf Research Program funded by the National Academies of Science Engineering and Medicine. As part of this initiative, our team will develop mindfulness exercises and test their effectiveness in promoting safety with offshore service workers and drilling crews from collaborating companies Diamond Offshore Drilling and Baker Hughes.

The mission of this project is to combine research-based evidence with expertise from our oil industry partners to establish and distribute low-cost, high-impact mindfulness activities techniques aimed at improving the safety and well-being of offshore workers in the Gulf of Mexico. Specifically, we will determine how and why mindfulness can be used to improve offshore safety culture, develop and deploy mindfulness activities techniques that are compatible with offshore workers, establish assessment tools to measure mindfulness effectiveness offshore and work with industry partners to determine the most effective ways to distribute mindfulness activities techniques offshore.



Build Academic-Industry Partnership

We developed an academia-industry partnership with two large industry organizations. We positioned this project uniquely to respond to the need for more evidence-based safety culture interventions that make sense from a research and from an industry perspective.



Select Exercises for Offshore Personnel

We designed and chose the particular exercises suitable for offshore population and pilot tested with workers in two companies to make further modifications. Exercises with the most positive feedback from industry partners would be used in the formal training.



Start with the Gulf of Mexico

We applied mindfulness training to promote safety to respond to the calls for reducing risks in offshore operations after the blow-out on the Deepwater Horizon facility in the Gulf of Mexico and wished to design deployable tools usable at other offshore facilities as well.



Explore Underlying Mechanisms

We will explicitly test the mechanism underlying the benefits of mindfulness training, such as stress reduction and cognitive function improvements, to explore the effect of mindfulness training in improving employee wellbeing and cognitive functions.



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