Leadership Influence on Occupational Safety:

Psychological Safety and Safety Climate as Mediators

Between Leadership and Safety Performance

Shanon Randall Harmon

A Dissertation Submitted to the Faculty of

The Chicago School of Professional Psychology

In Partial Fulfillment of the Requirements

For the Degree of Doctor of Philosophy in Business Psychology

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Dedication

In memory of my brother, Sheldon Richard Harmon, and my cousin, Brandon M. Pierce. Your lives were taken too early. I hope that this research helps prevent accidents and save lives, so everyone can go home safe to their loved ones. I hope that other families will not have to experience the grief and loss that we've experienced. We (family and friends) love you very much.

Sheldon Richard Harmon, 21, passed away Wednesday (Nov. 11, 2009) as a result of injuries sustained in an automobile accident. He was a senior at Edinboro University of Pennsylvania in Edinboro, PA, pursuing his Bachelor of Fine Arts with an animation major and drawing minor (Sheldon Richard Harmon obituary, 2009).

Brandon M. Pierce, 30, passed away Thursday (Aug. 30, 2018) in West Virginia, from injuries sustained in a work-related accident. He worked in the oil and gas fields for most of his career for Universal Well Services in Bradford, PA and was currently employed by North Country Services in Coudersport, PA (Brandon Pierce obituary, 2018).

Abstract

Leaders have a critical role in influencing employees' safety behaviors. This study clarifies how leadership competencies and behaviors influence psychological safety climate, safety climate, and safety performance from full-time employees who work in a range of hazardous conditions. The study used an archival dataset comprised of questionnaire responses and safety information from 3,698 full-time employees who each were supervised by one supervisor for two years at an electric utility company. The study used confirmatory factor analysis (CFA), multiple mediation structural equation modeling (SEM), and multiple mediation multi-group structural equation modeling to examine the influence of leadership competencies, psychological safety climate, safety climate, safety observations, safety recognitions, safety reporting, and safety compliance on safety incidents. The results show the influence of leadership on safety performance does not differ across work settings. General leadership competencies do have a direct effect on safety performance. There were direct relationships between communication, safety reporting, and safety compliance on safety incidents. Psychological safety climate mediated the relationship between all the leadership competencies and safety climate at the individual level across work settings. Employees' perception of their manager's leadership capability and commitment to safety compliance does influence their participation in safety programs and safety performance to decrease safety incidents. Leaders may be more effective at achieving desired organizational performance by creating a work environment that promotes psychological safety. Leaders should develop their effectiveness in supportive leadership behaviors and learn to flex their leadership style given the desired impact they want to make on their direct reports' safety performance. This study provides evidence towards the safety climate theory, where safety climate may be better understood at the group or organizational level to predict safety performance.

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Chapter 1: Nature of the Study

This chapter provides an introduction of the research study, including a background of the study, problem statement, research questions, application of the results, and definition of key terms. The research focuses on understanding how employees' perception of their supervisor's leadership behavior influences psychological safety climate and safety climate, and the effect of their participation in safety programs (i.e., safety observation, safety recognition) on number of occupational safety incidents. The focus of this research will be on the social and psychological predictors of safety behaviors and performance in the discipline of applied psychology.

Background

Despite the efforts by government regulatory agencies, management, labor unions, and other organizations to improve occupational safety over the past century, a significant number of injuries and fatalities still occur in the workplace. Safety has become one of the highest priorities for companies due to the incalculable human loss, increased regulations, and significant financial costs. Organizations have been making investments to improve occupational safety. The focus on occupational safety over the past century has contributed to saving countless number of lives (Hofmann, Burke, & Zohar, 2017; Lee, Huang, Cheung, Chen, & Shaw, 2018), improved organizational safety performance, competitive advantage, and financial performance (Cooper, 2015; Fernández-Muñiz, Montes-Peón, & Vázquez-Ordás, 2009; Peng, Boyle, Neyens, & Short, 2010). Even with this focus and improvements, occupational safety is still a significant concern, as there are still too many occupational injuries and fatalities in the workplace (U.S. Bureau of Labor Statistics, 2017a). Leaders made significant improvements to increase safety in the workplace during the 20th century by focusing on individual and organizational factors (Hofmann et al., 2017), but they failed to understand how their own leadership style and behaviors may be impacting employees and safety performance. Even today, the impact of leadership style and behaviors on safety environment and performance is not understood well enough to provide clear recommendations on how leaders may reduce or eliminate injuries or fatalities in the workplace.

History of Occupational Safety

Occupational safety became an important social and political issue as a response to poor working conditions for workers during the Industrial Revolution (Hofmann et al., 2017). At the beginning of the 20th century, workers in the United States faced high health and safety risks on the job. Due to the number of occupational injuries and fatalities across industries, many organizations turned their attention to occupational safety (Palmer, 1926). The safety movement began in the early 1900s when organizational leaders and advocates for human welfare brought attention to organizational practices that led to employee deaths while working on the job. Workers, unions, employers, government agencies, scientists, and others advocated for people's workplace well-being. Collectively, they influenced policies and practices to ensure employees were taking the appropriate steps to be safe while performing their job responsibilities, and organizations were creating working conditions to prevent injuries and fatalities.

In the early 1900s, organizational leaders recognized that they have an important role in occupational safety of their employees. Leaders advocated for the adoption of organized safety. Their advocacy for universal safety influenced many people and organizations to make significant advancements in occupational safety, such as forming safety committees to evaluate accidents and make improvement to safety practices (Palmer, 1926). These efforts decreased the number of work-related injuries and deaths (more than 50,000 lives annually) dating back to the early 20th century (Hersey, 1936; Palmer, 1926). The declines in the number of occupational injuries and fatalities can be attributed to many interrelated factors, including efforts by workers, management, and researchers to improve occupational safety. Additional efforts by government agencies and labor and health authorities, such as research, education, and regulatory activities, contributed to physical, psychological, and behavioral changes in the workplace, such as safer equipment, development of safer work practices, and improved health and safety training (Hofmann et al., 2017; *Improvements in workplace safety--United States, 1900-1999,* 1999).

In the years between 1900 and 1914, progressive reformers, journalists, and labor unions pressed for change in many areas of American life. As a result, the United States Congress created the Federal Food and Drug Administration (FDA), which eventually passed regulations that had a small impact on reducing the number of occupational injuries and fatalities. The new federal employers' liability laws passed by Congress in 1908 contributed significantly to workplace safety. In addition, New York State became the first state to pass a Workmen's Compensation Law, which automatically compensated all workers with injuries at a fixed rate. Because of a study by the American Federation of Labor on the effects of compensation and how it stimulated business interest in safety, 44 states passed the compensation laws following New York State between 1911 and 1921 (Aldrich, 2001).

The compensation laws and tighter liability caused a rise in accident costs for organizations. Because of the financial costs, management increased their attention on occupational safety and workplace practices, which initiated the long-term decline in work accidents and injuries (Aldrich, 2001). For example, management began looking for factors that could contribute to a safer workplace, such as workers wearing personal protective equipment. In addition, management created safety departments and committees that included both workers and managers. Because of these efforts by management during the years between 1918 and 1939, accident costs and safety concerns began to decrease (Aldrich, 2001); however, the economic boom during World War II worsened occupational safety. After 1945, accidents again declined with powerful labor unions playing an important role in improving workplace safety. Occupational injuries and fatalities increase in times of economic boom, so in the 1970s the Occupational Safety and Health Administration (OSHA) was founded and contributed to the continuing reduction in work injuries after 1970 (Aldrich, 2001).

Impacts of Safety Incidents

Despite the efforts of many organizations in the 20th century, workplace injuries and fatalities continued to occur year after year. The total number of nonfatal workplace injuries and illnesses continued to decrease over time (see Table 1). In 2013, there were 3.0 million nonfatal workplace injuries and illnesses reported by private industry employers, a rate of 3.3 cases per 100 full-time workers (U.S. Bureau of Labor Statistics, 2014a). In 2014, there were 3.0 million nonfatal workplace injuries and illnesses reported by private industry employers, a rate of 3.2 cases per 100 full-time workers (U.S. Bureau of Labor Statistics, 2016a). In 2015, there were approximately 2.9 million nonfatal workplace injuries and illnesses reported, a rate of 3.0 cases per 100 full-time workers (U.S. Bureau of Labor Statistics, 2016b). In 2016, there were approximately 2.9 million nonfatal workplace injuries and illnesses reported, a rate of 2.9 cases per 100 full-time workers (U.S. Bureau of Labor Statistics, 2017a). In 2017, there were approximately 2.8 million nonfatal workplace injuries and illnesses reported, a rate of 2.8 cases per 100 full-time workers (U.S. Bureau of Labor Statistics, 2018a).

Despite the total number of nonfatal workplace injuries and illnesses decreasing over time, the number of fatal work injuries reported in the workplace continued to increase over time (see Table 1). In 2013, there were a total of 4,405 fatal work injuries reported in the United

States (U.S. Bureau of Labor Statistics, 2014b). In 2014, there were a total of 4,679 fatal work injuries reported, which is a 2% increase from the fatal injuries reported in 2013 (U.S. Bureau of Labor Statistics, 2016c). In 2015, there were a total of 4,836 fatal work injuries reported, which was a slight increase from the fatal injuries reported in 2014 (U.S. Bureau of Labor Statistics, 2016d). In 2016, there were a total of 5,190 fatal work injuries reported, which was a 7% increase from the fatal injuries reported in 2015 (U.S. Bureau of Labor Statistics, 2017b). In 2017, there were a total of 5,147 fatal work injuries reported, which was a slight decrease from the 5,190 fatal injuries reported in 2016 (U.S. Bureau of Labor Statistics, 2018b). The most common reasons for work fatalities included the following: transportation incidents, accounting for about 40% of the total events; violence by persons (both homicides and suicides) or animals; and falls, slips, and trips (U.S. Bureau of Labor Statistics, 2018b).

Table 1

Employee-Reported Workplace Injuries and Illnesses

Injuries	2013	2014	2015	2016	2017
Nonfatal[a]	3.0	3.0	2.9	2.9	2.8
Rate[b]	3.3	3.2	3.0	2.9	2.8
Fatalities[c]	4,405	4,679	4,836	5,190	5,147

Note. Adapted from “Employer-Reported Workplace Injuries and Illnesses” and “National Census of Fatal Occupational Injuries” reports by U.S. Bureau of Labor Statistics, U.S. Department of Labor. Source is https://www.bls.gov/bls/news-release/home.htm#CFOI

[a]Millions of nonfatal workplace injuries and illnesses. [b]Rate is cases per 100 full-time workers. [c]Total number of fatalities within the year.

Occupational injuries and fatalities continue to have negative financial impacts on organizations. OSHA estimates that, in addition to the incalculable human cost, the 2.8 million workplace injuries and illnesses and more than 5,147 fatal work injuries reported in 2017 (U.S. Bureau of Labor Statistics, 2018a, 2018b) cost businesses in the United States about $170 billion each year. If accidents occur, the company is responsible for impacts that occur to the environment, communities, and employees (Pagell, Veltri, & Johnston, 2016).

In addition to the financial costs, safety has become a priority to many organizations due to the changing regulatory standards in industries (Roger & Flin, 2011). Companies want to ensure all employees prevent injuries and perform their work safely while on the job. Occupational injuries can occur while performing fieldwork or in the office setting. Employees working in the field may be working with heavy or sharp equipment, harsh weather conditions, or extreme job sites. These are common conditions where safety is a priority. Also, employees that work in the office must practice safety. Lifting packages incorrectly, eye strain from looking at computer monitors, and sitting incorrectly are all common causes of office injuries that can result in chronic issues for employees. Companies are not only financially responsible, but there is a loss in productivity. Employees may be away from work; therefore, injuries and illnesses have multiple negative impacts for companies. This raises the question of how companies can reduce the number of injuries that occur in the workplace.

Occupational Safety Research

The study of occupational safety evolved over the last one hundred years. Early research and practices focused on individual workers and personnel factors that may lead to accidents. Over time researchers focused their efforts on organizational factors that may lead to accidents. While researchers continually advance the field of safety to understand individual, group, and organizational factors that contributed to safety performance, researchers focused their attention on leadership and organizational climate towards the late 20th and early 21st centuries. Despite the research on occupational safety over the past one hundred years contributing to saving countless lives (Hofmann et al., 2017), serious injuries continue to occur, and fatalities are trending upward.

In the late 20th and early 21st centuries, researchers began to focus their attention on leadership as a significant factor for organization's safety performance. Today's research on leadership style and behaviors influencing employees' perception of safety and their safety performance is not well understood in the academic community, which leads to unclear recommendations on how to eliminate safety incidents and fatalities in the workplace. Additional research is necessary to understand the influence of leadership style and behaviors on safety performance.

In addition to the research, organizations are encouraging their employees to contribute to continuous improvement of safety processes and practices for the benefit of the organization's safety and financial performance. While these contributions can benefit the organization, sharing opinions on improvements have potential risks for the individuals - experimentation of new ideas may result in failure and challenging current practices may be seen by others as negative. These contributions require a psychological safe work environment where employees feel safe to voice safety concerns, have a willingness to seek feedback, provide honest feedback, collaborate with others, and encourage risk taking to support organizational learning and growth (Edmondson, 1999; Newman, Donohue, & Eva, 2017). Leaders create environments where employees can share safety concerns and improvement ideas by displaying supportive leadership behaviors (Newman et al., 2017), but there is little research that clearly supports how a psychologically safe work environment contributes to a safe work environment.

Problem Statement

Leaders have a critical role in influencing employees' safety behaviors. Despite the pivotal role that leaders play in influencing employees' safety behaviors, many leaders do not demonstrate effective safety leadership behaviors or do not know which behaviors are effective (Krause, 2005). This study examined how employees' perception of their supervisor's leadership behaviors influences psychological safety climate and safety climate, and the effect on their participation in safety programs (i.e., safety observation, safety recognition) and number of safety incidents at an electric utility company. Employees rated their direct supervisor's proficiency of leadership behaviors, psychological safety behaviors, and safety leadership behaviors in a direct report feedback survey to determine how their perception of their supervisor may influence their participation in safety programs, safety compliance behaviors, and number of safety incidents. The theoretical foundation of this research was informed by social learning theory (Bandura, 1977; Bandura & Walters, 1963), full range of leadership theory (Bass, 1990; Bass & Avolio, 1994), and safety climate theory (Zohar, 2008; Zohar & Luria, 2005).

Purpose of the Study

The research on leadership style and behaviors impact on safety environment and performance is not understood well enough to provide clear recommendations on how leaders may reduce or eliminate injuries or fatalities in the workplace. The purpose of this study is to provide clarity on how leadership competencies and behaviors influence employees' safety performance in the workplace by exploring the influence of leadership on psychological safety climate, safety climate, and safety incidents within the workplace. This study examines leadership and safety performance from full-time employees' who work in a range of hazardous conditions at an electric utility company.

Research Questions

The following research questions are explored in the study:

1. What leadership competencies influence employee safety incidents?
2. What leadership competencies influence psychological safety climate?
3. What leadership competencies influence safety climate?
4. What leadership competencies indirectly influence employee safety incidents through psychological safety climate?
5. What leadership competencies indirectly influence employee safety incidents through safety climate?
6. Does psychological safety climate influence employee safety incidents?
7. Does safety climate influence employee safety incidents?
8. Does psychological safety climate indirectly influence employee safety incidents through safety climate?
9. Does psychological safety climate indirectly influence employee safety incidents through participation in safety programs?
10. Does safety climate indirectly influence employee safety incidents through participation in safety programs?
11. Does safety climate indirectly influence employee safety incidents through safety compliance behaviors?
12. Do leadership competencies indirectly influence safety climate through psychological safety climate?
13. Does the influence of leadership on safety performance differ across work settings?

Significance of the Study

The research and field of occupational health and safety is broad and spans across multiple disciplines. The focus of this research will be on the social and psychological predictors of safety behaviors and performance. Specifically, the research will focus on developments of occupational safety in the discipline of applied psychology. The research on how employees' perception of their supervisor's leadership behavior influences psychological safety climate and safety climate, and the effect on their participation in safety programs (i.e., safety observation, safety recognition) and number of safety incidents is not well understood (Hofmann et al., 2017; Lee et al., 2018; Newman et al., 2017). These results may benefit leaders, employees, safety specialists, and human resource professionals by defining the leadership behaviors that are most significant to influence employees' safety behaviors, increase employee health and wellbeing, and prevent serious injuries and fatalities.

Theoretical Framework

The theoretical basis for this research includes: social learning theory (Bandura, 1977; Bandura & Walters, 1963), full range of leadership theory (Bass, 1990; Bass & Avolio, 1994), and safety climate theory (Zohar, 2008; Zohar & Luria, 2005). Social learning theory proposes that new behaviors can be acquired by observing and imitating others in the environment (Bandura, 1977, 1986; Bandura, Ross, & Ross, 1961, 1963; Bandura & Walters, 1963). Full range of leadership theory describes leadership on a continuum combining both transactional and transformational leadership styles (Bass, 1990, 1999; Bass & Avolio, 1994). Safety climate theory goes beyond the measurement and operational definition (Zohar, 1980) and expands into a full multilevel, systems-focused model. The framework is a comprehensive and integrated model for occupational safety (Zohar, 2008; Zohar & Luria, 2005).

Definition of Key Terms

The key terms used throughout this research study are defined below:

Close Call. Incident where a person did not sustain a personal injury but could have sustained an injury if there was a slight shift in time or position (United States Department of Labor, 2001).

Days Away from Work (OSHA Recordable). Record if the case involves one or more days away from work (United States Department of Labor, 2001).

First Aid (OSHA Recordable). Providing treatment to an employee included in the list of procedures provided by OSHA (e.g., nonprescription medications, cleaning wounds on the surface of the skin) that are all-inclusive (United States Department of Labor, 2001).

Full Range of Leadership Model. Full Range of Leadership Model describes leadership on a continuum combining both transactional and transformational leadership styles (Bass, 1990, 1999; Bass & Avolio, 1994; Northouse, 2010).

Hearing Loss (OSHA Recordable). Must record all work-related hearing loss cases. An employee has experienced a Standard Threshold Shift (STS) or a change in hearing threshold, relative to the baseline audiogram, of an average of 10 dB or more at 2000, 3000, and 4000 Hz in one or both ears (United States Department of Labor, 2001).

Incident (Safety). An event that results in an injury, illness, or close call (United States Department of Labor, 2001).

Injury. Condition including but not limited to a cut, fracture, sprain, or amputation (United States Department of Labor, 2001).

Illness. Conditions that are both acute and chronic illnesses such as, but are not limited to, a skin disease, respiratory disorder, or poisoning (United States Department of Labor, 2001).

Lagging Indicator. A measurement of safety outcomes (e.g., incidents, accidents, injuries, days away from work, fatalities) for safety-related events (Blair, 2017; Krause, 2005).

Leader-Member Exchange (LMX). Leader-Member Exchange Theory is a process that is centered on the interaction between the leader and the followers. This theory describes the differences that might exist between the leader and each of the followers and how those differences result in the follower's behaviors or performance (Northouse, 2010).

Leading Indicator. A measurement of quantifiable variables that show a valid, predictive relationship to safety-related outcomes that are meant to prevent accidents (e.g., safety behaviors, safety program participation, wearing personal protective equipment, removing hazards, safety observations, safety behavior recognition) (Blair, 2017; Krause, 2005).

Loss of Consciousness (OSHA Recordable). All work-related cases involving loss of consciousness must be recorded.

Occupational Safety and Health Administration (OSHA). The United States government organization, Occupational Health and Safety Administration, created in 1970 to direct compliance with federal initiatives in occupational health and safety. The Federal OSHA is a small agency that partners with the state governments that are comprised of 2,100 inspectors responsible for the health and safety of 130 million workers, employed at more than 8 million worksites around the nation (Occupational Safety and Health Administration [OSHA], 2018).

Organizational Climate. Shared perceptions by members of a group or organization regarding aspects of the work environment (i.e., policies, procedures, and practices) (James & James, 1989; Schneider, 1975).

Organizational Culture. The set of shared values and norms that controls organizational members' interactions with each other and with suppliers, customers, and other people outside the organization (Jones, 2013).

OSHA Recordables. Work-related injuries and illnesses that result in death, loss of consciousness, days away from work, restricted work activity, transfer to another job, medical treatment beyond first aid, or a significant injury or illness diagnosed by a physician or other licensed health care professional (United States Department of Labor, 2001).

Passive Leadership. Leaders fail to intervene on safety-related events until problems are either brought to their attention or become serious enough to require their attention. Leaders with a passive leadership style avoid both decision making and the responsibilities of leadership and may avoid taking any action (Bass, 1990, 1999; Kelloway, Mullen, & Francis, 2006).

Psychological Climate. Individuals' perceptions of the work environment, including leader support and facilitation, role stress and lack of harmony, job challenge and autonomy, and workgroup cooperation, warmth, and friendliness (James & James, 1989).

Psychological Safety Climate (Individual). A feeling of being able to show and employ one's self without fear of negative consequences of self-image, status, or career (Kahn, 1990).

Psychological Safety Climate (Group). A shared belief held by members of a team that the team is safe for interpersonal risk taking (Edmondson, 1999).

Psychological Safety Climate (Organization). Formal and informal organizational practices and procedures guiding and supporting open and trustful interactions within the work environment where employees are safe to speak up without being rejected or punished (Baer & Frese, 2003).

Restricted Work Activity or Job Transfer (OSHA Recordable). Record if the case involves one or more days of restricted work. Restricted work activity exists if the employee is unable to work the full workday he or she would otherwise have been scheduled to work; or unable to perform one or more routine job functions. A case is recordable if the injured or ill employee performs his or her routine job duties for part of a day and is assigned to another job for the rest of the day (United States Department of Labor, 2001).

Safety. Practices, activities, and behaviors focusing on reducing hazards or safety incidents (Krause, 2005).

Safety Behavior. The way a person acts or conducts oneself related to preventing injuries in the workplace. Safety behavior is divided into two types – safety compliance and safety participation (Clarke & Ward, 2006; Zahoor, Chan, Utama, Gao, & Zafar, 2017). Researchers suggested that leading indicators (e.g., safety behavior) are better measures of safety than safety performance, as they are more effective at the prevention, prediction, and prescription of safety incidents (Blair, 2017; Christian, Bradley, Wallace, & Burke, 2009; Clarke, 2006a; Neal & Griffin, 2006).

Safety Climate. A measure of shared employee perceptions about the relative importance of safe, observable conduct in their occupational behavior at a place and time (Zohar, 1980; Zohar & Luria, 2005).

Safety Climate Interventions. Interventions specifically intended to show a marked change in safety attitudes and norms across the organization (Lee et al., 2018).

Safety Compliance. Employees perform required behaviors that maintain a minimum level of workplace safety, such as following safety policies, rules, and procedures, and wearing personal protective equipment (Clarke & Ward, 2006; Neal & Griffin, 2006; Zahoor et al., 2017).

Safety Culture. Safety culture represents the underlying beliefs or values on safety among a group of people that govern how they behave or operate related to safety in the workplace (Krause, 2005; Lee et al., 2018). Safety culture is valuing employee safety, such as caring for each employee's health and wellbeing. Each person should have a deep sense of care for himself or herself and the safety of others to protect against workplace injuries or fatalities (Wheatley, 2015).

Safety Leader. Any employee that influences safety behaviors of others or safety outcomes within the organization (Krause, 2005).

Safety Leadership. Style of leadership that specifically relates to influencing safety behaviors of employees and the company's safety success (Krause, 2005).

Safety Measurement. Methods of quantification and qualification of safety activities that focus on reducing harm and undesirable events. The dangers of work are usually measured by the number of injuries or fatalities to a group of workers over a period, usually one year.

Safety Outcomes. Any measurement or variable related to safety, such as safety behaviors or safety performance. Safety behaviors include both safety participation or safety compliance (Neal & Griffin, 2002). Safety performance includes incidents (i.e., injuries, illness) and close calls (Blair, 2017; Christian et al., 2009; Clarke, 2006a; Neal & Griffin, 2006).

Safety Participation. Behaviors that do not directly contribute to an individual's personal safety, but which do help to develop an environment that supports safety (Neal & Griffin, 2002), such as helping coworkers with safety and participating in workplace safety programs (Clarke & Ward, 2006; Neal & Griffin, 2006; Zahoor et al., 2017).

Safety Performance. Safety performance is a multi-dimensional construct that includes number of incidents, injuries and illnesses and later to involve close calls (Blair, 2017; Christian et al., 2009; Clarke, 2006a; Neal & Griffin, 2006).

Safety Recognition. Employees recognize others for working safety (Sparer, Catalano, Herrick, & Dennerlein, 2016).

Significant Diagnosed Injury or Illness (OSHA Recordable). Work-related conditions must always be recorded at the time of diagnosis by a professional licensed healthcare professional, including cancer, chronic irreversible disease, punctured eardrum, fractured or cracked bone or tooth (United States Department of Labor, 2001).

Transactional Leadership. Transactional leadership refers to the relationship between leader and employee where the leader identifies the roles and task requirements for the employee to fulfill the leader's expectations to meet both parties' self-interests (Bass, 1990, 1999).

Transformational Leadership. Transformational leadership refers to a leader who elevates the interests of their employees, generates awareness and acceptance of the purpose and mission of the group, and influences the employee to look beyond their own self-interests for the benefit of the group (Bass, 1990).

Chapter Summary

This chapter provided an introduction of the research study, including a background of the study, problem statement, research questions, application of the results, and definition of key terms. The research focuses on understanding how employees' perception of their supervisor's leadership behavior influences psychological safety climate and safety climate, and the effect of their participation in safety programs (i.e., safety observation, safety recognition) on number of occupational safety incidents. The remaining chapters will provide an overview of the literature and describe the methodology for this research. Chapter 2 provides a review of the theoretical background and research literature pertaining to leadership theories, psychological safety climate, and safety climate. Chapter 3 provides a description of the research questions, hypothesis, and methodology. Chapter 4 presents the findings of the research study. Chapter 5 presents the discussion of the findings as well as the conclusions.

Chapter 2: Literature Review

Chapter Overview

This chapter provides a comprehensive review of the literature pertaining to safety leadership and occupational safety. The chapter discusses current research on the influence of safety leadership on employee safety performance. The theoretical framework for this study defines the relationship between leaders' behavior and the influence on their employees' safety performance according to different perspectives of leadership.

Review of Theoretical Background

In the literature, there are several foundational theories for understanding safety leadership styles and occupational safety. The theoretical basis for this research include: social learning theory (Bandura, 1977; Bandura & Walters, 1963), full range of leadership theory (Bass, 1990; Bass & Avolio, 1994), and safety climate theory (Zohar, 2008, 2010).

Social Learning Theory

Social learning theory explains how people can learn new behaviors by observing behaviors of others (Bandura, 1977, 1986; Bandura et al., 1961, 1963; Bandura & Walters, 1963; Bushman & Bartholow, 2010). Bandura developed the theory of social learning through studies with exposing children to aggressive acts or models. The children who were exposed to aggressive models were more likely to demonstrate the same aggressive acts. If the children saw the behavior as acceptable, they were more likely to demonstrate the same behavior. The importance of whether the children demonstrated the behavior or not depended on the children's interpretation of the observed behavior and the confidence the children had in doing the behavior (Bandura et al., 1961).

Bandura further advanced his research to introduce other concepts. Bandura et al. (1961) provided strong evidence that the observation of other behaviors was an effective means of eliciting the same behavior in a different setting without the need of classical conditioning (e.g., rewards and punishments). Bandura et al. (1963) also developed the concept of vicarious learning by showing that children are likely to imitate aggressive behaviors demonstrated by others when the behavior was rewarded and are less likely to imitate the aggressive behavior when the person was punished. The results of Bandura's studies of exposing children to aggressive behaviors can be generalized to other behaviors, which we now understand as social learning theory, a theory of learning and social behavior.

Social learning theory applies to leaders' influence of employees' occupational safety. Organizational leaders are role models for psychological and physical safety as employees are likely to imitate their leader's behaviors, especially when the leader's behaviors are rewarded. Researchers (Edmondson & Lei, 2014; Hirak, Peng, Carmeli, & Schaubroeck, 2012; Liu, Hu, Li, Wang, & Lin, 2014; Newman et al., 2017; Walumbwa & Schaubroeck, 2009; Yanchus, Derickson, Moore, Bologna, & Osatuke, 2014) argued that leaders who model supportive behaviors (e.g., listening, providing support, providing clear consistent direction) to subordinates showed security in taking risks and engaged in honest communication, which created a climate of psychological safety. Social learning theory explains why a significant relationship may exist between supportive leadership behaviors and psychological safety climate (Newman et al., 2017).

If leaders demonstrate the importance of physical safety through their actions, employees will inherently believe that safety is a priority and demonstrate the appropriate behaviors to stay safe on the job. As shown in the research, leaders directly influence employees' unsafe work behaviors (Zohar, 2002b; Zohar & Luria, 2003), participation in safety programs (Zohar, 1980), compliance with safety rules (Simard & Marchand, 1997), and number of employees' safety incidents (Simard & Marchand, 1994; Zohar, 2002b; Zohar & Luria, 2003). Social learning theory explains the underlying principle for how leaders influence employees' safety attitudes and behaviors in the workplace (Zohar, 2010).

Full Range of Leadership Theory

The major leadership theories for safety leadership are transactional and transformational leadership, which fall within the full range of leadership model. Full range of leadership model described leadership on a continuum combining both transactional and transformational leadership styles (Bass, 1990, 1999; Bass & Avolio, 1994; Northouse, 2010). In the late 20th and early 21st centuries, researchers focused their attention on leadership as a significant factor for organization's safety performance. The research showed that leadership styles have degrees of effectiveness on safety outcomes. Some research on safety leadership (Bass, 1999; Clarke, 2006a, 2013; Hofmann & Morgeson, 1999; Hofmann et al., 2017; Simard & Marchand, 1997; Yule, Flin, Davies, & McKee, 2008; Zohar, 1980) showed that effective safety leaders demonstrated certain leadership styles, characteristics, and behaviors that improved an organization's safety performance. Leaders who use a combination of both transformational leadership and active transactional leadership appear to be the most effective with influencing their employees' safety behaviors and safety performance, depending on the context (Willis, Clarke, & O'Connor, 2017). The combination of leadership styles ensures that employees are engaging in safety behaviors (Clarke, 2013; Zohar, 2002a). Demonstrating specific leadership styles can yield better organizational safety performance. A review of these leadership theories is described in the following section.

Transactional Leadership. Transactional leadership refers to the relationship between leader and employee where the leader and subordinate make exchanges or agreements to meet their own self-interests (Bass, 1990). Transactional leaders identify the actions the employees must take to achieve the outcome by clarifying the roles and task requirements and to fulfill the leader's expectations. The leader clarifies the level of effort required by the employee to receive a reward or punishment. They use rewards and punishment with employees to reinforce current policies and practices within the organization (Bass, 1990, 1999; Bass & Avolio, 1994; Northouse, 2010).

There are several factors of transactional leadership, which include laissez-faire, management by exception (passive), management by exception (active), and contingent reward (Bass, 1990, 1999; Bass & Avolio, 1994; Northouse, 2010). According to Bass (1999), laissez-faire leadership is essentially the absence of leadership. The leader who demonstrates this leadership style does not engage the follower (e.g., takes no responsibility, delays decisions) or does not attempt to help them develop skills. Bass's research explains that management by exception has both a passive and active style. The leader may take an active style by monitoring the employee's performance and taking corrective action if the employee fails to meet the standards required to achieve the outcome. The leader may also take a passive style where the leader intervenes only if standards are not met or may wait for problems to occur before taking corrective action. Contingent reward is a contract between the leader and employee that specifies an exchange of rewards for effort, promises rewards for good performance, and recognizes accomplishments (Bass, 1990, 1999; Bass & Avolio, 1994; Northouse, 2010).

Transformational Leadership. Transformational leadership focuses on improving the follower's performance and developing followers to their fullest potential (Bass, 1990, 1999).

According to Bass's research, leaders who exemplify this style have a strong set of internal values and ideals, and they are effective at motivating followers to behave in a way to support the greater good of the group rather than their own self-interests. This leadership style uses charismatic influence to motivate followers to increase maturity, confidence, and the value placed on outcomes such that they increase efforts to achieve goals of the organization rather than self-interests. The leader influences the employees by being charismatic and inspirational with the employees, meeting the emotional needs of the employees, and stimulating the employees intellectually (Bass, 1990, 1999).

Transformational leaders use four factors - idealized influence, inspirational motivation, intellectual stimulation, and individualized consideration (Bass, 1990, 1999; Bass & Avolio, 1994; Northouse, 2010). According to Bass (1999), idealized influence or charisma is described as leaders who act as strong role models and provide an inspiring vision and sense of mission for employees. They instill pride and gain respect and trust from employees. Bass defines inspirational motivation as communicating high expectations, using symbols to focus employees' efforts, and expressing important purposes in simple ways. Intellectual stimulation inspires followers to try new approaches or innovative ways to solve problems, which promotes thoughtfulness, rationality, and problem solving amongst followers (Bass, 1990, 1999). Individualized consideration provides a supportive climate in which the leader listens to the followers for their needs. The leader acts as a coach or advisor for the followers (Bass, 1990, 1999).

In today's modern business world, leaders must go beyond the practices of self-interest to aligning the employees to the mission, vision, and values of the organization. According to Bass (1999), transformational leaders move the employee beyond their self-interests to concerns of achievement, self-actualization, and the well-being of others, the organization, and society. The leader envisions a desirable future, shares how it can be reached, sets high standards of performance, and shows determination to achieve it (Bass, 1999).

Despite transformational leadership being an effective leadership style, leaders must have the skill to flex between transactional and transformational leadership styles. According to Bass (1999) leaders can use different styles and behaviors given the situation. They must be able to evaluate the situation and determine the most effective leadership behaviors to obtain the most desired outcome or performance from their employees. Full range leadership theory provides a model that explains the varying degrees of leadership styles that influence employees' performance (Bass, 1999; Northouse, 2010).

Safety Climate Theory

Zohar's (1980) original research on safety climate originated as an operational construct or measurement of the shared perceptions of safe conduct in the workplace. With additional research that advanced the understanding of safety climate, Zohar (2008) presented a theoretical framework that described safety climate as a multilevel paradigm. The framework goes beyond the measurement and operational definition and expanded into a full multilevel, more systems-focused model. The framework was a comprehensive and integrated model for occupational safety.

Zohar and Luria (2005) defined safety climate theory as a multilevel analysis interpretation of climate or "a convergent, level-adjusted perceptions or appraisals of relevant policies, procedures, and practices as indicators of desired role behavior" (p. 616). The theory explained that employees understand and interpret the organization's safety climate at the organization level, group level, and individual level, which shaped the individuals' safety behaviors and performance. Safety climate was a social construct that originated from policies and procedures established by top management and executed by supervisor actions. Supervisors' safety leadership behaviors may vary within or between groups, which created distinct organization level and group level safety climates. Studies of organizational safety climate continuously showed distinct group level climates emerged with organizations, which influenced safety performance (Barling, Loughlin, & Kelloway, 2002; Clarke, 2006a, 2006b; Clarke & Ward, 2006; Desai, Roberts, & Ciavarelli, 2006; Griffin & Neal, 2000; Neal & Griffin, 2002, 2006; Zohar, 1980, 2002a, 2002b; Zohar & Luria, 2003, 2005, 2010; Zohar & Polachek, 2014; Zohar & Tenne-Gazit, 2008).

Review of Current Research Literature

Based on the theoretical background, the current literature provides explanations on occupational safety, safety outcomes, psychological safety climate, safety climate, and safety leadership.

Occupational Safety Historical Research

Early psychological research on occupational safety focused on the role of individual differences (e.g., general cognitive abilities, personality traits) and later included how modifying aspects of the worker's environment (e.g., hours of work, rest, exposure to hazards) contributed to accidents, injuries, illness, and death. Advancements in the study of occupational safety continued to evolve over the last 100 years (Hofmann et al., 2017; Lee et al., 2018). Later in the 20th century, researchers recognized that a broader organizational context influences safety performance. General organizational factors that impact safety performance are job demands, safety leadership practices, and overall commitment to safety. The research on occupational safety further evolved to study the interconnections between the worker and the worker's environment. This holistic view led to studies on how the immediate supervisor, workgroup, selection, and training may prevent safety accidents (Hofmann et al., 2017). Job demands on workers included the range of physical and cognitive demands such as scheduling, workload, physically-performed work and its complexity (Barling et al., 2002). Leadership includes the way workers are managed by their supervisors, such as leadership style, relationship, accountability, and trust with the worker (Fogarty, 2004; Hofmann, Morgeson, & Gerras, 2003).

This literature review will focus on how employees' perception of their supervisor's leadership behavior influences psychological safety climate and safety climates and the effect on their participation in safety programs (i.e., safety observation, safety recognition) and number of safety incidents and fatalities.

Safety Outcomes

For organizations to determine their level of safety, they use measurements of safety outcomes (Blair, 2017; Krause, 2005). Safety outcomes are any measurement or variable related to safety, such as safety performance (i.e., injuries and illness incidents, and close calls) or safety behaviors (i.e., safety participation, safety compliance). Both Blair (2017) and Krause (2005) explain two types of safety metrics used across industries – leading and lagging indicators. Lagging indicators are traditional measures of safety or typically measures of the lack of safety (i.e., safety performance), while leading indicators (i.e., safety behaviors) send messages to employees that certain actions or behaviors are important and are likely to prevent accidents from occurring. Most organizations have a combination between leading and lagging indicators to accurately measure safety in the workplace (Blair, 2017; Krause, 2005).

Safety Performance. Safety performance is a multi-dimensional construct (Blair, 2017; Christian et al., 2009; Clarke, 2006a; Neal & Griffin, 2006), which includes incidents (i.e., injuries, illness) and close calls. Injuries and illnesses are classified into OSHA recordables or a work-related injury or illness that results in: death; days away from work, restricted work or transfer to another job, medical treatment beyond first aid, loss of consciousness; or a significant injury or illness diagnosed by a physician or other licensed health care professional. OSHA recordable rates are calculated using the number of injuries or illnesses, lost time away, and severity rates (OSHA, 2018).

Some researchers argue that the reduction in incident rates provides the best measure of safety performance (Chenhall, 2010). Incident rates tend to be used as a primary measure of safety performance because the rates provide a measurement of an organization's safety management. The incident rates also provide a benchmark by which companies can compare the effectiveness of their safety management with other organizations. In studies that measure safety performance, the minimum criteria for injuries have ranged from including nearly all injuries, such as slips and trips to only those that required at least first aid treatment (Christian et al., 2009; Hofmann & Stetzer, 1996) or time off work (Neal & Griffin, 2006). Christian et al. (2009) recommends including close calls (i.e., microaccidents) and first aid along with incidents to accurately measure safety performance.

Despite the usefulness of measuring incident rates, not all researchers find the measurement beneficial and often find the use of this measurement as inaccurate and counterproductive to safety efforts. Research showed that employees do not report incidents when they are being measured by safety performance (Christian et al., 2009; Probst, 2015). Some organizations reward and compensate employees who are safe on the job, so employees are unlikely to report incidents. Rather than be proactive, organizations that focus on incident rates as a measure of safety performance tend to be reactive in their approach to safety. Unfortunately, this tends to result in management's attention and resources only when accident rates rise. In most cases when problems appear to be resolved, management's attention and resources are diverted to other pressing organizational issues. Incident rates are not always an accurate measure for overall safety performance (Chenhall, 2010).

Safety Behavior. Organizations must use strategic safety measures, which are preventative, predictive, and prescriptive to positively influence safety in the workplace (Blair, 2017). Safety behavior may be defined as the way a person acts or conducts oneself related to preventing injuries in the workplace. Safety behavior is divided into two types – safety compliance and safety participation (Griffin & Neal, 2000). Safety compliance is when employees perform required behaviors that maintain a minimum level of workplace safety, such as following safety policies, rules, and procedures, wearing personal protective equipment. Safety participation is when employees demonstrate behaviors that help to create a safety work environment, such as helping coworkers with safety and participating in workplace safety programs (Clarke & Ward, 2006; Griffin & Neal, 2000; Neal & Griffin, 2006; Zahoor et al., 2017).

Researchers suggested that leading indicators (i.e., safety behaviors) are better measures of safety in the workplace than lagging indicators (i.e., safety performance), as they were more effective at the prevention, prediction, and prescription of safety incidents (Blair, 2017; Christian et al., 2009; Clarke, 2006a; Neal & Griffin, 2006). Also, implementing leading indicators (i.e., safety behaviors) in organizations increased employees' awareness of safety (Blair, 2017; Tsao, Hsieh, & Chen, 2017).

Psychological Safety Climate

Psychological safety climate originated in the publication by Schein and Bennis (1965) on organizational change. The researcher described the concept as the extent to which individuals feel secure and confident in their ability to manage change. They argued that psychological safety was essential for making people feel secure and capable of changing their behavior in response to shifting organizational challenges (Schein & Bennis, 1965).

Since the original publication a half-century later, other researchers explored the effect of psychological safety in the workplace. In a publication by Kahn (1990), he reintroduced the concept in a qualitative study exploring conditions at work in which people personally engage or disengage in work role performance. Kahn (1990) defined psychological safety as “the experience of feeling able to show and employ one’s self without fear of negative consequences to self-image, status, or career” (p. 708). Later Edmondson (1999) argued that psychological safety is better treated at the group level climate and measured as a shared construct instead of individuals’ perceptions. Edmondson (1999) defined psychological safety as the “shared belief held by members of a team that the team is safe for interpersonal risk taking” (p. 350). Additional research explored psychological safety at the organizational level (Baer & Frese, 2003; Carmeli, 2007). Baer and Frese (2003) defined psychological safety at the organizational climate level as “formal and informal organizational practices and procedures guiding and supporting open and trustful interactions within the work environment where employees are safe to speak up without being rejected or punished” (p. 50).

