Development of a comprehensive approach to physical and psychosocial safety: The physical and psychosocial workplace safety model

By

Cat Yaris

This thesis is presented in fulfilment of requirements for the degree of Doctor of Philosophy.

Discipline of Psychology

College of Science, Health, Engineering and Education

Murdoch University, Western Australia

October 2021

Author Declaration

I declare that this thesis is my own account of my research and contains as its main content work which has not previously been submitted for a degree at any tertiary institution.

____

Cat Yaris

Statement of Contributions

Within the main thesis is one manuscript, appearing in Chapter 2, prepared for submission, and published in a peer-reviewed journal. The doctoral candidate collected all data and prepared the draft manuscripts. Supervisors contributed by way of critical review, advice on analysis, and responses to peer review of manuscripts. All authors give permission for inclusion of manuscripts within this thesis.

Cat Yaris (Candidate) ____________________________________

Dr. Graeme Ditchburn (Principal Supervisor) ____________________________________

Dr. Guy Curtis (Supervisor) ____________________________________

Dr. Brody Heritage (Supervisor) ____________________________________

Dr. Libby Brook (Supervisor) ____________________________________

Table of Contents

Abstract

Since the 1860s, workplace accidents have consistently been identified and documented. There are numerous theories, approaches, and methodologies to improving workplace safety. Although there has been consistent growth and improvement in the field, there are still numerous accidents, injuries, fatalities, and near misses every year across numerous industries. Researchers have focused on developing approaches and models to explain, and potentially prevent, negative safety outcomes. Each of these approaches has limitations. One limitation is the distinct separation of physical and psychosocial safety in the literature. Several studies and researchers have tried to merge the research paths, although this has been met with varying evidence of efficacy. Each of the papers presented in this thesis move towards the development of a model that encompasses both physical and psychosocial safety climate to create a comprehensive approach to workplace safety. Each paper builds upon the previous chapter to explain the theoretical foundation, the measurement model, and the structural model of physical and psychosocial safety. In sum, the studies are designed to develop a clear, and more comprehensive, approach to workplace safety.

The first paper is a literature review detailing the current research on physical and psychosocial safety climate. The intent of this review was to outline the history and evolution of research on both aspects of safety climate separately and the movement made to address them jointly. The review focused on why the integration is needed both for academics and practitioners.

The second paper introduces the new Physical and Psychosocial Workplace Safety (PPWS) model. This provided the theoretical foundation to address the separation between physical and psychosocial safety climate. The PPWS model is an extension of leading theoretical

models such as the model of safety performance (Neal & Griffin, 1997) and job-demands resources (JD-R) model of workplace safety (Nahrgang et al., 2011). This paper specifically provided clear definitions and distinctions between variable conceptualization, expanding the leading theoretical models, integrating physical and psychosocial safety, providing a generalizable approach across industries, and considering self-regulatory processes as mediators of safety behaviors. Self-regulatory processes were introduced as safety factors and help understand employee behavior. Safety behaviors were the dependent variable of interest for this model. Specifically, physical and psychosocial safety participation and safety compliance. Therefore, self-regulatory processes were introduced as mediators to explain the relationships between job demands and resources with safety behaviors. This paper laid the foundation to test the measurement model and provide preliminary validation evidence to support researchers in the safety space and help industries understand antecedents of safety behaviors.

The third paper describes the assessment of the factor structure of job demands, job resources, safety factors, and safety behaviors through a series of exploratory and confirmatory factor analyses. Participants (n = 941) were sampled from high-risk physical or psychological occupations, such as fire fighter, police, and healthcare, to participate in a survey. The exploratory factor analyses identified the factor structure of each construct and subsequent the confirmatory factor analyses refined each. This laid the foundation to test the structural model in the fourth paper.

The fourth paper focused on validating the PPWS model with a repeated measures design. The final structure identified from the third paper was tested with structural equation modeling. For Study 1 (n = 941), there were 19 models before finding adequate model fit, x^2 (60, n = 941) = 526.53, p < .001, SRMR = .07, TLI = .80, CFI = .89, RMSEA = .09 [.08, .10]. The specific standardized factor loading patterns supported the theory and identified modifications for improvement. This model served as the baseline model for Study 2. Study 2 (n = 456) tested five models before confirming adequate model fit, x^2 (85, n = 456) = 162.36, p < .001, SRMR = .08, TLI = .79, CFI = .85, RMSEA = .10 [.09, .11]. RMSEA = .09 [.08, .10]. Model adjustments were made through modification indices, as aligned to theory. Both studies failed to reach good model fit. The individual factor loading patterns found more support in Study 2 than Study 1. In conclusion, there was some support for the model, but major reconsiderations are required for future research and applied utility.

The fifth paper discussed the implications of the previous chapters and suggested paths for future research to further develop the area of psychosocial and physical safety factor modeling. The chapter detailed the research, finding, limitations, and future directions for the PPWS model for the research and applied space. For research, additional sample sizes and populations are recommended. This research attempted to focus on a generalizable model and the variability in industry and occupation reduced the ability to derive specific insights. Taking a more targeted approach would support specific industries while providing practitioners clearer guidance. There are alternative measures of safety control, safety motivation, and employee engagement available in the research literature. This might lead to a more robust measure and ensure the correct construct is being assessed (e.g., employee engagement versus organizational commitment). Additionally, the PPWS model focused on a parsimonious approach. The PPWS model was streamlined throughout the validation process but still fell short of good model fit. Therefore, the model needs to be refined to support parsimony and achieve good fit. Additional next steps and considerations were suggested to continue the integration of physical and psychosocial safety climate research paths.

This thesis was designed to create a model, generalizable across industries, that integrated physical and psychosocial safety elements to understand safety behaviors. While the PPWS model fell short of global good model fit, individual components for the model found support. Additional studies and research are needed to deepen the understanding of the relationships between self-regulatory processes and safety behaviors and address the limitations found in this research. The theoretical foundation and organizational need exists for a comprehensive approach to workplace safety. The PPWS model is a foundation to fill that need and future research will refine and establish clear paths and support to improving safety behavior.

Acknowledgements

This multi-year journey seen to completion is largely due to the support from my supervisors and family. Dr. Graeme Ditchburn, Dr. Guy Curtis, and Dr. Brody Heritage patiently helped me navigate this project. Graeme, I thoroughly appreciate your time and energy invested. You have consistently been a positive source throughout the PhD (and life's) ups and downs and a wealth of knowledge. Guy, I appreciate how you always asked about life beyond the PhD. It was a grounding piece and good reminder that this is just one part of a bigger picture. Brody, you rolled onto my supervisor team when we were struggling to find someone. I appreciate the time and effort you put in getting caught up and your statistical expertise. All three of you consistently challenged and improved each chapter by providing deep insights and new ideas. My knowledge as an Industrial Organizational psychologist, skills as a researcher, and perseverance as a person was molded and shaped from what I learned from you.

I'd like to also acknowledge and thank Dr. Libby Brook. You were part of my team early on and I am forever grateful for the collaboration opportunities. I am sad that you found new options and paths beyond Murdoch but am happy for the opportunities and career growth you've experienced.

Next, I'd like to thank the various anonymous organizations that collaborated with me to complete this project. Distributing my survey to your employees and believing in what we are trying to do was monumental in maintaining my belief in this research. It grounded me to know that organizations found real-world value in what we wanted to change.

Last, to my friends and family. I've said for many years that I have no idea where I would be without you. My mum and grandpa, in particular, have been unwavering support systems.

You inspire me with your unconditional belief and support. Finally, my partner and daughter. I simply can’t image life without you.

List of Figures and Tables

Note. Figures and tables in Chapter 2 are from manuscripts for journal submissions and are thus numbered as they appear in the articles.

Author note: Papers submitted to peer-reviewed journals are included within the written chapter. This suggests a certain level of repetition within the thesis and inconsistencies in format and spelling (United States / United Kingdom English).

Abbreviations

CFA	Confirmatory factor analysis
CFI	Comparative Fit Index
EFA	Exploratory factor analysis
EM	Expectation-Maximization
ISA Engagement Scale	Intellectual, Social, Affective Engagement Scale
JD-R Model	The Job Demands-Resources Model
KMO	Kaiser-Meyer-Olkin
MCAR	Missing Completely at Random
MLR	Robust Maximum Likelihood
Mturk	Mechanical Turk
OSHA	Occupational Safety and Health Administration
PPWS Model	Physical and psychosocial workplace safety model
PSC-12	Psychosocial Safety Climate Measure
RMSEA	Root mean square error of approximation
SIG	Stress in General Scale
SRT	Self-regulation theory
TLI	Tucker Lewis Index
UWES	Utrecht Work Engagement Scale
WDQ	Work Design Questionnaire

CHAPTER 1

Introduction and Thesis Overview

Occupational health and safety became a topic of interest in the 19th century in parts of Europe and the early 20th century in the United States (Swuste et al., 2010). At this time, research focused on the conditions of the working-classes (Engles, 1844) and associated factors such as occupational diseases (Thackrah, 1831), hazards, and shifting towards an adult workforce (Swuste et al., 2010). As the 20th century progressed laws and legislations were passed (e.g., British Factory Inspectorate in 1833, Dutch Factory Inspectorate in 1892), research and publications started to focus on safety (e.g., the Pittsburgh survey in 1906), and industry started supporting safety initiatives (e.g., The American Safety First Movement in 1906; Swuste et al., 2010). It was not until the late 20th century that safety climate was introduced in the scientific literature (Zohar, 1980) and it has been a popular research topic in a variety of contexts such as leadership (Grill, e al., 2017; Martínez-Córcoles & Stephanou, 2017), productivity (von Thiele Schwarz et al., 2016; Whiteoak & Mohamed, 2016), and social learning impact (Tucker et al., 2016). Safety climate is a well-established research avenue that has made an invaluable contribution to occupational health and safety; however, it predominately focused only on the physical aspects of safety (Beus et al., 2016), despite the introduction psychosocial safety climate (Dollard & Bakker, 2010).

Psychosocial safety climate has an increasing presence in the safety literature (Yulita et al., 2016). However, the research literature is largely fragment looking at these two components separately, not integrated (Beus et al., 2016; Yulita et al., 2016). Therefore, it is important to have a current understanding of the literature surrounding both physical and psychosocial safety. The purpose of this review is to consider the current state of research on physical and psychosocial safety climate and to determine the future directions.

Chapter 1: Introducing physical and psychosocial safety

Overview of Physical Safety

The foundation of safety is rooted in industries such as textile, manufacturing, and mining where, by nature of the work, research focused on physical elements, such as accidents and labor conditions of the time (Swuste et al., 2010). Two theoretical positions formed from this increased focus on occupational safety and accidents in the 19th and 20th centuries, which were a continuation of nature (individual or accident proneness; Farmer, 1925) versus nurture (environment or external causes; Eastman, 1910) positions (Swuste et al., 2010). These differ in terms of the extent to which safety is under the control of individual or accident proneness (Farmer, 1925; Greenwood & Woods, 1919; Newbold 1926) and the environment or external causes (Eastman, 1910; Kellogg, 1914; Swuste et al., 2010). Application of the individual position or accident proneness can be seen when Farmer (1925) and Marbe (1925) attempted to identify accident-prone individuals during selection processes. The Pittsburgh Survey (Eastman, 1910; Kellogg, 1914) laid the foundation for the environment hypothesis or external causes. This survey resulted in proposing that accidents are caused by labor conditions such as long hours, productivity demands, and other environmental aspects (e.g., noise; Eastman, 1910; Kellogg, 1914; Swuste et al., 2010).