Psychological safety evolved from an individual level concept into a multilevel framework and the literature supported psychological safety as a multilevel construct (Edmondson & Lei, 2014; Newman et al., 2017), which varies across organizations and teams within organizations (Edmondson & Mogelof, 2006). Psychological safety has an important role in workplace performance (Baer & Frese, 2003; Edmondson, 1999, 2019; Leroy et al., 2012; Newman et al., 2017; Ortega, Van den Bossche, Sánchez-manzanares, Rico, & Gil, 2014) at the individual, group, and organizational levels (Edmondson & Lei, 2014; Newman et al., 2017).

Safety Climate

Safety climate originated in a publication of Zohar's (1980) paper where he defined the concept of safety climate, expanding on the organizational climate research from Schneider (1975). Safety climate is one of the types of climate that can be experienced and perceived by individuals within an organization. Zohar (1980) defined the concept, offered a measurement questionnaire, and empirically supported the questionnaire's validity. The study combined the research on organizational climate (Schneider, 1975) with the understanding of occupational safety. Zohar (1980) defined safety climate as "shared employee perceptions about the relative importance of safe conduct in their occupational behavior" (p. 96). The shared perceptions from employees are based upon an understanding that safety is a priority above other competing priorities. Safety climate perceptions emerge from ongoing social interactions where employees share personal experiences, usually influenced from leadership's commitment to employees' health and safety (Hofmann et al., 2017).

Safety climate originated only as an organizational level measurement analysis (Zohar, 1980) and evolved into a multilevel model framework (Zohar, 2002a; Zohar & Luria, 2003, 2004, 2005). Today, research supports safety climate as a theoretical framework (Hofmann et al., 2017; Zohar, 2008, 2010), where an individual's perception of individual level safety climate (Christian et al., 2009; Hofmann & Stetzer, 1996; Hofmann et al., 2003; Zohar & Luria, 2005), group level safety climate (Neal & Griffin, 2006; Zohar, 2008; Zohar & Luria, 2005, 2010), and organizational level safety climate (Tsao et al., 2017; Zohar, 1980) predicted individual outcomes of safety performance. The multilevel safety climate model is based on employees' shared perceptions of the organization's safety policies, procedures, and practices and the perceptions within their workgroups of their supervisor's actions to implement the safety policies, procedures, and practices (Zohar, 2008; Zohar & Luria, 2005, 2010). Safety climate contains a number of factors, such as perception of managerial commitment (Christian et al., 2009; Hofmann & Stetzer, 1996; Zohar, 1980), employee's involvement in safety (Neal & Griffin, 2006; Zahoor et al., 2017), safety communication, safety training, safety systems and procedures, and employees' attitude to safety and risk (Zahoor et al., 2017).

Safety Leadership

Despite occupational safety being researched for over 100 years (Hofmann et al., 2017), the influence of leadership on safety performance has been researched more frequently within the last twenty years. There are many contributing factors that lead to safety performance, but a significant factor contributing to safety performance is leadership (Christian et al., 2009; Krause, 2005; Lundell & Marcham, 2018; Probst, 2015; Simard & Marchand, 1997; Tucker, S., Ogunfowora, & Ehr, 2016; Willis et al., 2017; Zohar, 2002b; Zohar & Luria, 2003, 2010). Today, there is common understanding in the research that effective safety leaders can reduce or prevent safety incidents or fatalities (Bass, 1999; Clarke, 2006a, 2013; Hofmann et al., 2017; Krause, 2005; Yule et al., 2008; Zohar & Luria, 2004, 2010; Zohar & Polachek, 2014). When organizational leaders actively promote safety, organizations have better safety records, higher safety performance, and more positive safety outcomes (Hofmann et al., 2017; Tucker, S. et al., 2016). Organizational leaders have an important role in influencing employees' safety attitudes and behaviors in the workplace and the organization's safety performance. Their actions and decisions influence employees' perception of safety within the organization.

Leaders at each level of the organization play a critical role in influencing the safety climates, behaviors of employees, and the organization's safety performance (Roger & Flin, 2011; Schaubroeck et al., 2012; Tucker, S. et al., 2016). Senior-level leaders are responsible for the safety performance for the organization. Safety leadership starts at the highest level of leadership within an organization. The chief executive officer (CEO) or president directly influences the safety leadership orientation of the executive leadership team, which share and influence the safety leadership behaviors of their subsequent department leadership team. The CEO or president directly influences the safety climate amongst the executive leadership team and influences the safety climate throughout the organization (Roger & Flin, 2011; Tucker, S. et al., 2016). Together the executive leadership team fosters a broader, stronger safety culture within their organization. A safety-oriented executive leadership team positively influences the supervisors' perception of the broader organizational safety climate, which influences frontline employees' support for safety at the group level and fewer employee injuries at the individual level (Tucker, S. et al., 2016).

Senior leadership behaviors directly influence their mid-level leaders' participation and involvement in safety initiatives and indirectly influence employees' safety behaviors and performance (Roger & Flin, 2011; Simard & Marchand, 1997). Mid-level leaders can leverage their unique position in the organization to most effectively influence safety climate (Zohar, 1980). They have a role in the strategic activities as defined by their senior leaders to engage with employees completing daily routines; however, mid-level leaders' influence on the organization and employees' safety performance is not well understood (Gutberg & Whitney, 2017).

Subsequently, first-line leaders directly influence employees' safety behaviors and performance. First-line leaders influence the number of unsafe employee work behaviors (Zohar, 2002b; Zohar & Luria, 2003), employees' participation in safety programs (Zohar, 1980), employees' compliance with safety rules (Simard & Marchand, 1997), and number of employees' safety incidents (Simard & Marchand, 1994; Zohar, 2002b; Zohar & Luria, 2003).

In addition to the level of leadership, leadership styles have varying degrees of effectiveness in influencing safety and demonstrate certain characteristics and behaviors that improves an organization's safety performance (Bass, 1999; Clarke, 2006a, 2013; Hofmann & Morgeson, 1999; Hofmann et al., 2017; Kelloway et al., 2006; Lundell & Marcham, 2018; Mullen, Kelloway, & Teed, 2011; Simard & Marchand, 1997; Yule et al., 2008; Zohar, 1980, 2002b). Effective safety leaders reinforce employees' safety behaviors that reduce or prevent safety incidents. The review of the leadership theories (i.e., transactional, transformational) in the following section describes varying degrees of success with influencing employee's safety behaviors and how they relate to safety performance.

Transactional Leadership. Leaders with a transactional safety leadership style identify the safety policies, rules, and procedures the employees must follow to prevent safety incidents. An example of transactional leadership is being directive and placing expectations on leaders to set an example and have strict policies on safety. The leader may clarify the safety behaviors and job task requirements, such as wearing personal protective equipment to understand the amount of discretionary effort to fulfill the leader's expectations. Transactional leadership has several factors that show varying degrees of effectiveness with safety performance (Clarke, 2013; Clarke

& Ward, 2006; Probst, 2015; Kelloway et al., 2006). Passive transactional leadership style is ineffective with safety performance (Clarke, 2013; Kelloway et al., 2006; Mullen et al., 2011), while active transactional leadership can be effective with safety performance depending on the context (Willis et al., 2017). The sections below describe the variations of transactional leadership and the effectiveness with safety performance.

***Management by Exception (Passive)*.** Passive transactional leadership style negatively influences employees' safety behaviors. Leaders that fail to intervene until safety incidents occur have employees with higher number of injuries (Kelloway et al., 2006), lower number of safety compliance behaviors, and lower participation in safety-related behaviors (Clarke, 2013). Employees are out of compliance with safety rules, regulations, and behaviors (Mullen et al., 2011).

Leaders with a passive transactional leadership style demonstrate negative effects on workplace safety climate. There are inconsistent findings on whether passive transactional leadership predicts safety climate (Kelloway et al., 2006; Mullen et al., 2011; Yule et al., 2008). Passive transactional leadership does not create a safety climate within organizations (Yule et al., 2008) or negatively impacts an existing safety climate (Kelloway et al., 2006) in which employees are likely to have a higher number of safety incidents and reduces the organization's safety performance (Kelloway et al., 2006). Passive transactional leadership is ineffective in influencing employees' safety mindset and behaviors and has a negative impact on the organization's safety performance.

***Management by Exception (Active)*.** Leaders with an active transactional leadership style can be effective with employees' safety behaviors by monitoring employees and intervening if they are not following safety policies, rules, and procedures. Leaders with an active transactional leadership style take corrective action when employees are not following the organization's safety standards (Clarke, 2006a, 2013; Probst, 2015; Willis et al., 2017; Yule et al., 2008).

There are inconsistent findings on whether active transactional leadership creates a safety climate within organizations. Several findings state that a safety climate must exist already to influence employees to participate in safety (Clarke & Ward, 2006; Yule et al., 2008). When there is an existing safety climate, leaders with an active transactional leadership style may encourage employees to participate in safety by using a combination of influencing tactics. Leaders can use rational arguments, involve employees in safety decisions, and generate enthusiasm for safety to influence employees to participate in safety (Clarke & Ward, 2006). Also, active transactional leadership may strengthen perceived safety climate (Clarke, 2013), as it has a significant relationship with influencing employees to follow safety rules and regulations and participate in safety (Clarke, 2013; Probst, 2015).

Contingent Reward. Safety leadership behavior of contingent rewards is an agreement that the leader will reward an employee for following safety policies, rules, and procedures. First-line leaders who reward employees for safe behaviors decrease employee unsafe work behaviors and injuries and increase safety climate (Luria, Zohar, & Erev, 2008; Yule et al., 2008; Zohar, 2002b; Zohar & Luria, 2003). Leaders that provide personal feedback during safety-related interactions with employees communicate the importance of safety and reinforce safety behaviors.

Transformational Leadership. Leaders who are charismatic and inspirational with the employees, meet the emotional needs of the employees, and stimulate the employees intellectually are most effective with safety outcomes (Mullen et al., 2011) and decrease injury rates (Mullen & Kelloway, 2009). Transformational leadership promotes employee perceptions that safety is highly valued, motivates employees to follow safety standards, and encourages employee engagement with safety activities (Clarke & Ward, 2006; Mirza & Isha, 2017). Transformational leaders are effective in influencing employees' safety participation and safety compliance – following safety policies, rules, and procedures (Clarke & Ward, 2006; Mullen et al., 2011; Simard & Marchand, 1997) and reducing occupational injuries in the workplace (Barling et al., 2002). Leaders with high transformational leadership are more consistent than leaders with low transformational leadership across a range of scenarios when prioritizing safety (Zohar & Luria, 2004) and they buffer the effects of poor safety climate (Zohar & Luria, 2010).

Leaders must have genuine, trusting relationships with their employees and continuously promote the importance of safety to improve safety performance and reduce injuries in the workplace. Employees' level of trust in management can enhance a leader's influence on employee's safety performance (Clarke, 2013; Clarke & Ward, 2006; Conchie & Donald, 2009; Conchie, Donald, & Taylor, 2006; Conchie, Taylor, & Donald, 2012; Kelloway, Turner, Barling, & Loughlin, 2012). When there is mutual trust between the employee and the leader, the employee will engage in behaviors that contribute to safety performance, including safety behaviors and participation (Clarke, 2013; Clarke & Ward, 2006). Leaders that create a trusting, caring relationship with their employees increase the safety behaviors of their employees and improve safety performance (Barling et al., 2002; Conchie & Donald, 2009; Conchie et al., 2006; Conchie et al., 2012). Employees who believe that their leader cares and is concerned for their safety will be more likely to be proactive in sharing the importance of safety and speak up relating to safety concerns (Conchie et al., 2012).

Safety Transactional Versus Transformational Leadership. The research between safety transactional and safety transformational leadership effectiveness on safety outcomes is unclear. Some research shows that employees' perceived safety climate is stronger under active transactional leadership than under transformational leadership (Clarke, 2013), while other research shows that employees' perceived safety climate is stronger under transformational leadership than under passive transactional leadership (Kelloway et al., 2006). In addition, some research shows that safety transformational leadership predicts both safety participation and safety compliance uniquely over passive leadership (Mullen et al., 2011), while other research shows that passive transactional leadership contributes incrementally to the prediction of safety-related outcomes, such as predicting safety events and predicting injuries over transformational leadership (Kelloway et al., 2006). Active transactional leadership can strengthen a safety climate. Although passive transactional leadership does not have a relationship with safety climate (Yule et al., 2008), other research states that active transactional leadership has a positive association with perceived safety climate above the effect of transformational leadership to ensure employees are in compliance with safety rules and regulations (Clarke, 2013).

The existing leadership research is unclear due to not fully understanding the role of context in shaping leadership effectiveness. Understanding context may uncover the complexities of leadership influence on safety outcomes. Transformational and active transactional leadership are both effective at influencing safety outcomes, safety behaviors and safety performance, depending on the context (Willis et al., 2017). Willis et al. (2017) explored how employees' perception of hazard exposure and accident likelihood may moderate the relationship between transformational leadership and active transactional leadership with safety behaviors, safety participation, and safety compliance. Active transactional leadership was strongly linked to safety performance if accident likelihood was high, but not under low accident likelihood conditions. Transformational leadership was less strongly related to safety behaviors when safety was perceived as highly critical. Team-level hazard exposure did not influence the relationships between active transformational leadership and transformational leadership with safety behaviors, safety participation, and safety compliance (Willis et al., 2017).

Transformational and transactional leadership are not mutually exclusive to influence safety outcomes. A combination of both transformational leadership and active transactional leadership appear to be the most beneficial for safety performance. The combination of leadership styles ensures that employees are engaging in safety behaviors (Clarke, 2013; Zohar, 2002a). Active transactional leadership has incremental effects on safety outcomes beyond transformational leadership (Kelloway et al., 2006; Krause, 2005). Other research shows that having either transformational or active transactional leadership styles do not have a significant difference on safety participation amongst employees (Clarke & Ward, 2006; Zohar, 2002a); leaders appear to have an influence on employee’s safety participation regardless of either leadership style. Coalition tactics, rational persuasion, and consultation appear to influence safety participation directly, while inspirational appeals and consultation appear to influence safety participation indirectly; therefore, transformational and active transactional leadership styles do not differentiate between safety participation amongst employees.

Despite research showing that a combination of leadership styles can be effective, leaders should avoid inconsistent leadership styles. Inconsistent leadership is defined as when the leader inconsistently demonstrates the importance of safety by the presence or absence of their behaviors. Research shows that inconsistent leadership styles with both transformational leadership and passive transactional leadership negatively predicts both safety participation and safety compliance (Mullen et al., 2011).

Leadership and Psychological Safety Climate

Leaders have a significant influence on the psychological safety, or employee's ability to employ one's self without fear of negative consequences to self-image, status, or career (Kahn, 1990). Above other factors, a leader's behavior contributes to an individual's perception of psychological safety in the workplace (Carmeli, Reiter-Palmon, & Ziv, 2010; Detert & Burris, 2007; Edmondson, 1999; Lundell & Marcham, 2018; Newman et al., 2017).

Leadership styles have varying degrees of effectiveness with creating a psychologically safe climate or positive work environment. Active transactional leadership and lasses-faire leadership negatively affected employee psychological well-being (Kelloway et al., 2012; Lundell & Marcham, 2018). Other research found that positive leadership styles such as transformational leadership (Nemanich & Vera, 2009), ethical leadership (Walumbwa & Schaubroeck, 2009), change-oriented leadership (Ortega et al., 2014), shared leadership (Liu et al., 2014), and inclusive leadership (Carmeli et al., 2010) are positively related to employee outcomes, such as employee voice behavior, team learning, and individual learning through mediation of psychological safety climate (Newman et al., 2017).

Research at the individual and group level examined the effects of supportive leadership behaviors on work outcomes through psychological safety climate. At the individual level, research showed that leader inclusiveness (Carmeli et al., 2010), support (May, Gilson, & Harter, 2004), interpersonal communication (Siemsen, Roth, Balasubramanian, & Anand, 2009; Yanchus et al., 2014), trustworthiness (Madjar & Ortiz-Walters, 2009), openness (Detert & Burris, 2007), and behavioral integrity (Palanski & Vogelgesang, 2011) strongly influence an individual's perception of psychological safety climate, which influences employee workplace outcomes, such as voice behaviors, creativity, job performance, engagement, and safety.

Similarly at the group level, employees shared perceptions of their leaders' support and coaching (Edmondson, 1999), inclusiveness (Hirak et al., 2012), trust (Schaubroeck et al., 2012), and the behavioral integrity (Leroy et al., 2012) have found to improve group level outcomes, such as learning behavior, team performance, engagement in continuous improvement work, and reduction in errors through psychological safety climate.

Although, employees' psychological safety at the individual, group, and organizational levels impact performance (Edmondson & Lei, 2014; Newman et al., 2017), an individual's experience with his or her leader is predictive of an employee's well-being rather than shared perceptions of the leader (Kelloway et al., 2012). Specifically, leaders who have high quality interpersonal relationships with employees play an integral role in promoting psychological safety; leaders who communicate more frequently and listen to employees' concerns and ideas create a more psychologically safe work environment (Siemsen et al., 2009; Yanchus et al., 2014). Leaders who encourage innovative thinking, explain the need for change, envision change, and take personal risk model behaviors that are acceptable and promote a psychological safe work environment for employees (Ortega et al., 2014).

Leadership, Psychological Safety Climate, and Safety Performance

Psychological safety is critical in work environments where employees' safety is a priority. Psychological safety has shown to reduce employees' errors and enhance safety (Fogarty, 2004; Leroy et al., 2012) and been shown to increase individual, team and organizational performance (Newman et al., 2017; Ortega et al., 2014). Ortega et al. (2014) found that psychological safety climate mediates the relationship between change leaders and team performance. Change leaders encourage innovative thinking, envision change, take personal risks, and facilitate the open discussion of errors and solutions (Ortega et al., 2014).

The mental or psychological state of an employee can impact their job performance or increase the risk associated with having an incident (Fogarty, 2004; Lundell & Marcham, 2018; Oliver, Cheyne, Tomás, & Cox, 2002; Tomás, Cheyne, & Oliver, 2011). Incident reports often place the root cause of accidents on human error. Tomás et al. (2011) found a direct relationship between work environment and accidents. Employees make errors or mistakes when they are not focused or able to function properly while performing their job duties, which lead to serious incidents, injuries or even fatalities. Employees who feel psychologically safe are more likely to speak up and provide feedback to reduce errors and improve safety (Newman et al., 2017). Leroy et al. (2012) found that psychological safety climate mediated the relationship between leader's consistency in their words and employees' actions with reporting errors. Other research showed that employees' perceptions of their work environment predicted accidents on the job (Clarke, 2006b; Oliver et al., 2002; Tomás et al., 2011) and unsafe behavior (Clarke, 2006b; Hofmann & Stetzer, 1996).

Although psychological safety climate is related to reporting errors and accidents, it is not enough to impact safety performance. There are several additional factors that contribute to safety performance, including how employees perceive their leader's safety leadership behaviors or perceived safety climate (Griffin & Neal, 2000; Neal & Griffin, 2002, 2006).

Leadership and Safety Climate

Leadership is one factor that contributes to the safety climate within an organization. The research shows that leadership influences the organization's safety climate (Barling et al., 2002; Bian et al., 2019; Brown & Holmes, 1986; Christian et al., 2009; Clarke, 2006a; Griffin & Neal, 2000; Gutberg & Whitney, 2017; Lundell & Marcham, 2018; Neal & Griffin, 2002, 2006; Roger & Flin, 2011; Squires, Tourangeau, Laschinger, & Doran, 2010; Tucker, S. et al., 2016; Yule et al., 2008; Zohar, 1980; Zohar & Polachek, 2014). The research established a strong and consistent relationship between employee perceptions of safety and safety performance (Beus, Payne, Bergman, & Arthur, 2010; Zohar & Luria, 2005, 2010). Employees' perception of their leader's commitment and attitude towards safety is important for understanding the organization's safety climate and influence on employees' safety behaviors (Zohar, 1980). The perception of a leader's commitment to safety has the strongest association with and is the most robust predictor for employee injuries than any other safety climate dimension (Christian et al., 2009; Hofmann & Stetzer, 1996; Loushine, Hoonakker, Carayon, & Smith, 2004; Oliver et al., 2002) and is the only dimension where the validity can be generalized (Beus et al., 2010). Other research (Bian et al., 2019; Hansez & Chmiel, 2010; Neal & Griffin, 2002; Tsao et al., 2017; Zohar, 1980; Zohar & Polachek, 2014) shows that management commitment to safety is a significant predictor to safety climate and performance. Employees evaluate their leader's values by observing where the leaders spend their time and the decisions they make related to safety (Roger & Flin, 2011). A supervisor's support for safety shows up in how they communicate, encourage, and support employees in safety situations (Christian et al., 2009; DeJoy, Schaffer, Wilson, Vandenberg, & Butts, 2004; Michael, Guo, Wiedenbeck, & Ray, 2006). If employees' perceptions of their leader's safety practices are positive, then we can conclude that a leader's safety practices are impactful to the employees' safety performance.

Leaders also influence the level of agreement between members' climate perceptions, i.e., climate strength (Zohar & Luria, 2004, 2010; Zohar & Tenne-Gazit, 2008). Zohar and Luria (2004) found that the strength of an organization's safety climate is dependent on the consistency or shared perception by individuals. The more consistent the leaders apply and reinforce the safety policies, procedures, and practices within an organization, the stronger the safety climate.

For example, consistent, clear actions by supervisors regarding safety policies, procedures, and practices resulted in strong safety climates (Zohar & Luria, 2004). In addition, supervisors with an immediate boss who emphasized implementation of formal safety procedures were more diligent with safety than supervisors whose boss did not emphasize safety. Supervisors implemented safety policies at their discretion; therefore, the supervisors' perception of their bosses had an influence on the supervisors' consistency in implementing safety policies (Zohar, 2002a).

Zohar and Luria (2005) expanded on the research to show that supervisors with inconsistent safety actions resulted in variation amongst their employees' perception of safety climate at the group and individual level. This isomorphic replication at different levels of the organization resulted in lower safety climate strength. The safety policies, procedures, and practices are open to interpretation and implementation from the front-line supervisors, which creates variation across different groups to create group level safety climates. The individual perceptions from employees on how the safety policies, procedures, and practices are demonstrated resulted in individual difference within workgroups on the safety climate (Zohar & Luria, 2005).

Leadership does not predict occupational injuries directly (Michael et al., 2006); however, leadership can predict occupational injuries through distal measures such as the effects of safety climate (Barling et al., 2002; Zohar, 2002a). Also, leaders have a positive influence on employees' safety behaviors and safety performance when the organizational safety climate is strong (Barling et al., 2002; Bian et al., 2019). Bian et al. (2019) found that safety climate mediated the impact of transactional leadership on employee safety behavior. The next section expands on the relationship between safety climate and safety performance with a distal measure of safety participation.

Safety Climate, Participation, Compliance, and Performance

Significant amount of research supports the relationship between organizational safety climate on safety outcomes (Clarke, 2006a; Griffin & Neal, 2000; Hofmann & Stetzer, 1996; Neal & Griffin, 2002, 2006; Zahoor et al., 2017). Organizational members' perceptions on safety climate serve as situational cues for the expected relationship between safety behaviors and outcomes (Jiang, Lavaysse, & Probst, 2019; Lee et al., 2018) and employees' perception of safety climate are a reliable predictor of safety incidents (Ajslev et al., 2018; Christian et al., 2009; Hofmann & Morgeson, 1999; Zohar, 2002a, 2010). However, there are inconsistent results in the research as a meta-analysis conducted by Jiang et al. (2019) yielded a significant impact of safety climate on safety behavior but not on accidents and injuries.

Research supports an indirect relationship between safety climate and performance (Clarke, 2006b; Fogarty, 2004; Zahoor et al., 2017). Griffin and Neal (2000) made an important finding in understanding the relationship between safety climate and safety performance through safety participation. Griffin and Neal (2000) support a mediational model of safety climate, as there was not a direct path from higher order safety climate factors to safety performance measures. Griffin and Neal (2000) found that safety climate has an influence on safety performance through both safety participation and safety compliance. The study provided the framework to further investigate the impact of employee perceptions of safety on employee safety behaviors and organizational safety outcomes. Safety climate can predict safety incidents, but through more distal measures, such as safety behaviors, i.e., safety participation, safety compliance (Clarke, 2006a, 2010; Kessler, Lucianetti, Pindek, & Spector, 2015; Neal & Griffin,

2006) and individual attitudes on safety (Tomás et al., 2011). Clarke (2006a) found that the relationship between safety participation and safety compliance with occupational accidents and injuries were valid and generalizable. Kessler et al. (2015) conducted a cross-sectional study and found that safety compliance was associated with fewer accidents at the group level but not the individual level. Safety compliance may be better understood at the group level, not the individual level.

There were inconsistent findings on whether safety climate had a stronger impact on safety participation or safety compliance. Majority of the research showed safety climate having a stronger positive relationship with safety participation as compared to safety compliance (Christian et al., 2009; Clarke, 2006a; Griffin & Neal, 2000); however, Zahoor et al. (2017) showed that safety compliance has a stronger positive relationship with safety climate.

Research demonstrates a strong linkage between safety climate and participation in safety programs (Avci & Yayli, 2014; Clarke, 2006a). Hofmann and Stetzer (1996) conclude that when teams perceive a strong safety climate (e.g., strong management commitment to safety) then they take personal ownership in safety activities and engage in fewer unsafe behaviors. Additionally, Neal and Griffin (2006) found that employees who believe safety is important are more likely to demonstrate safety behaviors and contribute to the broader safety climate. Also, safety climate predicted safety participation over time, but had lagged effects. Adequate time must be given to measure the impacts of safety climate of at least two years (Ajslev et al., 2018; Neal & Griffin, 2006).

In addition to safety leadership and perception of safety, employees and their peers influence each other relating to safety behaviors. Peer influence on safety behaviors and performance is complex and needs to be further understood as the research is unclear. The individuals may be more influenced by colleagues in their immediate environment with whom they have more frequent interactions (Fugas, Meliá, & Silva, 2011). Additional studies found that reinforcement of safety behaviors from either the leader or other employees showed to have increased perceptions of importance of safety, safety climate, safety behaviors, or safety outcomes (Luria et al., 2008; Sparer et al., 2016; Zohar, 2002b; Zohar & Luria, 2003).

Leadership, Psychological Safety Climate, Safety Climate, and Safety Performance

Safety climate is directly related to a safe and healthy work environment. Leaders who display negative leadership behaviors toward employees' create a toxic work environment where employees feel fear of negative consequences or retaliation against their self-image, status, or career. Leaders that display negative behaviors can degrade the safety climate and safety within any organization (Webster, Brough, & Daly, 2016). A workplace environment that is toxic and allows leaders to bully employees can lead to presenteeism or when employees are present physically, but due to psychological conditions, are not focused or able to function properly on the job. The feeling of presenteeism may lead to injuries or fatalities while in hazardous working conditions or while performing work in high safety risk conditions (Lundell & Marcham, 2018).

Psychological safety and health indirectly influence the effect of safety climate on human errors (Fogarty, 2004) and accidents (Oliver et al., 2002). Employees who have a low perceived psychological safety are less likely to speak up about safety concerns, which does not allow safety risks to be mitigated. Psychological safety is important for high hazardous work conditions where speaking up and providing feedback is imperative in reducing errors and improving safety performance (Newman et al., 2017). Leaders must create and promote a healthy work environment where employees feel comfortable bringing safety concerns to the attention of their leaders. Researcher (Edmondson & Lei, 2014; Kahn, 1990; Newman et al., 2017) found that psychological safety promotes personal engagement where people feel they can speak up or participate without the fear of retaliation. When employees report safety concerns, supervisors and employees can address the root causes of safety problems to prevent future incidents (Probst, 2015).

Employees who have close relationships with their leaders are likely to have fewer safety-related incidents and lower levels of accidents (Hofmann & Morgeson, 1999; Hofmann et al., 2003; Hofmann et al., 2017; Michael et al., 2006). Leaders that have ongoing exchanges with employees exert a significant effect on improving employee safety performance, safety behaviors and reducing injuries (Luria et al., 2008; Zohar, 2002b; Zohar & Luria, 2003).

Evaluation of Research Literature

A significant amount of research shows that leadership influences the organization's safety climate (Barling et al., 2002; Bian et al., 2019; Brown & Holmes, 1986; Clarke, 2006a; Griffin & Neal, 2000; Gutberg & Whitney, 2017; Neal & Griffin, 2002, 2006; Roger & Flin, 2011; Squires et al., 2010; Tucker, S. et al., 2016; Yule et al., 2008; Zohar, 1980; Zohar & Polachek, 2014) and establishes a strong and consistent relationship between employee perceptions of safety and safety performance (Beus et al., 2010; Zohar & Luria, 2005, 2010); however, the different leadership styles have varying degrees of effectiveness in influencing safety outcomes and improving organizations' safety performance (Bass, 1999; Clarke, 2006a, 2013; Hofmann & Morgeson, 1999; Hofmann et al., 2017; Kelloway et al., 2006; Mullen et al., 2011; Simard & Marchand, 1997; Yule et al., 2008; Zohar, 1980, 2002b). There are inconsistent findings in the safety leadership research on which leadership style or characteristics has a stronger impact on safety climate, behaviors, and performance. Some researchers (Christian et al., 2009; Cooper, 2015) recommend focusing on behaviors instead of leadership style and recommend focusing on general leadership (Kark, Katz-Navon, & Delegach, 2015) instead of safety-specific leadership, which will allow leaders the opportunity to change specific leadership behaviors to increase safety performance. This study will explore and further clarify how different general leadership competencies and behaviors influence safety climate, behaviors, and performance.

In the research literature, there is a lack of safety climate intervention studies to improve occupational safety in organizations (Lee et al., 2018; Zohar & Polachek, 2014). As a result of Lee et al. (2018) review of safety climate study interventions, they identified trends to indicate a primary emphasis on organizational and managerial aspects of the job. Employees' perception of their leader's commitment to safety has the strongest association with and is the most robust predictor for employee injuries than any other safety climate dimension (Christian et al., 2009; Hofmann & Stetzer, 1996; Loushine et al., 2004; Oliver et al., 2002) and is the only dimension where the validity can be generalized (Beus et al., 2010). Other research (Hansez & Chmiel, 2010; Neal & Griffin, 2002; Tsao et al., 2017; Zohar, 1980; Zohar & Polachek, 2014) shows that management commitment to safety is a significant predictor of safety climate and performance. Safety intervention programs that engaged leaders and employees to communicate on safety showed an increase in perception from employees on safety climate, importance of safety (Donahue, Miller, Smith, Dykes, & Fitzpatrick, 2011; Kines et al., 2010; Sparer et al., 2016; Zohar & Polachek, 2014), and safety performance (Fernández-Muñiz et al., 2009). This study will further explore how safety climate interventions can improve occupational safety in organizations by understanding how employees' perception of their manager's leadership capability and commitment to safety may influence their participation in safety programs and safety performance to decrease safety incidents and fatalities.

Also, Lee et al. (2018) recommended enhancing the research with safety behavior modification programs with participation from both leaders and employees to reduce workplace accidents. Safety programs engage leaders and employees in safety practices, which promote a safer workplace. Employees are the key stakeholders with safety climate intervention efforts, because they are exposed to occupational risks and hazards and can benefit the most from improved safety climate. In this study, the safety program interventions include participation from both the employees and leaders to address the recommendation from Lee et al. (2018).

From the research literature, safety climate can predict safety incidents, but through more distal measures, such as safety behaviors, safety participation and safety compliance (Clarke, 2006a, 2010; Neal & Griffin, 2006). Even though there were inconsistent findings on whether safety climate had a stronger impact on safety participation or safety compliance, the majority of the research showed safety climate having a stronger positive relationship with safety participation as compared to safety compliance (Christian et al., 2009; Clarke, 2006a; Griffin & Neal, 2000). Other research (Avci & Yayli, 2014; Clarke, 2006a) demonstrates a strong linkage between safety climate and participation in safety programs. Clarke (2006a) found small effects for both safety participation and safety compliance with occupational accidents and injuries. Also, Kessler et al. (2015) conducted a cross-sectional study and found that safety compliance was associated with fewer accidents at the group level but not the individual level. Safety compliance may be better understood at the group level, not the individual level. For this study, participation in safety programs and safety compliance will be used to explore the mediation between safety climate and safety performance at the individual level. This study addresses Kessler et al. (2015) recommendation to conduct a longitudinal study with safety compliance on occupational injuries, as well as Clarke (2006a) suggestion to test the association between safety participation and safety compliance on accidents across occupational settings.

Research shows that employees' perceptions of their work environment predicted accidents on the job (Clarke, 2006b; Oliver et al., 2002; Tomás et al., 2011) and unsafe behavior (Clarke, 2006b; Hofmann & Stetzer, 1996). Tomás et al. (2011) found a direct relationship between work environment and accidents; however, there is a small amount of research that tries to explain how psychological safety climate may influence safety performance through safety climate. This study contributes to the research by testing how psychological safety climate may influence safety performance through safety climate.

This study will be methodologically and statistically beneficial for the safety leadership research. There is a need in the literature to further explore whether employees' perceptions of safety climate are a reliable predictor of future accidents with large sample sizes (Ajslev et al., 2018) and at the individual level (Christian et al., 2009; Hofmann & Stetzer, 1996). In early research, safety climate is measured at the organizational level (Zohar, 1980) and later evolved to include the group level (Hofmann & Stetzer, 1996; Neal & Griffin, 2006; Zohar, 2008; Zohar & Luria, 2005, 2010) and individual level (Christian et al., 2009; Hofmann & Stetzer, 1996; Hofmann et al., 2003; Zohar & Luria, 2005), which reflects the multilevel framework of safety climate (Hofmann et al., 2017; Zohar, 2002a, 2008, 2010; Zohar & Luria, 2003, 2004, 2005). This study contributes to the research by having a large sample size and explores the individual's perceptions of safety climate to support the multilevel safety climate framework.

There is a need to use objective, observable safety information to test the effect of safety leadership on employees' safety behaviors and performance. In contrast, the collection of safety information in past studies usually focused on a single method of data collection - self-report questionnaires (Christian et al., 2009; Clarke & Ward, 2006; Conchie et al., 2012; Fugas et al., 2011; Hansez & Chmiel, 2010; Simard & Marchand, 1997), which introduces common method and self-report biases in the results. In addition, Michael et al. (2006) used a combination of self-report and objective measures of OSHA recordables. The use of self-report was reported as a limitation for the study as the same source bias may have inflated the results when finding a significant relationship between leadership style and injuries. In a meta-analysis Christian et al. (2009) found a stronger relationship between individuals' perception of safety climate and archival safety performance (i.e., OSHA recordables of accidents and injuries) than self-reported measures and recommends including close calls (i.e., microaccidents) and first aid along with incidents to accurately measure safety performance. Recognizing that injuries are less common than accidents, researchers (Christian et al., 2009; Zohar, 2000, 2002b) recommended to include microaccidents (i.e., requiring first aid), as this includes events that could have led to more series injuries or fatalities. This study will use multiple objective measures of data collection, including a direct report leadership questionnaire, records of employees' participation and recognition in safety programs, and OSHA recordables, which goes beyond most of the limitations of a single method of data collection and self-report methods. Safety performance data will be archival to include close calls, first aid, injuries, and illnesses.

Currently, there are a limited number of studies that use structural equation modeling (SEM), which has inherent benefits (i.e., virtually no measurement error with latent variables), to study the impacts of leadership on safety climate and performance (Barling et al., 2002; Clarke & Ward, 2006; Preacher & Hayes, 2008; Squires et al., 2010; Tucker, S. et al., 2016). A small portion of the research articles have a sample size over 300 (Tucker, S. et al., 2016). Sample size and measurement error is a strength in this study, which makes this study more methodologically and statistically beneficial for the research.

The findings of this study will add to progress made to occupational safety research over the past 100 years (Hofmann et al., 2017). Organizations continue to have too many serious injuries and fatalities in the workplace (U.S. Bureau of Labor Statistics, 2018a, 2018b). The research must continue to determine how safety interventions can prevent safety incidents from occurring in the workplace (Lee et al., 2018). The significance of this research study is using multiple, objective, observable safety data to understand how employees' perception of their supervisor's leadership competencies and behaviors influence psychological safety climate and safety climate and the effect of their participation in safety programs (i.e., safety observation, safety recognition) on number of occupational safety incidents. The focus of this research will be on the social and psychological predictors of safety behaviors and performance in the discipline of applied psychology.

Summary

This chapter provided a historical background of occupational safety; theoretical framework for the research; and a comprehensive review of the literature pertaining to safety leadership, psychological safety climate, safety climate, safety participation, and safety performance. The theoretical framework for this study defined the relationship between leaders' behavior and the influence on their employees' safety performance according to different perspectives of leadership.

Chapter 3: Research Design and Method

Chapter Overview

This chapter explains the procedures to complete the research study with a plan for how to analyze the data. The chapter includes the research questions, participants, research design, research measures, and statistical analysis. In this chapter, a detailed explanation of the problem statement, hypotheses and their rationales, descriptions of data, method of data analysis, and ethical considerations for the study are presented.

Problem Statement

Leaders have a critical role in influencing employees' safety behaviors. Despite the pivotal role that leaders play in influencing employees' safety behaviors, many leaders do not demonstrate effective safety leadership behaviors or do not know which behaviors are effective (Krause, 2005). This study examined how employees' perception of their supervisor's leadership behaviors influences psychological safety climate and safety climate, and the effect on their participation in safety programs (i.e., safety observation, safety recognition) and number of safety incidents at an electric utility company. Employees rated their direct supervisor's proficiency of leadership behaviors, psychological safety behaviors, and safety leadership behaviors in a direct report feedback survey to determine how their perception of their supervisor may influence their participation in safety programs, safety compliance behaviors, and number of safety incidents. The theoretical foundation of this research was informed by social learning theory (Bandura, 1977; Bandura & Walters, 1963), full range of leadership theory (Bass, 1990; Bass & Avolio, 1994), and safety climate theory (Zohar, 2008; Zohar & Luria, 2005).

Research Questions, Hypotheses, and their Rationales

Research Question One

What leadership competencies influence employee safety incidents?

Null Hypothesis (H_{1o}): Leadership competencies (i.e., advances innovative solutions, communicates with impact, leads with vision, makes sound decisions, manages talent) do not influence safety incidents.

Alternative Hypothesis (H_{1a}): Communicates with impact influences safety incidents.

Statistical result needed to reject the null hypothesis and accept H_{1a}: The null hypothesis will be rejected if the regression coefficient for the effect of communicates with impact on safety climate is significantly different from zero ($p < .05$).

Rationale for H_{1a}: Researchers (Clarke, 2013; Clarke & Ward, 2006; Conchie & Donald, 2009; Conchie et al., 2006; Conchie et al., 2012; Kelloway et al., 2012) stated that leaders who have genuine, trusting relationships with their employees improve safety performance and reduce injuries in the workplace. Employees' level of trust in management can enhance a leader's influence on employee's safety performance.

Alternative Hypothesis (H_{1b}): Makes sound decisions influences safety incidents.

Statistical result needed to reject the null hypothesis and accept H_{1b}: The null hypothesis will be rejected if the regression coefficient for the effect of makes sound decisions on safety climate is significantly different from zero ($p < .05$).

Rationale for H_{1b}: Leaders can use rational arguments, involve employees in safety decisions, and generate enthusiasm for safety to influence employees to participate in safety (Clarke & Ward, 2006).

Research Question Two

What leadership competencies influence psychological safety climate?

Null Hypothesis (H_{2o}): Leadership competencies (i.e., advances innovative solutions, communicates with impact, leads with vision, makes sound decisions, manages talent) do not influence psychological safety climate.

Alternative Hypothesis (H_{2a}): Advances innovative solutions influences psychological safety climate.

Statistical result needed to reject the null hypothesis and accept H_{2a}: The null hypothesis will be rejected if the regression coefficient for the effect of advances innovative solutions on psychological safety climate is significantly different from zero ($p < .05$).

Rationale for H_{2a}: Leaders who encourage innovative thinking, explain the need for change, envision change, and take personal risk model behaviors that are acceptable and promote a psychologically safe work environment for employees (Ortega et al., 2014).

Alternative Hypothesis (H_{2b}): Communicates with impact influences psychological safety climate.

Statistical result needed to reject the null hypothesis and accept H_{2b}: The null hypothesis will be rejected if the regression coefficient for the effect of communicates with impact on psychological safety climate is significantly different from zero ($p < .05$).

Rationale for H_{2b}: Leaders who have high quality interpersonal relationships with employees play an integral role in promoting psychological safety climate; leaders who communicate more frequently and listen to employees' concerns and ideas create a more psychologically safe work environment (Siemsen et al., 2009; Yanchus et al., 2014).

Research Question Three

What leadership competencies influence safety climate?

Null Hypothesis (H_{3o}): Leadership competencies do not influence safety climate.

Alternative Hypothesis (H_3): Communicates with impact influences safety climate.

Statistical result needed to reject the null hypothesis and accept H_3: The null hypothesis will be rejected if the regression coefficient for the effect of communicates with impact on safety climate is significantly different from zero ($p < .05$).