These two initial theoretical positions are rooted in physical safety and furthered when Zohar (1980) introduced the construct of safety climate. Safety climate refers to employees' shared perceptions of the organization's policies, procedures, and practices in regard to the value and importance of physical safety within the organization (Bronkhorst, 2015; Griffin & Neal, 2000; Zohar, 2011). Safety climate consists of four domains; management support and commitment, management priority to physical health and safety as an organizational goal, organizational communication, and organizational participation and involvement with health and safety personnel or groups (Dedobbeleer & Beland, 1991; Griffin & Neal, 2000; Hall et al., 2010; Zohar, 1980). Research has shown that these factors are not only important to physical safety climate, but also impact physical safety behavior (e.g., Cooper & Phillips, 2004; Neal et al., 2000; Zohar, 1980). There also other dimensions of safety climate across the literature. Flin et al. (2000) identified other dimensions commonly found in safety climate measures. These include management-related, safety systems, risk, work pressure, and competence (Flin et al., 2000). Alternative, Beus et al. (2010) assert that risk, as a dimension, is impacted by coworkers and supervisors which, therefore, should be the dimensions. Additionally, Beus et al (2010) suggest management commitment to safety, priority of safety, general safety policies, procedures, and practices, safety training, safety communication, safety reporting, and employee safety involvement as dimension of safety climate due to the depth and breadth of coverage across the content domain. This research maintains Zohar's (1980) dimensions as the framework for safety climate. Since safety climate research initially focused on factories and high-risk manual jobs, the resulting research trends organically developed to focus on the physical aspects of safety (Neal & Griffin, 2006; Zohar, 1980, 2010).

Safety climate has been conceptualized from a perspective of multiple situational/environmental variables, many of which concern how organizational processes influence worker safety. An alternate approach is more focused on "who" is being safe rather than programs or systems (Schwatka & Rosecrance, 2016). There is continuous concentration on supervisor and co-worker commitment to safety (Zohar, 1980), with particular emphasis on co-workers' responsibilities (Schwatka & Rosecrance, 2016). The focus on "who" may be explained by union involvement in the US (Brondino et al., 2012; Melia et al., 2008) or frequency of safety-specific personnel within organizations (Brondino et al., 2012; Melia et al., 2008). Over time, this resulted in two additional distinct research paths; the physical safety path focusing on physical aspects and the newer work stress path focusing on psychological aspects (Dollard & Bakker, 2010; Hansez & Chmiel, 2010).

Research on safety climate, however, has faced several challenges, primarily around construct conceptualization (Christian et al., 2009). Researchers use a mix of variables which leads to lack of consensus around the operational definitions and conceptualizations for both predictors and outcome variables (Beus et al., 2016; Christian et al., 2009). An example discussed in more detail located further in this chapter concerns safety outcomes. For example, certain studies conceptualize them as accidents, near-misses, or fatalities (Nahrgang et al., 2011; Zohar et al., 2014) while others focus on, or adopt, measures of unsafe behaviors (Nahrgang et al., 2011) or safety behaviors (Martínez-Córcoles & Stephanou, 2017; Neal & Griffin, 1997). Another example is the extent to which safety climate should focus on the group (Neal & Griffin, 2006) or individual level (Christian et al., 2009; Neal & Griffin, 2006). This conceptual ambiguity means safety climate and related terms are defined on multiple levels, which presents measurement and methodological challenges (Glick, 1985; Zohar, 2003).

Despite these issues, safety climate continues to be a key element to organizations, researchers, and government agencies (Schwatka & Rosecrance, 2016). Physical safety climate research has considerable breadth, including key determinants such as social learning impact in CEO roles (Tucker et al., 2016) to hindrance and challenge stressors (Clarke, 2012). Positive safety climates encourage safety-oriented behaviors (Lee et al., 2019; Zohar, 1980) that reduce job demands in the safety context. One main value of a positive safety climate is the prioritization of safety to the employees (Zohar, 2011). An overview of leading theoretical models is discussed in Chapter 2.

Overview of Psychosocial Safety

As established, safety climate has traditionally focused on the physical aspects of health and safety (Bronkhorst & Vermeeren, 2016; Dollard & Bakker, 2010; Zadow et al., 2016) but has recently been extended to incorporate psychosocial safety climate. Psychosocial safety climate was introduced by Dollard and Bakker (2010) in a seminal piece addressing the gaps surrounding psychosocial working conditions and the impact of senior management. Psychosocial safety climate aimed to bridge the gap between physical safety and work stress research by incorporating physical and psychological well-being into one research stream (Dollard & Bakker, 2010). However, research has predominately continued to focus on either physical safety or psychosocial elements independently (Beus et al., 2016; Zadow & Dollard, 2016). Psychosocial safety climate and physical safety may differ within the same organization (Idris et al., 2012).

Psychosocial safety climate focuses on the psychological aspects of health and safety (Dollard & Bakker, 2010). Specifically, psychosocial safety climate relates to shared perceptions of the organization's policies, practices, and procedures in regard to the protection of workers' psychological health and safety (Hall et al., 2010). Positive safety climates value continuous safety improvement where organizations convey safety information effectively through training and meetings, resolve safety problems quickly, and treat safety training as an investment (Fugas et al., 2012). Employees in workplaces with high psychosocial safety climate feel safe and protected from psychological risk or harm because their workloads are manageable, the environment is free from bullying, and they can dedicate time and energy to be safe. Specifically, employees can learn new information, remember correct procedures for using equipment, and focus more on identifying and mitigating hazards (Zadow et al., 2016). Paralleling physical safety climate, the four domains have been extended to reflect psychosocial elements beyond the previously stated physical aspects 1) management support and commitment, 2) management prioritization of physical and psychological health and safety as an organizational goal, 3) organizational communication, and 4) organizational participation and involvement with health and safety personnel, (Dedobbeleer & Beland, 1991; Griffin & Neal, 2000; Hall et al., 2010; Zohar, 1980).

Psychosocial safety climate contributes to health-related outcomes beyond that of just physical safety climate. Therefore, it is important to consider both physical and psychosocial safety in organizations (Zadow et al., 2016). Physical safety climate has repeatedly been linked in psychological well-being, but psychosocial safety climate is a stronger antecedent (Idris et al., 2012). Therefore, it is important to fully explore psychosocial safety climate regarding workplaces and well-being. The number of studies compiling information and addressing those relationships to fulfill that need has drastically increased over the past decade (e.g., Idris et al., 2012; Law et al., 2011; Mansour & Tremblay, 2019; Nielsen et al., 2011; Zadow & Dollard, 2016; Zadow et al., 2017). Law et al (2011) first proposed psychosocial safety climate at the organizational level and established psychosocial safety climate as the main indicator of psychosocial risks (Idris et al., 2012). Idris et al. (2021) also established that psychosocial safety climate is a distinct construct from physical safety climate and the stronger indicator for psychological health outcomes (Zadow et al., 2017). High psychosocial safety climate has also been linked to higher levels of job satisfaction (Nielsen et al., 2011).

Job Demands-Resources Model

The Job Demands-Resources (JD-R) Model was one of the first frameworks to apply psychosocial safety climate (Bakker & Demerouti, 2007; Demerouti et al., 2001; Dollard &

Bakker, 2010). The JD-R Model has been the prominent framework when considering psychosocial safety (e.g., Hansez & Chmiel, 2010) across a breadth of research including jobs demands and psychological health (Idris et al., 2012), organizational health performance (Bronkhorst & Vermeeren, 2016), and safety behavior (Bronkhorst, 2015).

The JD-R model states that job demands and job resources impact burnout and engagement through two pathways: health impairment and motivation. Job demands are social and organizational factors that are not inherently negative but may become negative through continued effort and exertion (Bakker & Demerouti, 2007; Idris & Dollard, 2011; Nahrgang et al., 2011). Job resources are external, health-protecting factors (Richter & Hacker, 1998) that reduce psychological and/or physiological costs to the worker (Demerouti et al., 2001) and promote motivation (Nahrgang et al., 2011). The health impairment process is the first pathway where sustained effort from the individual to cope with high job demands can lead to burnout (Bakker & Demerouti, 2007, 2008). The second pathway is the motivational pathway where adequate resources reduce the negative impact of job demands and facilitate greater engagement (Bakker & Demerouti, 2007, 2008).

There is uncertainty surrounding where and how psychosocial safety climate fits into organizational safety models with many different relationships supported. Psychosocial safety climate was proposed to be an antecedent to working conditions, impacting risk and interpersonal factors, and described as an organizational resource, rather than a job resource, which influences both job demands and job resources (Dollard & Bakker, 2010). However, psychosocial safety climate has also been considered as an antecedent to job demands and resources (Dollard & Baker, 2010) or as a job resource at either/or the individual or organizational level (Dollard et al., 2012; Idris et al., 2011; Law et al., 2011). There is an uncertainty in the literature regarding what level psychosocial safety climate operates with support for individual (Dollard et al., 2012), team (Idris et al., 2011), or organizational (Dollard & Bakker, 2010) levels as well as the upstream impacts it provides. This identifies the need for clarity around what role psychosocial safety climate plays in organizational safety research.

Safety Outcomes

Safety outcomes are important to address as there are different perspectives between what are the salient outcomes and their impact on safety. Safety behavior (compliance and participation; Griffin & Neal, 2000), accidents (Grill et al., 2017), injuries (Zadow et al., 2016), and near-misses (Zohar et al., 2014) have all been studied as outcomes with various support. Using accidents and injuries as safety outcomes has been prevalent in the literature over the past 30 years (Zadow et al., 2016; Zohar, 2010).

Although these all have the potential to be salient outcomes, how they impact safety is important to consider. For example, the extent to which they are leading versus lagging indicators (Flin et al., 2000) or proximal and distal safety outcomes (Schwatcka & Rosecrance, 2016). It can be argued that safety behaviors fall under leading indicators (Beus et al., 2016; Flin et al., 2000). By measuring safety compliance and participation (Griffin & Neal, 2000), for example, the presence of safety can be determined through demonstrated safety behaviors. Proximal outcomes to safety include constructs such as safety knowledge where you gain knowledge about how to be safe and distal outcomes include safety behaviors where an individual applies that knowledge through behaviors (e.g., Schwatcka & Rosecrance, 2016). Accidents are workplace events that result in physical harm to a person and an example of a lagging indicator (Beus et al., 2016; Flin et al., 2000). The presence of accidents indicates a lack of safety, but the inverse does not hold. A lack of accidents does not indicate the presence or absence of safety; rather, that an accident has not occurred (Beus et al., 2016). This is a limitation to considering accidents as safety outcomes.