Rationale for H_3: Research shows that leadership influences the organization's safety climate (Barling et al., 2002; Brown & Holmes, 1986; Clarke, 2006a; Griffin & Neal, 2000; Gutberg & Whitney, 2017; Neal & Griffin, 2002, 2006; Roger & Flin, 2011; Squires et al., 2010; Tucker, S. et al., 2016; Yule et al., 2008; Zohar, 1980; Zohar & Polachek, 2014). Previous research (DeJoy et al., 2004; Donahue et al., 2011; Kines et al., 2010; Sparer et al., 2016; Zohar & Polachek, 2014) found that leaders who used effective communication with safety resulted in employees perceiving safety as a priority or increased perceptions of safety climate.

Research Question Four

What leadership competencies indirectly influence employee safety incidents through psychological safety climate?

Null Hypothesis (H_{4o}): Leadership competencies do not influence employee safety incidents through psychological safety climate.

Alternative Hypothesis (H_4): One or more of the leadership competencies indirectly influence employee safety incidents through psychological safety climate.

Statistical result needed to reject the null hypothesis and accept H_4: In testing the indirect effect of one or more leadership competencies on employee safety incidents through psychological safety climate, the estimate of the indirect effect for at least one of these tests will be significantly different from zero ($p < .05$).

Rationale for H_4: Researchers (Hofmann et al., 2017; Hofmann & Morgeson, 1999; Hofmann et al., 2003; Michael et al., 2006) found that employees who have close working relationships with their leaders are likely to have fewer safety-related incidents and lower levels of accidents. Leaders that have ongoing exchanges with employees exert a significant effect on improving employee safety performance, safety behaviors and reducing injuries (Luria et al., 2008; Zohar, 2002b; Zohar & Luria, 2003). Leaders who create and promote a healthy work environment where employees feel comfortable bringing safety concerns to the attention of their leaders allow supervisors and employees to address the root causes of safety problems to prevent future incidents (Probst, 2015).

Research Question Five

What leadership competencies indirectly influence employee safety incidents through safety climate?

Null Hypothesis (H_{5o}): Leadership competencies do not influence employee safety incidents through safety climate.

Alternative Hypothesis (H_5): Communicates with impact indirectly influence employee safety incidents through safety climate.

Statistical result needed to reject the null hypothesis and accept H_5: In testing the indirect effect of communicates with impact on employee safety incidents through safety climate, the estimate of the indirect effect for communicates with impact will be significantly different from zero ($p < .05$).

Rationale for H_5: Researchers (Christian et al., 2009; Krause, 2005; Probst, 2015; Simard & Marchand, 1997; Tucker, S. et al., 2016; Zohar, 2002b; Zohar & Luria, 2003, 2010) found that leadership is a significant factor contributing to safety performance and there is common understanding in the research (Bass, 1999; Clarke, 2006a, 2013; Hofmann et al., 2017; Krause, 2005; Yule et al., 2008; Zohar & Luria, 2004, 2010; Zohar & Polachek, 2014) that effective safety leaders reduce or prevent safety incidents or fatalities, but is hypothesized to be established through a strong and consistent relationship between employee perceptions of their leader's commitment for safety (Beus et al., 2010; Zohar & Luria, 2005, 2010). Specifically, researchers (Coyle, Sleeman, & Adams, 1995; DeJoy et al., 2004; Michael et al., 2006; Zohar, 1980) concluded that safety communication alone is not sufficient to ensure low accident rates and must be accompanied with other variables, such as safety climate and management commitment to safety. Perception of leader's commitment to safety has the strongest association with and is the most robust predictor for employee injuries than any other safety climate dimension (Christian et al., 2009; Hofmann & Stetzer, 1996; Loushine et al., 2004; Oliver et al., 2002) and is the only dimension where the validity can be generalized (Beus et al., 2010). Other research (Hansez & Chmiel, 2010; Neal & Griffin, 2002; Tsao et al., 2017; Zohar, 1980; Zohar & Polachek, 2014) shows that management commitment to safety is a significant predictor to safety climate and performance.

Research Question Six

Does psychological safety climate influence employee safety incidents?

Null Hypothesis (H_{6o}): Psychological safety climate does not influence employee safety incidents.

Alternative Hypothesis (H_6): Psychological safety climate influences employee safety incidents.

Statistical result needed to reject the null hypothesis and accept H_6: The null hypothesis will be rejected if the regression coefficient for the effect of psychological safety climate on employee safety incidents is significantly different from zero ($p < .05$).

Rationale for H_6: Researchers (Clarke, 2006b; Oliver et al., 2002; Tomás et al., 2011) found that employees' perception of their work environment predicted accidents on the job.

Research Question Seven

Does safety climate influence employee safety incidents?

Null Hypothesis (H_{7o}): Safety climate does not influence employee safety incidents.

Alternative Hypothesis (H_7): Safety climate influences employee safety incidents.

Statistical result needed to reject the null hypothesis and accept H_7: The null hypothesis will be rejected if the regression coefficient for the effect of safety climate on employee safety incidents is significantly different from zero ($p < .05$).

Rationale for H_7: Researchers (Christian et al., 2009; Hofmann & Stetzer, 1996; Loushine et al., 2004; Oliver et al., 2002) found that an employee's perception of their leader's commitment to safety has the strongest association with and is the most robust predictor for employee injuries than any other safety climate. Other research (Hansez & Chmiel, 2010; Neal & Griffin, 2002; Tsao et al., 2017; Zohar, 1980; Zohar & Polachek, 2014) shows that management commitment to safety is a significant predictor to safety climate and performance.

Research Question Eight

Does psychological safety climate indirectly influence employee safety incidents through safety climate?

Null Hypothesis (H_{8o}): Psychological safety climate does not influence employee safety incidents through safety climate.

Alternative Hypothesis (H_8): Psychological safety climate indirectly influences employee safety incidents through safety climate.

Statistical result needed to reject the null hypothesis and accept H_8: In testing the indirect effect of psychological safety climate on employee safety incidents through safety climate, the estimate of the indirect effect will be significantly different from zero ($p < .05$).

Rationale for H_8: Employees who believe that their leader cares and is concerned for their safety will be more likely to be proactive in sharing the importance of safety and speak up relating to safety concerns (Conchie et al., 2012; Newman et al., 2017). Leaders must create and promote a healthy work environment where employees feel comfortable bringing safety concerns and incidents to the attention of their leaders. When employees report safety concerns and incidents, supervisors can address the root causes of safety problems to prevent future incidents (Probst, 2015). Researchers (Clarke, 2006b; Oliver et al., 2002; Tomás et al., 2011) found that employees' perception of their work environment predicted accidents on the job.

Research Question Nine

Does psychological safety climate indirectly influence employee safety incidents through participation in safety programs?

Null Hypothesis (H_{9o}): Psychological safety climate does not influence employee safety incidents through participation in safety programs.

Alternative Hypothesis (H_9): Psychological safety climate indirectly influences employee safety incidents through participation in safety programs.

Statistical result needed to reject the null hypothesis and accept H_9: In testing the indirect effect of psychological safety climate on employee safety incidents through participation in safety programs, the estimate of the indirect effect will be significantly different from zero ($p < .05$).

Rationale for H_9: Researchers (Edmondson & Lei, 2014; Kahn, 1990; Newman et al., 2017) found that psychological safety climate promotes personal engagement where people feel they can speak up or participate without the fear of retaliation. When employees report safety concerns, supervisors and employees can address the root causes of safety problems to prevent future incidents (Probst, 2015).

Research Question Ten

Does safety climate indirectly influence employee safety incidents through participation in safety programs?

Null Hypothesis (H_{10o}): Safety climate does not influence employee safety incidents through participation in safety programs.

Alternative Hypothesis (H_{10}): Safety climate indirectly influences employee safety incidents through participation in safety programs.

Statistical result needed to reject the null hypothesis and accept H_{10}: In testing the indirect effect of safety climate on employee safety incidents through participation in safety programs, the estimate of the indirect effect will be significantly different from zero ($p < .05$).

Rationale for H_{10}: Researchers (Clarke, 2006a; Griffin & Neal, 2000; Neal & Griffin, 2002, 2006; Zahoor et al., 2017) supported the relationship between organizational safety climate on safety performance, but through safety participation.

Research Question Eleven

Does safety climate indirectly influence employee safety incidents through safety compliance behaviors?

Null Hypothesis (H_{11o}): Safety climate does not influence employee safety incidents through recognition of safety behaviors.

Alternative Hypothesis (H_{11}): Safety climate indirectly influences employee safety incidents through recognition of safety behaviors.

Statistical result needed to reject the null hypothesis and accept H_{11}: In testing the indirect effect of safety climate on employee safety incidents through recognition of safety behaviors, the estimate of the indirect effect will be significantly different from zero ($p < .05$).

Rationale for H_{11}: Researchers (Luria et al., 2008; Sparer et al., 2016; Zohar, 2002b; Zohar & Luria, 2003) suggested that reinforcement of safety behaviors from either the leader or other employees increased employees' perceptions of importance of safety, safety climate, safety behaviors, or safety outcomes. First-line leaders who reward employees for safe behaviors decrease employee unsafe work behaviors and injuries and increase safety climate (Luria et al., 2008; Yule et al., 2008; Zohar, 2002b; Zohar & Luria, 2003).

Research Question Twelve

Do leadership competencies indirectly influence safety climate through psychological safety climate?

Null Hypothesis (H_{12o}): Leadership competencies do not influence safety climate through psychological safety climate.

Alternative Hypothesis (H_{12}): Communicates with impact indirectly influences safety climate through psychological safety climate.

Statistical result needed to reject the null hypothesis and accept H_{12}: In testing the indirect effect of communicates with impact on safety climate through psychological safety climate, the estimate of the indirect effect will be significantly different from zero ($p < .05$).

Rationale for H_{12}: Research at the individual level examined the effects of supportive leadership behaviors on work outcomes through psychological safety climate. Research showed that leader inclusiveness (Carmeli et al., 2010), support (May et al., 2004), interpersonal communication (Siemsen et al., 2009; Yanchus et al., 2014), trustworthiness (Madjar & Ortiz-Walters, 2009), openness (Detert & Burris, 2007), and behavioral integrity (Palanski & Vogelgesang, 2011) strongly influence an individual's perception of psychological safety climate, which influences employee workplace outcomes, such as safety.

Research Question Thirteen

Does the influence of leadership on safety performance differ across work settings?

Null Hypothesis (H_{13o}): The influence of leadership on safety performance does not differ across work settings.

Alternative Hypothesis (H_{13}): The influence of leadership on safety performance does differ across work settings.

Statistical result needed to reject the null hypothesis and accept H_{13}: The chi-square from a model with all parameters allowed to be unequal across groups compared to the chi-square from a model with only the loadings constrained to be equal across groups is significantly different ($p < .05$) and has a better model that fits the data.

Rationale for H_{13}: Leadership effectiveness with reducing safety incidents may be contextual. Willis et al. (2017) found that accident likelihood moderates the relationship between transformational leadership and active transactional leadership with safety participation;

however, they found that employees' perception of hazard exposure did not moderate the relationship between transformational leadership and active transactional leadership with safety behaviors (e.g., safety participation, safety compliance). This study will further explore the relationship between leadership and safety performance through work setting, which has varying levels of hazard exposure.

Research Design

The section below provides a description of the research design – research method, operational definitions, instrumentation, levels of measurement, procedures, participants, data processing, assumptions and limitations, delimitations, and ethical assurances. Predictors were the employees' perceptions of their supervisor's leadership competencies and behaviors (i.e., advances innovative solutions, communicates with impact, leads with vision, makes sound decisions, manages talent), employee participation in safety programs (i.e., safety observations, safety recognitions, safety reporting), recognition of safety behaviors by their leaders and peers (i.e., safety compliance), and employees' exposure to hazards while performing job duties. Mediators were psychological safety climate, safety climate, safety observations, safety recognitions, safety reporting, and safety compliance. The outcome or dependent variable was safety incidents (i.e., OSHA recordables).

Research Method

A quantitative (correlational) survey design used archival data from questionnaires, safety program records, and safety records (i.e., OSHA recordables) from an electric utility company. The research method introduced a time element with safety program and records of safety incidents. The archival survey design was the preferred data collection for this study because the design allowed for efficiency of data collection and analysis for a large sample of the company population.

The purpose of the research design was to generalize the results of the study from an electric utility so that inferences can be made about how employees' perception of their supervisor's leadership competencies and behaviors influence psychological safety climate, safety climate, and the effect on their participation in safety programs (i.e., safety observations, safety recognitions, safety reporting), safety compliance behaviors (i.e., safety compliance), and number of OSHA recordables (i.e., safety incidents) they may have on the job. The study examined how recognition of safety behaviors may impact the relationship between psychological safety climate, safety climate, and the number of employee safety incidents.

The research has two models. The first model used archival data from 2013 and 2014 to test how employees' perception of their supervisor's leadership competencies and behaviors influence psychological safety climate, safety climate, and the effect on their number of safety incidents occurring on the job. The leadership behavior questionnaire includes data collected during 2013 and safety incidents occurring throughout 2014.

The second model used archival data from 2013 through 2015 to test how employees' perception of their supervisor's leadership competencies and behaviors influence psychological safety climate, safety climate, and the effect on their participation in safety programs (i.e., safety observations, safety recognitions, safety reporting), safety compliance behaviors (i.e., safety compliance), and number of safety incidents occurring on the job. The study examined how recognition of safety behaviors may impact the relationship between psychological safety climate, safety climate, and the number of employee safety incidents.

The study adopted the perspective that leadership was experienced by the unique relationship between the individual and the leader. The construct of leadership was divided into leadership competencies which were rated by the individual. All the variables were treated both theoretically and empirically as individual level variables.

Population and Sample

In 2013, the company had 14,115 full-time employees. The archival dataset contained employee information between 2013 and 2015 and has demographic information including age, gender, race/ethnicity, time in job, length of service, and generation, and work setting. Participants in the study must be an individual contributor and not have employees reporting directly to them.

The first model used an archival dataset comprised of questionnaire responses and safety information from 3,698 full-time employees who reported directly to their supervisor for a two-year period across departments within an electric utility company. The participants must have maintained a reporting relationship with the same supervisor for a period of two years from 2013 to 2014.

The second model used an archival dataset comprised of questionnaire responses and safety information from 2,222 full-time employees who reported directly to supervisor for a three-year period across departments within an electric utility company. The participants must have maintained a reporting relationship with the same supervisor for a period of three years from 2013 to 2015.

Procedures

The researcher presented the research project proposal to the executive, mid-level, and line-level leaders from human resources and the safety organizations at the electric utility company. The Chief Human Resource Officer and Vice President of Safety, Security, and Business Resiliency provided written permission to use archival data to conduct the research project (see Appendix A). The researcher cleaned the archival data, and the researcher applied the parameters set forth in the study to identify the sample from the population to be included in the analysis. Participants' ratings included in the analysis must be of their direct supervisor. The final sample size was 3,698 participants for the first model and 2,222 participants for the second model. The archival data was analyzed using confirmatory factor analysis (CFA) to test the measurement model, followed by multiple mediation structural equation modeling (SEM) to test the relationships amongst the constructs. A multiple mediator multi-group structural equation modeling tested the validity of the model with direct and indirect effects across groups in work settings with different levels of hazard exposure.

Validity

The results of the study can be applied to similar populations as specified in the study. This study used archival dataset to measure the proposed research model due to being granted access to the data from the company. The archival dataset allowed for efficiency of data collection with availability of a large sample size that was representative of the company population of diverse employees, including individuals working in office settings to individuals working in high hazardous work conditions. The analysis gave insights to both office workers and field employees working in a range of hazardous conditions. The dataset was large and representative of the entire company, but only several departments have safety program data, which limited the sample size in the analysis. The participants included full-time employees who reported directly to their supervisor for a two-year period for the first model and three-year period for the second model across departments within a Fortune 500 electric utility company.

The results may benefit leaders, safety specialists, and human resource professionals by defining the leadership behaviors that are most significant to influence employees' safety behaviors, increase employee health and wellbeing, and prevent serious injuries and fatalities.

Operational Definitions

There was a total of eleven independent variables and one dependent variable. The predictor variables are the following: advances innovative solutions, communicates with impact, leads with vision, makes sound decisions, manages talent, psychological safety climate, safety climate, participation in safety observation program, participation in safety recognition program, reporting of close calls, and recognition of safety behavior. The mediating variables are the following: psychological safety climate, safety climate, participation in safety observation program, participation in safety recognition program, reporting of close calls, and recognition of safety behavior. The dependent variable was employee safety incidents to include OSHA recordables. The employee's work setting, whether office, field – non-hazard, or field – hazard, was considered in the group analysis. The operational definitions for each variable are listed in Table 2. Safety climate was measured by active transactional safety leadership behaviors that support a safety compliance climate – leaders hold themselves and others accountable for following safety standards and policies and provides contingent rewards for others following safe and effective work practices.

Table 2

Variable Definitions

Variable	Variable Definition
Advances Innovative Solutions	Draws out new ideas to advance solutions.
Communicates with Impact	Strengthens relationships through clear communications.
Leads with Vision	Generates support by articulating the destinations.
Makes Sound Decisions	Uses good judgement when making tough calls.
Manages Talent	Selects, develops, and retains high performers.
Psychological Safety Climate	Creates a positive work environment that generates feeling of being able to show and employ one's self without fear of negative consequences of self-image, status, or career.
Safety Climate	Ensures a safe work environment that creates perceptions about the relative importance of safe, observable conduct in their occupational behavior.
Safety Observations	Number of safety observation submissions in safety observation program.
Safety Recognitions	Number of safety recognition submissions in safety recognition program.
Safety Reporting	Number of safety close calls reported.
Safety Compliance	Number of safety behavior recognitions received via safety recognition program.
Safety Incidents	Number of OSHA recordables, including incidents, injuries, and illnesses.

Instrumentation

There are multiple measures for data collection, including a leadership behavior questionnaire, records of employees' participation in safety observation and recognition programs, and safety records.

Demographics

Demographic information of the participants, including category, age, gender, race/ethnicity, time in job, length of service, generation, and work setting – hazard exposure. *Age*, *time in job*, and *length of service* were measured in *number of years*. *Gender* was a dichotomous measure (0 = *female*, 1 = *male*). *Race/ethnicity* was nominal (1 = *American Indian or Alaskan Native*, 2 = *Asian*, 3 = *Black or African American*, 4 = *Hispanic*, 5 = *Native Hawaiian or Other Pacific Islander*, 6 = *Two or More Races*, 7 = *White*). *Generation* was measured by an interval scale (1 = *Millennial*, 2 = *Gen X*, 3 = *Boomer*, 4 = *Traditional*). Finally, *work setting - hazard exposure* was measured by an interval scale from least to most exposed to hazards while on the job (1 = *office*, 2 = *field – non-hazard*, 3 = *field – hazard*). Individuals in the office setting have office jobs located in an office building (e.g., Accountant, Customer Service

Representative, Engineer). Individuals in the field – non-hazard setting have jobs located in the field but do not have responsibilities that expose them to potentially life-threatening situations (e.g., Meter Technician, Field Service Representative, Utilityman). Individuals in the field – hazard setting have jobs located in the field and have jobs that expose them to life-threatening situations, such as exposure to high voltage electricity (e.g., Substation Electrician, Groundman, Lineman).

Leadership Behavior Questionnaire

Employees completed a direct report leadership questionnaire that measured their perceptions of their supervisor's leadership effectiveness on 34 behaviors within seven latent variables (see Table 3) by using a 6-point Likert scale (0 = *Unable to Rate/Not Applicable*; 1 = *Not at all effective*; 2 = *Somewhat effective*; 3 = *Effective*; 4 = *Very effective*; 5 = *Extremely effective*). A team of Industrial and Organizational Psychology professionals at the utility company developed the leadership behavior questionnaire. The latent variables were advances innovative solutions, communicates with impact, leads with vision, makes sound decisions, manages talent, psychological safety climate, and safety climate. The list of leadership behaviors on the questionnaire can be found in Table 3. The leadership behavior questionnaire provided leaders a standardized way of obtaining constructive feedback from their direct reports on their leadership effectiveness and to help identify strengths and development opportunities. The questionnaire instructions informed the direct reports that their feedback would be anonymous and encouraged them to be candid with their ratings. The written participant instructions for the leadership behavior questionnaire can be found in Appendix B.

Table 3

Leadership Behavior Questionnaire Items

Item No.	Item Description
	Advances Innovative Solutions
AIS1	Provides the latitude and support to examine the full potential of new ideas; challenges old paradigms.
AIS2	Draws on resources to create innovative solutions.
AIS3	Rewards innovative thinking.
AIS4	Shapes potential solutions into practical business opportunities.
AIS5	Ensures that new ideas are implemented, supported, and refined.
	Communicates with Impact
CWI1	Communicates directly and with candor.
CWI2	Adjusts style to the audience and knows others' perspectives and motivations.
CWI3	Listens actively and builds on others' ideas.
CWI4	Preserves and strengthens relationships with each communication.
CWI5	Ensures that messages are heard and acted upon.
	Leads with Vision
LWV1	Implements new strategies throughout the organization.
LWV2	Keeps others focused on the future.
LWV3	Creates plans that balance near- and long-term needs.
LWV4	Links vision and strategy to practical business results.
LWV5	Conceives visionary ideas and builds on the strategic ideas of others.
	Makes Sound Decisions
MSD1	Takes accountability for making and implementing decisions; respects the decision-making authority of others.
MSD2	Makes unpopular decisions when it is the right direction for the organization.
MSD3	Knows when to include others in the decision-making process.
MSD4	Makes timely decisions.
MSD5	Uses the appropriate level of analysis given the risks and complexities of a decision.
	Manages Talent
MT1	Shapes roles and assignments to leverage and develop capabilities.
MT2	Motivates, challenges, and rewards top performance; confronts and manages underperformance.
MT3	Provides valuable feedback on a regular basis.
MT4	Builds a strong team; develops bench strength at all levels within the organization.
MT5	Evaluates, hires, promotes, and shares top talent.
	Psychological Safety Climate
PS1	Challenges current practices when necessary to ensure alignment with company values.
PS2	Models work behaviors that reinforce our company values.
PS3	Creates a work environment where employees feel supported and can learn from mistakes.
PS4	Treats people with respect and assumes positive intentions.
PS5	Provides honest feedback and constructive coaching.
	Safety Climate
SC1	Holds self and others accountable for following safety rules, policies, and guidelines.
SC2	Corrects or stops unsafe behavior.
SC3	Ensures safety is integrated into daily work activities.
SC4	Recognizes others for safe and effective work practices.

Safety Observation Program Records

The utility company's safety observation program data was a record of employees' behavior-based observations using a standard list of questions that cover typical work activities. Employees submitted their safety observations via a safety observation card, online pdf document, or an online application to the program coordinator. Safety observation participation was measured by the number of safety observation submissions. Employees have access to the safety observation data, including raw data, trends, and descriptive statistics.

The safety observation program's purpose is to encourage employees to have quality safety conversations that allowed employees to identify and reinforce behaviors that reduced serious injuries and fatalities. As part of the program, a safety observation card outlined six steps to having an effective safety conversation. The program encourages open communication about safety and provided a standardized program and system that allowed employees to share lessons learned, provide coaching, and recognize safe behaviors. There were no specific requirements for employees to complete safety observations; however, some departments did have goals to promote participation.

Employees performed a safety observation by having effective conversations with fellow employees regarding safe and at-risk work practices and/or conditions to achieve a hazard-free work environment. If employees observed at-risk behaviors and conditions during a safety observation, they were required to act and correct the condition. At no time should an observation be performed in a manner that would put the observer or coworkers at risk of injury. Through effective safety conversations with fellow employees and collectively taking ownership of the corrective action process, the program empowered participating employees to improve the safety climate and achieve an injury-free workplace.

The safety observation data comprised of a mandatory and optional section. The mandatory section contained the following: date of the observation, observer's department, organization where the observation took place, agreement between the observer and the coworker to address identified hazards, category to which the observation pertains, and whether it was safe or at-risk followed by a comment reflecting the facts of the observation. There were additional fields that may be filled out depending on the nature of the observation. Observers selected “anonymous” if they wished to have their name removed from the observation record; only the observer’s group information remained.

Safety Recognition Program Records

The utility company’s safety recognition program data is a record of submissions of employees’ recognizing others for demonstrating safety behaviors. The dataset contains both employees who participated in safety recognition program and those who were recognized for modeling safety behaviors. All active employees may nominate fellow employees for recognition upon observing outstanding safety behaviors. Safety recognition participation was measured by the number of safety recognition submissions. Safety compliance was measured by the number of safety recognitions received. There was no limit to the number of recognitions that eligible employees may receive, except for represented employees who follow the established award limits per the union agreement.

Employees nominated others by completing the safety recognition via a safety recognition card, online pdf document, or an online application to the program coordinator. The observer could have chosen to recognize an employee who demonstrated outstanding safety behavior or safety leadership by describing the nature of the behavior and the reason for recommending recognition. The submission was routed to the employee’s direct manager who reviewed and approved or denied the nomination. After approval, the employee was awarded with points as a form of safety recognition in the amount of $2.50 per point. The points were to be redeemed for award items.

Safety Records

The utility company's safety incidents were a record of the number of incidents as defined by Occupational Safety and Health Association (OSHA), such as close calls, first aid, incident only, hearing loss, lost time, no lost time, and restricted days away or job transfer that occurred for each person. The four categories of OSHA recordables accidents, which included hearing loss, lost time, no lost time, and restricted days away or job transfer was summed for each employee's total safety incidents. The number of close calls submitted were summed for each employee's safety reporting, as they were optional for employees to submit.

Researchers (Christian et al., 2009; Hofmann & Morgeson, 1999; Michael et al., 2006; Neal & Griffin, 2006) used and recommended using objective safety incident records, such as OSHA recordables, in research studies. This study included OSHA recordables as the measure for safety incidents. Other researchers (Martínez-Córcoles, Gracia, Tomás, & Peiró, 2011) suggested that accidents and injury records are problematic, because they are "insufficiently sensitive, or dubious accuracy and retrospective, and they ignore risk exposure" (p. 1119). This study explored close calls, first aid, and incident only in the safety incident totals, but these metrics were not mandatory to report at the company and likely had bias in the data. First aid and incident only incidents may not have been a result of work-related incidents; therefore, they were deemed as insufficient to answer the research questions. However, close calls are included as an indicator of participation in safety reporting. Risk exposure was considered a control variable and the study explored the group differences across work settings with each setting having an increase level of hazard exposure from office, field – non-hazard, to field - hazard.

The OSHA recordkeeping regulation requires the preparation and maintenance of records of serious occupational injuries and illnesses. This information is important for employers, workers, and OSHA in evaluating the safety of a workplace, understanding industry hazards, and implementing worker protections to reduce and eliminate hazards. Each safety incident was classified by choosing between both recordable and non-recordable cases (see Table 4). The classification of the severity was based on the most serious known outcome associated with the case, such as the result in death, loss of consciousness, days away from work, restricted work activity, transfer to another job, medical treatment beyond first aid, or a significant injury or illness diagnosed by a physician or other licensed health care professional (United States Department of Labor, 2001).

Table 4

OSHA Safety Incident Descriptions

Item No.	Safety Incidents	Description
ICC	Close Call	Number of incidents where an employee did not sustain a personal injury.
IFA	First Aid	Number of first aid treatments to an employee included in the list of procedures provided by OSHA.
IO	Incident Only	Number of injuries and illnesses resulting from events or exposures that did not require first aid or medical treatment.
IHL	OSHA Recordable – Hearing Loss	Number of cases resulting in a change in hearing threshold relative to the baseline audiogram as defined by OSHA.
ILT	OSHA Recordable – Lost Time	Number of injuries or illnesses involving one or more days away from work beyond the day the injury or illness occurred.
INLT	OSHA Recordable – No Lost Time	Number of injuries or illnesses involving no days away from work beyond the day the injury or illness occurred.
IRDA	OSHA Recordable – Restricted Days Away	Number of injuries or illnesses involving restricted work or job transfer but does not involve days away from work.

Note. Retrieved from "OSHA laws & regulations (standards - 29 CFR)" by U.S. Bureau of Labor Statistics, U.S. Department of Labor. Source is https://www.osha.gov/laws-regs/regulations/standardnumber/1904

The safety records are submitted to the United States Bureau of Labor Statistics via a survey. The Survey of Occupational Injuries and Illnesses is designed to provide an estimate of the number of work-related injuries and illnesses and a measure of the frequency (rate) at which they occur. The survey collects data on non-fatal injuries and illnesses for each calendar year from a sample of employers. These reports form the basis of the annual estimates published by the United States Bureau of Labor Statistics.

Levels of Measurement

The model tested both direct and indirect effects of the observed and latent variables. The measurement model consisted of the indicators loading on the latent variables. The structural model on top of the measurement model tested the relationships amongst the latent and observed variables.

The latent variables of advances innovative solutions, communicates with impact, leads with vision, makes sound decisions, manages talent, psychological safety climate, and safety climate were not directly observable and have behavioral indicators, which are directly observable. The behavioral indicators cluster together in congeneric sets and load on the underlying constructs. These indicator variables from the leadership behavior questionnaire are continuous and measured with interval scales discussed in the instrumentation section. The indicator variables load on the latent variables as part of the measurement model.

The observed variables of safety observations, safety recognitions, safety reporting, safety compliance, and safety incidents, are all directly observable. Safety observations was comprised of the number of times the employee participated in the safety observation program. Safety recognitions was comprised of the number of times the employee participated in the safety recognition program. Safety reporting was comprised of the number of close calls reported. Safety compliance was the number of times the employee was recognized for modeling safety behaviors. Employee safety incidents are a total of OSHA recordables – hearing loss, OSHA recordable – lost time, OSHA recordable – no lost time, and OSHA recordable – restricted days away. The safety program and safety records data has observed variables, which are continuous and measured with ratio scales discussed in the instrumentation section.

Five variables were used as control variables in the analysis. Generation was redundant with age and was not included in the analysis. Age, time in job, and length of service were measured on a ratio scale with the number of years. Gender was a dichotomous measure using a ratio scale. Generation and work setting – hazard exposure was measured by an interval scale.

Data Processing

The initial step in the data analysis of the archival data determined the demographics of the sample, including the number and percentage representation for each demographic variable. The statistical analysis used for the study was multiple mediation structural equation modeling (SEM), which has two parts – measurement model and a structural model. The measurement model is a multivariate regression model that describes the relationships between a set of observed dependent variables and a set of continuous latent variables. The observed dependent variables are referred to as factor indicators and the continuous latent variables are referred to as factors. Confirmatory factor analysis (CFA) tested the relationships between a set of observed variables and a set of continuous latent variables by means of Mplus software version 7.23 (Muthén & Muthén, 2012) to obtain evidence for the validity of the constructs in the leadership behavior questionnaire shown in the measurement model (see Figure 1).

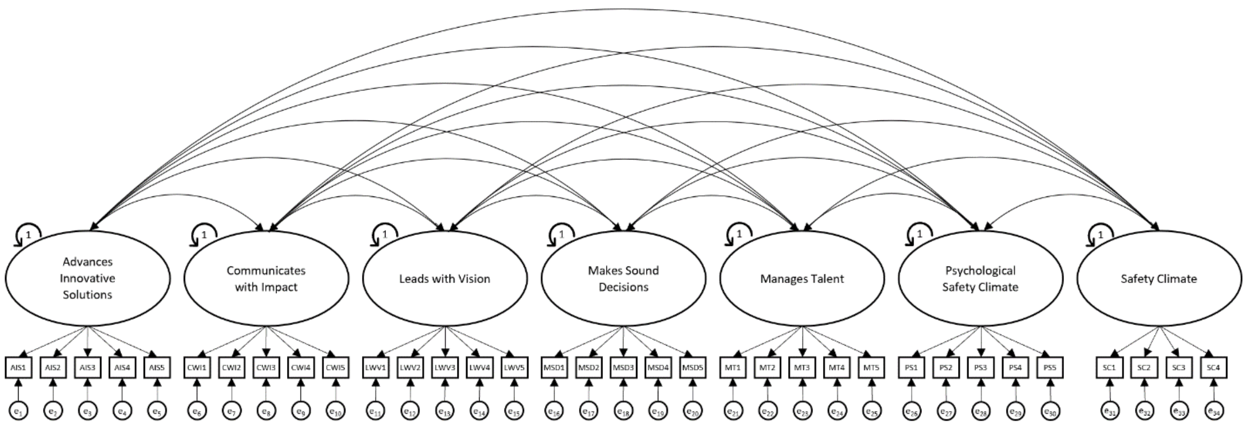

Figure 1. Measurement model.

The steps to complete SEM (Kline, 2011) are: (a) specify the model; (b) evaluate model identification; (c) select the measures and collect, prepare, and screen the data; (d) estimate the model; (e) re-specify the model; and (f) report the results. The initial analysis determined the psychometric properties of the leadership behavior scales. Using IBM SPSS 23, the analysis determined the internal consistency reliability or the Cronbach's alpha value of the leadership competency scales or how closely related a set of items are as a group to measure a construct. Cronbach's alpha of 0.7 is considered minimally acceptable (Kline, 2011).

The next step determined the model identification, which is a process to determine the unique set of parameters that is consistent with the data. The model's degrees of freedom indicate whether the model is just-identified, over-identified, or under-identified. This step in the analysis compared the number of data points (i.e., variances and covariances) to the number of parameters to be estimated. The goal was to have an overidentified model where the number of estimated parameters was less than the number of data points. When the model is overidentified, there are positive degrees of freedom or there is enough information to allow for rejection of the model, rendering the mode for scientific use. The number of elements comprising the variance-covariance matrix is determined by p (p + 1)/2, where p is the number of observed variables.

In the first model, the conceptual model has 35 observed variables, which yields 630 data points. The additional 35 observed variable means are added, which gives a total of 665 data points. Degrees of freedom are calculated by subtracting the total number of model parameters to be estimated from the total number of data points (Byrne, 2012). The total number of parameters are 132 (35 regression coefficients, 34 error variances, 7 factor variances, 21 factor covariances, and 35 observed variable intercepts). The total degrees of freedom in the conceptual model are 533 ($df_M = 533$). The conceptual model was over-identified ($df_M > 0$), which allowed for rejection of the model, thereby rendering the model for scientific use.

In the second study, the conceptual model has 39 observed variables, which yields 780 data points. The additional 39 observed variable means are added, which gives a total of 819 data points. The total number of parameters are 145 (39 regression coefficients, 39 error variances, 7 factor variances, 21 factor covariances, 39 observed variable intercepts). The total degrees of freedom in the conceptual model are 674 ($df_M = 674$). The conceptual model was over-identified ($df_M > 0$), which allowed the for rejection of the model, thereby rendering the model for scientific use.

When estimating the model, the chi-square test of model fit, comparative fit index (CFI), Tucker Lewis index (TLI), root mean square error approximation (RMSEA), and standardized root mean square residual (SRMR) goodness of fit statistics determines how well the model fits the data. During the CFA, the first observed measure or reference variable in each congeneric set was constrained to a factor loading value of 1.0 in the analysis, while the rest of the observed variables act as free parameters to be estimated. Hu and Bentler (1999) recommended the incremental indices of model fit, CFI (Bentler, 1990) and TLI (Tucker, L. & Lewis, 1973), be close to or greater than 0.95. The RMSEA is a discrepancy per degree of freedom in a model (Browne & Cudeck, 1992) and is considered to have good fit at 0.06 between the hypothesized model and observed data (Hu & Bentler, 1999). The interpretation of these indexes is the following for an acceptable fit: CFI ≥ .90, RMSEA ≤ .05, and SRMR ≤ .08 (Kline, 2011) with other recommendations as CFI ≥ .95, RMSEA ≤ .05, and SRMR ≤ .05 (Byrne, 2012). If the initial, preferred model does not fit the data, re-specifying the model to fit the data would be necessary using the modification indices. There is a possibility to have additional equivalent models, and exploration of alternative models may be necessary. Additional statistical analyses were conducted as deemed appropriate for the analysis.

Before conducting the SEM analysis to determine the estimates of the parameters, the statistical assumptions for regression (e.g., linearity, normality, no multicollinearity, homogeneity of variance) must be met for the sample to generalize the findings to the population. However according to Field (2013), the assumptions are not a concern with large sample sizes because the sampling distribution tends to be normal regardless of the sample data characteristics. The study has a sample of the population of 3,698 full-time employees and has unequal group sizes for each subgroup, so the tests of statistical assumptions did not have to be met to interpret the findings of the study. To understand the data further, participant responses across questionnaire items with Likert scales were all slightly negatively skewed (i.e., the frequent scores are clustered at the higher scores) and mostly slightly positive kurtosis (i.e., many scores at the tails of the distribution). The three safety items (SC1, SC2, and SC3) were more kurtotic (2.3 to 3.8). All other items were less than 2.0. The observed variables (i.e., safety participation, safety recognition, safety incidents) had most of the values at the lower values, which did not yield a normal distribution. There is no clear consensus regarding how far a kurtosis value may deviate from zero to be considered non-normal with ranges between ± 2.0 and 7.0 (Byrne, 2012).

Structural equation modeling (SEM) tests the structural model, which describes three types of relationships amongst the variables: the relationships among factors, the relationships among observed variables, and the relationships between factors and observed variables that are not factor indicators. Multiple mediation SEM for Model 1 (see Figure 2) determined the influence of leadership competencies on safety incidents through mediation of safety climate and psychological safety climate and tested the hypothesized relationships between the variables as specified in the conceptual model (see Figure 3). Multiple mediation SEM for Model 2 (see Figure 4) determined the influence of leadership competencies on safety incidents through mediation of psychological safety climate, safety climate, and participation in safety programs and tested the hypothesized relationships between the variables as specified in the conceptual model (see Figure 5).

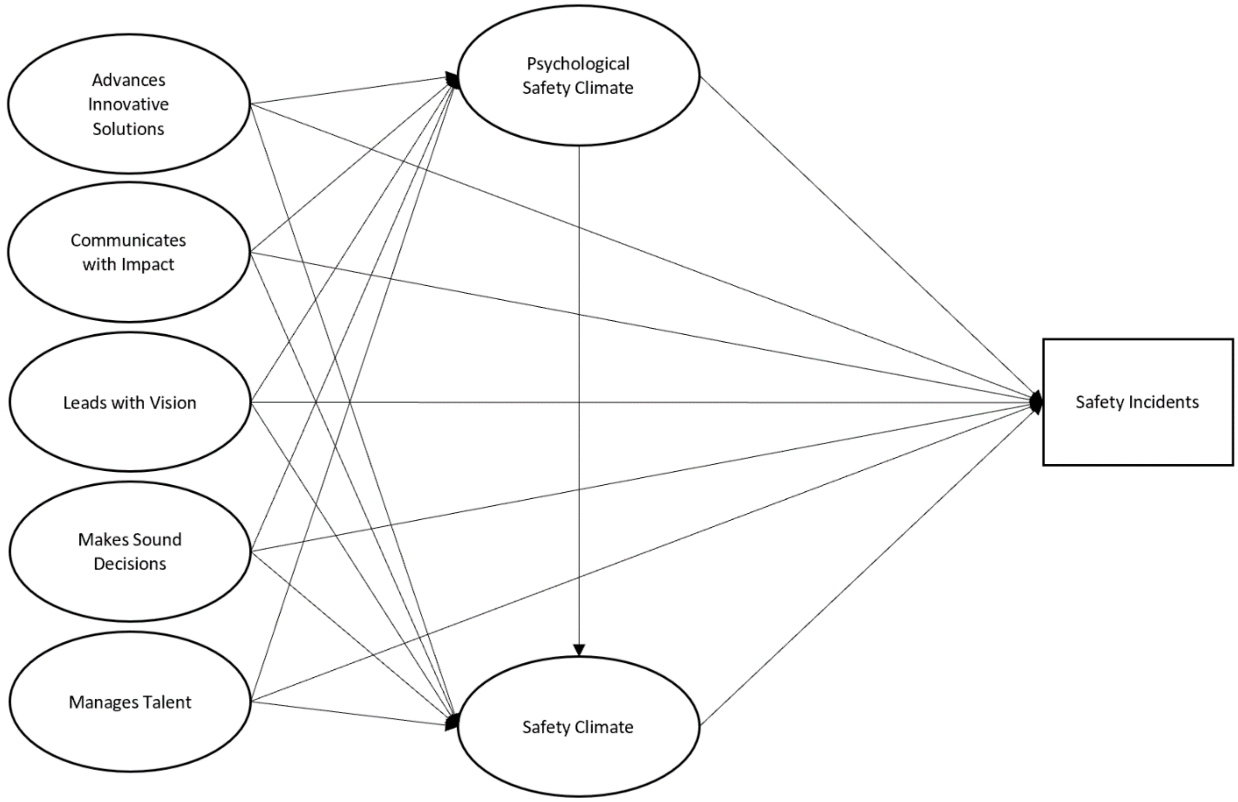

Figure 2. Structural Model 1.