An extension of the leading and lagging indicator debate focuses on the temporal nature of accidents and injuries. Some studies (e.g., Christian et al., 2009) propose that safety outcomes result from a lack of safety behaviors at some point in time. The argument being the greater the safety behaviors, the lower the safety outcomes. In contrast, others propose that management actions are indicators of safety because managers set priorities and are ultimately responsible for them being carried out (Schwatka & Rosecrance, 2016). The value of management is seen in the domains of safety climate as well as across safety climate measures (Schwatka & Rosecrance, 2016).

Safety compliance and safety participation (Neal et al., 2000) provide a widely accepted framework for safety behaviors. The relationship between safety behaviors and physical safety climate is well established. Christian et al. (2009) noted safety climate predicts safety participation more so than safety compliance. Specifically, individuals in more positive safety climates will volunteer and participate in safety behaviors above and beyond those that are compulsory. Numerous studies (Beus et al., 2010; Christian et al., 2009; Griffin & Curcuruto, 2016; Lee et al., 2019; Nahrgang et al., 2011) support safety climate as a predictor of safety behavior and safety outcomes (i.e., accidents and injuries) with the focus on physical behaviors and outcomes. This framework only includes physical safety behaviors and needs to be adapted to include psychological behaviors and outcomes (Bronkhorst, 2015). Safety compliance and participation need to be addressed at both the physical and psychosocial level. This will identify how physical and psychosocial safety elements interact in the workplace and clarify the relationships physical and psychosocial safety have with safety behaviors and, subsequently, safety outcomes.

Physical and Psychosocial Safety

While there is a clear division between physical and psychosocial safety, research has started bridging that divide, identifying there are strong relationships between work and health (Jimmieson et al., 2016). Research is moving towards the integration of physical and psychosocial safety, but there are still gaps regarding a holistic approach, such as lack of an integrated framework. A summary of the research combining physical and psychosocial safety is presented below, and it is apparent that there is no overarching model or comprehensive approach to the integration of physical and psychosocial safety. A more detailed discussion of theoretical frameworks is in Chapter 2 of this thesis.

The shift in the focus of safety research has been seen before. In the early phases of safety research, studies focused on understanding how people, personalities, or attitudes impacted accident rates (Hansen, 1989; Shaw & Sichel, 1971; Sutherland & Cooper, 1991; Neal & Griffin, 2006). Gradually, partially in response due to workplace disasters (i.e., Piper Alpha and Chernobyl), the research started to focus on climate and management rather than only the individuals' contribution (Neal & Griffin, 2006; Reason, 1990). A noticeable trend in research focused on the determinants of safety arose (Neal & Griffin, 2006).

Psychosocial safety elements, such as workplace conditions, have continuously been examined as a predictor of musculoskeletal problems (Lang et al., 2012; Zadow et al., 2016) and other physical and psychological outcomes (Bronkhorst & Vermeeren, 2016; Yulita et al., 2014; Bailey et al., 2015). Lang et al. (2012) conducted a meta-analysis looking at psychosocial factors as predictors of physical outcomes (i.e., lower back symptoms, neck and/or shoulder symptoms).

This meta-analysis demonstrates that experiencing these psychosocial factors as ongoing stressors may result in negative physical musculoskeletal outcomes, supporting the linkage between physical and psychosocial elements.

Bronkhorst and Vermeeren (2016) explored the relationship between physical and psychosocial safety and both mental and physical health outcomes. Their findings suggest that psychological costs (e.g., emotional exhaustion) may not be sufficient for employees to use health care services or seek support; rather, that employees wait until they experience a physical cost. Considering Lang et al. (2012) findings, those physical costs may be alleviated through addressing psychosocial factors. Other negative outcomes, such as decreased concentration, cognitive failure, and burnout, are found when individuals have lower levels of psychological well-being or physical health (Clarke, 2012; Fogarty & McKeon, 2006; Halbesleben, 2010). Perhaps unsurprisingly, additional studies noted that psychosocial safety climate was a significant predictor of workplace injuries (Zadow et al., 2016).

Idris et al. (2011) found that perceptions of physical safety climate were higher in both Australian and Malaysian samples given the emphasis on physical safety climate by both academics and practitioners. Additionally, that study suggests that focusing on psychosocial safety climate over any other climate construct is the best way to improve employees' psychological health.

Given that laws and legislation, as well as organizational policies, address health and safety at work together as one, it is important for research and literature to also consider both physical and psychosocial safety when creating safety models to best support real-world applications (Hansez & Chmiel, 2010; Snyder et al., 2008). For example, in Australia, psychological injuries and health, in addition to physical injuries and health, are now covered under the model Work Health and Safety Act (Safe Work Australia, 2020).

Future Directions

Previous studies (e.g., Bronkhorst & Vermeeren, 2016; Lang et al., 2012) have identified factors and specific relationships that exist between physical and psychosocial elements. However, there is more to understand about the interaction between physical and psychological safety factors with physical and psychological outcomes. One way to build that understanding is through a model that considered both physical and psychological predictors and outcomes. Understanding how physical and mental health is predicted from physical and psychological factors will reduce injuries, accidents, and illnesses.

Additionally, academic and applied settings support the need for approaching physical and psychosocial safety consistently and in a unified manner. There currently is no overarching framework that unites physical and psychosocial safety. One approach would fill that gap in the empirical world and provide a comprehensive solution to drive business change and meet the growing needs around physical and psychological health and well-being.

Chapter References

Bakker, A. B., & Demerouti, E. (2007). The job demands-resources model: State of the art. *Journal of Managerial Psychology, 22*, 309-328. Doi: 10.1108/02683940710733115

Bakker, A.B., & Demerouti, E. (2008). Towards a model of work engagement. *Career Development International, 13,* 209-223. https://doi.org/10.1108/13620430810870476

Bailey, T. S., Dollard, M. F., McLinton, S. S., & Richards, P. A. M. (2015). Psychosocial safety climate, psychosocial and physical factors in the etiology of musculoskeletal disorder symptoms and workplace injury compensation claims. *Work & Stress, 29*(2), 190-211. https://doi.org/10.1080/02678373.2015.1031855

Beus, J. M., Payne, S. C., Bergman, M. E., & Arthur, W., Jr. (2010). Safety climate and injuries: An examination of theoretical and empirical relationships. *Journal of Applied Psychology, 95*(4), 713–727. https://doi.org/10.1037/a0019164

Beus, J. M., McCord, M. A., & Zohar, D. (2016). Workplace safety: A review and research synthesis. *Organizational Psychology Review, 6*(4), 352-381. Doi: 10.1177/2041386615626243

Brondino, M., Pasini, M., & Silva, S. A. (2012). Multilevel approach to organizational and group safety climate and safety performance: Co-workers as the missing link. *Safety Science, 50*(9), 1847-1856. Doi: 10.1016/j.ssci.2012.04.010

Chapter 1: Introducing physical and psychosocial safety

Bronkhorst, B. (2015). Behaving safely under pressure: The effects of job demands, resources, and safety climate on employee physical and psychosocial safety behavior. *Journal of Safety Research, 55*, 63-72. https://doi.org/10.1016/j.jsr.2015.09.002

Bronkhorst, B., & Vermeeren, B. (2016). Safety climate, worker health and organizational health performance. *International Journal of Workplace Health Management*, *9*(3), 279-289. https://doi.org/10.1108/ijwhm-12-2015-0081

Christian, M. S., Bradley, J. C., Wallace, J. C., & Burke, M. J. (2009). Workplace safety: A meta-analysis of the roles of person and situation factors. *Journal of Applied Psychology, 94*, 1103-1127. Doi: 10.1037/a0016172

Clarke, S. (2012). The effect of challenge and hindrance stressors on safety behavior and safety outcomes: A meta-analysis. *Journal of Occupational Health Psychology*, *27*(4), 387-397. Doi: 10.1037/a0029817

Cooper, M. D., & Phillips, R. A. (2004). Exploratory analysis of safety climate and safety behavior relationships. *Journal of Safety Research*, *35*, 497-512. Doi: 10.1016/j.jsr.2004.08.004

Dedobbeleer, N., & Beland, F. (1991). A safety climate measure for construction sites. *Journal of Safety Research*, *22*, 97-103. Doi: 10.1016/0022-4375(91)90017-P

Demerouti, E., Bakker, A. B., Nachreiner, F., & Schaufeli, W. B. (2001). The job demands-resources model of burnout. *Journal of Applied Psychology, 86*, 499-512. Doi: 10.1037/0021-9010.86.3.499

Dollard, M. F. & Bakker, A. B. (2010). Psychosocial safety climate as a precursor to conducive work environments, psychological health problems, and employee engagement. *Journal of Occupational and Organizational Psychology, 83,* 579-599. Doi: 10.1348/096317909X470690

Dollard, M. F., Tuckey, M. R., & Dormann, C. (2012). Psychosocial safety climate moderates the job demand-resources interaction in predicting workgroup distress. *Accident Analysis and Prevention, 45,* 694-704. https://doi.org/10.1016/j.aap.2011.09.042

Eastman, C. (1910). *Work-accidents and the law, the Pittsburgh Survey: Vol. II*. N Russell Sage Foundation Publications.

Engels, F. (1844). The conditions of the working class in England. Allen and Unwin.

Farmer, E. (1952). The method of grouping by differential tests in relation to accident proneness. *Industrial Fatigue Research Board, Annual Report*, 43-45.

Flin, R., Mearns, K., O'Connor, P., & Bryden, R. (2000). Measuring safety climate: Identifying the common features. *Safety Science*, *34*(1-3), 177–192. https://doi.org/10.1016/S0925-7535(00)00012-6

Fogarty, G. J., & McKeon, C. M. (2006). Patient safety during medication administration: The influence of organisational and individual variables on unsafe work practices and medication errors. *Ergonomics, 49*(5-6), 444-456. DOI: 10.1080/00140130600568410

Fugas, C. S., Silva, S. A., & Meliá, J. L. (2012). Another look at safety climate and safety behavior: Deepening the cognitive and social mediator mechanisms. *Accident Analysis and Prevention, 45,* 468-477. Doi: 10.1016/j.aap.2011.08.013

Glick, W. H. (1985). Conceptualizing and measuring organizational and psychological climate: Pitfalls in multilevel research. *Academy of Management Review, 10*(3), 601-615. https://doi.org/10.2307/258140

Greenwood, M., & Woods, H. M. (1919). The incidence of industrial accidents upon individuals with special references to multiple accidents. *Industrial Fatigue Research Board, Medical Research Committee.*

Griffin, M. A., & Neal, A. (2000). Perceptions of safety at work: A framework for linking safety climate to safety performance, knowledge, and motivation. *Journal of Occupational Health Psychology, 5*(3), 347-358. https://doi.org/10.1037/1076-8998.5.3.347

Griffin, M. A., & Curcuruto, M. (2016). Safety climate in organizations. *Annual Review of Organizational Psychology and Organizational Behavior, 3*, 191-212. https://doi.org/10.1146/annurev-orgpsych-041015-062414

Grill, M., Pousette, A., Nielsen, K., Grytnes, R., & Törner, M. (2017). Safety leadership at construction sites: The important of rule-oriented and participative leadership. *Scandinavian Journal of Work, Environment, & Health, 43*(4), 375-384. Doi: 10.5271/sjweh.3650