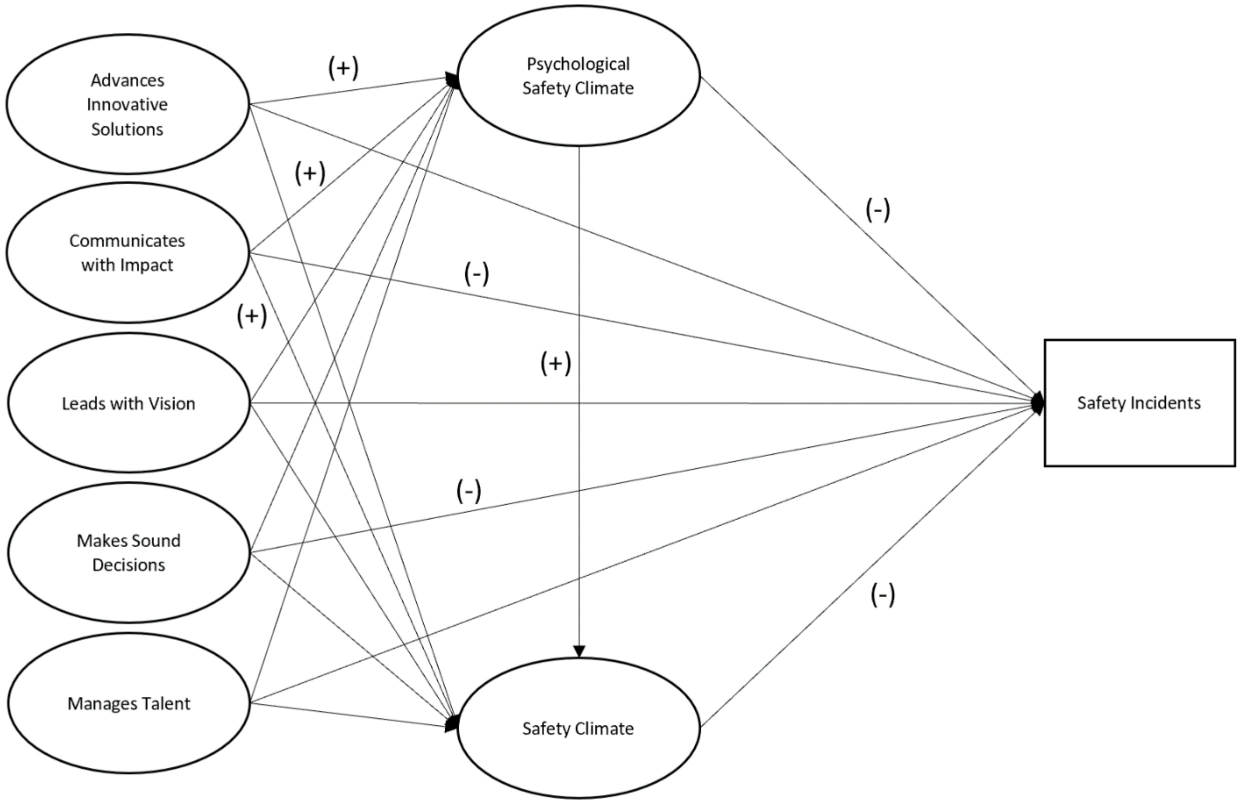

Figure 3. Conceptual Model 1.

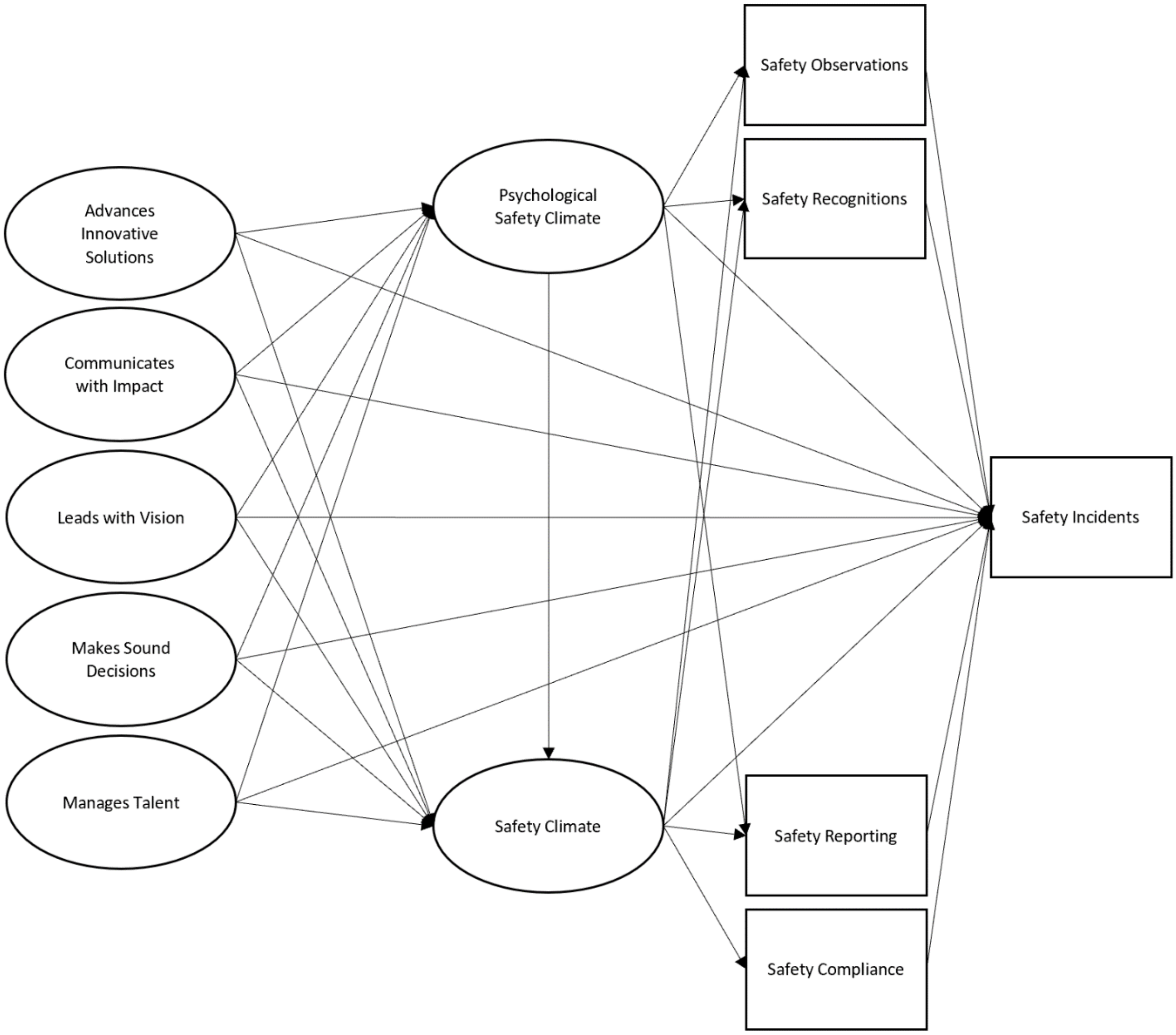

Figure 4. Structural Model 2.

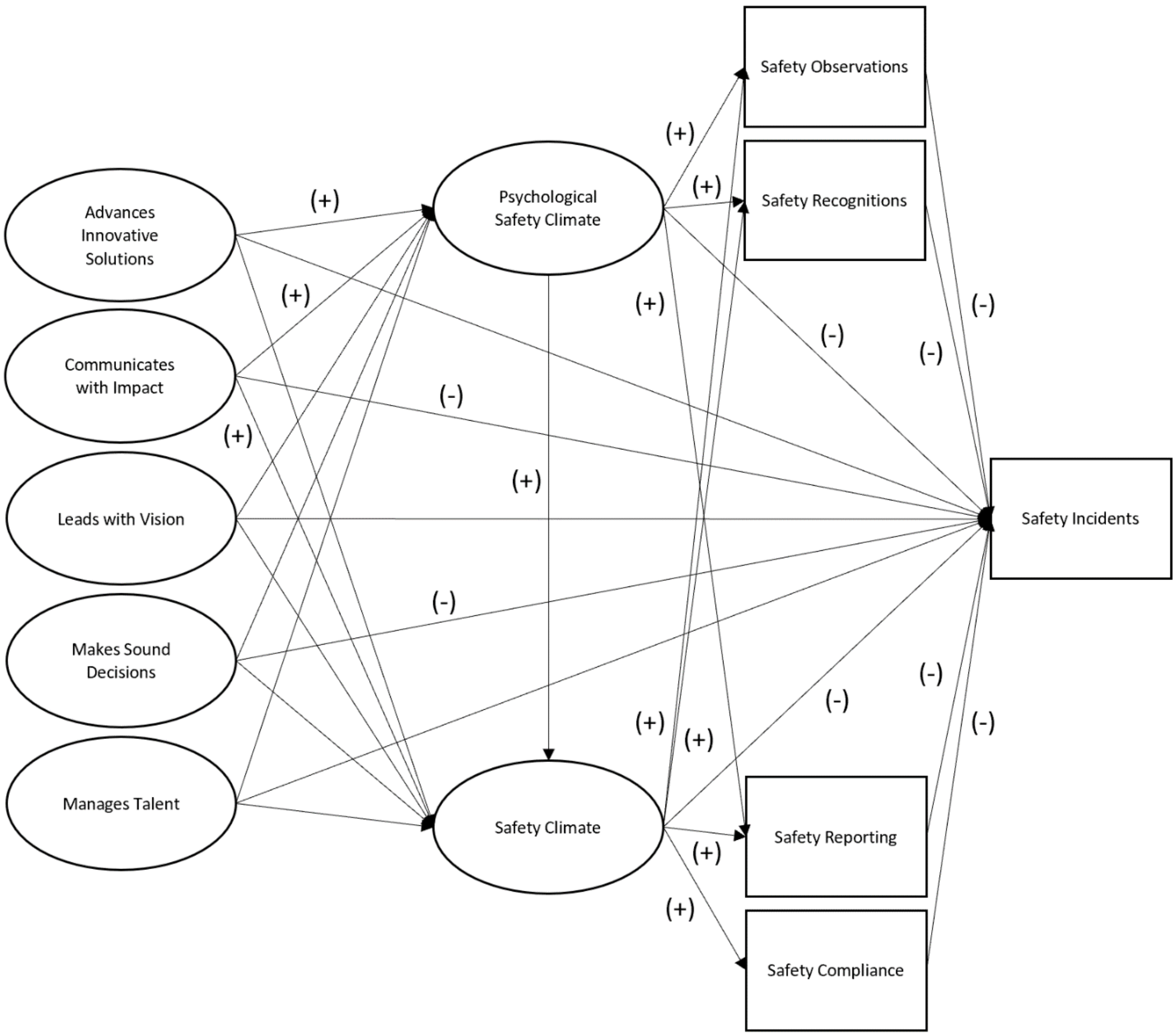

Figure 5. Conceptual Model 2.

Researchers (Hayes & Preacher, 2010; Preacher & Hayes, 2004, 2008; Preacher, Rucker, & Hayes, 2007; Ryu & Cheong, 2017) have studied robust statistical procedures for mediation effects. Preacher and Hayes (2008) recommended investigating multiple mediation with two parts: (a) investigate the total indirect effect or deciding whether the set of mediators transmits the effect of the independent variable to the dependent variable and (b) testing hypotheses regarding individual mediators in the context of a multiple mediator model. Researchers (MacKinnon, Lockwood, & Williams, 2004; Preacher & Hayes, 2004) argued the importance of directly testing the significance of indirect effects through bias-corrected bootstrap or a process by which a sample of the study sample data is taken with replacement from the original sample to estimate the properties of the sampling distribution and corrects for the bias in the central tendency of the estimate. The replacement was recommended to occur at least 1,000 times to obtain the bootstrap confident intervals. In addition, this study contained a conceptual model with multiple mediators. Preacher and Hayes (2008) recommended using bias-corrected bootstrap confident intervals in multiple mediator analysis for estimating total and specific indirect effects, as percentile bootstrap confidence intervals can be asymmetrical on the empirical estimation of the sampling distribution for indirect effects. The first variable was freely estimated, and factor variances were constrained to 1.0.

The analysis controlled for age, gender, length of service, time in job, and work setting – hazard exposure. These variables have been used as control variables in previous studies. Hofmann and Morgeson (1999) found that organizational tenure was significantly related to accidents. Other studies found that age, gender, and job tenure were not significantly related to accidents (Hofmann & Morgeson, 1999; Michael et al., 2006). Willis et al. (2017) found that hazard exposure was significantly correlated to safety participation, which gives support to control for work settings with varying degrees of hazard exposure.

Multigroup SEM was applied to both Model 1 and Model 2. A multigroup SEM analysis tested for group invariance for the factorial structure of the statistical models by testing whether the factor structure was the same across work settings with different levels of hazard exposure – independent samples drawn from the same study sample. Specifically, the analysis determined how the influence of leadership on psychological safety climate and safety climate may differ across work settings. A well-fitting baseline model structure for each group was tested to meet the necessary requisite for testing the multigroup invariance. The first variable was freely estimated, and factor variances were constrained to 1.0.

The first analysis assumed the factor structure was different across the work settings (e.g., configural model with no constraints), while the second analysis assumed the factor structure was the same across work settings (i.e., constrained equal for invariance). For the configural and constrained models, the first variable was freely estimated, factor variances were constrained to 1.0, the factor means were constrained to 0.0, and the variable intercepts were not estimated. The comparison of the model fit between the configural model and constrained model determined which of the two models fit better to the data (Byrne, 2012; Dimitrov, 2006; Muthén & Muthén, 2017; Ryu & Cheong, 2017). Byrne (2012) recommends two criteria to test for invariance – multigroup model exhibits an adequate fit to the data and the change in CFI (and other robust fit indices) values between the configural and constrained models are negligible.

To determine if the conceptual model was equivalent across the work settings, the results of the analysis compared the fit indices (CFI, TLI, RMSEA, SRMR) from a model with only the loadings constrained to be equal across groups, i.e., constrained model, to the fit indices from a model with all parameters allowed to be unequal across groups, i.e., configural model (Byrne, 2012; Dimitrov, 2006; Ryu & Cheong, 2017). The traditional approach to test the model for group invariance uses a change in chi-square goodness of fit statistic value. Researchers (Byrne, 2012; Cheung & Rensvold, 2002; Little, 1997) argued that the change in chi-square fit statistic is sensitive to sample size and non-normality. Some of the data fields were non-normal and the sample size between the office, field – non-hazard, and field – hazard vary significantly making the measurement impractical and unrealistic criterion to base evidence for invariance in this study. The change in CFI value provides the best information for determining evidence for measurement invariance. Little (1997) suggested the difference should not exceed a value of .05, but Cheung and Rensvold (2002) stated the value of .05 does not have a strong theoretical or empirical support. This study used a change in CFI value smaller than or equal to -0.01 to indicate that the null hypothesis of invariance should not be rejected (Cheung & Rensvold, 2002).

In addition to the change in CFI, Ryu and Cheong (2017) recommended both the likelihood ratio test and the Wald test to determine if there was statistical significance between the constrained and unconstrained model for an indirect effect in multigroup analysis. The likelihood ratio test estimates two nested models with and without the constraints and is a more powerful test compared to the Wald test. The Wald test evaluates the asymptotic variance in the indirect effect in the multigroup model and can test multiple parameters simultaneously. If these tests are found to be significant, the less restrictive model fits the data significantly better than the more restrictive model. This information gives support to complete additional analysis to determine the relationships between variables across work settings.

Ryu and Cheong (2017) also recommended bias-corrected confidence intervals as a more powerful test and is more balanced than percentile bootstrap and Monte Carlo confidence intervals; however, bias-corrected has a higher Type I error rate. The bias-corrected confidence interval was used in the multigroup analysis to compare the conceptual model between the different work settings: office, field – non-hazard, and field – hazard work settings.

Assumptions

The intended audience for this research is organizational leaders, health and safety professionals, safety researchers, and safety consultants. The results of this research benefit these audiences by improving effectiveness of leadership development programs, improving safety program interventions, strengthening safety climate practices, and improving workplace environment interventions.

Limitations

The data being used for this study was from one utility company; therefore, the results may not be generalizable to all other utility companies. The safety programs were implemented and managed within multiple departments, so the programs may have been inconsistently applied across participants; some organizations required employees to participate in the safety observation program. The leadership behavior questionnaire was developed by the utility company and does not have psychometric properties, such as reliability and validity of the measurement tool; however, the leadership competencies have content validity, but may not generalize to other organizations. This study tested the internal consistency reliability properties of the questionnaire. Safety incident reporting for close calls, first aid, and safety incident only were not mandatory to report, which may have bias results in the data.

Ethical Assurances

Information was archival, and the participants were not identifiable directly or through identifiers linked to the participants. The investigator did not contact the participants and the investigator did not re-identify participants. The organization was not identified and remained anonymous for the purposes of the study. The company obtained consent from employees to use their responses on the leadership behavior questionnaire for leadership development – improving leadership capabilities and work environment. The results of this study benefits employees and leaders in identifying leadership competencies and behaviors to increase psychological safety and physical safety by decreasing serious injuries and fatalities in the workplace. The safety program records are available to all employees, including trends and descriptive statistics. The

OSHA recordkeeping regulation requires the preparation and maintenance of records of serious occupational injuries and fatalities be reported to OSHA as specified in the OSHA laws & regulations (United States Department of Labor, 2001).

Chapter Summary

This chapter explained the research methodology, such as procedures to complete the research study with a plan for how to analyze the data – the research questions, participants, company settings, research design, research measures, and statistical analysis. A detailed explanation of the problem statement, hypotheses and their rationales, description of data, method of data analysis, and ethical considerations for the study were presented.

The study used confirmatory factor analysis (CFA) to examine the factor structure of leadership competencies, psychological safety climate, and safety climate. The analysis consisted of archival data containing leadership behavior questionnaire responses, records of employees' participation and recognition in safety programs, safety reporting, and safety records. Employees rated their direct supervisor's proficiency of leadership behaviors, psychological safety behaviors, and safety leadership behaviors in a direct report feedback survey.

After applying the parameters set forth in the study, the final dataset for Model 1 contained 3,698 full-time employees that maintained a reporting relationship with the same supervisor for a period of two years from 2013 to 2014 within departments across an electric utility company. Model 1 used the sum of safety incidents for each employee during 2014. Model 2 contained 2,222 full-time employees that maintained a reporting relationship with the same supervisor for a period of three years from 2013 to 2015 within departments across an electric utility company. Model 2 used the sum of safety program participation for each employee during 2014 and the safety incident during 2015. The study included only OSHA recordables in the dependent variable, as they were the only mandatory safety incidents to report by the population.

Using Mplus software (Muthén & Muthén, 2012), confirmatory factor analysis (CFA) established a measurement model and multiple mediation structural equation model (SEM) tested the structural model to determine the influence of leadership competencies on safety incidents through mediation of psychological safety climate, safety climate, safety observations, safety recognitions, safety reporting, and safety compliance. Multiple mediation SEM also tested the hypothesized relationships between the variables as specified in the conceptual model. The study examined how recognition of safety behaviors may impact the relationship between safety climate and number of safety incidents.

Chapter 4: Findings

Introduction

This study employed two models using multiple statistical procedures – confirmatory factor analysis (CFA), multiple mediation structural equation modeling (SEM), and multiple mediation multi-group structural equation modeling (SEM) – to examine the influence of leadership competencies, psychological safety climate, safety climate, safety observations, safety recognitions, safety reporting, and safety compliance on safety incidents. The first statistical procedure – confirmatory factor analysis – tested the relationships between a set of observed variables and a set of continuous latent variables to obtain evidence for the validity of the constructs in the leadership behavior questionnaire. The second statistical procedure – multiple mediation structural equation model (SEM) – tested the hypothesized relationships in the models to determine the influence of leadership competencies on safety incidents through multiple mediators. The final statistical procedure – multiple mediation multi-group structural equation modeling – tested the equivalence of a factorial structure across multiple work settings. This section provides the results of the study, which reports on the demographics, confirmatory factor analysis (CFA), descriptive statistics, psychometric analysis, multiple mediation structural equation modeling (SEM), and multiple mediation multigroup structural equation modeling (SEM).

Demographics

The sample for the study for Model 1 was 3,698 full-time employees who reported directly to supervisor for a two-year period across departments within an electric utility company for a period between 2013 and 2014. Model 2 had 2,222 full-time employees who reported directly to supervisor for a three-year period across departments within an electric utility company for a period between 2013 and 2015. The demographic characteristics for the sample in Model 1 are listed in Table 5 and Model 2 are listed in Table 6. Each of the tables provide the number and percentages of the sample characteristics, including gender, race/ethnicity, age (years), generation, time in job (years), and length of service (years).

The samples for both models were diverse with representation from many demographic groups in today's workforce, including males and females, range of races/ethnicities, age groups, and generations. Most of the sample was male for Model 1 (63%) and Model 2 (62.5%). Most of the sample worked in the office for Model 1 (71.3%) and Model 2 (66.2%). Both males and females are represented equally in the office work setting for Model 1 (52% male, 48% female) and Model 2 (51% male, 49% female) with men having significantly more representation in the field – non-hazard work setting for Model 1 (91.2% male, 8.8% female) and Model 2 (90.3% male, 90.7% female) and field – hazard work setting for Model 1 (88.7% male, 11.3% female) and Model 2 (86.7% male, 13.3% female). There was more representation from Caucasian (Model 1 – 41.6%, Model 2 – 44.3%), Hispanic (Model 1 – 30.4%, Model 2 – 31.2%), and Asian (Model 1 – 18.2%, Model 2 – 15.1%) ethnicities compared to the other groups. Most of the sample was over 40 years of age in Model 1 (67.4%) and Model 2 (69.1%) where Generation X and the Baby Boomer generation have the largest representation. The workforce in the electric utility company was stable with most of the sample having 5 or more years of service; however, there was employee job movement with the company as about half of the employees have 3 or less years' experience within their job.

Table 5

Model 1: Demographic Characteristics for the Sample

Variable	Sample *N*	Sample %	Office *n*	Office %	Field – Non-Hazard *n*	Field – Non-Hazard %	Field – Hazard *n*	Field – Hazard %
Total	3698	100.0	2,637	71.3	617	16.7	444	12.0
Gender								
Male	2,328	63.0	1371	52.0	563	91.2	394	88.7
Female	1,370	37.0	1266	48.0	54	8.8	50	11.3
Race/Ethnicity								
American Indian[a]	18	0.5	13	0.5	3	0.5	2	0.5
Asian	673	18.2	603	22.9	36	5.8	34	7.7
Black[b]	257	6.9	202	7.7	37	6.0	18	4.1
Hispanic	1124	30.4	774	29.4	211	34.2	139	31.3
Native Hawaiian[c]	9	0.2	7	0.3	1	0.2	1	0.2
Two or More Races	80	2.2	68	2.6	8	1.3	4	0.9
White	1537	41.6	970	36.8	321	52.0	246	55.4
Age (years)								
< 25	24	0.6	20	0.8	1	0.2	3	0.7
25-29	223	6.0	176	6.7	19	3.1	28	6.3
30-34	469	12.7	348	13.2	64	10.4	57	12.8
35-39	492	13.3	355	13.5	72	11.7	65	14.6
40-44	476	12.9	337	12.8	82	13.3	57	12.8
45-49	521	14.1	379	14.4	86	13.9	56	12.6
50-54	628	17.0	420	15.9	128	20.7	80	18.0
55-59	569	15.4	379	14.4	124	20.1	66	14.9
60-64	223	6.0	163	6.2	36	5.8	24	5.4
> 65	73	2.0	60	2.3	5	0.8	8	1.8
Generation								
Millennial	510	13.8	381	14.4	64	10.4	65	14.6
Gen X	1568	42.4	1142	43.3	237	38.4	189	42.6
Boomer	1592	43.1	1092	41.4	313	50.7	187	42.1
Traditional	28	0.8	22	0.8	3	0.5	3	0.7
Time in Job (years)								
0 – 1	1114	30.1	770	29.2	200	32.4	144	32.4
> 1 – 3	840	22.7	645	24.5	95	15.4	100	22.5
> 3 – 5	698	18.9	564	21.4	70	11.3	64	14.4
> 5 – 10	733	19.8	514	19.5	135	21.9	84	18.9
> 10 – 20	313	8.5	144	5.5	117	19.0	52	11.7
Length of Service (years)								
0 – 1	36	1.0	32	1.2	1	0.2	3	0.7
> 1 – 3	306	8.3	268	10.2	10	1.6	28	6.3
> 3 – 5	591	16.0	513	19.5	28	4.5	50	11.3
> 5 – 10	1050	28.4	730	27.7	169	27.4	151	34.0
> 10 – 20	798	21.6	557	21.1	149	24.1	92	20.7
> 20	917	24.8	537	20.4	260	42.1	120	27.0

Note. Complete labels for the Race/Ethnicity are [a]American Indian or Alaskan Native, [b]Black or African American, [c]Native Hawaiian or Other Pacific Islander.

Table 6

Model 2: Demographic Characteristics for the Sample

Variable	Sample *N*	Sample %	Office *n*	Office %	Field – Non-Hazard *n*	Field – Non-Hazard %	Field – Hazard *n*	Field – Hazard %
Total	2222	100.0	1470	66.2	452	20.3	300	13.5
Gender								
Male	1389	62.5	721	49.0	408	90.3	260	86.7
Female	833	37.5	749	51.0	44	9.7	40	13.3
Race/Ethnicity								
American Indian[a]	14	0.6	9	0.6	3	0.7	2	0.7
Asian	335	15.1	283	19.3	29	6.4	23	7.7
Black[b]	147	6.6	113	7.7	24	5.3	10	3.3
Hispanic	694	31.2	456	31.0	146	32.3	92	30.7
Native Hawaiian[c]	4	0.2	3	0.2	0	0.0	1	0.3
Two or More Races	44	2.0	35	2.4	6	1.3	3	1.0
White	984	44.3	571	38.8	244	54.0	169	56.3
Age (years)								
< 25	15	0.7	12	0.8	1	0.2	2	0.7
25-29	118	5.3	87	5.9	12	2.7	19	6.3
30-34	269	12.1	188	12.8	44	9.7	37	12.3
35-39	305	13.7	206	14.0	51	11.3	48	16.0
40-44	276	12.4	178	12.1	59	13.1	39	13.0
45-49	320	14.4	218	14.8	67	14.8	35	11.7
50-54	402	18.1	243	16.5	98	21.7	61	20.3
55-59	354	15.9	219	14.9	94	20.8	41	13.7
60-64	125	5.6	86	5.9	24	5.3	15	5.0
> 65	38	1.7	33	2.2	2	0.4	3	1.0
Generation								
Millennial	290	13.1	200	13.6	43	9.5	47	15.7
Gen X	933	42.0	635	43.2	172	38.1	126	42.0
Boomer	987	44.4	624	42.4	236	52.2	127	42.3
Traditional	12	0.5	11	0.7	1	0.2	0	0.0
Time in Job (years)								
0 – 1	692	31.1	456	31.0	145	32.1	91	30.3
> 1 – 3	503	22.6	366	24.9	73	16.2	64	21.3
> 3 – 5	378	17.0	279	19.0	52	11.5	47	15.7
> 5 – 10	455	20.5	293	19.9	100	22.1	62	20.7
> 10 – 20	194	8.7	76	5.2	82	18.1	36	12.0
Length of Service (years)								
0 – 1	24	1.1	21	1.4	1	0.2	2	0.7
> 1 – 3	156	7.0	130	8.8	8	1.8	18	6.0
> 3 – 5	301	13.5	244	16.6	20	4.4	37	12.3
> 5 – 10	647	29.1	416	28.3	128	28.3	103	34.3
> 10 – 20	499	22.5	329	22.4	113	25.0	57	19.0
> 20	595	26.8	330	22.4	182	40.3	83	27.7

Note. Complete labels for the Race/Ethnicity are [a]American Indian or Alaskan Native, [b]Black or African American, [c]Native Hawaiian or Other Pacific Islander.

Confirmatory Factor Analysis

Confirmatory factor analysis (CFA) with maximum likelihood estimation tested the relationships between a set of observed variables and a set of continuous latent variables by means of Mplus software (Muthén & Muthén, 2012) to obtain evidence for the validity of the constructs in the leadership behavior questionnaire. The Mplus syntax for the measurement model can be found in Appendix C. The measurement model as shown in Figure 1 located in Chapter 3 displays the relationships between the 34 continuous observed variables and 7 first-order continuous latent variables.

The CFA determined that the hypothesized seven-factor model has a good fit to the data. The initial model fit for the chi-square test of model fit was significant at $\chi^2(506) = 6410.810$, $p < 0.001$, which indicated that the structured model has better fit than an unstructured model. Two of the other most common incremental indices of model fit are the comparative fit index (Bentler, 1990) and Tucker Lewis index (Tucker, L. & Lewis, 1973). The measurement model has a CFI = 0.950 and TLI = 0.945, which indicated a well-fitting model. The cutoff for both fit statistics is close to or greater than 0.95 (Hu & Bentler, 1999). The root mean square error of approximation (RMSEA) is a discrepancy per degree of freedom in a model (Browne & Cudeck, 1992). The RMSEA for the analysis was 0.056, which is considered to have good fit at 0.06 between the hypothesized model and observed data (Byrne, 2012; Hu & Bentler, 1999). The standardized root mean square residual (SRMR), or the average value across all standardized residuals, for the model was 0.036. The SRMR for the model meets the recommended value of 0.05 or less for a well-fitting model (Byrne, 2012).

Overall, the model fit statistics indicated a good model fit to the data; however, the modification indices indicated an opportunity to increase model fit to the data. After reviewing the modification indices and content of item PS1, the item fit better with leads with vision. The item was moved from psychological safety climate to load on leads with vision. The Mplus syntax for the respecified model can be found in Appendix D. The respecified model fit to the data, $\chi^2(506) = 5927.919$, $p < 0.001$; CFI = 0.954, TLI = 0.949, RMSEA = 0.054, SRMR = 0.033. The fit indices for the initial and respecified models can be found in Table 7.

Table 7

Fit Indices of Measurement Model for the Leadership Behavior Questionnaire

Model	χ^2	*df*	$\Delta\chi^2$	CFI	TLI	RMSEA	SRMR
1. Initial Model	6410.810***	506		0.950	0.945	0.056	0.036
2. Respecified Model	5927.919***	506	482.891	0.954	0.949	0.054	0.033

Note. *N* = 3,698. χ^2 = chi-square goodness-of-fit; *df* = degrees of freedom; CFI = comparative fit index; TLI = Tucker-Lewis index; RMSEA = root mean square error of approximation; SRMR = root mean square residual.
*** $p < .001$

An analysis of the measurement model revealed that all the paths between the first-order latent variables and their respective observed variables were significant as they achieved the desired values of the standardized path coefficients (>0.5) and squared multiple correlations (>0.25). The standardized and unstandardized coefficients for the observed variables on the leadership behavior questionnaire can be found on Table 8. The standardized coefficients and covariances for the measurement can be found on Figure 6.

Table 8

Standardized and Unstandardized Coefficients for CFA

Item No.	Item Description	λ*	λ	*SE*
	Advances Innovative Solutions			
AIS1	Provides the latitude and support to examine the full potential of new ideas; challenges old paradigms.	0.857	0.967	0.015
AIS2	Draws on resources to create innovative solutions.	0.863	1.003	0.015
AIS3	Rewards innovative thinking.	0.769	1.080	0.020
AIS4	Shapes potential solutions into practical business opportunities.	0.818	1.083	0.018
AIS5	Ensures that new ideas are implemented, supported, and refined.	0.847	1.033	0.016
	Communicates with Impact			
CWI1	Communicates directly and with candor.	0.840	0.895	0.014
CWI2	Adjusts style to the audience and knows others' perspectives and motivations.	0.833	0.971	0.016
CWI3	Listens actively and builds on others' ideas.	0.883	0.980	0.014
CWI4	Preserves and strengthens relationships with each communication.	0.893	1.017	0.015
CWI5	Ensures that messages are heard and acted upon.	0.856	0.956	0.015
	Leads with Vision			
LWV1	Implements new strategies throughout the organization.	0.769	1.129	0.021
LWV2	Keeps others focused on the future.	0.845	1.037	0.016
LWV3	Creates plans that balance near- and long-term needs.	0.870	1.160	0.018
LWV4	Links vision and strategy to practical business results.	0.876	1.183	0.018
LWV5	Conceives visionary ideas and builds on the strategic ideas of others.	0.860	1.206	0.019
PS1	Challenges current practices when necessary to ensure alignment with company values.	0.735	0.969	0.019
	Makes Sound Decisions			
MSD1	Takes accountability for making and implementing decisions; respects the decision-making authority of others.	0.821	0.984	0.016
MSD2	Makes unpopular decisions when it is the right direction for the organization.	0.584	0.951	0.025
MSD3	Knows when to include others in the decision-making process.	0.832	1.046	0.017
MSD4	Makes timely decisions.	0.856	1.006	0.016
MSD5	Uses the appropriate level of analysis given the risks and complexities of a decision.	0.816	1.063	0.018
	Manages Talent			
MT1	Shapes roles and assignments to leverage and develop capabilities.	0.844	1.078	0.017
MT2	Motivates, challenges, and rewards top performance; confronts and manages underperformance.	0.830	1.190	0.019
MT3	Provides valuable feedback on a regular basis.	0.850	1.046	0.016
MT4	Builds a strong team; develops bench strength at all levels within the organization.	0.865	1.210	0.019
MT5	Evaluates, hires, promotes, and shares top talent.	0.691	1.186	0.025
	Psychological Safety Climate			
PS2	Models work behaviors that reinforce our company values.	0.828	0.920	0.015
PS3	Creates a work environment where employees feel supported and can learn from mistakes.	0.894	1.076	0.016
PS4	Treats people with respect and assumes positive intentions.	0.846	0.904	0.014
PS5	Provides honest feedback and constructive coaching.	0.878	1.008	0.015
	Safety Climate			
SC1	Holds self and others accountable for following safety rules, policies, and guidelines.	0.818	0.863	0.015
SC2	Corrects or stops unsafe behavior.	0.820	1.155	0.020
SC3	Ensures safety is integrated into daily work activities.	0.878	1.037	0.016
SC4	Recognizes others for safe and effective work practices.	0.809	1.124	0.019

Note. *N* = 3,698. Measurement model was respecified to move PS1 from psychological safety climate to leads with vision. CFA = Confirmatory Factor Analysis. λ* = standardized coefficient of a directional relation between a latent variable and its indicators. λ = unstandardized coefficient of a directional relation between a latent variable and its indicators. SE = standard error.

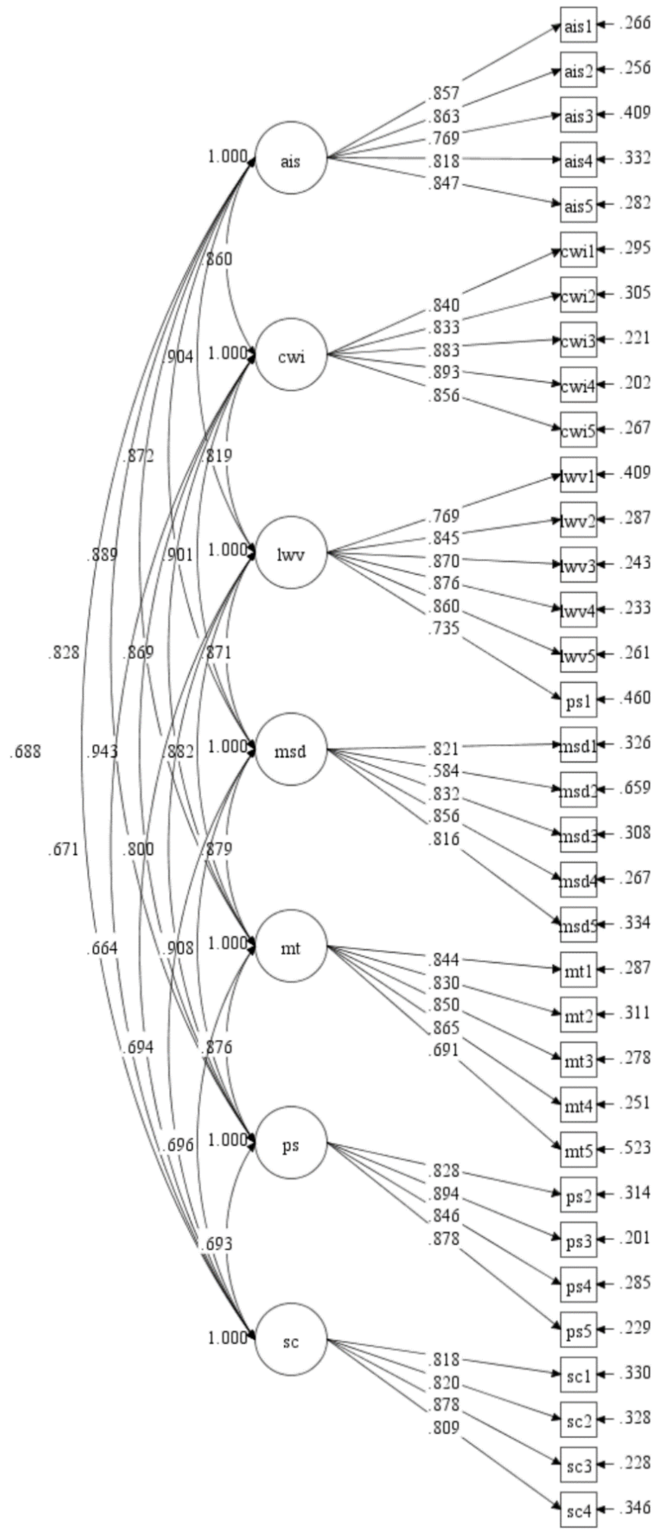

Figure 6. Results of the confirmatory factor analysis (CFA) for the measurement model. N = 3,698. Chi-square test of model fit = $\chi^2(506) = 5927.919$, $p < 0.001$. Comparative fit index = 0.954. Tucker-Lewis index = 0.949. Root mean square error of approximation = 0.054. Root mean square residual = 0.033.

Descriptive Statistics

The descriptive statistics for the variables from each of the three working conditions are listed in Table 9 for Model 1 as per their age, time in job, length of service, leadership competencies, safety participation, safety recognition, and safety incidents. The average age of the sample was 45.97 years (*SD* = 10.51, range = 21.68 – 73.87). The average time in their job was 3.87 years (*SD* = 3.87, range = 0.00 – 18.30) and average length of service in the utility company was 13.13 years (*SD* = 10.11, range = 0.04 – 47.26).

Table 9

Model 1: Descriptive Statistics for the Sample and Across Work Settings

	Sample (*N* = 3,698)		Office (*n* = 2,637)		Field – Non-Hazard (*n* = 617)		Field – Hazard (*n* = 444)	
Variable	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Age	45.97	10.51	45.65	10.69	47.51	9.58	45.71	10.50
Time in Job	3.87	3.87	3.51	3.32	5.35	5.27	4.00	4.12
Length of Service	13.13	10.11	11.87	9.61	18.04	10.52	13.84	10.29
Advances Innovative Solutions	3.78	1.08	3.76	1.08	3.77	1.11	3.91	1.03
Communicates with Impact	3.95	1.00	3.95	0.99	3.93	1.02	4.04	1.00
Leads with Vision	3.63	1.19	3.62	1.18	3.55	1.26	3.76	1.14
Makes Sound Decisions	3.81	1.08	3.79	1.09	3.82	1.09	3.91	1.04
Manages Talent	3.53	1.21	3.52	1.21	3.49	1.22	3.62	1.19
Psychological Safety Climate	4.01	1.00	4.01	1.00	3.94	1.06	4.09	0.96
Safety Climate	4.07	1.10	3.99	1.16	4.24	0.96	4.29	0.89
Safety Incidents Total[a]	0.108	0.400	0.094	0.338	0.118	0.419	0.176	0.634
Close Calls	0.040	0.286	0.035	0.217	0.034	0.313	0.077	0.515
First Aid	0.012	0.112	0.009	0.104	0.015	0.120	0.020	0.141
Incident Only	0.034	0.186	0.033	0.185	0.032	0.177	0.043	0.203
OSHA Recordables[b]	0.022	0.146	0.016	0.125	0.037	0.190	0.036	0.187
Hearing Loss	0.001	0.023	0.001	0.028	0.000	0.000	0.000	0.000
Lost Time	0.007	0.084	0.003	0.058	0.018	0.132	0.014	0.116
No Lost Time	0.014	0.116	0.012	0.108	0.018	0.132	0.018	0.133
Restricted Days Away	0.001	0.028	0.000	0.000	0.002	0.040	0.005	0.067

Note. Safety records are reported in average annual occurrences per employee during 2014. [a]Safety Incidents Total is represented as the average of the sum of all incidents. [b]OSHA recordables is represented as the average of the sum of hearing loss, lost time, no lost time, and restricted days away.

The sample reported positive perceptions of psychological safety climate and safety climate with higher comparative mean scores for both psychological safety climate (*M* = 4.01, *SD* = 1.00) and safety climate (*M* = 4.07, *SD* = 1.10) than the leadership competencies. The participants in the field locations indicated higher perceptions of safety climate than the office setting. There was a positive trend of higher average number of safety incidents totals and OSHA recordables as employees are exposed to hazardous work conditions; both the field locations have a higher average number of safety incidents than the office setting.

The descriptive statistics for the variables from each of the three working conditions for Model 2 are listed in Table 10. The descriptive statistics for Model 2 are similar to Model 1. The field employees exposed to hazardous work conditions had higher average participation in safety programs than employees working in non-hazardous conditions and office setting. There was a similar average number of safety incidents and OSHA recordables across the office, field – non-hazard, and field – hazard work settings.

Table 10

Model 2: Descriptive Statistics for the Sample and Across Work Settings

Variable	Sample (*N* = 2,222)		Office (*n* = 1,470)		Field – Non-Hazard (*n* = 452)		Field – Hazard (*n* = 300)	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Age	46.18	10.29	45.85	10.53	47.77	9.32	45.36	10.30
Time in Job	3.89	3.93	3.42	3.33	5.24	5.13	4.14	4.12
Length of Service	13.76	10.18	12.52	9.74	17.84	10.55	13.71	10.17
Advances Innovative Solutions	3.79	1.07	3.77	1.06	3.79	1.09	3.92	1.03
Communicates with Impact	3.95	1.01	3.93	1.01	3.95	1.01	4.04	1.03
Leads with Vision	3.66	1.15	3.65	1.14	3.60	1.21	3.83	1.07
Makes Sound Decisions	3.80	1.07	3.78	1.08	3.82	1.07	3.90	1.02
Manages Talent	3.53	1.19	3.53	1.19	3.52	1.20	3.62	1.20
Psychological Safety Climate	4.05	1.03	4.05	1.02	4.02	1.05	4.11	1.02
Safety Climate	4.06	1.09	3.95	1.16	4.28	0.93	4.30	0.86
Safety Observations	0.597	11.116	0.384	8.716	0.091	1.432	2.041	21.402
Safety Recognitions	0.074	0.721	0.049	0.602	0.113	0.408	0.145	0.503
Safety Reporting	0.044	0.310	0.038	0.215	0.042	0.353	0.077	0.546
Safety Compliance	0.079	0.354	0.042	0.248	0.113	0.408	0.145	0.503
Total Safety Incidents[a]	0.104	0.435	0.099	0.405	0.137	0.572	0.083	0.322
Close Calls	0.040	0.340	0.033	0.292	0.071	0.515	0.023	0.190
First Aid	0.010	0.101	0.007	0.086	0.013	0.115	0.020	0.140
Incident Only	0.032	0.187	0.037	0.207	0.024	0.154	0.013	0.115
OSHA Recordables[b]	0.023	0.159	0.020	0.151	0.029	0.167	0.027	0.181
Hearing Loss	0.001	0.030	0.000	0.000	0.004	0.066	0.000	0.000
Lost Time	0.006	0.079	0.003	0.058	0.013	0.115	0.010	0.100
No Lost Time	0.016	0.132	0.017	0.139	0.011	0.105	0.017	0.128
Restricted Days Away	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Note. Safety records are reported in average annual occurrences per employee during 2015. [a]Safety participation is the average of the sum of safety observations and recognitions given. [b]Safety Incidents is represented as the average of the sum of all OSHA recordables. [c]OSHA recordables are represented as the average of the sum of hearing loss, lost time, no lost time, and restricted days away.

Psychometric Analysis

The leadership behavior questionnaire has an overall Cronbach's coefficient alpha of 0.978, which is considered a reliable instrument. Table 11 shows the correlations and reliability for all the variables in Model 1. All the leadership competency scales have either excellent or very good reliabilities as they are above .8 for psychological constructs (Kline, 2011). All the leadership competencies are significantly positively related to each other and they are also significantly positively related to safety climate and psychological safety climate. The dependent variable safety incidents, or OSHA recordables, was negatively related to all the leadership competencies, psychological safety climate, and safety climate. All the control variables had a significant positive relationship with safety incidents – hazard exposure (*r* = .06, *p* < .001), time in job (*r* = .06, *p* < .001), length of service (*r* = .04, *p* = .009), and age (*r* = .03, *p* = .037). Gender is categorical and was not included in the correlations.

Table 11

Model 1: Correlations and Reliabilities for all Variables

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Advances Innovative Solutions	**.91**	.86**	.90**	.87**	.89**	.85**	.69**	-	-	-	-	-	-
2. Communicates with Impact	.80**	**.94**	.81**	.90**	.87**	.94**	.67**	-	-	-	-	-	-
3. Leads with Vision	.84**	.76**	**.93**	.86**	.88**	.81**	.65**	-	-	-	-	-	-
4. Makes Sound Decisions	.79**	.81**	.81**	**.88**	.88**	.92**	.69**	-	-	-	-	-	-
5. Manages Talent	.82**	.79**	.81**	.79**	**.90**	.89**	.70**	-	-	-	-	-	-
6. Psychological Safety Climate	.76**	.88**	.75**	.81**	.78**	**.92**	.71**	-	-	-	-	-	-
7. Safety Climate	.64**	.62**	.62**	.63**	.63**	.64**	**.89**	-	-	-	-	-	-
8. Safety Incidents	-.01	-.03	-.02	-.02	-.01	-.02	-.01	-	-	-	-	-	-
9. Hazard Exposure	.04*	.02	.03	.04*	.02	.01	.11**	.06**	-	-	-	-	-
10. Time in Job	-.00	-.03	-.02	-.01	-.01	-.03	.03	.06**	.10**	-	-	-	-
11. Length of Service	-.03*	-.06**	-.03	-.02	-.05**	-.06**	.02	.04*	.14**	.46**	-	-	-
12. Age	-.08**	-.07**	-.08**	-.05**	-.08**	-.07**	-.04*	.03*	.03	.34**	.57**	-	-

Note. *N* = 3,698. Values above the diagonal represent standardized correlations among the first-order factors; values below the diagonal represent correlations among the scales. Scale reliabilities are show along the diagonal (Cronbach's Alpha). **Correlation is significant at the 0.01 level (2-tailed). *Correlation is significant at the 0.05 level (2-tailed).

Table 12 shows the correlations and reliability for all the variables in model 2. The psychometric properties for Model 2 was similar to Model 1. Safety behavior was significantly positively correlated with makes sound decisions (*r* = 0.05, *p* = 0.049), and safety climate (*r* = 0.06, *p* = 0.011), safety recognitions (*r* = 0.25, *p* < .001), and safety incidents (*r* = 0.07, *p* = .003). Hazard exposure has a significant positive relationship with safety climate (*r* = .11, *p* < .01), safety participation (*r* = .05, *p* < .01), safety recognition (*r* = .14, *p* < .01), and safety incidents (*r* = .06, *p* < .01). Time in job had significant relationships with safety climate (*r* = 0.04, *p* = .037), safety reporting (*r* = -0.05, *p* = .012), safety behavior (*r* = 0.06, *p* = .015), and safety incidents (r = 0.05, p = .018). Compared to Model 1, time in job was the only control variable that had a significant relationship with safety incidents.

Table 12

Model 2: Correlations and Reliabilities for all Variables

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1. AIS	**.91**	.86**	.90**	.87**	.89**	.85**	.69**	-	-	-	-	-	-	-	-	-	-
2. CWI	.81**	**.94**	.81**	.90**	.87**	.94**	.67**	-	-	-	-	-	-	-	-	-	-
3. LWV	.84**	.77**	**.93**	.86**	.88**	.81**	.65**	-	-	-	-	-	-	-	-	-	-
4. MSD	.79**	.81**	.81**	**.88**	.88**	.92**	.69**	-	-	-	-	-	-	-	-	-	-
5. MT	.82**	.79**	.81**	.79**	**.90**	.89**	.70**	-	-	-	-	-	-	-	-	-	-
6. PS	.77**	.88**	.75**	.80**	.79**	**.92**	.71**	-	-	-	-	-	-	-	-	-	-
7. SC	.63**	.61**	.61**	.61**	.63**	.63**	**.89**	-	-	-	-	-	-	-	-	-	-
8. SO	-.01	-.01	.00	.01	-.00	.01	-.00	-	-	-	-	-	-	-	-	-	-
9. SN	.02	.01	.01	.02	.00	-.01	.01	-.01	-	-	-	-	-	-	-	-	-
10. ICC	.10	.01	.01	-.00	.02	.02	.01	-.01	.01	-	-	-	-	-	-	-	-
11. SR	.04	.02	.03	.05*	.04	.03	.06*	-.01	.25*	-.03	-	-	-	-	-	-	-
12. IOS	-.02	-.02	-.02	-.02	-.02	-.03	.00	-.01	.01	-.02	.07**	-	-	-	-	-	-
13. HAZ	.05*	.03	.04	.04	.02	.01	.14**	.04	.07**	.04	.12	.20	-	-	-	-	-
14. TIJ	.01	-.02	-.01	-.00	-.02	-.04	.04*	-.02	-.00	-.05*	.06*	.05*	.12**	-	-	-	-
15. LOS	-.02	-.04*	-.02	-.01	-.05*	-.07**	.03	.01	.00	.00	.03	.03	.11**	.47**	-	-	-
16. AGE	-.08**	-.07**	-.08**	-.06**	-.08**	-.08**	-.04*	-.00	-.02	.04	.01	.01	.01	.35**	.58**	-	-

Note. N = 2,222. Control variables in the study are HAZ = Hazard exposure, TIJ = Time in job, LOS = Length of service, and Gen = Gender. Variables in the study are 1 = advances innovative solutions, 2 = communicates with impact, 3 = leads with vision, 4 = makes sound decisions, 5 = manages talent, 6 = psychological safety climate, 7 = safety climate, 8 = safety observations, 9 = safety recognitions, 10 = safety reporting, 11 = safety compliance, 12 = safety incidents, 13 = hazard exposure, 14 = time in job, 15 = length of service, and 16 = age.
**Correlation is significant at the 0.01 level (2-tailed). *Correlation is significant at the 0.05 level (2-tailed).

Structural Equation Model

Multiple mediation structural equation model (SEM) tested the hypothesized relationships in the models to determine the influence of leadership competencies on safety incidents through mediation of safety climate, psychological safety climate, and participation in safety programs. For Model 1 the full multiple mediation SEM assumed the influence of leadership competencies were intercorrelated and that they influence safety incidents directly and indirectly through psychological safety climate and safety climate. For Model 2, the full multiple mediation SEM assumed the influence of leadership competencies were intercorrelated and that they influence safety incidents directly and indirectly through psychological safety climate, safety climate, safety observations, safety recognitions, safety reporting, and safety compliance.

Multiple Mediation Structural Equation Model 1 Analysis

A multiple mediation analysis with bias-corrected confident interval estimations (Preacher & Hayes, 2008) tested the direct and indirect effects in Model 1 using Mplus software version 7.23 (Muthén & Muthén, 2012). The Mplus syntax for the multiple mediation analysis for Model 1 can be found in Appendix E. Specifically, the model specified the direct relationships between leadership competencies, psychological safety climate, safety climate, and safety incidents. The model included the indirect effects between the leadership competencies and safety incidents through multiple mediators – psychological safety climate, safety climate. Testing for the direct and indirect effects in the analysis included bias-corrected bootstrap confidence interval procedure (MacKinnon et al., 2004; Preacher & Hayes, 2004) with 5,000 replications (see Figure 7). The first variable was freely estimated, and factor variances were constrained to 1.0. Overall, the model fit statistics indicated a good model fit to the data, $\chi^2(693) = 6287.878$, $p < 0.001$; CFI = 0.953, TLI = 0.948, RMSEA = 0.047, SRMR = 0.033. Figure 8 shows the results of the multiple mediation structural equation model analysis and shows the significant relationships between the study variables.

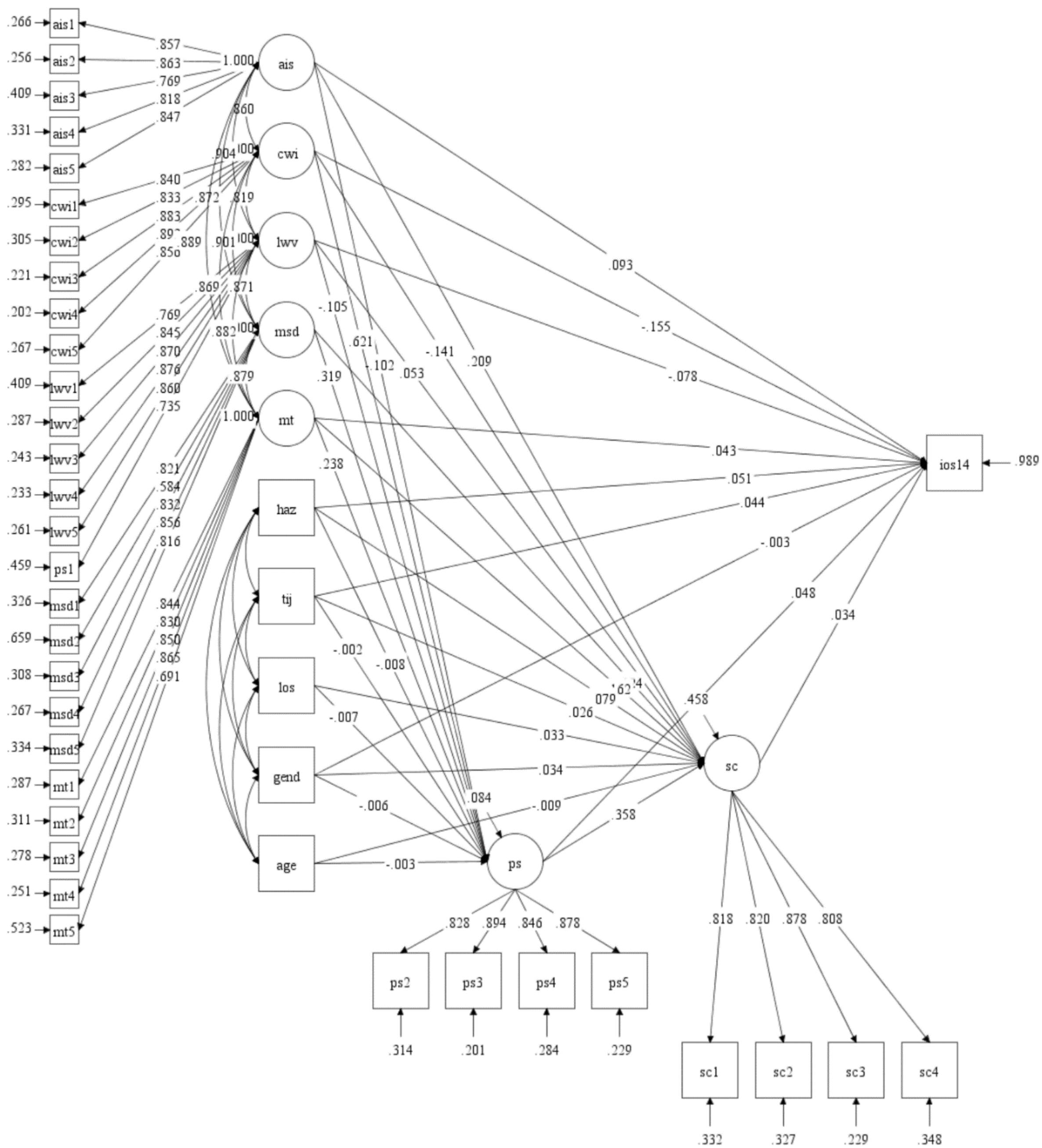

Figure 7. Multiple mediator structural equation Model 1 Mplus diagram. Model includes the indicators for the latent variables and the direct and indirect effects between the leadership competencies and safety incidents with multiple mediators – psychological safety climate, safety climate – controlling for age, gender, length of service, time in job, and work setting – hazard exposure. *N* = 3,698. Direct and indirect effects analyzed with bias-corrected bootstrap confident interval procedure with 5,000 replications. Numbers are the standardized estimates of the model. Variables are ais = advances innovative solutions, cwi = communicates with impact, lwv = leads with vision, msd = makes sound decisions, mt = manages talent, haz = hazard exposure, tij = time in job, los = length of service, age = age, ps = psychological safety climate, sc = safety climate, and ios14 = safety incidents.

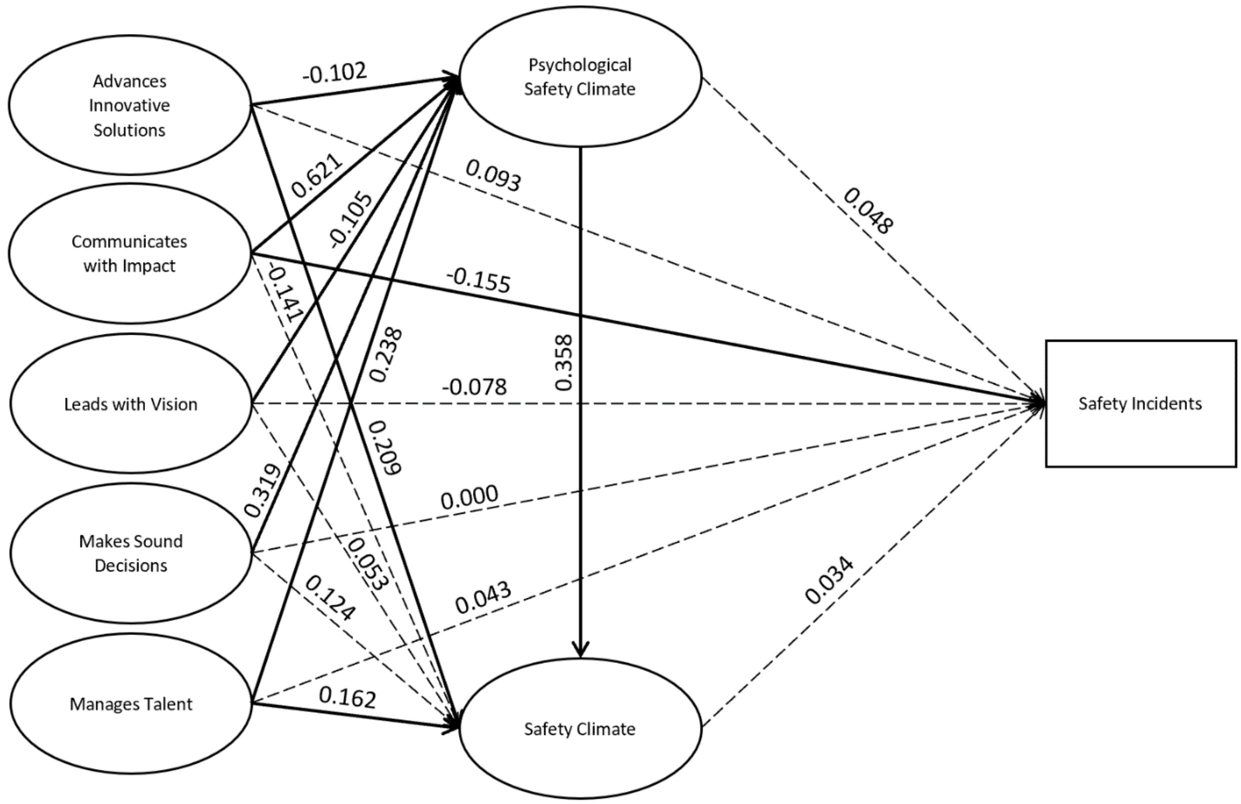

Figure 8. Multiple mediator structural equation Model 1 results. The model determined the influence of leadership competencies on safety incidents through mediation of safety climate and psychological safety climate controlling for age, gender, length of service, time in job, and work setting – hazard exposure. *N* = 3,698. Direct and indirect effects analyzed with bias-corrected bootstrap confident interval procedure with 5,000 replications. Numbers are the standardized estimates of the model. Bold lines indicate bias-corrected bootstrap significance. Dashed lines indicate the parameters that were not significant with the bias-corrected bootstrap.

The model controlled for age, gender, length of service, time in job, and work setting – hazard exposure. Table 13 presents the results for the control variables in the multiple mediator SEM analysis. The control variables that significantly predicted safety incidents are time in job ($\gamma = 0.002$, $p = 0.045$) and hazard exposure ($\gamma = 0.011$, $p = 0.011$).

Table 13

Model 1: Direct Effects for the Control Variables in the SEM

Variable	γ	Product of Coefficients *SE*	Product of Coefficients *p*	γ*	Bootstrap BC 95% CI Lower	Bootstrap BC 95% CI Upper
Direct Effects						
Safety Incidents						
Age	0.000	0.000	0.458	0.014	0.000	0.001
Gender	-0.001	0.005	0.870	-0.003	-0.011	0.008
Length of Service	0.000	0.000	0.839	0.005	-0.001	0.001
Time in Job	0.002	0.001	0.045	0.044	0.000	0.003
Hazard Exposure	0.011	0.004	0.011	0.051	0.003	0.020
Psychological Safety Climate						
Age	-0.001	0.003	0.713	-0.003	-0.007	0.005
Gender	-0.044	0.057	0.433	-0.006	-0.155	0.069
Length of Service	-0.002	0.003	0.479	-0.007	-0.009	0.004
Time in Job	-0.002	0.008	0.802	-0.002	-0.017	0.014
Hazard Exposure	-0.039	0.041	0.335	-0.008	-0.122	0.043
Safety Climate						
Age	-0.001	0.002	0.584	-0.009	-0.006	0.003
Gender	0.104	0.044	0.017	0.034	0.018	0.188
Length of Service	0.005	0.002	0.044	0.033	0.000	0.010
Time in Job	0.010	0.005	0.036	0.026	0.000	0.019
Hazard Exposure	0.168	0.024	0.000	0.079	0.120	0.214

Note. *N* = 3,698. γ = unstandardized coefficient. γ* = standardized coefficient. BC 95% CI = bias corrected 95% confidence interval, 5,000 bootstrap sample. Gender was coded as 0 = female and 1 = male. Hazard exposure was coded as 1 = office, 2 = field – non-hazard, and 3 = field – hazard. Age, length of service, and time in job were coded in years.

Table 14 presents the results of the multiple mediator SEM for the direct effects. Table 15 presents the results of the multiple mediator SEM for the indirect effects, which includes both the total indirect effect with the set of mediators transmitting the effect of the independent variable to the dependent variable and results of the individual mediators in the context of a multiple mediator model.

Table 14

Model 1: Direct Effects in the SEM for Leadership Influence on Safety Incidents

Variable	*B*	Product of Coefficients *SE*	Product of Coefficients *p*	β	Bootstrap BC 95% CI Lower	Bootstrap BC 95% CI Upper
Direct Effects						
Safety Incidents						
Advances Innovative Solutions	0.014	0.010	0.193	0.093	-0.006	0.035
Communicates with Impact	-0.023	0.012	0.056	-0.155	-0.048	-0.001
Leads with Vision	-0.011	0.010	0.251	-0.078	-0.033	0.006
Makes Sound Decisions	0.000	0.010	0.999	0.000	-0.021	0.018
Manages Talent	0.006	0.008	0.422	0.043	-0.009	0.021
Psychological Safety Climate	0.002	0.004	0.608	0.048	-0.005	0.010
Safety Climate	0.003	0.003	0.231	0.034	-0.002	0.009
Psychological Safety Climate						
Advances Innovative Solutions	-0.351	0.139	0.011	-0.102	-0.639	-0.091
Communicates with Impact	2.145	0.176	0.000	0.621	1.807	2.499
Leads with Vision	-0.362	0.132	0.006	-0.105	-0.621	-0.102
Makes Sound Decisions	1.104	0.193	0.000	0.319	0.744	1.502
Manages Talent	0.823	0.139	0.000	0.238	0.557	1.097
Safety Climate						
Advances Innovative Solutions	0.308	0.107	0.004	0.209	0.100	0.514
Communicates with Impact	-0.209	0.139	0.133	-0.141	-0.480	0.061
Leads with Vision	0.078	0.088	0.372	0.053	-0.082	0.255
Makes Sound Decisions	0.184	0.124	0.140	0.124	-0.047	0.443
Manages Talent	0.240	0.105	0.022	0.162	0.035	0.449
Psychological Safety Climate	0.153	0.045	0.001	0.358	0.068	0.242

Note. *N* = 3,698. *B* = unstandardized coefficient. β = standardized coefficient. BC 95% CI = bias corrected 95% confidence interval, 5,000 bootstrap sample. Controlled for age, gender, length of service, time in job, and work setting – hazard exposure.

Table 15

Model 1: Indirect Effects in the SEM for Leadership Influence on Safety Incidents

Variable	*B*	Product of Coefficients *SE*	*p*	β	Bootstrap BC 95% CI Lower	Upper
Indirect Effects						
Safety Incidents						
Psychological Safety Climate						
Advances Innovative Solutions	-0.001	0.002	0.651	-0.005	-0.005	0.002
Communicates with Impact	0.004	0.009	0.616	0.030	-0.012	0.022
Leads with Vision	-0.001	0.002	0.637	-0.005	-0.005	0.002
Makes Sound Decisions	0.002	0.005	0.622	0.015	-0.006	0.012
Manages Talent	0.002	0.003	0.616	0.011	-0.004	0.009
Safety Climate						
Advances Innovative Solutions	0.001	0.001	0.281	0.007	-0.001	0.003
Communicates with Impact	-0.001	0.001	0.394	-0.005	-0.003	0.000
Leads with Vision	0.000	0.000	0.557	0.002	0.000	0.002
Makes Sound Decisions	0.001	0.001	0.411	0.004	-0.001	0.006
Manages Talent	0.001	0.001	0.324	0.006	0.000	0.003
Psychological Safety Climate	0.001	0.000	0.270	0.012	0.000	0.002
Safety Climate						
Psychological Safety Climate						
Advances Innovative Solutions	-0.054	0.027	0.047	-0.036	-0.123	-0.015
Communicates with Impact	0.328	0.100	0.001	0.222	0.139	0.536
Leads with Vision	-0.055	0.025	0.028	-0.037	-0.122	-0.018
Makes Sound Decisions	0.169	0.057	0.003	0.114	0.074	0.300
Manages Talent	0.126	0.043	0.004	0.085	0.053	0.225
Sum of Indirect Effects						
Safety Incidents						
Advances Innovative Solutions	0.000	0.002	0.862	0.002	-0.004	0.004
Communicates with Impact	0.004	0.009	0.680	0.025	-0.013	0.022
Leads with Vision	0.000	0.002	0.778	-0.003	-0.004	0.002
Makes Sound Decisions	0.003	0.005	0.530	0.020	-0.005	0.013
Manages Talent	0.002	0.003	0.454	0.017	-0.004	0.010
Psychological Safety Climate	0.001	0.000	0.270	0.012	0.000	0.002

Note. *N* = 3,698. *B* = unstandardized coefficient, β = standardized coefficient. BC 95% CI = bias corrected 95% confidence interval, 5,000 bootstrap sample. Controlled for age, gender, length of service, time in job, and work setting – hazard exposure.

Multiple Mediation Multigroup Structural Equation Model 1 Analysis

A multiple mediation multigroup analysis with bias-corrected confident interval estimations (Preacher & Hayes, 2008) tested the factorial structure across the office, field – non-hazard, and field – hazard work settings using Mplus software version 7.23 (Muthén & Muthén, 2012). The Mplus syntax for the multiple mediation multigroup analysis for Model 1 can be found in the appendices – baseline model (Appendix F), configural model (Appendix G), and constrained model (Appendix H). To test for weak factorial invariance (Meredith, 1993) across groups, two criteria were used to test for invariance – whether the multigroup model exhibits an adequate fit to the data and the change in CFI (and other robust fit indices) value between the configural model, where there were no constraints, and the constrained model were negligible.

The configural model assumed the factor structure was different across the work settings, while the constrained model assumed the factor structure was the same across work settings. The comparison of the model fit between the configural and constrained models determined which of the two models fit better to the data (Byrne, 2012; Dimitrov, 2006; Muthén & Muthén, 2017; Ryu & Cheong, 2017). To determine if the conceptual model was equivalent across the work settings, the results of the analysis compared the fit indices (CFI, TLI, RMSEA, SRMR) from a model with all parameters allowed to be unequal across groups (i.e., configural model) to the fit indices from a model with the loadings constrained to be equal across groups, i.e., constrained model (Byrne, 2012; Dimitrov, 2006; Ryu & Cheong, 2017).

The baseline model fit the data well, $\chi^2(661) = 6223.026$, $p < .001$, CFI = 0.953, TLI = 0.948, RMSEA = 0.048, and SRMR = 0.033. The modification indices did not indicate a practical structure change to the model that the empirical research and theory would support. No configural changes were made to the group models. For the configural and constrained models, the first variables were freely estimated, factor variances were constrained to 1.0, and the factor intercepts were constrained to 0.0. The multigroup structural equation model fit indices for Model 1 can be found in Table 16.

Table 16

Multigroup Structural Equation Model 1 Fit Indices

Model	χ^2	*df*	$\Delta\chi^2$	Δdf	CFI	ΔCFI	TLI	RMSEA	SRMR
1. Baseline Model	6223.026***	661			0.953		0.948	0.048	0.033
2. Configural Model	13632.381***	2126	7409.355	1465	0.905	0.048	0.901	0.066	0.118
3. Constrained Model	9085.239***	2051	4547.142	75	0.942	0.037	0.937	0.053	0.037

Note. N = 3,698. χ^2 = chi-square goodness-of-fit; *df* = degrees of freedom; CFI = comparative fit index; TLI = Tucker-Lewis index; RMSEA = root mean square error of approximation; SRMR = root mean square residual.
*** $p < .001$

Multiple Mediation Structural Equation Model 2 Analysis

A multiple mediation analysis with bias-corrected confident interval estimations (Preacher & Hayes, 2008) tested the direct and indirect effects in Model 2 using Mplus software version 7.23 (Muthén & Muthén, 2012). The Mplus syntax for the multiple mediation analysis for Model 2 can be found in Appendix I. Specifically, the model specified the direct relationships between leadership competencies, psychological safety climate, safety climate, safety observations, safety recognitions, safety reporting, safety compliance, and safety incidents. The model included the indirect effects between the leadership competencies and safety incidents through multiple mediators – psychological safety climate, safety climate, safety observations, safety recognitions, safety reporting, and safety compliance. Testing for the direct and indirect effects in the analysis included bias-corrected bootstrap confident interval procedure (MacKinnon et al., 2004; Preacher & Hayes, 2004) with 5,000 replications (see Figure 9). The first variable was freely estimated, and factor variances were constrained to 1.0. Overall, the model fit statistics indicate a good model fit to the data, $\chi^2(828) = 4421.854$, $p < 0.001$; CFI = 0.950, TLI = 0.943, RMSEA = 0.044, SRMR = 0.033. Figure 10 shows the results of the structural equation model analysis to see the significant relationships between the study variables.

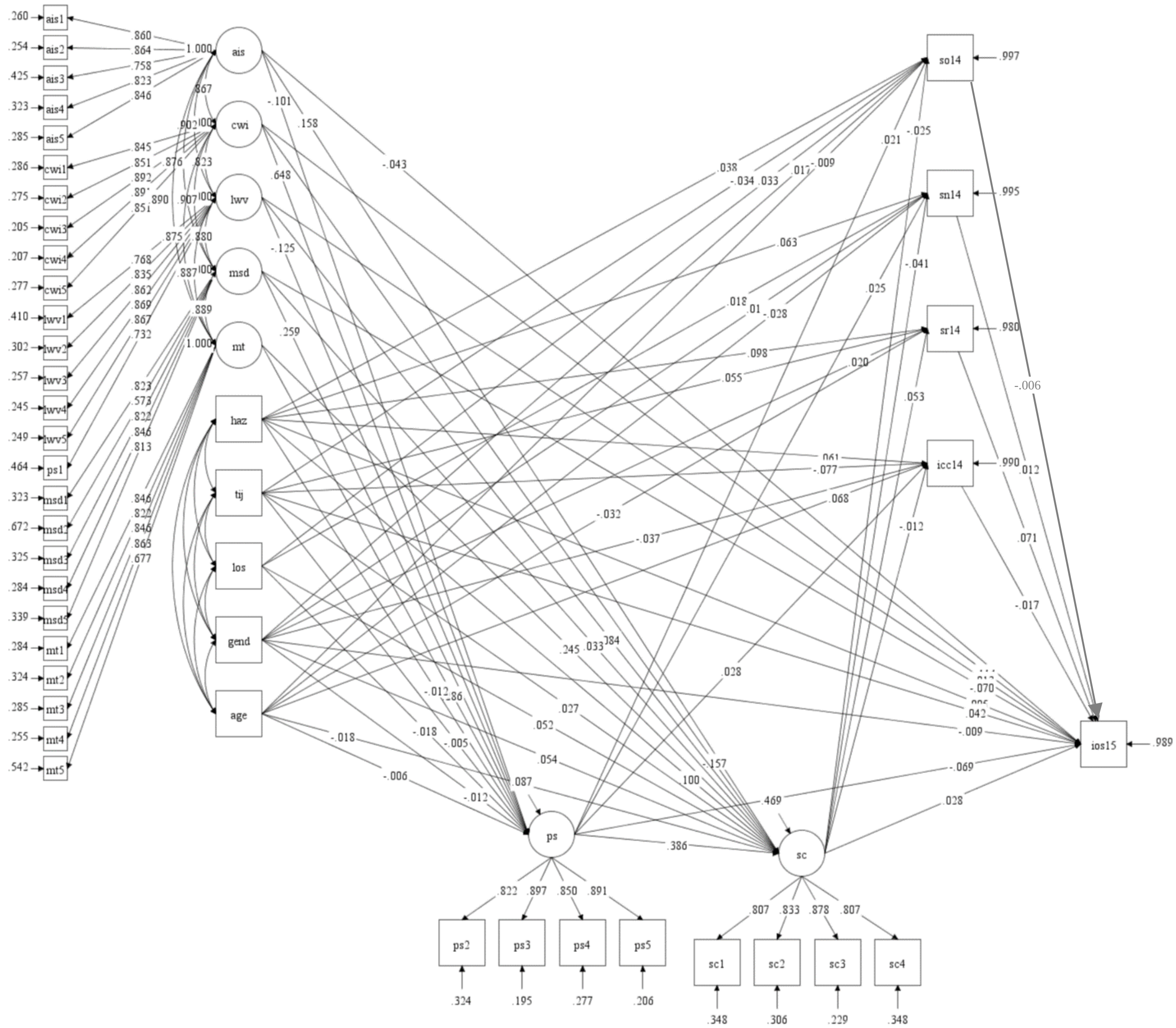

Figure 9. Multiple mediator structural equation Model 2 Mplus diagram. Model includes the indicators for the latent variables and the direct and indirect effects between the leadership competencies and safety incidents with multiple mediators – psychological safety climate, safety climate, safety observations, safety recognitions, safety reporting, safety compliance – controlling for age, gender, length of service, time in job, and work setting – hazard exposure. *N* = 2,222. Direct and indirect effects analyzed with bias-corrected bootstrap confident interval procedure with 5,000 replications. Numbers are the standardized estimates of the model. Variables are ais = advances innovative solutions, cwi = communicates with impact, lwv = leads with vision, msd = makes sound decisions, mt = manages talent, haz = hazard exposure, tij = time in job, los = length of service, age = age, ps = psychological safety climate, sc = safety climate, ios14 = safety incidents, icc14 = safety reporting, sr14 = safety compliance, sn14 = safety recognitions, and so14 = safety observations.

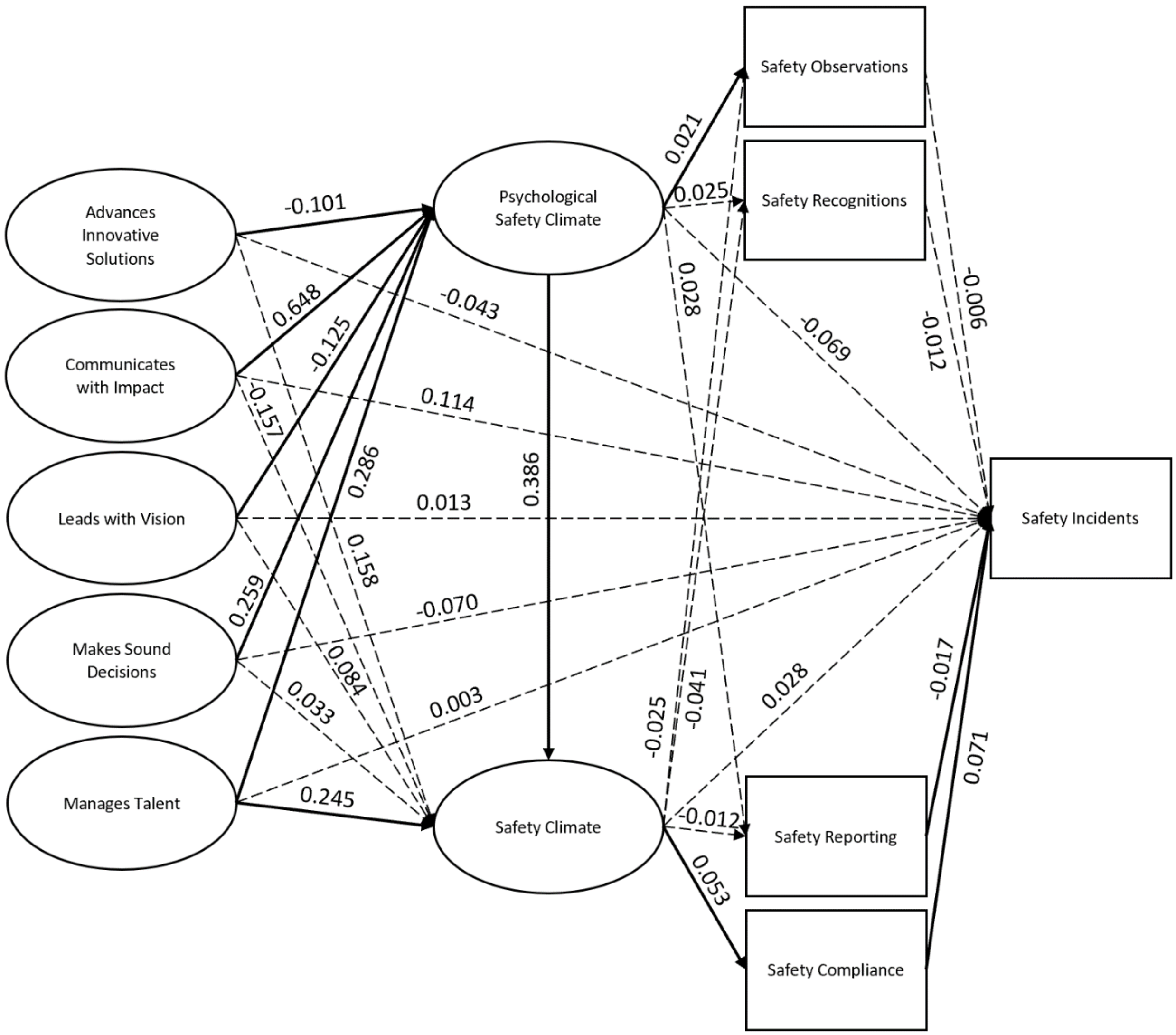

Figure 10. Multiple mediator structural equation Model 2 results. The model determined the influence of leadership competencies on safety incidents through mediation of safety climate, psychological safety climate, safety observations, safety recognitions, safety reporting, and safety behavior controlling for age, gender, length of service, time in job, and work setting – hazard exposure. N = 2,222. Direct and indirect effects analyzed with bias-corrected bootstrap confident interval procedure with 5,000 replications. Numbers are the standardized estimates of the model. Bold lines indicate bias-corrected bootstrap significance. Dashed lines indicate the parameters that were not significant with the bias-corrected bootstrap.

The model controlled for age, gender, length of service, time in job, and work setting – hazard exposure. Table 17 presents the results for the control variables in the multiple mediation SEM analysis. No control variables significantly predicted safety incidents in Model 2.

Table 17

Model 2: Direct Effects for the Control Variables in the SEM

Variable	γ	Product of Coefficients *SE*	*p*	γ*	Bootstrap BC 95% CI Lower	Upper
Direct Effects						
Safety Incidents						
Age	0.000	0.000	0.538	-0.018	-0.001	0.001
Gender	-0.003	0.007	0.651	-0.009	-0.016	0.010
Length of Service	0.000	0.000	0.646	0.014	-0.001	0.001
Time in Job	0.002	0.001	0.142	0.042	0.000	0.004
Hazard Exposure	0.001	0.005	0.809	0.005	-0.008	0.011
Psychological Safety Climate						
Age	-0.002	0.004	0.609	-0.006	-0.010	0.006
Gender	-0.082	0.073	0.262	-0.012	-0.227	0.059
Length of Service	-0.006	0.004	0.159	-0.018	-0.014	0.002
Time in Job	-0.004	0.010	0.700	-0.005	-0.024	0.016
Hazard Exposure	-0.057	0.050	0.257	-0.012	-0.152	0.044
Safety Climate						
Age	-0.003	0.003	0.404	-0.018	-0.009	0.003
Gender	0.164	0.058	0.005	0.054	0.051	0.278
Length of Service	0.007	0.003	0.018	0.052	0.002	0.014
Time in Job	0.010	0.006	0.094	0.027	-0.002	0.022
Hazard Exposure	0.203	0.029	0.000	0.100	0.144	0.259
Safety Observations						
Age	-0.009	0.013	0.455	-0.009	-0.041	0.011
Gender	0.398	0.416	0.338	0.017	-0.223	1.436
Length of Service	0.036	0.017	0.039	0.033	0.006	0.075
Time in Job	-0.096	0.053	0.070	-0.034	-0.238	-0.019
Hazard Exposure	0.588	0.549	0.285	0.038	-0.213	1.966
Safety Recognitions						
Age	-0.002	0.002	0.342	-0.028	-0.006	0.003
Gender	0.014	0.034	0.676	0.010	-0.051	0.086
Length of Service	0.001	0.002	0.589	0.018	-0.003	0.007
Time in Job	0.000	0.003	0.888	-0.003	-0.007	0.006
Hazard Exposure	0.063	0.035	0.073	0.063	0.004	0.142
Safety Reporting						
Age	0.002	0.001	0.005	0.068	0.001	0.004
Gender	-0.024	0.021	0.260	-0.037	-0.073	0.010
Length of Service	0.000	0.001	0.941	-0.002	-0.002	0.002
Time in Job	-0.006	0.002	0.007	-0.077	-0.011	-0.002
Hazard Exposure	0.026	0.013	0.142	0.061	0.000	0.071
Safety Compliance						
Age	-0.001	0.001	0.170	-0.032	-0.003	0.000
Gender	0.014	0.014	0.304	0.020	-0.013	0.042
Length of Service	0.000	0.001	0.897	0.003	-0.002	0.002
Time in Job	0.005	0.002	0.025	0.055	0.001	0.009
Hazard Exposure	0.048	0.013	0.000	0.098	0.022	0.075

Note. N = 2,222. γ = unstandardized coefficient. γ* = standardized coefficient. BC 95% CI = bias corrected confidence interval, 5,000 bootstrap sample. Gender was coded as 0 = female and 1 = male. Hazard exposure was coded as 1 = office, 2 = field – non-hazard, and 3 = field – hazard. Age, length of service, and time in job were coded in years.