Halbesleben, J. R. B. (2010). The role of exhaustion and workarounds in predicting occupational injuries: A cross-lagged panel study of health care professionals. *Journal of Occupational Health Psychology, 15*(1), 1-16. Doi: 10.1037/a0017634

Hall, G. B., Dollard, M. F., & Coward, J. (2010). Psychosocial Safety Climate: Development of the PSC-12. *International Journal of Stress Management, 17*(4), 353-383. https://doi.org/10.1037/a0021320

Hansen, C. P. (1989). A causal model of the relationship among accidents, biodata, personality, and cognitive factors. *Journal of Applied Psychology*, *74*(1), 81. https://doi.org/10.1037/0021-9010.74.1.81

Hansez, I., & Chmiel, N. (2010). Safety behavior: Job demands, job resources, and perceived management commitment to safety. *Journal of Occupational Health Psychology, 15*(3), 267-278. Doi: 10.1037/a0019528

Idris, M. A., & Dollard, M. F. (2011). Psychosocial safety climate, work conditions, and emotions in the workplace: A Malaysian population-based work stress study. *International Journal of Stress Management, 18*(4), 324-347. https://doi.org/10.1037/a0024849

Idris, M. A., Dollard, M. F., Coward, J., & Dormann, C. (2012). Psychosocial safety climate: Conceptual distinctiveness and effect on job demands and worker psychological health. *Safety Science*, *50,* 19-28. https://doi.org/10.1016/j.ssci.2011.06.005

Jimmieson, N. L., Hobman, E. V., Tucker, M. K., & Bordia, P. (2016). Change in psychosocial work factors predicts follow-up employee strain: An examination of Australian employees. *Journal of Occupational and Environmental Medicine*, *58*(10), 1002-1013. Doi: 10.1097/JOM.0000000000000827

Kellogg, P. U. (1914). *The Pittsburgh Survey: Vol 5 and 6*. Russell Sage Foundation Publications.

Lang, J., Ochsmann, E., Kraus, T., & Lang, J. W. B. (2012). Psychosocial work stressors as antecedents of musculoskeletal problems: A systematic review and meta-analysis of stability-adjusted longitudinal studies. *Social Science & Medicine, 75,* 1163-1174. Doi: 10.1016/j.socscimed.2012.04.015

Law, R., Dollard, M. F., Tuckey, M. R., & Dormann, C. (2011). Psychosocial safety climate as a lead indicator of workplace bullying and harassment, job resources, psychological health and employee engagement. *Accident Analysis and Prevention, 43,* 1782-1793. Doi: 10.1016/j.aap.2011.04.010

Lee, J., Huang, Y-H., Sinclair, R. R., & Cheung, J. H. (2019). Outcomes of safety climate in trucking: A longitudinal framework. *Journal of Business and Psychology, 34*(6), 865-878. https://doi.org/10.1007/s10869-018-9610-5

Mansour, S., & Tremblay, D.-G. (2019). How can we decrease burnout and safety workaround behaviors in health care organizations? The role of psychosocial safety climate. *Personnel Review, 48*(2), 528–550. https://doi.org/10.1108/PR-07-2017-0224

Marbe, K. 1925. Zur praktischen psychologie der unfälle und betriebsunglücke. *Verhandlungen der phys.-med. Gesellschaft zu Würzburg,* 172–175.

Martínez-Córcoles, M. & Stephanou, K. (2017). Linking active transactional leadership and safety performance in military operations. *Safety Science, 96,* 93-101. https://doi.org/10.1016/j.ssci.2017.03.013

Melia, J. L., Mearns, K., Silva, S. A., & Lima, M. L. (2008). Safety climate responses and the perceived risk of accidents in the construction industry. *Safety Science*, *46*(6), 949-958. https://doi.org/10.1016/j.ssci.2007.11.004

Chapter 1: Introducing physical and psychosocial safety

Newbold, E. M. (1926) A contribution to the study of the human factor in the causation of accidents. *Industrial Health Research Board.*

Nahrgang, J. D., Morgeson, F. P., & Hofmann, D. A. (2011). Safety at work: A meta-analytic investigation of the link between job demands, job resources, burnout, engagement, and safety outcomes. *Journal of Applied Psychology*, *96*, 71-74. Doi: 10.1037/a0021484

Neal, A., & Griffin, M. A. (1997). Perceptions of safety at work: Developing a model to link organizational safety climate and individual behavior. Paper presented to the 12th Annual Conference of the Society for Industrial and Organizational Psychology, St. Louis, MO.

Neal, A., & Griffin, M. A. (2006). A study of the lagged relationships among safety climate, safety motivation, safety behavior, and accidents at the individual and group levels. *Journal of Applied Psychology, 91*, 946-953. https://doi.org/10.1037/0021-9010.91.4.946

Neal, A., Griffin, M. A., & Hart, P. M. (2000). The impact of organizational climate on safety climate and individual behavior. *Science Safety, 34*, 99-109. http://0-dx.doi.org.prospero.murdoch.edu.au/10.1016/S0925-7535(00)00008-4

Nielsen, M. B., Mearns, K., Matthiesen, S. B., & Eid, J. (2011). Using the job demands-resources model to investigate risk perception, safety climate and job satisfaction in safety critical organization. *Scandinavian Journal of Psychology, 52*, 465-475. DOI: 10.1111/j.1467-9450.2011.00885.x

Reason, J. (1990). *Human error.* Cambridge University Press. https://doi.org/10.1017/CBO9781139062367

Richter, P., & Hacker, W. (1998). Workload and strain: Stress, fatigue, and burnout in working life. Asagner.

Safe Work Australia. (2020, Mar 11). Guide to the model work health and safety act. Retrieved from https://www.safeworkaustralia.gov.au/doc/guide-model-work-health-and-safety-act

Schwatka, N., & Rosecrance, J. (2016). Safety climate and safety behaviours in the construction industry: The importance of co-workers commitment to safety. *Work: Journal of Prevention, Assessment, & Rehabilitation, 54*(2), 401-413. https://doi.org/10.3233/WOR-162341

Shaw, L., & Sichel, H. S. (1971). Accident proneness: Research in the occurrence, causation, and prevention of road accidents. Pergamon.

Snyder, L. A., Krauss, A. D., Chen, P. Y., Finlinson, S., & Huang, Y-H. (2008). Occupational safety: Application of the job demand-control-support model. *Accident Analysis & Prevention, 40*(5), 1713-1723. https://doi.org/10.1016/j.aap.2008.06.008

Sutherland, V. J., & Cooper, C. L. (1990). Understanding stress. A psychological perspective for health professionals. Chapman and Hall.

Swuste, P., van Gulijk, C., & Zwaard, W. (2010). Safety metaphors and theories, a review of the occupational safety literature of the US, UK and the Netherlands, till the first part of the 20th century. *Safety Science, 48*, 1000-1018. doi: 10.1016/j.ssci.2010.01.020

Thackrah, C. (1831). The effects of arts, trades and professions and of civic states and habits of living on health and longevity with suggestions for removal of many of the agents, which produce disease and shorten the duration of life. Longman.

Tucker, S., Ogunfowora, B., & Ehr, D. (2016). Safety in the c-suite: How chief executive officers influence organizational safety climate and employee injuries. *Journal of Applied Psychology, 101*(9), 1228-1239. http://dx.doi.org/10.1037/apl0000116

von Thiele Schwarz, U., Hasson, H., & Tafvelin, S. (2016). Leadership training as an occupational health intervention: Improved safety and sustained productivity. *Safety Science, 81*, 35-45. Doi: 10.1016/j.ssci.2015.07.020

Whiteoak, J. W., & Mohamed, S. (2016). Employee engagement, boredom and frontline construction workers feeling safe in their workplace. *Accident Analysis & Prevention, 93,* 291-298. https://doi.org/10.1016/j.aap.2015.11.001

Yulita, Idris, M. A., & Dollard, M. F. (2014). A multi-level study of psychosocial safety climate, challenge and hindrance demands, employee exhaustion, engagement and physical health. In M. Dollard, A. Shimazu, R. B. Nordin, P. Brough,& M. R. Tuckey (Eds.), *Psychosocial factors at work in the Asia Pacific* (pp. 127-143). Springer.

Yulita, Idris, M. A., & Dollard, M. (2016). Psychosocial safety climate: Past, present, and future research. In A. Shimazu, R. B. Nordin, M. Dollard, & J. Oakman (Eds.), *Psychosocial factors at work in the Asia Pacific* (pp. 89-134). Springer. https://doi.org/10.1007/978-3-319-44400-0_6

Zadow, A., & Dollard, M. F. (2016). Psychosocial safety climate. In S. Clarke, T. M. Probst, F. Guldenmund, & J. Passmore (Eds.), *The Wiley Blackwell handbook of the psychology of occupational safety and workplace health* (pp. 414–436). Wiley Blackwell.

Zadow, A. J., Dollard, M. F., Mclinton, S. S., Lawrence, P., & Tuckey, M. R. (2017). Psychosocial safety climate, emotional exhaustion, and work injuries in healthcare workplaces. *Stress and Health, 33,* 558-569. DOI: 10.1002/smi.2740

Zohar, D. (1980). Safety climate in industrial organizations: Theoretical and applied implications. *Journal of Applied Psychology, 65*, 96-102. Doi: 10.1037/0021-9010.65.1.96

Zohar, D. (2003). Safety climate: Conceptual and measurement issues. In J. C. Quick & L. E. Tetrick (Eds.), Handbook of occupational health psychology (pp. 123–142). American Psychological Association. https://doi.org/10.1037/10474-006

Zohar, D. (2010). Thirty tears of safety climate research: Reflections and future directions. *Accident Analysis & Prevention, 42*(5), 1517-1522. Doi: 10.1016/j.aap.2009.12.019

Zohar, D. (2011). Safety climate: Conceptual and measurement issues. In J. Quick, & L. Tetrick (Eds.), *Handbook of organizational health psychology* (pp. 141-164). Washington, D.C.: American Psychological Association.

Zohar, D., Huang, Y-H., Lee., J., & Robertson, M. (2014). A mediation model linking dispatcher leadership and work ownership with safety climate as predictor of truck driver safety performance. *Accident Analysis and Prevention, 62,* 17-25. http://dx.doi.org/10.1016/j.aap.2013.09.005

CHAPTER 2

Theoretical Foundation for the Physical and Psychosocial Workplace Safety Model

Chapter 2 establishes the theoretical foundation for the proposed physical and psychosocial workplace safety (PPWS) model. The PPWS model is proposed as an extension of the Model of Safety Performance (Neal & Griffin, 1997) and the Job Demands-Resources Model (Demerouti et al., 2001) of workplace safety (Nahrgang et al., 2011). This chapter lays the foundation to test the measurement model (Chapter 3) and structural model (Chapter 4).

The purpose of introducing this new model is provide a comprehensive approach to workplace safety. Physical and psychosocial safety have frequently been examined independently (Beus et al., 2016). The PPWS model takes a parsimonious approach (Epstein, 1984) through the integration of physical and psychosocial safety into one model. This allows researchers and practitioners to gather relevant and standardized information while making fewer assumptions to create solutions.