Table 18 presents the results of the multiple mediator SEM for the direct effects. Table 19 presents the results of the multiple mediator SEM for the indirect effects, which includes both the total indirect effect with the set of mediators transmitting the effect of the independent variable to the dependent variable and results of the individual mediators in the context of a multiple mediator model.

Table 18

Model 2: Direct Effects in the SEM for Leadership Influence on Safety Incidents

Variable	*B*	Product of Coefficients		β	Bootstrap BC 95% CI	
		SE	*p*		Lower	Upper
Direct Effects						
Safety Incidents						
Advances Innovative Solutions	-0.007	0.010	0.496	-0.043	-0.028	0.012
Communicates with Impact	0.018	0.016	0.273	0.114	-0.012	0.054
Leads with Vision	0.002	0.013	0.872	0.013	-0.028	0.024
Makes Sound Decisions	-0.011	0.014	0.428	-0.070	-0.041	0.015
Manages Talent	0.000	0.011	0.967	0.003	-0.023	0.023
Psychological Safety Climate	-0.003	0.005	0.544	-0.069	-0.014	0.007
Safety Climate	0.003	0.003	0.359	0.028	-0.003	0.010
Safety Observations	0.000	0.000	0.567	-0.006	0.000	0.000
Safety Recognitions	-0.003	0.007	0.682	-0.012	-0.019	0.013
Safety Reporting	-0.009	0.003	0.009	-0.017	-0.016	-0.004
Safety Compliance	0.032	0.020	0.105	0.071	0.001	0.080
Psychological Safety Climate						
Advances Innovative Solutions	-0.344	0.175	0.049	-0.101	-0.690	-0.018
Communicates with Impact	2.204	0.225	0.000	0.648	1.789	2.647
Leads with Vision	-0.426	0.159	0.007	-0.125	-0.753	-0.131
Makes Sound Decisions	0.880	0.241	0.000	0.259	0.449	1.389
Manages Talent	0.971	0.191	0.000	0.286	0.615	1.363
Safety Climate						
Advances Innovative Solutions	0.231	0.138	0.094	0.158	-0.032	0.512
Communicates with Impact	-0.229	0.178	0.198	-0.157	-0.564	0.129
Leads with Vision	0.123	0.113	0.277	0.084	-0.088	0.351
Makes Sound Decisions	0.048	0.157	0.761	0.033	-0.266	0.347
Manages Talent	0.358	0.144	0.013	0.245	0.085	0.649
Psychological Safety Climate	0.166	0.054	0.002	0.386	0.062	0.270
Safety Observations						
Psychological Safety	0.067	0.040	0.095	0.021	0.004	0.164
Safety Climate	-0.190	0.216	0.379	-0.025	-0.722	0.166
Safety Recognitions						
Psychological Safety Climate	0.005	0.009	0.547	0.025	-0.008	0.027
Safety Climate	-0.020	0.026	0.441	-0.041	-0.091	0.017
Safety Reporting						
Psychological Safety Climate	0.003	0.003	0.334	0.028	-0.002	0.008
Safety Climate	-0.003	0.006	0.665	-0.012	-0.017	0.007
Safety Compliance						
Safety Climate	0.013	0.006	0.023	0.053	0.002	0.025

Note. *N* = 2,222. *B* = unstandardized coefficient. β = standardized coefficient. BC 95% CI = bias corrected 95% confidence interval, 5,000 bootstrap sample. Controlled for age, gender, length of service, time in job, and work setting – hazard exposure.

Table 19

Model 2: Indirect Effects in the SEM for Leadership Influence on Safety Incidents

Variable	*B*	Product of Coefficients *SE*	*p*	β	Bootstrap BC 95% CI Lower	Upper
Indirect Effects						
Safety Incidents						
Psychological Safety Climate						
Advances Innovative Solutions	0.001	0.002	0.616	0.007	-0.002	0.007
Communicates with Impact	-0.007	0.012	0.555	-0.045	-0.032	0.015
Leads with Vision	0.001	0.003	0.592	0.009	-0.003	0.008
Makes Sound Decisions	-0.003	0.005	0.578	-0.017	-0.015	0.006
Manages Talent	-0.003	0.005	0.563	-0.020	-0.015	0.007
Safety Climate						
Advances Innovative Solutions	0.001	0.001	0.486	0.004	0.000	0.004
Communicates with Impact	-0.001	0.001	0.566	-0.004	-0.005	0.001
Leads with Vision	0.000	0.001	0.577	0.002	0.000	0.003
Makes Sound Decisions	0.000	0.001	0.844	0.001	-0.001	0.003
Manages Talent	0.001	0.001	0.423	0.007	-0.001	0.005
Psychological Safety Climate	0.001	0.001	0.413	0.011	0.000	0.002
Safety Observations						
Psychological Safety	0.000	0.000	0.519	0.000	0.000	0.000
Safety Climate	0.000	0.000	0.549	0.000	0.000	0.000
Safety Recognitions						
Psychological Safety Climate	0.000	0.000	0.777	0.000	0.000	0.000
Safety Climate	0.000	0.000	0.728	0.001	0.000	0.001
Safety Reporting						
Psychological Safety Climate	0.000	0.000	0.397	0.000	0.000	0.000
Safety Climate	0.000	0.000	0.703	0.000	0.000	0.000
Safety Compliance						
Safety Climate	0.000	0.000	0.213	0.004	0.000	0.001
Safety Climate						
Psychological Safety Climate						
Advances Innovative Solutions	-0.057	0.037	0.122	-0.039	-0.155	-0.007
Communicates with Impact	0.365	0.127	0.004	0.250	0.133	0.618
Leads with Vision	-0.071	0.035	0.045	-0.048	-0.162	-0.019
Makes Sound Decisions	0.146	0.064	0.022	0.100	0.052	0.301
Manages Talent	0.161	0.063	0.011	0.110	0.059	0.307
Sum of Indirect Effects						
Safety Incidents						
Advances Innovative Solutions	0.002	0.003	0.481	0.011	-0.002	0.009
Communicates with Impact	-0.008	0.012	0.526	-0.049	-0.034	0.015
Leads with Vision	0.002	0.003	0.526	0.011	-0.002	0.009
Makes Sound Decisions	-0.003	0.005	0.600	-0.017	-0.014	0.006
Manages Talent	-0.002	0.005	0.703	-0.013	-0.013	0.008
Psychological Safety Climate	0.000	0.001	0.458	0.010	0.000	0.002
Safety Climate	0.001	0.000	0.186	0.005	0.000	0.002

Note. *N* = 2,222. *B* = unstandardized coefficient, β = standardized coefficient. BC 95% CI = bias corrected 95% confidence interval, 5,000 bootstrap sample. Controlled for age, gender, length of service, time in job, and work setting – hazard exposure.

Multiple Mediation Multigroup Structural Equation Model 2 Analysis

A multiple mediation multigroup analysis with bias-corrected confident interval estimations (Preacher & Hayes, 2008) tested the factorial structure across the office, field – non-hazard, and field – hazard work settings using Mplus software version 7.23 (Muthén & Muthén, 2012). The Mplus syntax for the multiple mediation multigroup analysis for Model 2 can be found in the appendices – baseline model (Appendix J), configural model (Appendix K), and constrained model (Appendix L). To test for weak factorial invariance (Meredith, 1993) across groups, two criteria were used to test for invariance – whether the multigroup model exhibited an adequate fit to the data and the change in CFI (and other robust fit indices) value between the configural model, where there were no constraints, and the constrained model were negligible.

The configural model assumed the factor structure was different across the work settings, while the constrained model assumed the factor structure was the same across work settings. The comparison of the model fit between the configural and constrained models determined which of the two models fit better to the data (Byrne, 2012; Dimitrov, 2006; Muthén & Muthén, 2017; Ryu & Cheong, 2017). To determine if the conceptual model was equivalent across the work settings, the results of the analysis compared the fit indices (CFI, TLI, RMSEA, SRMR) from a model with all parameters allowed to be unequal across groups, i.e., configural model, to the fit indices from a model with the loadings constrained to be equal across groups, i.e., constrained model (Byrne, 2012; Dimitrov, 2006; Ryu & Cheong, 2017).

The baseline model fit the data well, $\chi^2(796) = 4389.523$, $p < .001$, CFI = 0.950, TLI = 0.943, RMSEA = 0.045, and SRMR = 0.033. The modification indices did not indicate a practical structure change to the model that the empirical research and theory would support. No configural changes were made to the group models. For the configural and constrained models, the first variables were freely estimated, factor variances were constrained to 1.0, and the factor intercepts were constrained to 0.0. The multigroup structural equation model fit indices for Model 2 can be found in Table 20.

Table 20

Multigroup Structural Equation Model 2 Fit Indices

Model	χ^2	*df*	$\Delta\chi^2$	Δdf	CFI	ΔCFI	TLI	RMSEA	SRMR
1. Baseline	4389.523***	796			0.950		0.943	0.045	0.033
2. Configural Model	7896.946***	2582	3507.723	1786	0.928	0.022	0.925	0.053	0.052
3. Contrained Model	7569.577***	2456	327.369	126	0.930	0.002	0.924	0.053	0.039

Note. N = 2,222. χ^2 = chi-square goodness-of-fit; *df* = degrees of freedom; CFI = comparative fit index; TLI = Tucker-Lewis index; RMSEA = root mean square error of approximation; SRMR = root mean square residual.
*** $p < .001$

Results

The section below provides the results of the hypothesis testing, which synthesizes the analysis from the multiple mediation structural equation Models 1 and 2.

Leadership Influence on Safety Incidents

Hypothesis 1 proposed that two leadership competencies – communicates with impact and makes sound decisions – would influence the number of safety incidents. Hypothesis 1_a was partially supported where communicates with impact did significantly predict safety incidents in Model 1 with a small negative relationship with bias-corrected 95% confidence interval, B = -0.023, SE = 0.012, p = 0.056, β = -0.155, BC 95% CI [-0.048, -0.001], but did not significantly predict safety incidents in Model 2, B = 0.018, SE = 0.016, p = 0.273, β = 0.114, BC 95% CI [-0.012, 0.054]. The null hypothesis was rejected as the regression coefficient for the effect of communicates with impact on safety incidents in Model 1 was significantly different from zero ($p < .05$).

Makes sound decisions did not significantly predict safety incidents in Model 1, B = 0.000, SE = 0.010, p = 0.999, β = 0.000, BC 95% CI [-0.021, 0.018], or Model 2, B = -0.011, SE

= 0.014, p = 0.428, β = -0.070, BC 95% CI [-0.041, 0.015]. The null hypothesis failed to be rejected as the regression coefficient for the effect of makes sound decisions on safety incidents was not significantly different from zero (p < .05). The other leadership competencies were included in the analysis but did not significantly predict safety incidents.

Leadership Influence on Psychological Safety Climate

Hypothesis 2 proposed that two leadership competencies – advances innovative solutions and communicates with impact – would influence psychological safety climate. Hypothesis 2_a was supported as advances innovative solutions predicted psychological safety climate in Model 1 with a significant small negative relationship, B = -0.351, SE = 0.139, p = 0.011, β = -0.102, BC 95% CI [-0.639, -0.091], and Model 2 with a significant small negative relationship, B = -0.344, SE = 0.175, p = 0.049, β = -0.101, BC 95% CI [-0.690, -0.018]. The null hypothesis was rejected as the regression coefficient for the effect of advances innovative solutions on psychological safety climate was significantly different from zero (p < .05).

Hypothesis 2_b was supported as communicates with impact predicted psychological safety climate in Model 1 with a significant large positive relationship, B = 2.145, SE = 0.176, p < 0.001, β* = 0.621, BC 95% CI [1.807, 2.499], and in Model 2 with a significant large positive relationship, B = 2.204, SE = 0.225, p < 0.001, β = 0.648, BC 95% CI [1.789, 2.647]. The null hypothesis was rejected as the regression coefficient for the effect of communicates with impact on psychological safety climate was significantly different from zero (p < .05).

In addition, all other leadership competencies predicted psychological safety climate. Leads with vision predicted psychological safety climate in Model 1 with a significant small negative relationship, B = -0.362, SE = 0.132, p = 0.006, β = -0.105, BC 95% CI [-0.621, -0.102], and in Model 2 with a significant small negative relationship, B = -0.426, SE = 0.159, p =

0.007, β* = -0.125, BC 95% CI [-0.753, -0.131]. Makes sound decisions predicted psychological safety climate in Model 1 with a significant medium positive relationship, *B* = 1.104, *SE* = 0.193, $p < 0.001$, β = 0.319, BC 95% CI [0.744, 1.502], and in Model 2 with a significant medium positive relationship, *B* = 0.880, *SE* = 0.241, $p < 0.001$, β = 0.259, BC 95% CI [0.449, 1.389]. Manages talent predicted psychological safety climate in Model 1 with a significant small positive relationship, *B* = 0.823, *SE* = 0.139, $p < 0.001$, β = 0.238, BC 95% CI [0.557, 1.097], and in Model 2 with a significant small positive relationship, *B* = 0.971, *SE* = 0.191, $p < 0.001$, β = 0.286, BC 95% CI [0.615, 1.363].

Leadership Influence on Safety Climate

Hypothesis 3 proposed that communicates with impact would influence safety climate. Hypothesis 3 was not supported as communicates with impact did not predict safety climate in Model 1, *B* = -0.209, *SE* = 0.139, $p = 0.133$, β = -0.141, BC 95% CI [-0.480, 0.061], or Model 2, *B* = -0.229, *SE* = 0.178, $p = 0.198$, β = -0.157, BC 95% CI [-0.564, 0.129]. The null hypothesis failed to be rejected as the regression coefficient for the effect of communicates with impact on safety climate was not significantly different from zero ($p < .05$).

In addition, other leadership competencies predicted safety climate. Advances innovative solutions predicted safety climate in Model 1 with a significant small positive relationship, *B* = 0.308, *SE* = 0.107, $p = 0.004$, β = 0.209, BC 95% CI [0.100, 0.514], but did not predict safety climate in Model 2, *B* = 0.231, *SE* = 0.138, $p = 0.094$, β = 0.158, BC 95% CI [-0.032, 0.512]. Manages talent predicted safety climate in Model 1 with a significant small positive relationship, *B* = 0.240, *SE* = 0.105, $p = 0.022$, β = 0.162, BC 95% CI [0.035, 0.449], and in Model 2 with a significant small positive relationship, *B* = 0.358, *SE* = 0.144, $p = 0.013$, β = 0.245, BC 95% CI [0.085, 0.649]. Leads with vision and makes sound decisions did not predict safety climate.

Psychological Safety Climate Mediation Between Leadership and Safety Incidents

Hypothesis 4 proposed that psychological safety climate would mediate the relationship between leadership competencies and safety incidents. Hypothesis 4 was not supported as psychological safety climate did not mediate the relationship between any of the leadership competencies and safety incidents. In testing the indirect effect for each of the leadership competencies on employee safety incidents through psychological safety climate, the estimate of the indirect effect was not significantly different from zero ($p > .05$).

Safety Climate Mediation Between Leadership and Safety Incidents

Hypothesis 5 proposed that safety climate would mediate the relationship between communicates with impact and safety incidents. Hypothesis 5 was not supported as safety climate did not mediate the relationship between communicates with impact and safety incidents in Model 1, $B = -0.001$, $SE = 0.001$, $p = 0.394$, $\beta = -0.005$, BC 95% CI [-0.003, 0.000], or Model 2, $B = -0.001$, $SE = 0.001$, $p = 0.566$, $\beta = -0.004$, BC 95% CI [-0.005, 0.001]. In testing the indirect effect of communicates with impact on employee safety incidents through safety climate, the estimate of the indirect effect for communicates with impact was not significantly different from zero ($p > .05$).

Psychological Safety Climate Influence on Safety Incidents

Hypothesis 6 proposed that psychological safety climate would influence employee safety incidents. Hypothesis 6 was not supported as psychological safety climate did not predict employee safety incidents for Model 1, $B = 0.002$, $SE = 0.004$, $p = 0.608$, $\beta = 0.048$, BC 95% CI [-0.005, 0.010], or Model 2, $B = -0.003$, $SE = 0.005$, $p = 0.544$, $\beta = -0.069$, BC 95% CI [-0.014, 0.007]. The null hypothesis failed to be rejected as the regression coefficient for the effect of psychological safety climate on employee safety incidents was not significantly different from zero ($p > .05$).

Safety Climate Influence on Safety Incidents

Hypothesis 7 proposed that safety climate would influence employee safety incidents. Hypothesis 7 was not supported as safety climate did not predict employee safety incidents. Safety climate did not influence employee safety incidents for Model 1, $B = 0.003$, $SE = 0.003$, $p = 0.231$, $\beta = 0.034$, BC 95% CI [-0.002, 0.009], or Model 2, $B = 0.003$, $SE = 0.003$, $p = 0.359$, $\beta = 0.028$, BC 95% CI [-0.003, 0.010]. The null hypothesis failed to be rejected as the regression coefficient for the effect of safety climate on employee safety incidents was not significantly different from zero ($p > .05$).

Safety Climate Mediation Between Psychological Safety Climate and Safety Incidents

Hypothesis 8 proposed that psychological safety climate indirectly influences employee safety incidents through safety climate. Hypothesis 8 was not supported as safety climate does not mediate the relationship between psychological safety and employee safety incidents in Model 1, $B = 0.001$, $SE = 0.000$, $p = 0.270$, $\beta = 0.012$, BC 95% CI [0.000, 0.002], or Model 2, $B = 0.001$, $SE = 0.001$, $p = 0.413$, $\beta = 0.011$, BC 95% CI [0.000, 0.002]. In testing the indirect effect of psychological safety on employee safety incidents through safety climate, the estimate of the indirect effect was not significantly different from zero ($p > .05$).

Safety Participation Mediation Between Psychological Safety Climate and Safety Incidents

Hypothesis 9 proposed that psychological safety climate indirectly influences employee safety incidents through participation in safety programs (i.e., safety observations, safety recognitions, safety reporting). Hypothesis 9 was not supported as safety observations, $B = 0.000$, $SE = 0.000$, $p = 0.519$, $\beta = 0.000$, BC 95% CI [0.000, 0.000], safety recognitions, $B =$

0.000, *SE* = 0.000, *p* = 0.777, β = 0.000, BC 95% CI [0.000, 0.000], and safety reporting, *B* = 0.000, *SE* = 0.000, *p* = 0.397, β = 0.000, BC 95% CI [0.000, 0.000], did not mediate the relationship between psychological safety climate and employee safety incidents. In testing the indirect effect of psychological safety climate on employee safety incidents through safety observations, safety recognitions, or safety reporting, the estimate of the indirect effects were not significantly different from zero ($p > .05$).

Safety Participation Mediation Between Safety Climate and Safety Incidents

Hypothesis 10 proposed that safety climate indirectly influences employee safety incidents through participation in safety programs (i.e., safety observations, safety recognitions, safety reporting). Hypothesis 10 was not supported as safety observations, *B* = 0.000, *SE* = 0.000, *p* = 0.549, β = 0.000, BC 95% CI [0.000, 0.000], safety recognitions, *B* = 0.000, *SE* = 0.000, *p* = 0.728, β = 0.001, BC 95% CI [0.000, 0.001], and safety reporting, *B* = 0.000, *SE* = 0.000, *p* = 0.703, β = 0.000, BC 95% CI [0.000, 0.000], did not mediate the relationship between safety climate and employee safety incidents. In testing the indirect effect of safety climate on employee safety incidents through safety observations, safety recognitions, or safety reporting, the estimate of the indirect effects were not significantly different from zero ($p > .05$).

Safety Compliance Mediation Between Safety Climate and Safety Incidents

Hypothesis 11 proposed that safety climate indirectly influences employee safety incidents through safety compliance behaviors. Hypothesis 11 was not supported as safety compliance did not mediate the relationship between safety climate and employee safety incidents, *B* = 0.000, *SE* = 0.000, *p* = 0.213, β = 0.004, BC 95% CI [0.000, 0.001]. In testing the indirect effect of safety climate on employee safety incidents through safety compliance, the estimate of the indirect effect was not significantly different from zero ($p > .05$).

Leadership Influence on Safety Climate Through Psychological Safety Climate

Hypothesis 12 proposed that communicates with impact indirectly influences safety climate through psychological safety climate. Hypothesis 12 was supported as psychological safety climate does mediate the relationship between communicates with impact and safety climate with a significant low to moderate positive relationship in Model 1, $B = 0.328$, $SE = 0.100$, $p < 0.001$, $\beta = 0.222$, BC 95% CI [0.139, 0.536], and Model 2, $B = 0.365$, $SE = 0.127$, $p < 0.004$, $\beta = 0.250$, BC 95% CI [0.133, 0.618]. In testing the indirect effect of communicates with impact on safety climate through psychological safety climate, the estimate of the indirect effect was significantly different from zero ($p < .05$).

In addition, psychological safety climate mediated the relationship between all other leadership competencies and safety climate. Advances innovative solutions indirectly influenced safety climate through psychological safety climate with a significant small negative relationship in Model 1, $B = -0.054$, $SE = 0.027$, $p = 0.047$, $\beta = -0.036$, BC 95% CI [-0.123, -0.015], and Model 2, $B = -0.057$, $SE = 0.037$, $p = 0.122$, $\beta = -0.039$, BC 95% CI [-0.155, -0.007]. Leads with vision indirectly influenced safety climate through psychological safety climate with a significant small negative relationship in Model 1, $B = -0.055$, $SE = 0.025$, $p = 0.028$, $\beta = -0.037$, BC 95% CI [-0.122, -0.018], and Model 2, $B = -0.071$, $SE = 0.035$, $p = 0.045$, $\beta = -0.048$, BC 95% CI [-0.162, -0.019]. Makes sound decisions indirectly influenced safety climate through psychological safety climate with a significant small positive relationship in Model 1, $B = 0.169$, $SE = 0.057$, $p = 0.003$, $\beta = 0.114$, BC 95% CI [0.074, 0.300], and Model 2, $B = 0.146$, $SE = 0.064$, $p = 0.022$, $\beta = 0.100$, BC 95% CI [0.052, 0.301]. Manages talent indirectly influenced safety climate through psychological safety climate with a significant small positive relationship in Model 1, $B = 0.126$, $SE = 0.043$, $p = 0.004$, $\beta = 0.085$, BC 95% CI [0.053, 0.225], and Model 2, $B = 0.161$, $SE = 0.063$, $p = 0.011$, $\beta = 0.110$, BC 95% CI [0.059, 0.307].

Leadership Influence on Occupational Safety Across Work Settings

Hypothesis 13 was concerned whether Model 1 and Model 2 significantly differed across work settings. Specifically, this hypothesis proposed that the influence of leadership on safety performance differs across work settings with varying levels of hazard exposure. Hypothesis 13 was not supported for Model 1 or Model 2 as the influence of leadership on safety performance does not differ across work settings. The multigroup models do not exhibit an adequate fit to the data compared to the constrained models for Model 1 or Model 2. The change in CFI value for Model 1 or Model 2 indicated that the constrained models fit the data better than the configural models.

For Model 1, the testing of equivalence of path models determined the influence of leadership on safety incidents does not differ across work settings. The configural model with all parameters freely estimated in the three work settings does not fit the data well, $\chi^2(2126) = 13623.381$, $p < .001$, CFI = 0.905, TLI = 0.901, RMSEA = 0.066, and SRMR = 0.118, according to fit criteria suggested by Hu and Bentler (1999). The constrained model with loadings constrained to be equal across work settings fit the data well, $\chi^2(2051) = 9085.239$, $p < .001$, CFI = 0.942, TLI = 0.937, RMSEA = 0.053, and SRMR = 0.037. The change in CFI value was 0.037, which indicated that the constrained model fits the data better than the configural model. The difference in CFI value (constrained CFI minus configural CFI) must have be less than or equal to -0.01 to support a multigroup model. The null hypothesis of invariance was not rejected (Cheung & Rensvold, 2002). Furthermore, given that the RMSEA and SRMR values indicated a better fit with the constrained model, we can conclude that these parameters are operating equivalently across work settings.

The loglikelihood ratio test found to be significant determined the constrained model fits the data significantly better than the configural model. The likelihood ratio test was significant, $\Delta\chi^2(75) = 4547.142$, $p < .001$. The Wald test was significant, $W(36) = 105.712$, $p < .001$, indicating that the configural model is a better fit. Despite the evidence of the Wald test, most of the tests do not support model variance between the work settings.

For Model 2, the testing of equivalence of path models determined the influence of leadership on safety incidents does not differ across work settings. The configural model with all parameters freely estimated in the three work settings does not fit the data well, $\chi^2(2582) = 7896.946$, $p < .001$, CFI = 0.928, TLI = 0.925, RMSEA = 0.053, and SRMR = 0.052, according to fit criteria suggested by Hu and Bentler (1999). The constrained model with loadings constrained to be equal across work settings fit the data well, $\chi^2(2456) = 7569.577$, $p < .001$, CFI = 0.930, TLI = 0.924, RMSEA = 0.053, and SRMR = 0.039. The change in CFI value was 0.002, which indicates that the constrained model fits the data better than the configural model. The difference in CFI value (constrained CFI minus configural CFI) must be less than or equal to -0.01 to support a multigroup model. The null hypothesis of invariance was not be rejected (Cheung & Rensvold, 2002). Furthermore, given that the RMSEA and SRMR values indicated a better fit with the constrained model, we can conclude that these parameters are operating equivalently work settings.

The loglikelihood ratio test found to be significant determined the constrained model fits the data significantly better than the configural model. The likelihood ratio test was significant, $\Delta\chi2(126) = 327.369$, $p < .01$. The Wald test was significant, $W(58) = 107.606$, $p < .001$, indicating that the configural model is a better fit. Despite the evidence of the Wald test, most of the tests do not support model variance between the work settings.

The results suggested that the factorial structure of the conceptual model may best be explained as one population. These findings suggested that the conceptual model does not differ across work settings. Based on Meredith's (1993) categorization of weak, strong, and strict invariance, these results indicated clear evidence of strong measurement and structural invariance.

Leadership Influence on Safety Behavior Through Psychological Safety Climate and Safety Climate

Additional analysis explored the impact of leadership competencies on safety behavior mediated by both psychological safety climate and safety climate. The first analysis explored the influence of leadership on safety observations through psychological safety climate and safety climate. Psychological safety climate mediated the relationship between leadership competencies and safety observations, including advances innovative solutions with a significant low negative relationship, $B = -0.023$, $SE = 0.020$, $p = 0.244$, $\beta = -0.002$, BC 95% CI [-0.090, -0.001], communicates with impact with a significant low positive relationship, $B = 0.148$, $SE = 0.089$, $p = 0.097$, $\beta = 0.013$, BC 95% CI [0.007, 0.360], leads with vision with a significant low negative relationship, $B = -0.029$, $SE = 0.021$, $p = 0.173$, $\beta = -0.003$, BC 95% CI [-0.090, -0.002], makes sound decisions with a significant low positive relationship, $B = 0.059$, $SE = 0.041$, $p = 0.146$, $\beta = 0.005$, BC 95% CI [0.005, 0.174], and manages talent with a significant low positive relationship, $B = 0.065$, $SE = 0.042$, $p = 0.120$, $\beta = 0.006$, BC 95% CI [0.005, 0.178]. Safety climate did not mediate the relationships between the leadership competencies and safety observations; the estimates of the indirect effects were not significantly different from zero (p > .05).

The second analysis explored the influence of leadership on safety compliance through psychological safety climate and safety climate. There was a serial mediation of psychological safety climate and safety climate between communicates with impact and safety compliance with a significant low positive relationship, B = 0.005, SE = 0.003, p = 0.077, β = 0.013, BC 95% CI [0.001, 0.012]. Safety climate mediated the relationship between manages talent and safety compliance with a significant low positive relationship, B = 0.005, SE = 0.003, p = 0.108, β = 0.013, BC 95% CI [0.001, 0.012]. The sum of the indirect effects between manages talent and safety compliance for psychological safety climate and safety climate had a low positive relationship, B = 0.007, SE = 0.004, p = 0.057, β = 0.019, BC 95% CI [0.001, 0.016].

Psychological safety climate and safety climate did not mediate the relationship between leadership competencies and safety recognitions; the estimates of the indirect effects were not significantly different from zero (p > .05). Psychological safety climate and safety climate did not mediate the relationship between leadership competencies and safety reporting; the estimates of the indirect effects were not significantly different from zero (p > .05).

Chapter Summary

The multiple mediation structural equation model and multiple mediation multigroup structural equation model analyses determined that the models are better understood across work settings. Communicates with impact had a significant negative impact on safety incidents in Model 1. For Model 2, safety reporting had a significant negative impact on safety incidents, while safety compliance had a significant positive impact on safety incidents.

For Model 1 and Model 2, all the leadership competencies significantly impacted psychological safety climate. Advances innovative solutions and leads with vision had a significant negative impact on psychological safety climate. Communicates with impact, makes sound decisions, and manages talent had a significant positive impact on psychological safety cilmate. Manages talent and psychological safety climate had a significant positive impact on safety climate. For Model 1, advances innovative solutions had a significant positive impact on safety climate. For Model 2, psychological safety climate had a significant positive impact on safety observations. Safety climate had a significant positive relationship on safety compliance.

Psychological safety climate mediated the relationship between all leadership competencies and safety climate. Advances innovative solutions and leads with vision have significant negative indirect effects on safety climate through psychological safety climate. Communicates with impact, makes sound decisions, and manages talent have significant positive indirect effects on safety climate through psychological safety climate.

Chapter 5: Summary, Conclusions, and Recommendations

Introduction

This study provides clarity on how leadership competencies and behaviors influence employees' safety performance in the workplace within a range of hazardous conditions by exploring the influence of leadership on psychological safety climate, safety climate, and safety incidents. Specifically, this study examined how employees' perception of their supervisor's leadership behaviors influenced psychological safety climate and safety climate, and the effect on their participation in safety programs (i.e., safety observations, safety recognitions, safety reporting, safety compliance) and number of safety incidents at an electric utility company. The results of this study support existing research that different leadership styles have varying degrees of effectiveness in influencing safety outcomes and improving organizations' safety performance. The results provide clarity on which leadership style or characteristics have a stronger impact on psychological safety climate, safety climate, safety behaviors, and safety performance. This study provides additional detail to the research on which leadership competencies and behaviors influence employees' safety performance in the workplace using a large sample of full-time employees' who work within a range of hazardous conditions at an electric utility company. This chapter provides an interpretation of the findings, makes recommendations for future studies, and notes the significance of the findings.

Interpretation of Findings

These findings are in alignment with the theoretical model stating that leaders should be effective with multiple leadership competencies to impact psychological safety climate, safety climate, and organizational safety performance. This study fills some of the gaps that exist in the research by explaining the relationships between multiple leadership competencies in fostering psychological safety climate and a safety climate across work settings at the individual level. Individuals' perspective of their supervisors' leadership effectiveness does have an impact on the psychological safety climate, safety climate, and safety incidents. This study expands on the research from Willis et al. (2017) that found employees' perception of hazard exposure did not moderate the relationship between transformational leadership and active transactional leadership with safety behaviors (e.g., safety participation, safety compliance); this study found that leadership competencies effectiveness as defined by the leadership competencies in this study on safety climate, safety observations, safety recognitions, safety reporting, safety compliance, and safety incidents is consistent across work settings that have different hazard exposure.

The study results indicate leaders that demonstrate effective leadership behaviors can foster a safety compliance climate through creating a psychologically safe environment. These findings suggest that leaders who demonstrate both supportive leadership behaviors and a focus on organizational performance create a safety compliance climate which predicts safety compliance behaviors. The research findings also support the observation that leadership competencies and behaviors that focus on interpersonal relationships between the leader and the direct report are important factors in promoting a psychologically safe work environment, while competencies focused on business results and organizational outcomes appear to diminish individuals' perspectives on a psychologically safe work environment – individuals can provide feedback without having fear of negative consequences and feel supported and can learn from their mistakes.

The interpretation of the results is not advocating for leaders to solely focus on interpersonal relationships and disregard organizational performance. Organizations must be able to meet financial targets. Leaders have expectations to achieve business and financial goals in their departments. Leaders must be able to demonstrate proficiency in behaviors that achieve organizational performance and often organizations give recognition to those leaders that provide value to the organization. Given the results of this study, we may consider an alternative perspective with how we define effective leadership behaviors to influence organizational performance. Leaders may be more effective at achieving desired organizational performance by demonstrating leadership behaviors that promote an environment where employees can perform at their best.

This study has several novel findings to contribute to the research on leadership, psychological safety climate, and safety climate. The novelty of this study is measuring psychological safety climate's impact on safety climate both directly and indirectly between leadership effectiveness and safety climate. Employees that view their leader promoting psychological safety climate are more likely to view their leader fostering a positive safety climate. There is a direct impact between how employees perceive their leaders' behaviors in promoting psychological safety climate and how employees see the organization's safety climate. Also, leaders who are effective at demonstrating supportive leadership behaviors can promote a safety climate when their employees view them as also promoting psychological safety climate. Employees are more likely to participate in the safety observation program when the leader demonstrates behaviors that promote psychological safety climate. Employees that view their leader promoting a safety climate are more likely to demonstrate safety compliance behaviors. This study advances the research on leadership effectiveness, psychological safety climate, safety climate theory, and safety performance at the individual level.

Leadership Influence on Safety Incidents

Leaders who demonstrate supportive leadership behaviors have a significant impact on employee's safety incidents across work settings. Specifically, leaders who communicate with impact or strengthen relationships through clear communications reduce injuries in the workplace, which is consistent with past research. Leaders that have genuine, trusting relationships with their employees improve safety performance and reduce injuries in the workplace (Clarke, 2013; Clarke & Ward, 2006; Conchie & Donald, 2009; Conchie et al., 2006; Conchie et al., 2012; Kelloway et al., 2012). Employees' perception of their direct supervisor's effectiveness in communication has significantly less OSHA recordables on the job. Leaders that build their proficiency in interpersonal communication – preserves and strengthens relationships with each communication, listen actively and builds on others' ideas, and communicates directly with candor – will enhance their ability to influence an employee's safety performance.

Leadership Influence on Psychological Safety Climate

Leaders who demonstrate supportive leadership behaviors create a more psychologically safe work environment across work settings. Specifically, leaders that communicate with impact foster a more psychologically safe work environment. The results of this study are consistent with previous research (Siemsen et al., 2009; Yanchus et al., 2014), where leaders who have high quality interpersonal relationships with employees play an integral role in promoting psychological safety climate; leaders who communicate more frequently and listen to employees' concerns and ideas create a more psychologically safe work environment.

In addition to communication, the novelty of this study provides evidence that leaders that manage talent effectively on their team – leveraging individuals' capabilities to achieve organizational performance, motivate individuals to perform, reward top performance, and provide valuable feedback on a regular basis – create a psychologically safe work environment. Leaders that make sound decisions – take accountability for making and implementing decisions, respects the decision-making authority of others, makes unpopular decisions when it is the right direction for the organization, and knows when to include others in the decision-making process – promote a psychologically safe work environment. These results inform us that leaders who demonstrate supportive leadership behaviors create a more psychologically safe work environment across work settings.

Advances innovative solutions and leads with vision negatively impacted psychological safety climate, which was contrary to the expected results and previous research (Ortega et al., 2014). Compared to other studies where the competencies included leadership behaviors that created an environment for employees that supported innovation and creativity, this study measured advances innovative solutions and leads with vision with behaviors that focused on business results. Leaders who focus on business results by drawing out new ideas, challenging old paradigms, and implementing practical business solutions to advance the organization performance may create an environment that places pressure on individuals to perform to certain performance standards, placing business results as a priority above individual needs to perform on the job. Ortega et al. (2014) found that leaders who focused more on the needs of the individuals by encouraging innovative thinking, explaining the need for change, envisioning change, and modeling personal risk behaviors that are acceptable promote a psychological safe work environment for employees to model the same behaviors.

The research findings support that leadership competencies and behaviors that focus on interpersonal relationships between the leader and the direct report promote a psychologically safe work environment, while competencies focused on business results and organizational outcomes reduce individuals' perspectives on a psychologically safe work. Employees may feel that their leader esteems business results and performance above their individual needs as an employee.

Leadership Influence on Safety Climate

This study supports that leadership competencies that are supportive and focus on organizational performance are effective at impacting safety climate across work settings with varying levels of exposure to hazards. This study provides evidence that leaders that manage talent effectively on their team – leveraging individuals' capabilities to achieve organizational performance, motivate individuals to perform, reward top performance, and provide valuable feedback on a regular basis – promote safety climate. For Model 1, advances innovative solutions was positively associated with a compliance safety climate. Leaders who focus on business results by drawing out new ideas, challenging old paradigms, and implementing practical business solutions to advance the organization performance create an environment where individuals perceive an environment of following safety policies and practices.

In this study, leaders that communicate with impact did not influence a safety climate, which was inconsistent with previous research. Despite previous researchers (DeJoy et al., 2004; Donahue et al., 2011; Kines et al., 2010; Sparer et al., 2016; Zohar & Polachek, 2014) providing evidence that leaders who used effective communication with safety resulting in employees perceiving safety as a priority (i.e., increased perceptions of safety climate), these studies measured safety climate differently than this study. The novelty of this study is the measurement of safety climate based on compliance safety leadership behaviors. The results of this study advance the research by testing the leadership behaviors that create a safety compliance climate. In the case of this research, leaders that preserve and strengthen relationships with each communication, listen actively and builds on others' ideas, and communicates directly with candor may not create a compliance safety climate where employees feel they need to follow the safety policies and practices.

This research supports the finding that leadership influences the organization's safety climate, which is consistent with previous research (Barling et al., 2002; Brown & Holmes, 1986; Clarke, 2006a; Griffin & Neal, 2000; Gutberg & Whitney, 2017; Neal & Griffin, 2002, 2006; Roger & Flin, 2011; Squires et al., 2010; Tucker, S. et al., 2016; Yule et al., 2008; Zohar, 1980; Zohar & Polachek, 2014). The novelty of this study provided evidence that specific leadership competencies influence safety compliance climate. Leadership competencies and behaviors that focus on both organizational performance and supportive leadership behaviors promote a safety compliance climate.

The results of this study provide evidence that a combination of leadership competencies and behaviors may be effectiveness across work settings with different levels of hazard exposure, which supports previous research (Willis et al., 2017). Willis et al. (2017) provided support that employees' perception of hazard exposure did not depend on the relationship between transformational leadership and active transactional leadership with safety behaviors (e.g., safety participation, safety compliance). The novelty of this study found that leadership competencies impact psychological safety climate, safety compliance climate, and safety incidents across work settings with varying levels of exposure to hazards.

Leadership Influence on Safety Behavior

This study was the first to show how general leadership competencies influence safety behaviors through psychological safety climate and safety climate. The results of this study indicate that leaders can influence employees' participation in safety programs and safety compliance behaviors. In this study, employees' perception of their leader's behaviors indirectly influences their safety behaviors (i.e., participation in safety observation program, safety compliance behaviors) through psychological safety climate and safety compliance climate. This study supports previous research that leaders have a positive influence on employees' safety behaviors through safety climate (Barling et al., 2002; Bian et al., 2019; Clarke, 2013). Clarke (2013) found that safety climate mediated the relationship between transformational leadership and safety participation, but not safety compliance. This study found that safety climate mediated manages talent, closely aligned with inspirational motivation in transformational leadership, and safety compliance; however, safety climate did not mediate the relationships between the leadership competencies and safety participation. This study advanced the current research in understanding the impact of general leadership competencies on safety participation and safety compliance through safety climate. Leaders that manage talent effectively influence employees' safety compliance behaviors through safety climate. This study also distinguished safety participation into participation in several types of safety programs, such as participation in safety observation program, safety reporting of close calls, and safety recognition program.

In this study, leaders influenced their employees' participation in safety observations indirectly through fostering a psychological safety climate. Leaders that demonstrated supportive leadership behaviors to their teams and less on organizational performance or business results resulted in more participation in the safety observation program. Also, leaders that communicate with impact influenced employees' safety compliance behaviors through both psychological safety climate and safety climate. This was the first study to show how leaders' effectiveness with communication can influence their employees' compliance with safety practices and procedures through psychological safety climate and safety climate.

Safety Program Interventions

Safety intervention programs that engage leaders and employees in safety increases safety performance (Lee et al., 2018). The results of this study indicate that safety program interventions can improve safety performance incrementally, but additional research should continue to understand how safety program interventions can improve safety performance. Participation in safety reporting has an incremental improvement on safety performance. Employees that report close calls have lower total number of OSHA recordables. This result may indicate that employees who place safety as a priority by reporting close calls have lower number of safety incidents.

Employees who view their leaders demonstrating leadership behaviors that support psychological safety climate are more likely to participate in the safety observation program. Employees may feel comfortable to provide others feedback about their safety behaviors and recognize the safety behaviors of others when their leader promotes a positive work environment or creates a work environment where employees feel supported and can learn from their mistakes. However, employees' participation in the safety observation program does not influence the employees' number of safety incidents. A consideration for these results is that the safety programs were in their infancy and may need time to mature or given time to show how they may impact safety performance. The novelty of this study distinguishes between multiple types of safety programs and measures their impact concurrently. The study also adds to the research to further understand how safety climate interventions improve occupational safety in organizations.

Safety Compliance

In a safety compliance climate, employees perform required behaviors to maintain a minimum level of workplace safety, such as following safety policies, rules, and procedures, and wearing personal protective equipment (Clarke & Ward, 2006; Neal & Griffin, 2006; Zahoor et al., 2017). This study found that employees who perceive their leader demonstrating safety leadership behaviors that promote safety compliance were more likely to be recognized by leaders and peers for their safety leadership behaviors in the safety recognition program.

Unexpectedly, this study also found employees that were recognized for safety behaviors in the safety recognition program were more likely to have safety incidents at the individual level. This finding does not support previous research that reinforcement of safety behaviors from either the leader or other employees decrease employee unsafe work behaviors and injuries (Luria et al., 2008; Yule et al., 2008; Zohar, 2002b; Zohar & Luria, 2003). These results elude to the idea that leaders not only influence if employees demonstrate safety behaviors, but they influence what safety behaviors employees demonstrate. If leaders are demonstrating safety leadership behaviors that promote safety compliance, employees may be demonstrating and reinforcing behaviors that either do not have an impact on safety performance or contribute to safety incidents. Organizations may need to identify which behaviors reduce unsafe work behaviors and injuries, so leaders and employees can recognize their colleagues for demonstrating effective safety behaviors that reduce unsafe work practices and injuries as part of the safety recognition program.

Leadership Influence on Safety Climate through Psychological Safety Climate

Leadership influence on safety compliance climate is better understood through the perspective of a psychologically safe work environment across work settings. Leaders that demonstrate supportive leadership behaviors appear to be the most effective on impacting a safety compliance climate when they also demonstrate behaviors that promote psychological safety climate – an environment where individuals feel they can provide feedback without fear of negative consequences and feel supported they can learn from their mistakes. Leaders that communicate with impact, make sound decisions, and manage talent all have an impact on a safety compliance climate through psychological safety climate. Advances innovative solutions and leads with visions both have a significant negative indirect effect on a compliance safety climate through psychological safety climate. Leaders that preserve and strengthen relationships with each communication, take accountability for decisions, use good judgement when making tough decisions, and leverage individuals' strengths to develop organizational capabilities strengthen a safety compliance climate by creating a psychological safety climate.

As leaders focus more on demonstrating supportive leadership behaviors to their teams and less on organizational performance or business results, employees perceive a more psychologically safe work environment where safety is a priority. Leaders that focus on the future direction and results from employees may influence employees to place productivity as a priority above safety. Employees may feel that their leader esteems business results and performance above their individual needs as an employee. Leaders may be more effective at achieving desired safety performance by focusing their attention on creating a work environment that promotes psychological safety climate.

The results of this study are consistent with previous research (Carmeli et al., 2010; Detert & Burris, 2007; Madjar & Ortiz-Walters, 2009; May et al., 2004; Newman et al., 2017; Palanski & Vogelgesang, 2011; Siemsen et al., 2009; Yanchus et al., 2014) that supportive leadership behaviors affect work outcomes through psychological safety climate. The novelty of this research shows that individual perceptions of supportive leadership behaviors impact safety climate through psychological safety climate.

Leadership, Psychological Safety Climate, and Safety Climate Impacting Safety Performance

Employees' perception of their manager's leadership capability and commitment to safety compliance does influence their participation in safety programs and safety performance to decrease safety incidents and fatalities. General leadership competencies do have a direct effect on safety performance. The research findings did show a direct relationship between the communicates with impact, safety reporting, and safety compliance to influence safety incidents.

This study was first to test the effect of a safety compliance climate created by leaders demonstrating leadership behaviors that promote safety compliance. The study found that a focus on safety compliance may not create an environment where employees participate in safety programs. However, psychological safety climate did influence employees to participate in the safety observation program. Also, employees that reported safety close calls did have lower number of safety incidents on the job.

Despite this study not being consistent with previous research that states safety climate can predict safety incidents, but through more distal measures, such as safety behaviors, i.e., safety participation and safety compliance (Clarke, 2006a, 2010; Neal & Griffin, 2006), the study distinguishes between safety climate and safety compliance climate. The novelty of this study says that safety compliance climate may not predict safety incidents through more distal measures, such as safety behaviors, i.e., safety participation and safety compliance. This research used individual perceptions of transactional safety leadership behaviors that support safety compliance where the safety climate items measured compliance safety leadership behaviors at the individual level. Also, safety compliance climate at the individual level may not be the most effective measure to determine safety performance. The novelty of this study is measuring safety climate at the individual level, which did not yield significant results to impact safety performance.

In addition, safety climate is a measure of shared employee perceptions about the relative importance of safe, observable conduct in their occupational behavior at a place and time (Zohar, 1980; Zohar & Luria, 2005). Safety climate is at the surface of the perceived importance of safety in the workplace. Safety culture may also play an important role in understanding the impact on safety performance in the workplace. Organizations have different levels of safety culture maturity that shapes the perceptions and beliefs around safety, which create a collective understanding of how to conduct oneself safely in the workplace.

Safety maturity models are a recent means of assessing safety culture in organizations and the use of maturity models has seen a steady growth over the last two decades (Goncalves Filho & Waterson, 2018). There are many safety culture maturity models that exist across industries (Goncalves Filho & Waterson, 2018; Krause, 2005; Mylett, 2010; Reader, Noort, Shorrock, & Kirwan, 2015), but generally are used as organizational development tool to increase safety communication, management commitment to safety, and safety training. Organizations mature safety cultures from non-compliance, compliance, to personal ownership towards safety (Goncalves Filho & Waterson, 2018).

Safety compliant cultures where safety is viewed as a set of rules and policies are not as effective as more safety mature organizational cultures where safety is a value that guides individuals' behaviors (DeJoy, 2005; Mylett, 2010). DeJoy (2005) compared the relative importance of changing behaviors to changing culture. The key aspects of safety culture were communication, understanding safety roles and responsibilities, safety information, decision making, and trust. Theses aspects are in alignment with this study as leadership effectiveness with communicates with impact, makes sound decisions, and manage talent all have a significant positive indirect effect on a safety compliance climate through psychological safety climate.

Theoretical Support

Leaders have a significant role in creating a psychologically and physically safe work environment to allow individuals to do their best work. Organizational leaders are role models for psychological and physical safety as employees are likely to imitate their leader’s behaviors. Following the principles of social learning theory, the findings of this study provides additional support that leaders who model supportive behaviors to subordinates created a climate of psychological safety climate. This research study was able to provide additional support and novel findings that individuals will inherently believe that safety is a priority and demonstrate the appropriate behaviors to stay safe on the job by observing their supervisor leadership effectiveness.

In alignment with the full range of leadership theory, this research showed that effective safety leaders demonstrated certain leadership styles, characteristics, and behaviors that improved an organization’s safety performance; leadership competencies have degrees of effectiveness on psychological safety climate and safety climate. The novelty of this study is measuring the effectiveness of general leadership competencies on psychological safety climate and safety climate. In this study, the competency of leads with vision was closely aligned with idealized influence, which had unexpected results as there is a small inverse relationship with psychological safety climate across work settings and no effect on safety climate. However, leads with vision was more focused on organizational performance than transformational leadership. Manages talent, closely aligned with inspirational motivation, promoted psychological safety climate and safety climate across work settings. Advances innovative solutions, closely aligned with intellectual stimulation, had an inverse relationship with psychological safety climate across work settings. Communicates with impact, closely aligned with individualized consideration, promoted psychological safety climate across work settings. The results of this study provide evidence that leaders must have certain skills to impact both psychological safety climate and safety climate. They must use a combination of leadership competencies and behaviors to be effective with creating a psychologically and physically safe work environment. They must be able to evaluate the situation and determine the most effective leadership behaviors to obtain the most desired outcome or performance from their employees.

This research study evaluated employee's perspective of their supervisor's effectiveness on general leadership competencies to influence psychological safety climate and safety climate at the individual level. The evidence supports that psychological safety climate impacts safety climate at the individual level; however, there was not enough evidence to support that safety climate at the individual level impacts safety performance. Despite Zohar and Luria (2005) conceptualization of safety climate theory as a multilevel analysis at the individual, group and organizational levels, safety climate may be better understood and interpreted at the group and organization level to shape the individuals' safety behaviors and performance.

Recommendations

This section includes recommendations for future studies and discovered limitations based on the findings of the research. This study was consistent with other researchers (Christian et al., 2009; Hofmann & Morgeson, 1999; Michael et al., 2006; Neal & Griffin, 2006) in using objective safety incident records, such as OSHA recordables accidents as the employee's total safety incidents, but this study explored using close calls, first aid, and incident only in the safety incident totals for exploratory models. These metrics did not yield significant relationships between the leadership competencies, psychological safety climate, or safety climate, because they were not mandatory for employees to report at the company and likely had bias in the data. First aid and incident only incidents may not have been a result of work-related incidents; therefore, they were deemed as insufficient to answer the research questions. Using close calls, first aid, or incident only may not be appropriate for measuring safety incidents in future studies.

This study used two models to determine the influence of leadership competencies on safety incidents. Model 1 used 2014 safety incidents and Model 2 used 2015 safety incidents and determined that communicates with impact had a significant relationship with safety incidents over a one-year timeframe and was not significant after two years. This study provides evidence that leadership influence may have an impact after only one year. Future studies should examine the influence of leadership competencies on safety performance and incidents using longitudinal research and statistical modeling.

In the current study, safety climate was measured by leadership behaviors that support compliance with safety standards and policies. Leadership competencies and behaviors that focus on both organizational performance and supportive leadership behaviors promote a safety compliance climate. This study did not find significant direct or indirect effects with safety climate on safety performance. Based on these results, future research should determine which leadership behaviors foster the desired safety climate that is effective at influencing safety performance. Future studies should investigate the impact of varying degrees of safety climate maturity that exists in organizations from safety compliance to safety stewardship, because they may provide additional clarity on the impacts to safety performance.

Safety climate may be a better measure at the group and organizational level to determine impact on safety performance. This study measured safety climate from employees' perspective of their leader's effectiveness on a range of leadership competencies at the individual level. Most safety climate studies measured the construct at the group or organizational level. Future studies should focus their measurements and analysis from multiple levels, including individual, group, and organizational levels, to determine the best method to measure safety climate. Additional examination of the safety climate levels using multiple level statistical modeling may provide support for safety climate theory.

This study explored safety climate interventions to provide evidence for safety program effectiveness at reducing safety incidents in the workplace. This study did yield significant results to determine the effectiveness of safety observation, safety reporting, and safety recognition programs. Additional research on the quality of safety climate interventions needs to be explored to improve the implementation and effectiveness of safety programs. Additionally, employees may not be recognizing the correct safety behaviors that decrease safety incidents and may need additional training to be an effective participate. There may be additional training as part of the safety recognition program for employees to reinforce the right behaviors or be role models for safety.

Implications

This study fills the gaps that exist in the research by explaining the relationships between multiple leadership competencies in creating psychological safety climate and safety climate across work settings at the individual level. Leadership competencies are better understood across work settings to impact psychological safety climate, safety climate, and safety incidents. Leaders, employees, safety specialists, and human resource professionals should be aware of the leadership competencies that impact psychological safety climate, safety climate, and safety incidents to be able to hire and develop employees that can positively influence safety performance.

Leaders should develop their effectiveness in supportive leadership behaviors and learn to flex their leadership style given the desired impact they want to make on their direct reports' safety performance. The present research suggests that leaders must focus on their employees' individual needs and demonstrate supportive leadership behaviors to create a psychologically safe work environment and promote a safety compliance climate. Organizations should invest and design leadership training and development programs that enable supervisors to acquire these competencies and develop the skills to flex their leadership behaviors to impact psychological safety climate, safety climate, and safety performance.

Organization's leadership competency model should incorporate supportive leadership behaviors. Human Resource Professionals should integrate the competency model throughout the Human Resource processes, including hiring, development, performance management, talent planning, succession planning, and compensation. Specifying these competences as a framework that aligns with the business strategy will show improvements in the organization's work environment relating to psychological safety climate, safety climate, and safety performance.

Conclusion

This study sought to provide clarity on how leadership competencies and behaviors influence individuals' safety performance in the workplace within a range of hazardous conditions by exploring the influence of leadership on psychological safety climate, safety climate, and safety incidents. The results of this study provide clarity on how leadership competencies and behaviors influence psychological safety climate and safety climate in the workplace. These findings support that leaders who demonstrate supportive leadership behaviors create a safety compliance climate, but safety compliance climate did not predict safety outcomes, such as safety observations, safety recognitions, safety reporting, or safety incidents. However, safety compliance climate did predict employees' safety compliance behaviors, such as following safety rules and policies.

The novelty of this study is measuring psychological safety climate's impact on safety climate both directly and indirectly between leadership effectiveness and safety climate. Psychological safety climate has an impact on safety climate at the individual level, but psychological safety climate and safety climate at the individual level did not show impacts on safety performance. This study provides evidence towards the safety climate theory, where safety climate may be better understood at the group or organizational level to predict safety performance.

Leaders that demonstrate competencies and behaviors that focus on business results and organizational performance reduce psychological safety in the work environment. The research findings show how competencies that focus on organizational performance diminish a psychologically safe work environment. Employees may feel that their leader esteems business results and performance above their individual needs as an employee. We should not interpret these results that leaders need to focus only on supportive leadership behaviors, as leaders are still expected to reach business and financial targets to achieve their organization's performance goals. Instead, we may consider an alternative perspective with how we define effective leadership behaviors to influence organizational performance.

Leaders may be more effective at achieving desired organizational performance by focusing their attention on creating a work environment that promotes psychological safety. To make in impact, leaders should demonstrate leadership behaviors that promote an environment where employees can perform at their best. Organizations may need to reconsider how they define and reward effective leadership, such as focusing on selecting and developing leaders who are proficient in supportive leadership behaviors to promote an environment where employees can provide feedback without fear of negative consequences or retaliation against them. Also, leaders may need to reconsider how they lead. They should focus their behaviors on meeting the needs of the individual employees, such as demonstrating supportive leadership behaviors that create a psychologically safe work environment in order to drive business results and organizational performance.

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Appendix A: Sample Research Permission Letter

February 19, 2019

Institutional Review Board
The Chicago School of Professional Psychology
617 W. 7th Street
Los Angeles, CA 91106

Dear Institutional Review Board,

We give Shanon Harmon permission to conduct the research titled "Leadership Influence on Occupational Safety: Psychological Safety and Safety Climate as Mediators Between Leadership and Safety Performance" in partial fulfillment of the requirements for his degree of Doctor of Philosophy in Business Psychology from The Chicago School of Professional Psychology. Shanon has the role of an Organizational Development Consultant at our company.

We grant Shanon permission to use archival dataset "Safety Leadership Dataset" to conduct the research project. The data in excel includes records from participant demographics, leadership behavior questionnaires, safety programs, and safety records. The participants will remain anonymous in the dataset as they will not be identifiable directly from the dataset.

- *Participant Demographic Information* contains demographic information of participants.
- *Leadership Behavior Questionnaire* is a direct report feedback assessment tool completed by employees that measured their perceptions of their supervisor's leadership effectiveness on 34 behaviors within seven competencies. We obtained consent from employees to use their responses on the questionnaire for leadership development – improving leadership capabilities and work environment.
- *Safety Program Records* are employees' behavior-based safety observations using a standard list of questions that cover typical work activities. Safety program data is available to full-time employees, including trends and descriptive statistics.
- *Safety Records* include recordable accidents, such as first aid, incident only, and Occupational Safety and Health Association (OSHA) recordables that occurred for each person. The OSHA recordkeeping regulation requires the preparation and maintenance of records of serious occupational injuries and illnesses.

The results of this study may benefit leaders, safety specialists, and human resource professionals by defining the leadership behaviors that are most significant to influence employees' safety behaviors, increase employee health and wellbeing, and prevent serious injuries and fatalities.

If we have any concerns or require additional information, we will contact Shanon and/or the IRB Committee.

Sincerely,

SVP & CHRO Human Resources

VP Safety, Security & Business Resiliency

Appendix B: Leadership Behavior Questionnaire Participant Instructions

The Direct Report Feedback survey is designed to provide leaders a standardized way of obtaining constructive feedback from their direct reports. This process is being used for all leaders participating in the leadership assessment process, to help leaders identify strengths and development opportunities. The feedback survey targets the leadership competencies and values that are part of the assessment discussion. The Direct Report Feedback survey will provide average ratings and written comments across all direct reports. This provides an assessment of the leader's effectiveness in each of the targeted competencies as well as on the values. The competencies included are: Makes Sound Decisions, Advances innovative solutions, Communicates with impact, Leads with Vision, Manages Talent, Creates a Safety Culture. Your feedback will be anonymous and will be used for the sole purpose of leadership development. With this in mind, we ask that you be candid with your ratings and as thorough as possible with your written comments.

Appendix C: Mplus Input for Confirmatory Factor Analysis (CFA) Initial Model

```
TITLE: Dissertation Analysis - Measurement Model

DATA: File is "C:\Users\Shano\Dropbox\Dissertation\Data\Dissertation Analysis\
Safety_Leadership_Dataset.dat";

VARIABLE: Names are AIS1-AIS5, CWI1-CWI5, LWV1-LWV5, MSD1-MSD5, MT1-MT5, PS1-PS5,
SC1-SC4, SP, SR, IT, HAZ, TIJ, LOS, RACE, GEND, GENR, AGE;

USEVARIABLES ARE AIS1-AIS5, CWI1-CWI5, LWV1-LWV5, MSD1-MSD5, MT1-MT5, PS1-PS5, SC1-SC4;
MISSING = ALL (-9)

ANALYSIS:
TYPE IS GENERAL;
ESTIMATOR IS ML;

MODEL:

!Measurement Model

AIS by AIS1* AIS2 AIS3 AIS4 AIS5;
CWI by CWI1* CWI2 CWI3 CWI4 CWI5;
LWV by LWV1* LWV2 LWV3 LWV4 LWV5;
MSD by MSD1* MSD2 MSD3 MSD4 MSD5;
MT by MT1* MT2 MT3 MT4 MT5;
PS by PS1* PS2 PS3 PS4 PS5;
SC by SC1* SC2 SC3 SC4;

AIS@1;
CWI@1;
LWV@1;
MSD@1;
MT@1;
PS@1;
SC@1;

AIS WITH CWI;
AIS WITH LWV;
AIS WITH MSD;
AIS WITH MT;
AIS WITH PS;
AIS WITH SC;
CWI WITH LWV;
CWI WITH MSD;
CWI WITH MT;
CWI WITH PS;
CWI WITH SC;
LWV WITH MSD;
LWV WITH MT;
LWV WITH PS;
LWV WITH SC;
MSD WITH MT;
MSD WITH PS;
MSD WITH SC;
MT WITH PS;
MT WITH SC;
PS WITH SC;


OUTPUT: SAMPSTAT STANDARDIZED MODINDICES;
```

Appendix D: Mplus Input for Confirmatory Factor Analysis (CFA) Respecified Model

```
TITLE: Dissertation Analysis - Measurement Model Respecified

DATA: File is "C:\Users\Shano\Dropbox\Dissertation\Data\Dissertation Analysis\
Safety_Leadership_Dataset.dat";

VARIABLE: Names are AIS1-AIS5, CWI1-CWI5, LWV1-LWV5, MSD1-MSD5, MT1-MT5, PS1-PS5,
SC1-SC4, SP, SR, IT, HAZ, TIJ, LOS, RACE, GEND, GENR, AGE;

USEVARIABLES ARE AIS1-AIS5, CWI1-CWI5, LWV1-LWV5, MSD1-MSD5, MT1-MT5, PS1-PS5, SC1-SC4;
MISSING = ALL (-9)

ANALYSIS:
TYPE IS GENERAL;
ESTIMATOR IS ML;

MODEL:

!Measurement Model

AIS by AIS1* AIS2 AIS3 AIS4 AIS5;
CWI by CWI1* CWI2 CWI3 CWI4 CWI5;
LWV by LWV1* LWV2 LWV3 LWV4 LWV5 PS1;
MSD by MSD1* MSD2 MSD3 MSD4 MSD5;
MT by MT1* MT2 MT3 MT4 MT5;
PS by PS2* PS3 PS4 PS5;
SC by SC1* SC2 SC3 SC4;

AIS@1;
CWI@1;
LWV@1;
MSD@1;
MT@1;
PS@1;
SC@1;

AIS WITH CWI;
AIS WITH LWV;
AIS WITH MSD;
AIS WITH MT;
AIS WITH PS;
AIS WITH SC;
CWI WITH LWV;
CWI WITH MSD;
CWI WITH MT;
CWI WITH PS;
CWI WITH SC;
LWV WITH MSD;
LWV WITH MT;
LWV WITH PS;
LWV WITH SC;
MSD WITH MT;
MSD WITH PS;
MSD WITH SC;
MT WITH PS;
MT WITH SC;
PS WITH SC;


OUTPUT: SAMPSTAT STANDARDIZED MODINDICES;
```

Appendix E: Mplus Input for Multiple Mediation Structural Equation Model 1

```
TITLE: Dissertation Analysis - Structural Model (SEM) - OSHA 2014

DATA: File is "C:\Users\Shano\Dropbox\Dissertation\Data\Dissertation Analysis\
Safety_Leadership_Dataset_6.dat";

VARIABLE: Names ARE ID AIS1-AIS5, CWI1-CWI5, LWV1-LWV5, MSD1-MSD5, MT1-MT5, PS1-PS5,
SC1-SC4, SO14, SN14, SR14, ICC14, IFA14, IO14, IH14, ILT14, INLT14, IRDA14,
IOS14, IA14, IT14, HAZ, TIJ, LOS, RACE, GEND, GENR, AGE;

USEVARIABLES ARE AIS1-AIS5, CWI1-CWI5, LWV1-LWV5, MSD1-MSD5, MT1-MT5, PS1-PS5, SC1-SC4,
IOS14, HAZ, TIJ, LOS, GEND, AGE;
MISSING ARE ALL (-9);

ANALYSIS:
BOOTSTRAP IS 5000;

MODEL:
!Measurement Model
AIS by AIS1* AIS2 AIS3 AIS4 AIS5;
CWI by CWI1* CWI2 CWI3 CWI4 CWI5;
LWV by LWV1* LWV2 LWV3 LWV4 LWV5 PS1;
MSD by MSD1* MSD2 MSD3 MSD4 MSD5;
MT by MT1* MT2 MT3 MT4 MT5;
PS by PS2* PS3 PS4 PS5;
SC by SC1* SC2 SC3 SC4;

AIS@1;
CWI@1;
LWV@1;
MSD@1;
MT@1;
PS@1;
SC@1;

!Reserach Question 1: What leadership competencies influence employee safety incidents?
IOS14 ON AIS;
IOS14 ON CWI;
IOS14 ON LWV;
IOS14 ON MSD;
IOS14 ON MT;

!Reserach Question 6: Does psychological safety influence employee safety incidents?
IOS14 ON PS;

!Reserach Question 7: Does safety climate influence employee safety incidents?
IOS14 ON SC;

!Research Question 2: What leadership competencies influence psychological safety?
PS ON AIS;
PS ON CWI;
PS ON LWV;
PS ON MSD;
PS ON MT;

!Research Question 3: What leadership competencies influence safety climate?
SC ON AIS;
SC ON CWI;
SC ON LWV;
SC ON MSD;
SC ON MT;
SC ON PS;

!Covariates
IOS14 ON HAZ;
IOS14 ON TIJ;
IOS14 ON LOS;
IOS14 ON GEND;
IOS14 ON AGE;
```

```
PS ON HAZ;
PS ON TIJ;
PS ON LOS;
PS ON GEND;
PS ON AGE;

SC ON HAZ;
SC ON TIJ;
SC ON LOS;
SC ON GEND;
SC ON AGE;

MODEL INDIRECT:

!Research Question 4: What leadership competencies indirectly influence
!employee safety incidents through psychological safety?
IOS14 IND PS AIS;
IOS14 IND PS CWI;
IOS14 IND PS LWV;
IOS14 IND PS MSD;
IOS14 IND PS MT;

!Research Question 5: What leadership competencies indirectly influence
!employee safety incidents through safety climate?
IOS14 IND SC AIS;
IOS14 IND SC CWI;
IOS14 IND SC LWV;
IOS14 IND SC MSD;
IOS14 IND SC MT;

!Research Question 8: Does psychological safety indirectly influence
!employee safety incidents through safety climate?
IOS14 IND SC PS;

!Research Question 12 - Do leadership competencies indirectly influence
!safety climate through Psychological Safety?
SC IND PS AIS;
SC IND PS CWI;
SC IND PS LWV;
SC IND PS MSD;
SC IND PS MT;

OUTPUT: TECH1 TECH4 STANDARDIZED CINTERVAL(BCBOOTSTRAP) MODINDICES;
```

Appendix F: Mplus Input for Multigroup Structural Equation Model 1 – Baseline

```
TITLE: Dissertation Analysis - Structural Model (SEM) - Group - OSHA 2014 - Baseline

DATA: File is "C:\Users\Shano\Dropbox\Dissertation\Data\Dissertation Analysis\
Safety_Leadership_Dataset_6.dat";

VARIABLE: Names ARE ID AIS1-AIS5, CWI1-CWI5, LWV1-LWV5, MSD1-MSD5, MT1-MT5, PS1-PS5,
SC1-SC4, SO14, SN14, SR14, ICC14, IFA14, IO14, IH14, ILT14, INLT14, IRDA14,
IOS14, IA14, IT14, HAZ, TIJ, LOS, RACE, GEND, GENR, AGE;

USEVARIABLES ARE AIS1-AIS5, CWI1-CWI5, LWV1-LWV5, MSD1-MSD5, MT1-MT5, PS1-PS5, SC1-SC4,
IOS14, TIJ, LOS, GEND, AGE;
MISSING ARE ALL (-9);

MODEL:
!Measurement Model
AIS by AIS1* AIS2 AIS3 AIS4 AIS5;
CWI by CWI1* CWI2 CWI3 CWI4 CWI5;
LWV by LWV1* LWV2 LWV3 LWV4 LWV5 PS1;
MSD by MSD1* MSD2 MSD3 MSD4 MSD5;
MT by MT1* MT2 MT3 MT4 MT5;
PS by PS2* PS3 PS4 PS5;
SC by SC1* SC2 SC3 SC4;

AIS@1;
CWI@1;
LWV@1;
MSD@1;
MT@1;
PS@1;
SC@1;

!Reserach Question 1: What leadership competencies influence employee safety incidents?
IOS14 ON AIS;
IOS14 ON CWI;
IOS14 ON LWV;
IOS14 ON MSD;
IOS14 ON MT;

!Reserach Question 6: Does psychological safety influence employee safety incidents?
IOS14 ON PS;

!Reserach Question 7: Does safety climate influence employee safety incidents?
IOS14 ON SC;

!Research Question 2: What leadership competencies influence psychological safety?
PS ON AIS;
PS ON CWI;
PS ON LWV;
PS ON MSD;
PS ON MT;

!Research Question 3: What leadership competencies influence safety climate?
SC ON AIS;
SC ON CWI;
SC ON LWV;
SC ON MSD;
SC ON MT;
SC ON PS;

!Covariates
IOS14 ON TIJ;
IOS14 ON LOS;
IOS14 ON GEND;
IOS14 ON AGE;

PS ON TIJ;
PS ON LOS;
PS ON GEND;
```

```
PS ON AGE;

SC ON TIJ;
SC ON LOS;
SC ON GEND;
SC ON AGE;

MODEL INDIRECT:

!Research Question 4: What leadership competencies indirectly influence
!employee safety incidents through psychological safety?
IOS14 IND PS AIS;
IOS14 IND PS CWI;
IOS14 IND PS LWV;
IOS14 IND PS MSD;
IOS14 IND PS MT;

!Research Question 5: What leadership competencies indirectly influence
!employee safety incidents through safety climate?
IOS14 IND SC AIS;
IOS14 IND SC CWI;
IOS14 IND SC LWV;
IOS14 IND SC MSD;
IOS14 IND SC MT;

!Research Question 8: Does psychological safety indirectly influence
!employee safety incidents through safety climate?
IOS14 IND SC PS;

!Research Question 12 - Do leadership competencies indirectly influence
!safety climate through Psychological Safety?
SC IND PS AIS;
SC IND PS CWI;
SC IND PS LWV;
SC IND PS MSD;
SC IND PS MT;

OUTPUT: TECH1 TECH4 STDYX MODINDICES;
```

Appendix G: Mplus Input for Multigroup Structural Equation Model 1 – Configural

```
TITLE: Dissertation Analysis - Structural Model (SEM) - Group - OSHA 2014 - Configural

DATA: File is "C:\Users\Shano\Dropbox\Dissertation\Data\Dissertation Analysis\
Safety_Leadership_Dataset_6.dat";

VARIABLE: Names ARE ID AIS1-AIS5, CWI1-CWI5, LWV1-LWV5, MSD1-MSD5, MT1-MT5, PS1-PS5,
SC1-SC4, SO14, SN14, SR14, ICC14, IFA14, IO14, IH14, ILT14, INLT14, IRDA14,
IOS14, IA14, IT14, HAZ, TIJ, LOS, RACE, GEND, GENR, AGE;

USEVARIABLES ARE AIS1-AIS5, CWI1-CWI5, LWV1-LWV5, MSD1-MSD5, MT1-MT5, PS1-PS5, SC1-SC4,
IOS14, HAZ, TIJ, LOS, GEND, AGE;
GROUPING IS HAZ (1 = office, 2 = field-non-hazard, 3 = field-hazard);
MISSING ARE ALL (-9);

MODEL:
!Measurement Model
AIS by AIS1 AIS2 AIS3 AIS4 AIS5;
CWI by CWI1 CWI2 CWI3 CWI4 CWI5;
LWV by LWV1 LWV2 LWV3 LWV4 LWV5 PS1;
MSD by MSD1 MSD2 MSD3 MSD4 MSD5;
MT by MT1 MT2 MT3 MT4 MT5;
PS by PS2 PS3 PS4 PS5;
SC by SC1 SC2 SC3 SC4;

AIS@1;
CWI@1;
LWV@1;
MSD@1;
MT@1;
PS@1;
SC@1;

[AIS@0];
[CWI@0];
[LWV@0];
[MSD@0];
[MT@0];
[PS@0];
[SC@0];

[AIS1-AIS5];
[CWI1-CWI5];
[LWV1-LWV5];
[MSD1-MSD5];
[MT1-MT5];
[PS1-PS5];
[SC1-SC4];

!Reserach Question 1: What leadership competencies influence employee safety incidents?
IOS14 ON AIS;
IOS14 ON CWI;
IOS14 ON LWV;
IOS14 ON MSD;
IOS14 ON MT;

!Reserach Question 6: Does psychological safety influence employee safety incidents?
IOS14 ON PS;

!Reserach Question 7: Does safety climate influence employee safety incidents?
IOS14 ON SC;

!Research Question 2: What leadership competencies influence psychological safety?
PS ON AIS;
PS ON CWI;
PS ON LWV;
PS ON MSD;
PS ON MT;
```

```
!Research Question 3: What leadership competencies influence safety climate?
SC ON AIS;
SC ON CWI;
SC ON LWV;
SC ON MSD;
SC ON MT;
SC ON PS;

!Covariates
IOS14 ON TIJ;
IOS14 ON LOS;
IOS14 ON GEND;
IOS14 ON AGE;

PS ON TIJ;
PS ON LOS;
PS ON GEND;
PS ON AGE;

SC ON TIJ;
SC ON LOS;
SC ON GEND;
SC ON AGE;

MODEL INDIRECT:

!Research Question 4: What leadership competencies indirectly influence
!employee safety incidents through psychological safety?
IOS14 IND PS AIS;
IOS14 IND PS CWI;
IOS14 IND PS LWV;
IOS14 IND PS MSD;
IOS14 IND PS MT;

!Research Question 5: What leadership competencies indirectly influence
!employee safety incidents through safety climate?
IOS14 IND SC AIS;
IOS14 IND SC CWI;
IOS14 IND SC LWV;
IOS14 IND SC MSD;
IOS14 IND SC MT;

!Research Question 8: Does psychological safety indirectly influence
!employee safety incidents through safety climate?
IOS14 IND SC PS;

!Research Question 12 - Do leadership competencies indirectly influence
!safety climate through Psychological Safety?
SC IND PS AIS;
SC IND PS CWI;
SC IND PS LWV;
SC IND PS MSD;
SC IND PS MT;

MODEL office:


MODEL field-non-hazard:


MODEL field-hazard:


OUTPUT: TECH1 TECH4 STDYX MODINDICES;
```

Appendix H: Mplus Input for Multigroup Structural Equation Model 1 – Constrained

```
TITLE: Dissertation Analysis - Structural Model (SEM) - Group - OSHA 2014 - Constrained

DATA: File is "C:\Users\Shano\Dropbox\Dissertation\Data\Dissertation Analysis\
Safety_Leadership_Dataset_6.dat";

VARIABLE: Names ARE ID AIS1-AIS5, CWI1-CWI5, LWV1-LWV5, MSD1-MSD5, MT1-MT5, PS1-PS5,
SC1-SC4, SO14, SN14, SR14, ICC14, IFA14, IO14, IH14, ILT14, INLT14, IRDA14,
IOS14, IA14, IT14, HAZ, TIJ, LOS, RACE, GEND, GENR, AGE;

USEVARIABLES ARE AIS1-AIS5, CWI1-CWI5, LWV1-LWV5, MSD1-MSD5, MT1-MT5, PS1-PS5, SC1-SC4,
IOS14, HAZ, TIJ, LOS, GEND, AGE;
GROUPING IS HAZ (1 = office, 2 = field-non-hazard, 3 = field-hazard);
MISSING ARE ALL (-9);

MODEL:
!Measurement Model
AIS by AIS1* AIS2 AIS3 AIS4 AIS5;
CWI by CWI1* CWI2 CWI3 CWI4 CWI5;
LWV by LWV1* LWV2 LWV3 LWV4 LWV5 PS1;
MSD by MSD1* MSD2 MSD3 MSD4 MSD5;
MT by MT1* MT2 MT3 MT4 MT5;
PS by PS2* PS3 PS4 PS5;
SC by SC1* SC2 SC3 SC4;

AIS@1;
CWI@1;
LWV@1;
MSD@1;
MT@1;
PS@1;
SC@1;

[AIS@0];
[CWI@0];
[LWV@0];
[MSD@0];
[MT@0];
[PS@0];
[SC@0];

[AIS1-AIS5];
[CWI1-CWI5];
[LWV1-LWV5];
[MSD1-MSD5];
[MT1-MT5];
[PS1-PS5];
[SC1-SC4];

!Reserach Question 1: What leadership competencies influence employee safety incidents?
IOS14 ON AIS (a_io);
IOS14 ON CWI (c_io);
IOS14 ON LWV (l_io);
IOS14 ON MSD (md_io);
IOS14 ON MT (mt_io);

!Reserach Question 6: Does psychological safety influence employee safety incidents?
IOS14 ON PS (p_io);

!Reserach Question 7: Does safety climate influence employee safety incidents?
IOS14 ON SC (sc_io);

!Research Question 2: What leadership competencies influence psychological safety?
PS ON AIS (a_p);
PS ON CWI (c_p);
PS ON LWV (l_p);
PS ON MSD (md_p);
PS ON MT (mt_p);
```

```
!Research Question 3: What leadership competencies influence safety climate?
SC ON AIS (a_sc);
SC ON CWI (c_sc);
SC ON LWV (l_sc);
SC ON MSD (md_sc);
SC ON MT (mt_sc);
SC ON PS (p_sc);

!Covariates
IOS14 ON TIJ;
IOS14 ON LOS;
IOS14 ON GEND;
IOS14 ON AGE;

PS ON TIJ;
PS ON LOS;
PS ON GEND;
PS ON AGE;

SC ON TIJ;
SC ON LOS;
SC ON GEND;
SC ON AGE;

MODEL INDIRECT:

!Research Question 4: What leadership competencies indirectly influence
!employee safety incidents through psychological safety?
IOS14 IND PS AIS;
IOS14 IND PS CWI;
IOS14 IND PS LWV;
IOS14 IND PS MSD;
IOS14 IND PS MT;

!Research Question 5: What leadership competencies indirectly influence
!employee safety incidents through safety climate?
IOS14 IND SC AIS;
IOS14 IND SC CWI;
IOS14 IND SC LWV;
IOS14 IND SC MSD;
IOS14 IND SC MT;

!Research Question 8: Does psychological safety indirectly influence
!employee safety incidents through safety climate?
IOS14 IND SC PS;

!Research Question 12 - Do leadership competencies indirectly influence
!safety climate through Psychological Safety?
SC IND PS AIS;
SC IND PS CWI;
SC IND PS LWV;
SC IND PS MSD;
SC IND PS MT;

MODEL office:
!Measurement Model
AIS by AIS1* AIS2 AIS3 AIS4 AIS5;
CWI by CWI1* CWI2 CWI3 CWI4 CWI5;
LWV by LWV1* LWV2 LWV3 LWV4 LWV5 PS1;
MSD by MSD1* MSD2 MSD3 MSD4 MSD5;
MT by MT1* MT2 MT3 MT4 MT5;
PS by PS2* PS3 PS4 PS5;
SC by SC1* SC2 SC3 SC4;

!Reserach Question 1: What leadership competencies influence employee safety incidents?
IOS14 ON AIS (o_a_io);
IOS14 ON CWI (o_c_io);
IOS14 ON LWV (o_l_io);
IOS14 ON MSD (o_md_io);
IOS14 ON MT (o_mt_io);
```

```
!Reserach Question 6: Does psychological safety influence employee safety incidents?
IOS14 ON PS (o_p_io);

!Reserach Question 7: Does safety climate influence employee safety incidents?
IOS14 ON SC (o_sc_io);

!Research Question 2: What leadership competencies influence psychological safety?
PS ON AIS (o_a_p);
PS ON CWI (o_c_p);
PS ON LWV (o_l_p);
PS ON MSD (o_md_p);
PS ON MT (o_mt_p);

!Research Question 3: What leadership competencies influence safety climate?
SC ON AIS (o_a_sc);
SC ON CWI (o_c_sc);
SC ON LWV (o_l_sc);
SC ON MSD (o_md_sc);
SC ON MT (o_mt_sc);
SC ON PS (o_p_sc);

!Covariates
IOS14 ON TIJ;
IOS14 ON LOS;
IOS14 ON GEND;
IOS14 ON AGE;

PS ON TIJ;
PS ON LOS;
PS ON GEND;
PS ON AGE;

SC ON TIJ;
SC ON LOS;
SC ON GEND;
SC ON AGE;

MODEL INDIRECT:

!Research Question 4: What leadership competencies indirectly influence
!employee safety incidents through psychological safety?
IOS14 IND PS AIS;
IOS14 IND PS CWI;
IOS14 IND PS LWV;
IOS14 IND PS MSD;
IOS14 IND PS MT;

!Research Question 5: What leadership competencies indirectly influence
!employee safety incidents through safety climate?
IOS14 IND SC AIS;
IOS14 IND SC CWI;
IOS14 IND SC LWV;
IOS14 IND SC MSD;
IOS14 IND SC MT;

!Research Question 8: Does psychological safety indirectly influence
!employee safety incidents through safety climate?
IOS14 IND SC PS;

!Research Question 12 - Do leadership competencies indirectly influence
!safety climate through Psychological Safety?
SC IND PS AIS;
SC IND PS CWI;
SC IND PS LWV;
SC IND PS MSD;
SC IND PS MT;

MODEL field-non-hazard:
!Measurement Model
AIS by AIS1* AIS2 AIS3 AIS4 AIS5;
CWI by CWI1* CWI2 CWI3 CWI4 CWI5;
```

```
LWV by LWV1* LWV2 LWV3 LWV4 LWV5 PS1;
MSD by MSD1* MSD2 MSD3 MSD4 MSD5;
MT by MT1* MT2 MT3 MT4 MT5;
PS by PS2* PS3 PS4 PS5;
SC by SC1* SC2 SC3 SC4;

!Reserach Question 1: What leadership competencies influence employee safety incidents?
IOS14 ON AIS (f_a_io);
IOS14 ON CWI (f_c_io);
IOS14 ON LWV (f_l_io);
IOS14 ON MSD (f_md_io);
IOS14 ON MT (f_mt_io);

!Reserach Question 6: Does psychological safety influence employee safety incidents?
IOS14 ON PS (f_p_io);

!Reserach Question 7: Does safety climate influence employee safety incidents?
IOS14 ON SC (f_sc_io);

!Research Question 2: What leadership competencies influence psychological safety?
PS ON AIS (f_a_p);
PS ON CWI (f_c_p);
PS ON LWV (f_l_p);
PS ON MSD (f_md_p);
PS ON MT (f_mt_p);

!Research Question 3: What leadership competencies influence safety climate?
SC ON AIS (f_a_sc);
SC ON CWI (f_c_sc);
SC ON LWV (f_l_sc);
SC ON MSD (f_md_sc);
SC ON MT (f_mt_sc);
SC ON PS (f_p_sc);

!Covariates
IOS14 ON TIJ;
IOS14 ON LOS;
IOS14 ON GEND;
IOS14 ON AGE;

PS ON TIJ;
PS ON LOS;
PS ON GEND;
PS ON AGE;

SC ON TIJ;
SC ON LOS;
SC ON GEND;
SC ON AGE;

MODEL INDIRECT:

!Research Question 4: What leadership competencies indirectly influence
!employee safety incidents through psychological safety?
IOS14 IND PS AIS;
IOS14 IND PS CWI;
IOS14 IND PS LWV;
IOS14 IND PS MSD;
IOS14 IND PS MT;

!Research Question 5: What leadership competencies indirectly influence
!employee safety incidents through safety climate?
IOS14 IND SC AIS;
IOS14 IND SC CWI;
IOS14 IND SC LWV;
IOS14 IND SC MSD;
IOS14 IND SC MT;

!Research Question 8: Does psychological safety indirectly influence
!employee safety incidents through safety climate?
IOS14 IND SC PS;
```

```
!Research Question 12 - Do leadership competencies indirectly influence
!safety climate through Psychological Safety?
SC IND PS AIS;
SC IND PS CWI;
SC IND PS LWV;
SC IND PS MSD;
SC IND PS MT;

MODEL field-hazard:
!Measurement Model
AIS by AIS1* AIS2 AIS3 AIS4 AIS5;
CWI by CWI1* CWI2 CWI3 CWI4 CWI5;
LWV by LWV1* LWV2 LWV3 LWV4 LWV5 PS1;
MSD by MSD1* MSD2 MSD3 MSD4 MSD5;
MT by MT1* MT2 MT3 MT4 MT5;
PS by PS2* PS3 PS4 PS5;
SC by SC1* SC2 SC3 SC4;

!Reserach Question 1: What leadership competencies influence employee safety incidents?
IOS14 ON AIS (h_a_io);
IOS14 ON CWI (h_c_io);
IOS14 ON LWV (h_l_io);
IOS14 ON MSD (h_md_io);
IOS14 ON MT (h_mt_io);

!Reserach Question 6: Does psychological safety influence employee safety incidents?
IOS14 ON PS (h_p_io);

!Reserach Question 7: Does safety climate influence employee safety incidents?
IOS14 ON SC (h_sc_io);

!Research Question 2: What leadership competencies influence psychological safety?
PS ON AIS (h_a_p);
PS ON CWI (h_c_p);
PS ON LWV (h_l_p);
PS ON MSD (h_md_p);
PS ON MT (h_mt_p);

!Research Question 3: What leadership competencies influence safety climate?
SC ON AIS (h_a_sc);
SC ON CWI (h_c_sc);
SC ON LWV (h_l_sc);
SC ON MSD (h_md_sc);
SC ON MT (h_mt_sc);
SC ON PS (h_p_sc);

!Covariates
IOS14 ON TIJ;
IOS14 ON LOS;
IOS14 ON GEND;
IOS14 ON AGE;

PS ON TIJ;
PS ON LOS;
PS ON GEND;
PS ON AGE;

SC ON TIJ;
SC ON LOS;
SC ON GEND;
SC ON AGE;

MODEL INDIRECT:

!Research Question 4: What leadership competencies indirectly influence
!employee safety incidents through psychological safety?
IOS14 IND PS AIS;
IOS14 IND PS CWI;
IOS14 IND PS LWV;
IOS14 IND PS MSD;
```

```
IOS14 IND PS MT;

!Research Question 5: What leadership competencies indirectly influence
!employee safety incidents through safety climate?
IOS14 IND SC AIS;
IOS14 IND SC CWI;
IOS14 IND SC LWV;
IOS14 IND SC MSD;
IOS14 IND SC MT;

!Research Question 8: Does psychological safety indirectly influence
!employee safety incidents through safety climate?
IOS14 IND SC PS;

!Research Question 12 - Do leadership competencies indirectly influence
!safety climate through Psychological Safety?
SC IND PS AIS;
SC IND PS CWI;
SC IND PS LWV;
SC IND PS MSD;
SC IND PS MT;

OUTPUT: TECH1 TECH4 STDYX MODINDICES;

MODEL TEST:
0 = o_a_io - f_a_io;
0 = o_a_io - h_a_io;
0 = o_c_io - f_c_io;
0 = o_c_io - h_c_io;
0 = o_l_io - f_l_io;
0 = o_l_io - h_l_io;
0 = o_md_io - f_md_io;
0 = o_md_io - h_md_io;
0 = o_mt_io - f_mt_io;
0 = o_mt_io - h_mt_io;
0 = o_p_io - f_p_io;
0 = o_p_io - h_p_io;
0 = o_sc_io - f_sc_io;
0 = o_sc_io - h_sc_io;
0 = o_a_p - f_a_p;
0 = o_a_p - h_a_p;
0 = o_c_p - f_c_p;
0 = o_c_p - h_c_p;
0 = o_l_p - f_l_p;
0 = o_l_p - h_l_p;
0 = o_md_p - f_md_p;
0 = o_md_p - h_md_p;
0 = o_mt_p - f_mt_p;
0 = o_mt_p - h_mt_p;
0 = o_a_sc - f_a_sc;
0 = o_a_sc - h_a_sc;
0 = o_c_sc - f_c_sc;
0 = o_c_sc - h_c_sc;
0 = o_l_sc - f_l_sc;
0 = o_l_sc - h_l_sc;
0 = o_md_sc - f_md_sc;
0 = o_md_sc - h_md_sc;
0 = o_mt_sc - f_mt_sc;
0 = o_mt_sc - h_mt_sc;
0 = o_p_sc - f_p_sc;
0 = o_p_sc - h_p_sc;
```