References

Beus, J. M., McCord, M. A., & Zohar, D. (2016). Workplace safety: A review and research synthesis. *Organizational Psychology Review, 6*(4), 352-381. Doi: 10.1177/2041386615626243

Demerouti, E., Bakker, A. B., Nachreiner, F., & Schaufeli, W. B. (2001). The job demands-resources model of burnout. *Journal of Applied Psychology, 86,* 499-512. Doi: 10.1037/0021-9010.86.3.499

Epstein, R. (1984). The principle of parsimony and some applications in psychology. *Journal of Mind and Behavior, 5*(2), 119–130.

Nahrgang, J. D., Morgeson, F. P., & Hofmann, D. A. (2011). Safety at work: A meta-analytic investigation of the link between job demands, job resources, burnout, engagement, and safety outcomes. *Journal of Applied Psychology, 96,* 71-74. Doi: 10.1037/a0021484

Neal, A., & Griffin, M. A. (1997). *Perceptions of safety at work: Developing a model to link organizational safety climate and individual behavior.* Paper presented to the 12th Annual Conference of the Society for Industrial and Organizational Psychology, St. Louis, MO.

Combining physical and psychosocial safety: A comprehensive workplace safety model

Cat Yaris, Graeme Ditchburn, Guy J. Curtis, and Libby Brook

This is an original manuscript of an article published by Elsevier in *Safety Science* on the 9th of September, 2020, available online:

https://doi.org/10.1016/j.ssci.2020.104949

Chapter 2: Establishing the theoretical foundation

Combining physical and psychosocial safety: A comprehensive workplace safety model

Cat Yaris, Graeme Ditchburn, Guy J. Curtis, and Libby Brook

Abstract

The majority of workplace safety models focus solely on physical elements of safety. Evidence in the literature suggests the need for psychosocial safety to be considered in conjunction with physical safety. Previous models have identified certain job demands and resources as valuable indicators of safety behavior. This paper focuses on developing a comprehensive approach to workplace safety through a proposed physical and psychosocial workplace safety (PPWS) model, where self-regulatory processes mediate the relationship of job demands and resources to safety behaviors. The aim is to provide a parsimonious, comprehensive approach to safety by summarizing and strengthening current theoretical explanations. The PPWS provides multiple contributions to the literature; 1) clear definitions and distinctions between variable conceptualization, 2) expands job demands and resources, 3) integrates physical and psychosocial safety, 4) provides a generalizable approach across multiple industries, 5) considers self-regulatory processes as mediators of safety behavior. These contributions provide benefits and opportunities for practitioners and academics.

Keywords: physical safety, psychosocial safety, burnout, job demands, job resources

Chapter 2: Establishing the theoretical foundation

1. Introduction

With many businesses adopting zero-accident targets, work-related accidents and fatalities should be minimal. However, the International Labour Organization (ILO, 2017) estimates that globally there are over 374 million workplace accidents and 2.78 million work-related fatalities annually. In the United States, there were approximately 3.2 million workplace accidents resulting in injury and/or illness in 2016 (Bureau of Labor Statistics, 2017) and 4836 fatal workplace accidents (Bureau of Labor Statistics, 2016). Despite safety processes and procedures being developed and implemented, these statistics demonstrate the goal of zero accidents has yet to be achieved, suggesting a gap in the way safety is viewed and managed.

Although physical injuries are more frequent, the monetary and lost-time cost of psychological injury or illness is approximately 2.7 times greater (Safe Work Australia, 2015). Physical injury has received greater attention given the ease of risk identification and management and the more complex psychosocial aspects of safety have often been overlooked. Over 30 years ago, Zohar (1980) introduced the concept of safety climate resulting in workplace safety research gaining greater attention (Beus et al., 2016). Yet, there are still areas to address, particularly with the integration of psychosocial safety into safety models (Bronkhorst, 2015; Dollard and Bakker, 2010).

The goals and contributions of this paper are to highlight the current state of physical and psychosocial safety by discussing two leading theoretical representations; 1) The Model of Safety Performance (Neal and Griffin, 1997), 2) The Job Demands-Resources Model (JD-R model; Demerouti et al., 2001) of workplace safety (Nahrgang et al., 2011) in conjunction with self-regulation theory (Bandura, 1988) to introduce a comprehensive physical and psychosocial workplace safety (PPWS) model. As the proposed PPWS model is an extension of leading theoretical models (the Model of Safety Performance and the JD-R Model), the structure of this paper is to progress through both models followed by a discussion of self-regulation theory. After establishing the foundation, the PPWS model is introduced and discussed.

The aim of the PPWS model, in addition to extending the field, is to establish a comprehensive approach to workplace safety. The law of parsimony best describes this model, finding the simplest way to explain both physical and psychosocial safety. One comprehensive approach will allow us to gather more relevant and standardized information and make fewer assumptions enabling the creation of more beneficial solutions for both theoretical and practical purposes with greater utility (Epstein, 1984). Physical and psychosocial workplace safety share similar assumptions, are legislated together, and the

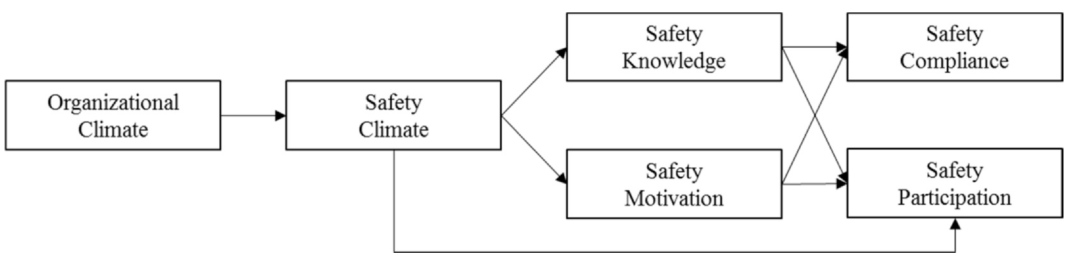

Fig. 1. Model of safety performance.

domains overlap, thus, having one model to apply to both domains further supports the applied and practical value of this comprehensive approach. Additionally, from an applied perspective, organizations have policies and practices that apply to both physical and psychological well-being. Addressing both pathways concurrently, as an organization helps facilitate best practices and applications for future uses.

2. Conceptual models of safety

2.1. Model of safety performance

Neal and Griffin (1997) propose a model of safety performance based on performance theories identifying antecedents, determinants, and outcomes of safety performance (Borman and Motowidlo, 1993; Campbell et al., 1993; Neal and Griffin, 1997; Neal et al., 2000) to explain how organizational and safety climates influence safety behavior (Neal et al., 2000). Individual and organizational level antecedents include ability and climate, respectively. The determinants for safety performance include safety knowledge and safety motivation (Neal and Griffin, 1997) while performance outcomes are conceptualized as safety compliance and safety participation (Neal et al., 2000) as illustrated in Fig. 1.

Safety knowledge refers to the individual's understanding of how to perform safely; and safety motivation is the individual's willingness to perform safely (Griffin and Neal, 2000; Neal and Griffin, 2006). Safety compliance and participation guide performance in the safety domain and these align with task and contextual performance as conceptualized by Borman and Motowidlo (1993). Safety compliance, relating to task performance, refers to employees following safety rules, regulations and procedures or safe work practices that are organization specific. Safety participation, mirroring contextual performance, concerns employees' participation in safety-related activities, which support the overall safety within the organization (Clarke, 2012; Griffin and Neal, 2000). Both safety knowledge and motivation have stronger relationships with safety compliance, i.e., task performance, than participation, i.e., contextual performance (Neal et al., 2000).

Clearly dividing safety compliance and participation is one strength of this model. Contextual behaviors are important to organizational effectiveness and in the context of safety, improve overall safety outcomes at the organizational level (Griffin and Neal, 2000; Johns, 2006; Katz and Kahn, 1966). Another strength is the conceptualization of organizational and safety climates as antecedents so that both individual and group level factors are included (Neal et al., 2000). This conceptualization clearly separates safety perceptions from climate perceptions and also identifies self-regulatory processes (e.g., motivation; Bandura, 1988) as mediators of the relationship between safety climate and safety behavior. Furthermore, the model is sufficiently flexible to incorporate additional antecedents including those that are organization or industry specific (Griffin and Neal, 2000).

Despite the strengths of the model, there are limitations. First, there is ambiguity surrounding the definition and subdimensions of safety climate that this model leaves unresolved. Griffin and Neal's (2000) and Neal and colleagues' (2000) findings suggest that the relationship between safety knowledge and safety participation is inconsistent, thus requiring further investigating to establish its true nature. Furthermore, the self-regulatory processes associated with knowledge, skill, and motivation, do not account for the situational factors that can influence an individual's performance (Hesketh and Neal, 1999; Neal et al., 2000). Finally, the model itself focuses on the traditionally physical approach to safety, excluding psychosocial elements.

2.2. Job demands-resources model

The Job Demands-Resources (JD-R) model, originally proposed as a model for burnout, postulates that demands and resources are evident across all organizational contexts but vary across occupations (Demerouti et al., 2001). Job demands include physical, social and organizational aspects of the job requiring effort or skills involving psychological and/or physiological costs to the employee. Job resources refer to physical, social, psychological, or organizational factors that help reduce job demands and promote work goal achievement, employee growth, and engagement (Bakker et al., 2005; Chrisopoulos et al., 2010; Demerouti et al., 2001).

The JD-R model proposes that demands and resources impact the individual through health impairment and motivational processes (Bakker et al., 2005; Demerouti et al., 2001; Dollard and Bakker, 2010). The health impairment process states that employees' physical and psychological resources are diminished when job demands are present, which can lead to exhaustion, burnout, and health deterioration, while the motivational process focuses on positive outcomes by introducing job resources that help employees manage and achieve goals (Demerouti et al., 2001). However, a lack of resources decreases motivation (Bakker et al., 2005; Bakker and Demerouti, 2007, 2008).

Nahrgang and colleagues (2011) extended the JD-R framework by hypothesizing a model of workplace safety and introducing safety behavior, including both physical and psychosocial behaviors, as a dependent variable, as shown in Fig. 2. Nahrgang and colleagues conceptualize safety outcomes as accidents and injuries, adverse events, and unsafe behavior. The interaction between demands and resources directly impacts workers' levels of burnout and engagement through the health impairment and motivational processes, respectively. Burnout and engagement then mediate the relationship between demands and resources and safety outcomes (Nahrgang et al., 2011). This model was validated in Nahrgang and colleagues' meta-analysis.

Job demands are conceptualized as multi-dimensional consisting of risks and hazards, physical demands, and complexity (Nahrgang et al., 2011). Job demands are not inherently negative to the employee but rather can turn into stressors through continued effort and exertion that may lead to deterioration in health and wellbeing (Bakker and Demerouti, 2007; Idris and Dollard, 2011). Deterioration in the employee's health occurs when stressors become overtaxing resulting in exhaustion. Therefore, job resources are necessary to alleviate the stressors (Demerouti et al., 2001).