Appendix I: Mplus Input for Multiple Mediation Structural Equation Model 2

```
TITLE: Dissertation Analysis - Structural Model (SEM) - OSHA 2015 CC - Bootstrap

DATA: File is "C:\Users\Shano\Dropbox\Dissertation\Data\Dissertation Analysis\
Safety_Leadership_Dataset_4.dat";

VARIABLE: Names ARE ID AIS1-AIS5, CWI1-CWI5, LWV1-LWV5, MSD1-MSD5, MT1-MT5, PS1-PS5,
SC1-SC4, SO14, SN14, SR14, ICC14, ICC15, IFA15, IO15, IH15, ILT15, INLT15,
IRDA15, IT15, IOS15, IA15, HAZ, TIJ, LOS, RACE, GEND, GENR, AGE;

USEVARIABLES ARE AIS1-AIS5, CWI1-CWI5, LWV1-LWV5, MSD1-MSD5, MT1-MT5, PS1-PS5, SC1-SC4,
SO14, SN14, SR14, ICC14, IOS15, HAZ, TIJ, LOS, GEND, AGE;
MISSING ARE ALL (-9);

ANALYSIS:
BOOTSTRAP IS 5000;

MODEL:
!Measurement Model
AIS by AIS1* AIS2 AIS3 AIS4 AIS5;
CWI by CWI1* CWI2 CWI3 CWI4 CWI5;
LWV by LWV1* LWV2 LWV3 LWV4 LWV5 PS1;
MSD by MSD1* MSD2 MSD3 MSD4 MSD5;
MT by MT1* MT2 MT3 MT4 MT5;
PS by PS2* PS3 PS4 PS5;
SC by SC1* SC2 SC3 SC4;

AIS@1;
CWI@1;
LWV@1;
MSD@1;
MT@1;
PS@1;
SC@1;

!Research Question 1: What leadership competencies influence employee safety incidents?
IOS15 ON AIS;
IOS15 ON CWI;
IOS15 ON LWV;
IOS15 ON MSD;
IOS15 ON MT;

!Research Question 6: Does psychological safety influence employee safety incidents?
IOS15 ON PS;

!Research Question 7: Does safety climate influence employee safety incidents?
IOS15 ON SC;

IOS15 ON SO14;
IOS15 ON SN14;
IOS15 ON SR14;
IOS15 ON ICC14;

!Research Question 2: What leadership competencies influence psychological safety?
PS ON AIS;
PS ON CWI;
PS ON LWV;
PS ON MSD;
PS ON MT;

!Research Question 3: What leadership competencies influence safety climate?
SC ON AIS;
SC ON CWI;
SC ON LWV;
SC ON MSD;
SC ON MT;
SC ON PS;

SO14 ON SC;
```

```
SO14 ON PS;
SN14 ON SC;
SN14 ON PS;
SR14 ON SC;
ICC14 ON SC;
ICC14 ON PS;

!Covariates
IOS15 ON HAZ;
IOS15 ON TIJ;
IOS15 ON LOS;
IOS15 ON GEND;
IOS15 ON AGE;

PS ON HAZ;
PS ON TIJ;
PS ON LOS;
PS ON GEND;
PS ON AGE;

SC ON HAZ;
SC ON TIJ;
SC ON LOS;
SC ON GEND;
SC ON AGE;

SO14 ON HAZ;
SO14 ON TIJ;
SO14 ON LOS;
SO14 ON GEND;
SO14 ON AGE;

SN14 ON HAZ;
SN14 ON TIJ;
SN14 ON LOS;
SN14 ON GEND;
SN14 ON AGE;

SR14 ON HAZ;
SR14 ON TIJ;
SR14 ON LOS;
SR14 ON GEND;
SR14 ON AGE;

ICC14 ON HAZ;
ICC14 ON TIJ;
ICC14 ON LOS;
ICC14 ON GEND;
ICC14 ON AGE;

MODEL INDIRECT:

!Research Question 4: What leadership competencies indirectly influence
!employee safety incidents through psychological safety?
IOS15 IND PS AIS;
IOS15 IND PS CWI;
IOS15 IND PS LWV;
IOS15 IND PS MSD;
IOS15 IND PS MT;

!Research Question 5: What leadership competencies indirectly influence
!employee safety incidents through safety climate?
IOS15 IND SC AIS;
IOS15 IND SC CWI;
IOS15 IND SC LWV;
IOS15 IND SC MSD;
IOS15 IND SC MT;

!Research Question 8: Does psychological safety indirectly influence
!employee safety incidents through safety climate?
IOS15 IND SC PS;
```

```
!Research Question 9: Does psychological safety indirectly influence
!employee safety incidents through participation in safety programs?
IOS15 IND SO14 PS;
IOS15 IND SN14 PS;
IOS15 IND ICC14 PS;

!Research Question 10: Does safety climate indirectly influence
!employee safety incidents through participation in safety programs?
IOS15 IND SO14 SC;
IOS15 IND SN14 SC;
IOS15 IND ICC14 SC;

!Research Question 11: Does recognition of safety behaviors indirectly influence
!employee safety incidents through safety climate?
IOS15 IND SR14 SC;

!Research Question 12: Do leadership competencies indirectly influence
!safety climate through psychological safety?
SC IND PS AIS;
SC IND PS CWI;
SC IND PS LWV;
SC IND PS MSD;
SC IND PS MT;

OUTPUT: TECH1 TECH4 STANDARDIZED CINTERVAL(BCBOOTSTRAP);
```

Appendix J: Mplus Input for Multigroup Structural Equation Model 2 – Baseline

```
TITLE: Dissertation Analysis - Structural Model (SEM) - Group - OSHA 2015 - Baseline

DATA: File is "C:\Users\Shano\Dropbox\Dissertation\Data\Dissertation Analysis\
Safety_Leadership_Dataset_4.dat";

VARIABLE: Names ARE ID AIS1-AIS5, CWI1-CWI5, LWV1-LWV5, MSD1-MSD5, MT1-MT5, PS1-PS5,
SC1-SC4, SO14, SN14, SR14, ICC14, ICC15, IFA15, IO15, IH15, ILT15, INLT15,
IRDA15, IT15, IOS15, IA15, HAZ, TIJ, LOS, RACE, GEND, GENR, AGE;

USEVARIABLES ARE AIS1-AIS5, CWI1-CWI5, LWV1-LWV5, MSD1-MSD5, MT1-MT5, PS1-PS5, SC1-SC4,
SO14, SN14, SR14, ICC14, IOS15, TIJ, LOS, GEND, AGE;
MISSING ARE ALL (-9);

MODEL:
!Measurement Model
AIS by AIS1* AIS2 AIS3 AIS4 AIS5;
CWI by CWI1* CWI2 CWI3 CWI4 CWI5;
LWV by LWV1* LWV2 LWV3 LWV4 LWV5 PS1;
MSD by MSD1* MSD2 MSD3 MSD4 MSD5;
MT by MT1* MT2 MT3 MT4 MT5;
PS by PS2* PS3 PS4 PS5;
SC by SC1* SC2 SC3 SC4;

AIS@1;
CWI@1;
LWV@1;
MSD@1;
MT@1;
PS@1;
SC@1;

!Research Question 1: What leadership competencies influence employee safety incidents?
IOS15 ON AIS;
IOS15 ON CWI;
IOS15 ON LWV;
IOS15 ON MSD;
IOS15 ON MT;

!Research Question 6: Does psychological safety influence employee safety incidents?
IOS15 ON PS;

!Research Question 7: Does safety climate influence employee safety incidents?
IOS15 ON SC;

IOS15 ON SO14;
IOS15 ON SN14;
IOS15 ON SR14;
IOS15 ON ICC14;

!Research Question 2: What leadership competencies influence psychological safety?
PS ON AIS;
PS ON CWI;
PS ON LWV;
PS ON MSD;
PS ON MT;

!Research Question 3: What leadership competencies influence safety climate?
SC ON AIS;
SC ON CWI;
SC ON LWV;
SC ON MSD;
SC ON MT;
SC ON PS;

SO14 ON SC;
SO14 ON PS;
SN14 ON SC;
SN14 ON PS;
```

```
SR14 ON SC;
ICC14 ON SC;
ICC14 ON PS;

!Covariates
IOS15 ON TIJ;
IOS15 ON LOS;
IOS15 ON GEND;
IOS15 ON AGE;

PS ON TIJ;
PS ON LOS;
PS ON GEND;
PS ON AGE;

SC ON TIJ;
SC ON LOS;
SC ON GEND;
SC ON AGE;

SO14 ON TIJ;
SO14 ON LOS;
SO14 ON GEND;
SO14 ON AGE;

SN14 ON TIJ;
SN14 ON LOS;
SN14 ON GEND;
SN14 ON AGE;

SR14 ON TIJ;
SR14 ON LOS;
SR14 ON GEND;
SR14 ON AGE;

ICC14 ON TIJ;
ICC14 ON LOS;
ICC14 ON GEND;
ICC14 ON AGE;

MODEL INDIRECT:

!Research Question 4: What leadership competencies indirectly influence
!employee safety incidents through psychological safety?
IOS15 IND PS AIS;
IOS15 IND PS CWI;
IOS15 IND PS LWV;
IOS15 IND PS MSD;
IOS15 IND PS MT;

!Research Question 5: What leadership competencies indirectly influence
!employee safety incidents through safety climate?
IOS15 IND SC AIS;
IOS15 IND SC CWI;
IOS15 IND SC LWV;
IOS15 IND SC MSD;
IOS15 IND SC MT;

!Research Question 8: Does psychological safety indirectly influence
!employee safety incidents through safety climate?
IOS15 IND SC PS;

!Research Question 9: Does psychological safety indirectly influence
!employee safety incidents through participation in safety programs?
IOS15 IND SO14 PS;
IOS15 IND SN14 PS;
IOS15 IND ICC14 PS;

!Research Question 10: Does safety climate indirectly influence
!employee safety incidents through participation in safety programs?
IOS15 IND SO14 SC;
```

```
IOS15 IND SN14 SC;
IOS15 IND ICC14 SC;

!Research Question 11: Does recognition of safety behaviors indirectly influence
!employee safety incidents through safety climate?
IOS15 IND SR14 SC;

!Research Question 12: Do leadership competencies indirectly influence
!safety climate through psychological safety?
SC IND PS AIS;
SC IND PS CWI;
SC IND PS LWV;
SC IND PS MSD;
SC IND PS MT;

OUTPUT: TECH1 TECH4 STDYX MODINDICES;
```

Appendix K: Mplus Input for Multigroup Structural Equation Model 2 – Configural

```
TITLE: Dissertation Analysis - Structural Model (SEM) - Group - OSHA 2015 - Configural

DATA: File is "C:\Users\Shano\Dropbox\Dissertation\Data\Dissertation Analysis\
Safety_Leadership_Dataset_4.dat";

VARIABLE: Names ARE ID AIS1-AIS5, CWI1-CWI5, LWV1-LWV5, MSD1-MSD5, MT1-MT5, PS1-PS5,
SC1-SC4, SO14, SN14, SR14, ICC14, ICC15, IFA15, IO15, IH15, ILT15, INLT15,
IRDA15, IT15, IOS15, IA15, HAZ, TIJ, LOS, RACE, GEND, GENR, AGE;

USEVARIABLES ARE AIS1-AIS5, CWI1-CWI5, LWV1-LWV5, MSD1-MSD5, MT1-MT5, PS1-PS5, SC1-SC4,
SO14, SN14, SR14, ICC14, IOS15, HAZ, TIJ, LOS, GEND, AGE;
GROUPING IS HAZ (1 = office, 2 = field-non-hazard, 3 = field-hazard);
MISSING ARE ALL (-9);

MODEL:
!Measurement Model
AIS by AIS1* AIS2 AIS3 AIS4 AIS5;
CWI by CWI1* CWI2 CWI3 CWI4 CWI5;
LWV by LWV1* LWV2 LWV3 LWV4 LWV5 PS1;
MSD by MSD1* MSD2 MSD3 MSD4 MSD5;
MT by MT1* MT2 MT3 MT4 MT5;
PS by PS2* PS3 PS4 PS5;
SC by SC1* SC2 SC3 SC4;

AIS@1;
CWI@1;
LWV@1;
MSD@1;
MT@1;
PS@1;
SC@1;

[AIS@0];
[CWI@0];
[LWV@0];
[MSD@0];
[MT@0];
[PS@0];
[SC@0];

[AIS1-AIS5];
[CWI1-CWI5];
[LWV1-LWV5];
[MSD1-MSD5];
[MT1-MT5];
[PS1-PS5];
[SC1-SC4];

!Research Question 1: What leadership competencies influence employee safety incidents?
IOS15 ON AIS (a_io);
IOS15 ON CWI (c_io);
IOS15 ON LWV (l_io);
IOS15 ON MSD (md_io);
IOS15 ON MT (mt_io);

!Research Question 6: Does psychological safety influence employee safety incidents?
IOS15 ON PS (p_io);

!Research Question 7: Does safety climate influence employee safety incidents?
IOS15 ON SC (sc_io);

IOS15 ON SO14 (so_io);
IOS15 ON SN14 (sn_io);
IOS15 ON SR14 (sr_io);
IOS15 ON ICC14 (cc_io);

!Research Question 2: What leadership competencies influence psychological safety?
PS ON AIS (a_p);
```

```
PS ON CWI (c_p);
PS ON LWV (l_p);
PS ON MSD (md_p);
PS ON MT (mt_p);

!Research Question 3: What leadership competencies influence safety climate?
SC ON AIS (a_sc);
SC ON CWI (c_sc);
SC ON LWV (l_sc);
SC ON MSD (md_sc);
SC ON MT (mt_sc);
SC ON PS (p_sc);

SO14 ON SC (sc_so);
SO14 ON PS (p_so);
SN14 ON SC (sc_sn);
SN14 ON PS (p_sn);
SR14 ON SC (sc_sr);
ICC14 ON SC (sc_cc);
ICC14 ON PS (p_cc);

!Covariates
IOS15 ON TIJ;
IOS15 ON LOS;
IOS15 ON GEND;
IOS15 ON AGE;

PS ON TIJ;
PS ON LOS;
PS ON GEND;
PS ON AGE;

SC ON TIJ;
SC ON LOS;
SC ON GEND;
SC ON AGE;

SO14 ON TIJ;
SO14 ON LOS;
SO14 ON GEND;
SO14 ON AGE;

SN14 ON TIJ;
SN14 ON LOS;
SN14 ON GEND;
SN14 ON AGE;

SR14 ON TIJ;
SR14 ON LOS;
SR14 ON GEND;
SR14 ON AGE;

ICC14 ON TIJ;
ICC14 ON LOS;
ICC14 ON GEND;
ICC14 ON AGE;

MODEL INDIRECT:

!Research Question 4: What leadership competencies indirectly influence
!employee safety incidents through psychological safety?
IOS15 IND PS AIS;
IOS15 IND PS CWI;
IOS15 IND PS LWV;
IOS15 IND PS MSD;
IOS15 IND PS MT;

!Research Question 5: What leadership competencies indirectly influence
!employee safety incidents through safety climate?
IOS15 IND SC AIS;
IOS15 IND SC CWI;
```

```
IOS15 IND SC LWV;
IOS15 IND SC MSD;
IOS15 IND SC MT;

!Research Question 8: Does psychological safety indirectly influence
!employee safety incidents through safety climate?
IOS15 IND SC PS;

!Research Question 9: Does psychological safety indirectly influence
!employee safety incidents through participation in safety programs?
IOS15 IND SO14 PS;
IOS15 IND SN14 PS;
IOS15 IND ICC14 PS;

!Research Question 10: Does safety climate indirectly influence
!employee safety incidents through participation in safety programs?
IOS15 IND SO14 SC;
IOS15 IND SN14 SC;
IOS15 IND ICC14 SC;

!Research Question 11: Does recognition of safety behaviors indirectly influence
!employee safety incidents through safety climate?
IOS15 IND SR14 SC;

!Research Question 12: Do leadership competencies indirectly influence
!safety climate through psychological safety?
SC IND PS AIS;
SC IND PS CWI;
SC IND PS LWV;
SC IND PS MSD;
SC IND PS MT;

MODEL office:


MODEL field-non-hazard:


MODEL field-hazard:


OUTPUT: TECH1 TECH4 STDYX MODINDICES;
```

Appendix L: Mplus Input for Multigroup Structural Equation Model 2 – Constrained

```
TITLE: Dissertation Analysis - Structural Model (SEM) - Group - OSHA 2015 - Constrained

DATA: File is "C:\Users\Shano\Dropbox\Dissertation\Data\Dissertation Analysis\
Safety_Leadership_Dataset_4.dat";

VARIABLE: Names ARE ID AIS1-AIS5, CWI1-CWI5, LWV1-LWV5, MSD1-MSD5, MT1-MT5, PS1-PS5,
SC1-SC4, SO14, SN14, SR14, ICC14, ICC15, IFA15, IO15, IH15, ILT15, INLT15,
IRDA15, IT15, IOS15, IA15, HAZ, TIJ, LOS, RACE, GEND, GENR, AGE;

USEVARIABLES ARE AIS1-AIS5, CWI1-CWI5, LWV1-LWV5, MSD1-MSD5, MT1-MT5, PS1-PS5, SC1-SC4,
SO14, SN14, SR14, ICC14, IOS15, HAZ, TIJ, LOS, GEND, AGE;
GROUPING IS HAZ (1 = office, 2 = field-non-hazard, 3 = field-hazard);
MISSING ARE ALL (-9);

MODEL:
!Measurement Model
AIS by AIS1* AIS2 AIS3 AIS4 AIS5;
CWI by CWI1* CWI2 CWI3 CWI4 CWI5;
LWV by LWV1* LWV2 LWV3 LWV4 LWV5 PS1;
MSD by MSD1* MSD2 MSD3 MSD4 MSD5;
MT by MT1* MT2 MT3 MT4 MT5;
PS by PS2* PS3 PS4 PS5;
SC by SC1* SC2 SC3 SC4;

AIS@1;
CWI@1;
LWV@1;
MSD@1;
MT@1;
PS@1;
SC@1;

[AIS@0];
[CWI@0];
[LWV@0];
[MSD@0];
[MT@0];
[PS@0];
[SC@0];

[AIS1-AIS5];
[CWI1-CWI5];
[LWV1-LWV5];
[MSD1-MSD5];
[MT1-MT5];
[PS1-PS5];
[SC1-SC4];

!Research Question 1: What leadership competencies influence employee safety incidents?
IOS15 ON AIS (a_io);
IOS15 ON CWI (c_io);
IOS15 ON LWV (l_io);
IOS15 ON MSD (md_io);
IOS15 ON MT (mt_io);

!Research Question 6: Does psychological safety influence employee safety incidents?
IOS15 ON PS (p_io);

!Research Question 7: Does safety climate influence employee safety incidents?
IOS15 ON SC (sc_io);

IOS15 ON SO14 (so_io);
IOS15 ON SN14 (sn_io);
IOS15 ON SR14 (sr_io);
IOS15 ON ICC14 (cc_io);

!Research Question 2: What leadership competencies influence psychological safety?
PS ON AIS (a_p);
```

```
PS ON CWI (c_p);
PS ON LWV (l_p);
PS ON MSD (md_p);
PS ON MT (mt_p);

!Research Question 3: What leadership competencies influence safety climate?
SC ON AIS (a_sc);
SC ON CWI (c_sc);
SC ON LWV (l_sc);
SC ON MSD (md_sc);
SC ON MT (mt_sc);
SC ON PS (p_sc);

SO14 ON SC (sc_so);
SO14 ON PS (p_so);
SN14 ON SC (sc_sn);
SN14 ON PS (p_sn);
SR14 ON SC (sc_sr);
ICC14 ON SC (sc_cc);
ICC14 ON PS (p_cc);

!Covariates
IOS15 ON TIJ;
IOS15 ON LOS;
IOS15 ON GEND;
IOS15 ON AGE;

PS ON TIJ;
PS ON LOS;
PS ON GEND;
PS ON AGE;

SC ON TIJ;
SC ON LOS;
SC ON GEND;
SC ON AGE;

SO14 ON TIJ;
SO14 ON LOS;
SO14 ON GEND;
SO14 ON AGE;

SN14 ON TIJ;
SN14 ON LOS;
SN14 ON GEND;
SN14 ON AGE;

SR14 ON TIJ;
SR14 ON LOS;
SR14 ON GEND;
SR14 ON AGE;

ICC14 ON TIJ;
ICC14 ON LOS;
ICC14 ON GEND;
ICC14 ON AGE;

MODEL INDIRECT:

!Research Question 4: What leadership competencies indirectly influence
!employee safety incidents through psychological safety?
IOS15 IND PS AIS;
IOS15 IND PS CWI;
IOS15 IND PS LWV;
IOS15 IND PS MSD;
IOS15 IND PS MT;

!Research Question 5: What leadership competencies indirectly influence
!employee safety incidents through safety climate?
IOS15 IND SC AIS;
IOS15 IND SC CWI;
```

```
IOS15 IND SC LWV;
IOS15 IND SC MSD;
IOS15 IND SC MT;

!Research Question 8: Does psychological safety indirectly influence
!employee safety incidents through safety climate?
IOS15 IND SC PS;

!Research Question 9: Does psychological safety indirectly influence
!employee safety incidents through participation in safety programs?
IOS15 IND SO14 PS;
IOS15 IND SN14 PS;
IOS15 IND ICC14 PS;

!Research Question 10: Does safety climate indirectly influence
!employee safety incidents through participation in safety programs?
IOS15 IND SO14 SC;
IOS15 IND SN14 SC;
IOS15 IND ICC14 SC;

!Research Question 11: Does recognition of safety behaviors indirectly influence
!employee safety incidents through safety climate?
IOS15 IND SR14 SC;

!Research Question 12: Do leadership competencies indirectly influence
!safety climate through psychological safety?
SC IND PS AIS;
SC IND PS CWI;
SC IND PS LWV;
SC IND PS MSD;
SC IND PS MT;

MODEL office:
!Measurement Model
AIS by AIS1 AIS2 AIS3 AIS4 AIS5;
CWI by CWI1 CWI2 CWI3 CWI4 CWI5;
LWV by LWV1 LWV2 LWV3 LWV4 LWV5 PS1;
MSD by MSD1 MSD2 MSD3 MSD4 MSD5;
MT by MT1 MT2 MT3 MT4 MT5;
PS by PS2 PS3 PS4 PS5;
SC by SC1 SC2 SC3 SC4;

!Reserach Question 1: What leadership competencies influence employee safety incidents?
IOS15 ON AIS (o_a_io);
IOS15 ON CWI (o_c_io);
IOS15 ON LWV (o_l_io);
IOS15 ON MSD (o_md_io);
IOS15 ON MT (o_mt_io);

!Reserach Question 6: Does psychological safety influence employee safety incidents?
IOS15 ON PS (o_p_io);

!Reserach Question 7: Does safety climate influence employee safety incidents?
IOS15 ON SC (o_sc_io);

IOS15 ON SO14 (o_so_io);
IOS15 ON SN14 (o_sn_io);
IOS15 ON SR14 (o_sr_io);
IOS15 ON ICC14 (o_cc_io);

!Research Question 2: What leadership competencies influence psychological safety?
PS ON AIS (o_a_p);
PS ON CWI (o_c_p);
PS ON LWV (o_l_p);
PS ON MSD (o_md_p);
PS ON MT (o_mt_p);

!Research Question 3: What leadership competencies influence safety climate?
SC ON AIS (o_a_sc);
SC ON CWI (o_c_sc);
SC ON LWV (o_l_sc);
```

```
SC ON MSD (o_md_sc);
SC ON MT (o_mt_sc);
SC ON PS (o_p_sc);

SO14 ON SC (o_sc_so);
SO14 ON PS (o_p_so);
SN14 ON SC (o_sc_sn);
SN14 ON PS (o_p_sn);
SR14 ON SC (o_sc_sr);
ICC14 ON SC (o_sc_cc);
ICC14 ON PS (o_p_cc);

!Covariates
IOS15 ON TIJ;
IOS15 ON LOS;
IOS15 ON GEND;
IOS15 ON AGE;

PS ON TIJ;
PS ON LOS;
PS ON GEND;
PS ON AGE;

SC ON TIJ;
SC ON LOS;
SC ON GEND;
SC ON AGE;

SO14 ON TIJ;
SO14 ON LOS;
SO14 ON GEND;
SO14 ON AGE;

SN14 ON TIJ;
SN14 ON LOS;
SN14 ON GEND;
SN14 ON AGE;

SR14 ON TIJ;
SR14 ON LOS;
SR14 ON GEND;
SR14 ON AGE;

ICC14 ON TIJ;
ICC14 ON LOS;
ICC14 ON GEND;
ICC14 ON AGE;

MODEL INDIRECT:

!Research Question 4: What leadership competencies indirectly influence
!employee safety incidents through psychological safety?
IOS15 IND PS AIS;
IOS15 IND PS CWI;
IOS15 IND PS LWV;
IOS15 IND PS MSD;
IOS15 IND PS MT;

!Research Question 5: What leadership competencies indirectly influence
!employee safety incidents through safety climate?
IOS15 IND SC AIS;
IOS15 IND SC CWI;
IOS15 IND SC LWV;
IOS15 IND SC MSD;
IOS15 IND SC MT;

!Research Question 8: Does psychological safety indirectly influence
!employee safety incidents through safety climate?
IOS15 IND SC PS;

!Research Question 9: Does psychological safety indirectly influence
```

```
!employee safety incidents through participation in safety programs?
IOS15 IND SO14 PS;
IOS15 IND SN14 PS;
IOS15 IND ICC14 PS;

!Research Question 10: Does safety climate indirectly influence
!employee safety incidents through participation in safety programs?
IOS15 IND SO14 SC;
IOS15 IND SN14 SC;
IOS15 IND ICC14 SC;

!Research Question 11: Does recognition of safety behaviors indirectly influence
!employee safety incidents through safety climate?
IOS15 IND SR14 SC;

!Research Question 12: Do leadership competencies indirectly influence
!safety climate through psychological safety?
SC IND PS AIS;
SC IND PS CWI;
SC IND PS LWV;
SC IND PS MSD;
SC IND PS MT;

MODEL field-non-hazard:
!Measurement Model
AIS by AIS1 AIS2 AIS3 AIS4 AIS5;
CWI by CWI1 CWI2 CWI3 CWI4 CWI5;
LWV by LWV1 LWV2 LWV3 LWV4 LWV5 PS1;
MSD by MSD1 MSD2 MSD3 MSD4 MSD5;
MT by MT1 MT2 MT3 MT4 MT5;
PS by PS2 PS3 PS4 PS5;
SC by SC1 SC2 SC3 SC4;

!Research Question 1: What leadership competencies influence employee safety incidents?
IOS15 ON AIS (f_a_io);
IOS15 ON CWI (f_c_io);
IOS15 ON LWV (f_l_io);
IOS15 ON MSD (f_md_io);
IOS15 ON MT (f_mt_io);

!Research Question 6: Does psychological safety influence employee safety incidents?
IOS15 ON PS (f_p_io);

!Research Question 7: Does safety climate influence employee safety incidents?
IOS15 ON SC (f_sc_io);

IOS15 ON SO14 (f_so_io);
IOS15 ON SN14 (f_sn_io);
IOS15 ON SR14 (f_sr_io);
IOS15 ON ICC14 (f_cc_io);

!Research Question 2: What leadership competencies influence psychological safety?
PS ON AIS (f_a_p);
PS ON CWI (f_c_p);
PS ON LWV (f_l_p);
PS ON MSD (f_md_p);
PS ON MT (f_mt_p);

!Research Question 3: What leadership competencies influence safety climate?
SC ON AIS (f_a_sc);
SC ON CWI (f_c_sc);
SC ON LWV (f_l_sc);
SC ON MSD (f_md_sc);
SC ON MT (f_mt_sc);
SC ON PS (f_p_sc);

SO14 ON SC (f_sc_so);
SO14 ON PS (f_p_so);
SN14 ON SC (f_sc_sn);
SN14 ON PS (f_p_sn);
SR14 ON SC (f_sc_sr);
```

```
ICC14 ON SC (f_sc_cc);
ICC14 ON PS (f_p_cc);

!Covariates
IOS15 ON TIJ;
IOS15 ON LOS;
IOS15 ON GEND;
IOS15 ON AGE;

PS ON TIJ;
PS ON LOS;
PS ON GEND;
PS ON AGE;

SC ON TIJ;
SC ON LOS;
SC ON GEND;
SC ON AGE;

SO14 ON TIJ;
SO14 ON LOS;
SO14 ON GEND;
SO14 ON AGE;

SN14 ON TIJ;
SN14 ON LOS;
SN14 ON GEND;
SN14 ON AGE;

SR14 ON TIJ;
SR14 ON LOS;
SR14 ON GEND;
SR14 ON AGE;

ICC14 ON TIJ;
ICC14 ON LOS;
ICC14 ON GEND;
ICC14 ON AGE;

MODEL INDIRECT:

!Research Question 4: What leadership competencies indirectly influence
!employee safety incidents through psychological safety?
IOS15 IND PS AIS;
IOS15 IND PS CWI;
IOS15 IND PS LWV;
IOS15 IND PS MSD;
IOS15 IND PS MT;

!Research Question 5: What leadership competencies indirectly influence
!employee safety incidents through safety climate?
IOS15 IND SC AIS;
IOS15 IND SC CWI;
IOS15 IND SC LWV;
IOS15 IND SC MSD;
IOS15 IND SC MT;

!Research Question 8: Does psychological safety indirectly influence
!employee safety incidents through safety climate?
IOS15 IND SC PS;

!Research Question 9: Does psychological safety indirectly influence
!employee safety incidents through participation in safety programs?
IOS15 IND SO14 PS;
IOS15 IND SN14 PS;
IOS15 IND ICC14 PS;

!Research Question 10: Does safety climate indirectly influence
!employee safety incidents through participation in safety programs?
IOS15 IND SO14 SC;
IOS15 IND SN14 SC;
```

```
IOS15 IND ICC14 SC;

!Research Question 11: Does recognition of safety behaviors indirectly influence
!employee safety incidents through safety climate?
IOS15 IND SR14 SC;

!Research Question 12: Do leadership competencies indirectly influence
!safety climate through psychological safety?
SC IND PS AIS;
SC IND PS CWI;
SC IND PS LWV;
SC IND PS MSD;
SC IND PS MT;

MODEL field-hazard:
!Measurement Model
AIS by AIS1 AIS2 AIS3 AIS4 AIS5;
CWI by CWI1 CWI2 CWI3 CWI4 CWI5;
LWV by LWV1 LWV2 LWV3 LWV4 LWV5 PS1;
MSD by MSD1 MSD2 MSD3 MSD4 MSD5;
MT by MT1 MT2 MT3 MT4 MT5;
PS by PS2 PS3 PS4 PS5;
SC by SC1 SC2 SC3 SC4;

!Research Question 1: What leadership competencies influence employee safety incidents?
IOS15 ON AIS (h_a_io);
IOS15 ON CWI (h_c_io);
IOS15 ON LWV (h_l_io);
IOS15 ON MSD (h_md_io);
IOS15 ON MT (h_mt_io);

!Research Question 6: Does psychological safety influence employee safety incidents?
IOS15 ON PS (h_p_io);

!Research Question 7: Does safety climate influence employee safety incidents?
IOS15 ON SC (h_sc_io);

IOS15 ON SO14 (h_so_io);
IOS15 ON SN14 (h_sn_io);
IOS15 ON SR14 (h_sr_io);
IOS15 ON ICC14 (h_cc_io);

!Research Question 2: What leadership competencies influence psychological safety?
PS ON AIS (h_a_p);
PS ON CWI (h_c_p);
PS ON LWV (h_l_p);
PS ON MSD (h_md_p);
PS ON MT (h_mt_p);

!Research Question 3: What leadership competencies influence safety climate?
SC ON AIS (h_a_sc);
SC ON CWI (h_c_sc);
SC ON LWV (h_l_sc);
SC ON MSD (h_md_sc);
SC ON MT (h_mt_sc);
SC ON PS (h_p_sc);

SO14 ON SC (h_sc_so);
SO14 ON PS (h_p_so);
SN14 ON SC (h_sc_sn);
SN14 ON PS (h_p_sn);
SR14 ON SC (h_sc_sr);
ICC14 ON SC (h_sc_cc);
ICC14 ON PS (h_p_cc);

!Covariates
IOS15 ON TIJ;
IOS15 ON LOS;
IOS15 ON GEND;
IOS15 ON AGE;
```

```
PS ON TIJ;
PS ON LOS;
PS ON GEND;
PS ON AGE;

SC ON TIJ;
SC ON LOS;
SC ON GEND;
SC ON AGE;

SO14 ON TIJ;
SO14 ON LOS;
SO14 ON GEND;
SO14 ON AGE;

SN14 ON TIJ;
SN14 ON LOS;
SN14 ON GEND;
SN14 ON AGE;

SR14 ON TIJ;
SR14 ON LOS;
SR14 ON GEND;
SR14 ON AGE;

ICC14 ON TIJ;
ICC14 ON LOS;
ICC14 ON GEND;
ICC14 ON AGE;

MODEL INDIRECT:

!Research Question 4: What leadership competencies indirectly influence
!employee safety incidents through psychological safety?
IOS15 IND PS AIS;
IOS15 IND PS CWI;
IOS15 IND PS LWV;
IOS15 IND PS MSD;
IOS15 IND PS MT;

!Research Question 5: What leadership competencies indirectly influence
!employee safety incidents through safety climate?
IOS15 IND SC AIS;
IOS15 IND SC CWI;
IOS15 IND SC LWV;
IOS15 IND SC MSD;
IOS15 IND SC MT;

!Research Question 8: Does psychological safety indirectly influence
!employee safety incidents through safety climate?
IOS15 IND SC PS;

!Research Question 9: Does psychological safety indirectly influence
!employee safety incidents through participation in safety programs?
IOS15 IND SO14 PS;
IOS15 IND SN14 PS;
IOS15 IND ICC14 PS;

!Research Question 10: Does safety climate indirectly influence
!employee safety incidents through participation in safety programs?
IOS15 IND SO14 SC;
IOS15 IND SN14 SC;
IOS15 IND ICC14 SC;

!Research Question 11: Does recognition of safety behaviors indirectly influence
!employee safety incidents through safety climate?
IOS15 IND SR14 SC;

!Research Question 12: Do leadership competencies indirectly influence
!safety climate through psychological safety?
SC IND PS AIS;
```

```
SC IND PS CWI;
SC IND PS LWV;
SC IND PS MSD;
SC IND PS MT;

OUTPUT: TECH1 TECH4 STDYX MODINDICES;

MODEL TEST:
0 = o_a_io - f_a_io;
0 = o_a_io - h_a_io;
0 = o_c_io - f_c_io;
0 = o_c_io - h_c_io;
0 = o_l_io - f_l_io;
0 = o_l_io - h_l_io;
0 = o_md_io - f_md_io;
0 = o_md_io - h_md_io;
0 = o_mt_io - f_mt_io;
0 = o_mt_io - h_mt_io;
0 = o_p_io - f_p_io;
0 = o_p_io - h_p_io;
0 = o_sc_io - f_sc_io;
0 = o_sc_io - h_sc_io;
0 = o_so_io - f_so_io;
0 = o_so_io - h_so_io;
0 = o_sn_io - f_sn_io;
0 = o_sn_io - h_sn_io;
0 = o_sr_io - f_sr_io;
0 = o_sr_io - h_sr_io;
0 = o_cc_io - f_cc_io;
0 = o_cc_io - h_cc_io;
0 = o_a_p - f_a_p;
0 = o_a_p - h_a_p;
0 = o_c_p - f_c_p;
0 = o_c_p - h_c_p;
0 = o_l_p - f_l_p;
0 = o_l_p - h_l_p;
0 = o_md_p - f_md_p;
0 = o_md_p - h_md_p;
0 = o_mt_p - f_mt_p;
0 = o_mt_p - h_mt_p;
0 = o_a_sc - f_a_sc;
0 = o_a_sc - h_a_sc;
0 = o_c_sc - f_c_sc;
0 = o_c_sc - h_c_sc;
0 = o_l_sc - f_l_sc;
0 = o_l_sc - h_l_sc;
0 = o_md_sc - f_md_sc;
0 = o_md_sc - h_md_sc;
0 = o_mt_sc - f_mt_sc;
0 = o_mt_sc - h_mt_sc;
0 = o_p_sc - f_p_sc;
0 = o_p_sc - h_p_sc;
0 = o_sc_so - f_sc_so;
0 = o_sc_so - h_sc_so;
0 = o_p_so - f_p_so;
0 = o_p_so - h_p_so;
0 = o_sc_sn - f_p_sn;
0 = o_sc_sn - h_sc_sn;
0 = o_p_sn - f_p_sn;
0 = o_p_sn - h_p_sn;
0 = o_sc_sr - f_sc_sr;
0 = o_sc_sr - h_sc_sr;
0 = o_sc_cc - f_sc_cc;
0 = o_sc_cc - h_sc_cc;
0 = o_p_cc - f_p_cc;
0 = o_p_cc - h_p_cc;
```