Job resources are also conceptualized as multi-dimensional consisting of autonomy, safety knowledge, and a supportive environment (Nahrgang et al., 2011) and tend to be external to the employee (Richter and Hacker, 1998). Resources are health-protecting factors that reduce psychological and/or physiological costs to the worker

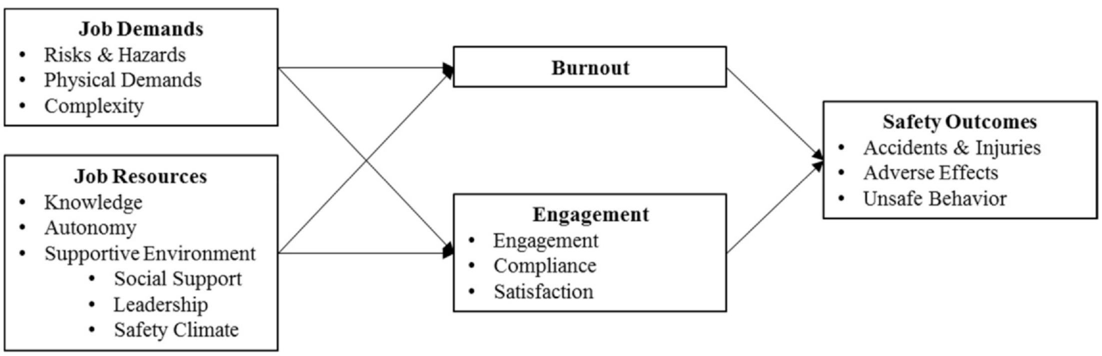

Fig. 2. JD-R model of workplace safety.

(Demerouti et al., 2001) and promote motivation (Nahrgang et al., 2011). If the environment lacks resources, the individual is less likely to be able to cope and achieve goals, potentially reducing engagement, motivation, and growth (Demerouti et al., 2001; Nahrgang et al., 2011). Nahrgang and colleagues (2011) also suggest that two self-regulatory processes, burnout and engagement, are influenced by both job demands and resources. Burnout manifests as emotional or physical exhaustion, depersonalization, and reduced personal accomplishment and can be evident within individuals performing any type of work (Maslach, 1982; Nahrgang et al., 2011; Neal and Griffin, 2006). In the workplace, burnout is negatively associated with employee wellbeing and working safely (Nahrgang et al., 2011; Neal and Griffin, 2006). Engagement is a work-related mental state that is positive and fulfilling, characterized by vigor, dedication, and absorption (Schaufeli and Bakker, 2003, 2010; Schaufeli et al., 2002). Engagement has been found to be negatively related to unsafe behaviors, but the empirical evidence suggests that the relationship with accidents and injuries fails to achieve significance (Nahrgang et al., 2011).

This model also has a variety of strengths and limitations. Nahrgang and colleagues (2011) explored the specific relationships to job demands and resources finding significant evidence that demands deter compliance while resources improve motivation and lessen burnout. Furthermore, they found specifically that the risks and hazards and supportive environment were the leading factors associated with improving safety. Finally, the JD-R model of workplace safety is intended to be generalizable across industries (Nahrgang et al., 2011), providing a strong foundation for future directions. In particular, risks and hazards and supportive environment were strong predictors across industries.

There are, however, specific limitations to this model. First, the JD-R model of workplace safety is derived from a meta-analysis (Nahrgang et al., 2011). Second, autonomy is established as a job resource (Karasek, 1979; Nahrgang et al., 2011) but needs further consideration. There is insufficient empirical evidence to fully understand the relationships that autonomy has with burnout and safety outcomes (Nahrgang et al., 2011). The JD-R model also needs to be tested across a greater number of industries to truly support the hypothesized generalizability. Last, safety outcomes are a lagging indicator of safety behavior and, in this context, lagging indicators may indicate a lack of safety but do not reflect the presence of safety (Beus et al., 2016).

2.3. Overarching conceptual model limitations

Recently Beus and colleagues (2016) reviewed current safety research and discussed an integrated model albeit one focusing specifically on physical safety elements. This further highlights the need for a more comprehensive model applying both physical and psychosocial safety elements to the workplace (e.g., Bronkhorst, 2015; Idris and Dollard, 2011). Psychosocial safety needs to be intentionally included rather than intentionally, or unintentionally, excluded. Moreover, there are inconsistencies in the models and, thus, the literature. For example, Neal and colleagues (2000) consider safety climate as an antecedent to job resources while Nahrgang and colleagues (2011) present safety climate as a job resource that is an antecedent to engagement and burnout.

There is also ambiguity regarding the component variables and their relationships. For example, Griffin and Neal (2000) consider compliance and participation as safety performance specifying that the outcomes are the "actual behaviors that individuals perform at work" (p. 348). In contrast, Nahrgang and colleagues propose that compliance and employee engagement are two types of engagement due to similar amounts of variance explained by job demands and resources. While unsafe behaviors are, instead, a safety outcome or unrelated construct having only moderate relationships with engagement.

Bronkhorst (2015) mentions how there are many unknowns in how safety climate relates to safety behavior due to the varying proposed mediators. Both safety models (Neal and Griffin, 1997; Nahrgang et al., 2011) propose different mediators without a unifying theoretical foundation. Until safety is approached comprehensively, full understanding of the relationship between safety climate and safety behavior is out of reach.

Finally, the generalizability of these models is questionable. As mentioned, Nahrgang and colleagues (2011) proposed their model based on their meta-analysis and Griffin and Neal (2000) and Neal and colleagues (2000) explored their model of safety performance only with Australian samples and only within three industries; manufacturing, mining, and health care. However, both models provide the foundation for further empirical study.

2.4. Self-regulation theory

According to Bandura's (1988) self-regulation theory (SRT) thought, affect, attention, and behavioral processes guide individuals towards goal setting and attainment (Hertel and Wittchen, 2008; Karoly, 1993; Latham and Locke, 1991; Mischel, 1996), focus on maintaining well-being (Hayes, 1989; Kanfer and Karoly, 1972; Mischel, 1996; Muraven and Baumeister, 2000; Sitzmann and Ely, 2011), and help individuals reduce discrepancies between ideal and actual conditions (Johnson et al., 2013; Miller et al., 1960; Newell et al., 1958). When discrepancies are found, individuals are motivated to take corrective actions or seek out solutions to resolve the dissonance (Johnson et al., 2013).

Self-regulation is voluntary self-guidance (Karoly, 1993) and, particularly in the workplace, allows individuals to function effectively and gain the skills and knowledge needed to succeed and stay safe (Sitzmann and Ely, 2011) and to understand employee behavior (Johnson et al., 2013; Latham and Locke, 1991; Latham and Pinder, 2005; Lord et al., 2010). While certain processes inherent in SRT have been considered by Nahrgang et al. (2011) and Neal and Griffin (1997) in the domain of workplace safety (Fugas et al., 2012) and SRT has been extensively considered across different domains such as personality (e.g., Singer and Bonanno, 1990), motivation (e.g., Bandura, 1988), social psychology (e.g., Koestner et al., 1992) and industrial organizational psychology (e.g., Johnson et al., 2013), SRT has yet to be fully explored in relation to workplace safety. This has applied utility as individuals are motivated to take action to resolve discrepancies between ideal and actual conditions (Johnson et al., 2013; Miller et al., 1960; Newell et al., 1958); therefore, applying self-regulatory processes to safety would facilitate safer working conditions.

Another reason to consider self-regulation theory is the focus on health. One of the beliefs around self-regulation theory is that individuals protect themselves from harm by modifying behavior, thoughts, and beliefs for goal attainment (Carver and Scheier, 2011). After all, physical and psychosocial safety are focused on the individual's physical and psychosocial health. Additionally, McAllister and Perrewé (2018) found self-regulatory resources help limit aggressive behaviors and bullying, which are elements of psychosocial in the workplace safety (Dollard et al., 2017). This lays the foundation for applying self-regulatory processes to determine their role in predicting physical and psychosocial safety behaviors.

2.5. Physical and psychosocial workplace safety model

The Physical and Psychosocial Workplace Safety Model (PPWS) builds on the JD-R model of workplace safety by considering additional psychological processes beyond burnout and engagement by integrating self-regulatory processes into the framework. The PPWS, as shown in Fig. 3, hypothesizes that job demands and resources impact burnout, engagement, motivation, attitude, and control. Safety behaviors are then considered the outcome variable and follow the conceptualization set forth by Griffin and Neal (2000) derived from Campbell et al.'s (1993) performance framework and self-regulation theories with the addition of considering psychosocial safety behaviors. Table 1, below, provides the main aspects of both models being extended, the model of safety performance and the JD-R model of workplace safety, and the proposed PPWS model.

The PPWS conceptualizes job demands as multi-dimensional, consisting of risks and hazards, physical demands, complexity (Nahrgang et al., 2011) and extends the JD-R model to include occupational stress. The commonality amongst these demands is that they are not inherently negative but over time, each demand, through continued effort and exertion, may negatively impact health and wellbeing (Bakker and Demerouti, 2007; Idris and Dollard, 2011; Nahrgang et al., 2011). To fully appreciate and understand the model presented in Fig. 3, it is important to clarify the definitions of the relevant constructs.

Hazards are intrinsic objects or situations in the workplace that could cause harm, for example, chemicals, and use of equipment and computer screens (Clarke and Cooper, 2000; DeJoy et al., 2004; Demerouti et al., 2001; Sutherland and Cooper, 1990; Wolfgang, 1988). In contrast, risk is the probability of harm actually happening and the magnitude of the consequences (Clarke and Cooper, 2000; Glendon and McKenna, 1995). As such, risk may be reduced through workplace efforts such as training that suggests a workplace commitment to safety (Hansez and Chmiel, 2010).

Physical demands such as physically taxing schedules, workloads, or workplace conditions or unfavorable environment require the employee to sustain physical effort and/or skill to reduce risks and hazards (Bakker and Demerouti, 2007; Demerouti et al., 2001; Nahrgang et al., 2011). These physical demands may result in physiological and psychological costs to the employee such as fatigue, stress, and anxiety (Bronkhorst, 2015).

Complexity refers to the intricacy of the work and involves the employee sustaining physical and/or cognitive effort in response to task complexity and work or task ambiguity (Bakker and Demerouti, 2007; Campbell, 1988; Demerouti et al., 2001; Nahrgang et al., 2011). Various factors contribute to task complexity including increase in volume of information, information diversity, and rate of information change (Campbell, 1988). All these factors require the employee to exert greater effort resulting in greater psychological cost, potentially leading to fatigue and burnout (Demerouti et al., 2001).

Occupational stress is the individual's experience derived from inadequate coping with work-related stressors, which is added as a job demand in the PPWS due to the psychological and physical cost it has on the employee (Cooper, 1996; Cooper and Marshall, 1976; Woodhead et al., 2016). For there to be negative consequences, the determinants of stress must be perceived as negative and the individual unable to cope adequately (Clarke and Cooper, 2000). These perceptions are time-dependent from exposure to stressors, because only when coping strategies fail do, they become a negative outcome (Clarke and Cooper, 2000; Cox et al., 2000). This makes stress dependent on individual differences, perceptions, and coping strategies that impact the individual's likelihood of experiencing and reporting stress symptoms (Cassar and Tattersall, 1998; Clarke and Cooper, 2000; Moyle, 1995). On the other hand, if the individual views the stressors positively, the individual will not, by definition, experience any negative outcomes (Clarke and Cooper, 2000).

When employees experience greater occupational stress, the organization faces lower job performance and greater turnover, absenteeism, and lost working days (Clarke and Cooper, 2000). When examining causes for lost working days, stress has been identified as the most prevalent work-related illness (Jones et al., 1998) and has been associated with a number of diseases (Cohen et al., 2007). Stress symptoms, if not reduced, can cause negative impacts to the individual's physical and/or psychological health (Griffin and Clarke, 2011) such as lower concentration, increased distractibility, and greater susceptibility to burnout (Clarke, 2012; Fogarty and McKeon, 2006; Halbesleben, 2010). While modest relationship between general well-being or work demands, and occupational accidents have been

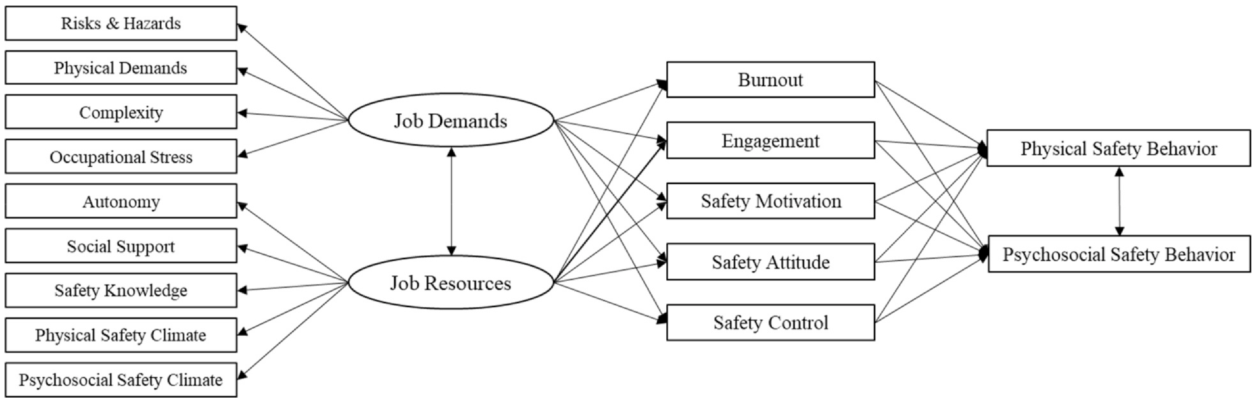

Fig. 3. Physical and psychosocial workplace safety model.

Table 1
Model overview.

Model	Reference	Aspects
Model of safety performance	Neal & Griffin, 1997	Explores individual and organizational level antecedents and impact on safety behavior Conceptualizes safety behaviors as safety compliance and participation
JD-R model of workplace safety	Nahrgang et al., 2011	Extends the JD-R model by focusing on workplace safety Includes both physical and psychosocial safety as safety outcomes
PPWS model		Comprehensive approach to physical and psychosocial safety by extending the model of safety performance and JD-R model of workplace safety and incorporating self-regulation theory

reported, further research is needed to fully understand the direct effects of occupational stress on safety behaviors (Clarke, 2006, 2012).

The PPWS conceptualizes job resources as multi-dimensional consisting of autonomy, social support, safety knowledge, and physical and psychosocial safety climate. Autonomy relates to how much freedom employees have in regulating work tasks including scheduling, decision making, freely choosing their own goals, and work methods (Lee, Sheldon, and Turban, 2003; Hackman and Oldham, 1976; Morgeson and Humphrey, 2006). Autonomy influences safety and reduces demands by giving the employee the freedom to work as desired to achieve safety objectives and safe productivity (Nahrgang et al., 2011). Autonomy has also been found to positively influence goal mastery and motivation (Elliot and McGregor, 2001; Lee et al., 2003), which also influences the willingness of an employee to perform safely (Griffin and Neal, 2000; Neal and Griffin, 2006).

Social support, as a job resource, refers to the amount of advice and assistance the employee receives from others regarding safety and teamwork (Morgeson and Humphrey, 2006) whereby support from colleagues helps achieve deadlines and reduces the effect of work overload (Van der Doef and Maes, 1999). Social support, also, reduces the psychological consequences from stressful experiences and prevents burnout effects (Bakker et al., 2005; Cohen and Wills, 1985; Woodhead et al., 2016). Furthermore, greater social support has been associated with fewer workplace injuries and reduced hazardous work events (Turner, Chmiel, Hershcovis, & Walls, 2010). An additional advantage in focusing specifically on co-worker social support as a job resource is that management level considerations are integrated in safety climate (Dedobbeleer and Beland, 1991; Griffin and Neal, 2000; Hall et al., 2010; Zohar, 1980).

Safety knowledge includes information regarding general health and knowing how to effectively use personal protective equipment and reduce risks (Burke et al., 2002). Knowledge has been shown to improve safety compliance, participation, and performance (Bakker and Demerouti, 2007; Demerouti et al., 2001; Neal et al., 2000). If individuals do not understand how to work safely, then they will not know how to perform the necessary behaviors appropriately (Neal et al., 2000).

Safety climate, which has traditionally focused on the physical aspects of health and safety (Beus et al., 2016), has been extended to incorporate psychosocial safety climate (PSC), which focuses on the psychological aspects of health and safety (Dollard and Bakker, 2010).

Specifically, PSC relates to shared perceptions of the organization's policies, practices, and procedure in regards to the protection of employees' psychological health and safety (Hall et al., 2010) including freedom from psychological risk and harm (Bronkhorst, 2015; Dollard and Hall, 2010). Positive safety climates prioritize safety, encourage safety-oriented behaviors, and value continuous safety improvement (Fugas et al., 2012; Zohar, 1980, 2011). These organizations convey safety information effectively through training and meetings, resolve safety problems quickly, and treat safety training as an investment (Fugas et al., 2012).

Four domains are considered for both physical and psychosocial safety climate, building on previous research. These are 1) management support and commitment, 2) management prioritization of physical and psychological health and safety as an organizational goal, 3) organizational communication, and 4) organizational participation and involvement with health and safety personnel (Dedobbeleer and Beland, 1991; Griffin and Neal, 2000; Hall et al., 2010; Zohar, 1980). Furthermore, research has shown that these factors are not only important to physical safety climate, but also impact physical safety behavior (e.g., Cooper and Phillips, 2004; Neal et al., 2000; Zohar, 1980).

2.6. Safety factors

The PPWS proposes that certain processes, beyond burnout and engagement, i.e., motivation, attitudes, and control, mediate the relationship between demands and resources and safety behaviors as explained from self-regulation frameworks (Bronkhorst, 2015; Fugas et al., 2012; Neal et al., 2000). See Fig. 3 for the mediation pathways for safety factors.

Burnout is a condition that any employee can experience resulting in emotional exhaustion and depersonalization (Nahrgang et al., 2011; Neal and Griffin, 2006; Maslach, 1982). This is similar to fatigue and job-related depression and other traditional stress reactions

(Buunk et al., 1998; Kahn and Byosiere, 1992; Maslach, 1982). Depersonalization, like alienation, results in an individual withdrawing or mentally distancing themselves from others (Demerouti et al., 2001) and functioning with detached and callous responses (Demerouti et al., 2001; Maslach et al., 1996). Both emotional exhaustion and depersonalization are strongly related to psychological and physiological strain (Lee and Ashforth, 1990). The counter to this, motivational processes, facilitate employee engagement through job resources (Demerouti et al., 2001). Considering burnout as a mediator contributes to the growing literature linking burnout to occupational safety (Halbesleben, 2010)

Demerouti and colleagues (2001) identified three scenarios in relation to demands and resources. First, when demands are high, employees experience exhaustion. Second, when resources are low, employees experience disengagement. Third, when demands are high and resources are low, the combination of exhaustion and disengagement characterizes burnout syndrome. Furthermore, burnout was found to negatively relate to goal attainment (i.e., safety behaviors; Olafsen, 2017).

Self-regulation theory is a key perspective to understanding motivation (Bolino et al., 2012; Vancouver et al., 2010) which, in the context of safety, refers to an individual's willingness and drive to engage in safety behaviors and the positive valence associated with them (Campbell et al., 1993; Neal et al., 2000; Neal and Griffin, 2006). An employee's reward for safety participation increases the level of safety motivation (Neal and Griffin, 2006). Furthermore, safety motivation mediates the relationship between job resources and safety behaviors (Griffin and Neal, 2000; Neal et al., 2000). For example, if the employee has safety knowledge, a job resource, but no motivation, safety behaviors are less likely to be performed (Neal et al., 2000).

Attitudes and beliefs that behavior has positive or negative consequences originates from behavioral beliefs and are developed through the formation of personal standards often formed in the context of social modeling (Bandura, 1988; Wood, 2000) as such they are influenced by group members and group norms. In the context of safety, positive safety group norms lead to positive safety attitudes and as a consequence greater engagement in safe behaviors (Fugas et al., 2012). Numerous studies (e.g., Barling et al., 2002; Brown and Holmes, 1986; Gillen et al., 2002; Hofmann and Stetzer, 1996; Zohar, 2000) suggest that individuals with positive attitudes towards safety are less likely to experience or be involved in an accident (Clarke, 2006).

Control is derived through self-knowledge (Bandura, 1988) and when employees believe that they have the required resources and opportunities to perform safely in addition to belief in their own capabilities, employees have a greater sense of personal behavior control (Ajzen, 2002; Fugas et al., 2012). Carver and Scheier (1981, 1998, 2011) established the link and overlap between self-regulation and control theories. This sense of perceived control allows the employee to choose to work safely (Fugas et al., 2012). As physical and psychosocial safety climate refer to employees' shared perceptions of the organization's policies, procedures, and practices in regard to the value and importance of physical and psychosocial safety, respectively, within the organization (Bronkhorst, 2015; Griffin and Neal, 2000; Zohar, 2011), these safety climates are antecedents to safety attitude as it would increase level of self-knowledge around safety.

2.7. Safety behavior

Physical and psychosocial safety behaviors stem from employee activities that support and maintain workplace physical and psychological safety or create environments that support safety (Bronkhorst, 2015; Griffin and Neal, 2000). Physical safety behaviors consist of wearing personal protective equipment, operating machinery, and proactive participation in making safety-related suggestions (Clarke, 2012; Griffin and Neal, 2000). Psychosocial safety behaviors include changing work habits to reduce work stress or starting procedures, such as incident reporting (Bronkhorst, 2015). Valuing these behaviors facilitates an environment supportive of physical and psychosocial safety (Bronkhorst, 2015; Griffin and Neal, 2000).

Safety compliance refers to employees following organization-specific safety rules, regulations, and procedures in contrast to safety participation which focuses on employee engagement in safety-related activities (Clarke, 2012; Neal et al., 2000). In the proposed PPWS, employees can be both physically and/or psychosocially compliant and participative. Organizations depend on both safety compliance and participation to prevent accidents and injuries. However, the relationship does vary. Safety compliance has a direct effect on accidents because the policy is followed or not (Clarke, 2012). In contrast, safety participation has a more indirect relationship because participating or not participating does not necessarily lead to an accident. Rather, participation could help reduce accidents by improving the environment through safety training or incident reports to improve safety in the workplace (Clarke, 2012; Neal et al., 2000).

Furthermore, the extent to which safety is prioritized relative to other organizational goals can impact the extent to which the employee is safety compliant (Zohar, 2000). Both physical and psychosocial safety climate directly influence the engagement in safety behaviors (Bronkhorst, 2015). Bronkhorst found that the job resources autonomy and supportive environment as well as psychosocial and physical safety climate were positively related to both physical and psychosocial safety behavior. For example, when employees are faced with high work pressure, they are less likely to use safety equipment or initiate incident reporting

(Bronkhorst, 2015). This further supports the proposed model extension and having safety climate and job resources as antecedents to safety behavior.

Safety behaviors are proposed as outcome variables as they are considered to be leading indicators of safety performance (Beus et al., 2016). Other outcomes, such as accidents and fatalities, are lagging indicators as they are dependent on safety behaviors. While their presence is indicative of poor safety their absence does not necessarily indicate safety (Beus et al., 2016; Wallace et al., 2012). Griffin and Neal’s (2000) measure of physical safety participation and compliance can thus be adapted to include psychosocial safety ensuring that both physical and psychosocial safety are balanced and acknowledged as critical outcomes.

3. Contributions

As safety is vital to organizations and individuals, one aim of the PPWS is to provide clarification about the relative importance of demands and resources with the intent of greater generalizability across industry. For example, what is a risk and hazard to a fire fighter might differ to that of a police officer. Despite there is extensive research on both job demands and job resources (Nahrgang et al., 2011). Bronkhorst (2015) conducted the only study to date that focuses on the relationships between job demands and resources with physical and psychosocial safety behaviors and there is limited research considering both physical and psychosocial safety climate (e.g., Bronkhorst, 2015; Idris et al., 2012). While research has extended the JD-R model to workplace safety (Nahrgang et al., 2001), there is also a gap in the literature addressing the JD-R model of workplace safety within and across high-risk industries. High-risk industries expand on previous research (e.g., Ângelo and Chambel, 2013, 2014; Mijakoski et al., 2015; Nahrgang et al., 2011) to identify generalizable findings for those individuals who face a greater possibility of psychological or physical harm during a typical shift.

There has also been limited research considering the impact various safety factors have on safety behaviors (Bronkhorst, 2015). Nahrgang and colleagues (2011) conceptualized unsafe behavior as a safety outcome while other research presents different conceptualizations (c.f., Christian et al., 2009; Clarke, 2012; Griffin and Neal, 2010). Clarke (2012) explored safety behavior, safety compliance and participation as mediators between stressors and safety outcomes and found a negative relationship between safety behaviors and occupational injuries suggesting that as antecedents safety behaviors should be clearly differentiated from safety outcomes. Additionally, the widely accepted safety behavior framework from Griffin and Neal (2000) considering both safety compliance and participation focuses on the physical aspects. This model extends that framework to consider the psychosocial equivalents while also strengthening the literature by considering safety behaviors as leading indicators of safety outcomes.

Thus, this model contributes to the literature in several ways: 1) clear definitions and distinctions between variable conceptualization, 2) expands job demands and resources, 3) integrates physical and psychosocial safety, 4) provides a generalizable approach across multiple industries, and 5) considers self-regulatory processes as mediators of safety behavior.

First, the PPWS model focuses on clear variable conceptualization. This proposed model examines safety factors suggested by the leading safety theoretical models (Griffin and Neal, 2000; Fugas et al., 2012; Nahrgang et al., 2011) and self-regulation theory (Bandura, 1988) as a way of strengthening the link to safety behavior frameworks. Therefore, validation of this model should strengthen the efficacy of interventions and applied applications, as the fundamental theory is already developed under a motivation-behavior framework.

Additionally, the PPWS model extends the conceptualization of safety behaviors. Safety behaviors have traditionally been focused on physical safety (Griffin and Neal, 2000) so the PPWS model provides clear conceptualization on how safety behaviors are extended for both a physical and psychosocial focus. Only one study to date has considered psychosocial safety behaviors (Bronkhorst, 2015). Furthermore, the model defines safety outcomes as safety behaviors. This is important for leading, i.e., safety behavior which indicates a presence of safety, rather than lagging outcomes variables, i.e., accidents, that are focused on the absence of safety.

Second, it extends Demerouti and colleagues' (2001) original JD-R model of burnout by integrating Nahrgang and colleagues' (2011) JD-R model of workplace safety and considering job demands and resources relevant to workplace safety. Specifically, considering occupational stress as a job demand and psychosocial safety climate as a job resource. Despite the literature considering occupational stress as a psychosocial hazard (Clarke and Cooper, 2000); it has yet to be explored as a job demand.

The individual effects of the JD-R Model are explained through the health impairment and motivational processes (Bakker et al., 2005; Demerouti et al., 2001; Dollard and Bakker, 2010). Safety research has previously focused on motivational processes (Christian et al., 2009), extended to include health impairment processes by Nahrgang and colleagues (2011). The PPWS provides a testable model incorporating both pathways as has only been done once before in Nahrgang and colleagues' meta-analysis.

Third, the existing safety behavior frameworks are extended to include the psychosocial counterparts to the physical elements including safety climate. This is addressed by considering psychosocial safety climate as a job resource, occupational stress as a job demand, and extending safety behaviors to include both physical and psychosocial. The model of safety performance (Neal and Griffin, 1997) is based on physical safety elements while the JD-R model of workplace safety (Nahrgang et al., 2011) is grounded in psychosocial safety. There have also been two streams of independent research due to the separation of physical and psychosocial safety (Dollard and Bakker, 2010). The PPWS model proposes an approach to combine physical and psychosocial safety to provide an integrated approach. The model is a combination and extension of leading physical and psychosocial safety models, giving equal value to both, rather than emphasizing only certain safety aspects.

Fourth, the proposed model serves to be generalizable across high-risk industries. The PPWS model needs to undergo validation across industries. Fifth, the PPWS model extends the literature by considering self-regulation theory (Bandura, 1988). SRT focuses on goal-attainment (Karoly, 1993) and protecting oneself from harm (Carver and Scheier, 2011). Physical and psychosocial safety climates are focused on the protection of health and safety, including freedom from harm (Bronkhorst, 2015; Dollard and Bakker, 2010; Dollard & Hall, 2100; Hall et al., 2010; Zohar, 1980, 2011). Therefore, it is important to understand how SRT impacts safety behaviors.

4. Conclusion

Although there are several predominant theories regarding workplace safety, limitations exist in the literature including the disparate nature of empirical research in this field and the lack of a comprehensive theoretical framework. For example, while Beus and colleagues (2016) very recently proposed a new integrated safety model this focused solely on physical safety. There remains a need to create a comprehensive model that incorporates both physical and psychosocial safety while adopting a holistic approach that is generalizable across industry, organizations and work roles (e.g., Bronkhorst, 2015). This paper's proposal to integrate the JD-R model of workplace safety as suggested by Nahrgang, Morgeson, and Hofmann (2011) with Neal, Griffin, and Hart's (2000) model of safety performance ensures that physical and psychosocial safety behaviors and their determinants are fully integrated.

Therefore, the next step and future direction for the proposed PPWS model is to assess the utility of the model. The purpose of the PPWS is to create a comprehensive model that is more representative of the real world, integrating physical and psychosocial safety, enabling academic validation and benefits to industry. Now that the theoretical foundation for extending existing safety models has been established, the next step is to assess the model in terms of validity and model fit.

References

Ajzen, I., 2002. Perceived behavioural control, self-efficacy, locus of control, and the theory of planned behavior. J. Appl. Soc. Psychol. 32, 1–20. https://doi.org/10.1111/j.1559-1816.2002.tb00236.x.

Ângelo, R.-P., Chambel, M.-J., 2013. An intervention with firefighters to promote psychological occupational health according to the Job Demands-Resources Model. Revista de Psicología Social 28 (2), 197–210.

Ângelo, R.P., Chambel, M.J., 2014. The role of proactive coping in the Job Demands–Resources Model: a cross-section study with firefighters. Eur. J. Work Organ. Psychol. 23 (2), 203–216.

Bakker, A.B., Demerouti, E., 2007. The Job Demands-Resources model: state of the art. J. Manage. Psych 22 (3), 309–328.

Bakker, A.B., Demerouti, E., 2008. Towards a model of work engagement. Career Dev. Int. 13 (3), 209–223.

Bakker, A.B., Demerouti, E., Euwema, M.C., 2005. Job resources buffer the impact of job demands on burnout. J. Occup. Health Psychol. 2, 170–180. https://doi.org/10.1037/1076-8998.10.2.170.

Bandura, A., 1988. Self-regulation of motivation and action through goal systems. In: Hamilton, V., Bower, G., Frijda, N.H. (Eds.), Cognitive Perspectives on Emotion and Motivation.

Kluwer Academic/Plenum Publishers, New York, NY, pp. 37–61. https://doi.org/10.1007/978-94-009-2792-6_2.

Barling, J., Loughlin, C., Kelloway, E.K., 2002. Development and test of a model linking safety-specific transformational leadership and occupational safety. J. Appl. Psychol. 87 (3), 488–496. https://doi.org/10.1037/0021-9010.87.3.488.

Beus, J.M., McCord, M.A., Zohar, D., 2016. Workplace safety: a review and research synthesis. Organ. Psychol. Rev. 6 (4), 352–381.

Bolino, M.C., Harvey, J., Bachrach, D.G., 2012. A self-regulation approach to understanding citizenship behavior in organizations. Organ. Behav. Hum. Decis. Process. 119 (1), 126–139.

Borman, W.C., Motowidlo, S.J., 1993. Expanding the criterion domain to include elements of contextual performance. In: Schmitt, N., Associates, W.C. (Eds.), Personnel Selection in Organizations. Jossey-Bass, San Francisco, CA, pp. 71–98.

Bureau of Labor Statistics, 2016. Census of fatal occupational injuries summary, 2015.

Retrieved from. https://www.bls.gov/news.release/cfoi.nr0.htm.

Bureau of Labor Statistics, 2017. Nonfatal injury and illness rates by industry. Retrieved from. https://www.bls.gov/iif/.

Bronkhorst, B., 2015. Behaving safely under pressure: The effects of job demands, resources, and safety climate on employee physical and psychosocial safety behavior. J. Saf. Res. 55, 63–72. https://doi.org/10.1016/j.jsr.2015.09.002.

Brown, R.L., Holmes, H., 1986. The use of a factor-analytic procedure for assessing the validity of an employee safety climate model. Accid. Anal. Prev. 18 (6), 455–470.

Burke, M.J., Sarpy, S.A., Tesluk, P.E., Smith-Crowe, K., 2002. General safety performance: a test of a grounded theoretical model. Pers. Psychol. 55, 429–457. https://doi.org/10.1111/j.1744-6570.2002.tb00116.x.

Buunk, B.P., de Jonge, J., Ybema, J.F., de Wolff, C.J., 1998. Psychosocial aspects of occupational stress. In: Drenth, P.J.D., Thierry, H., de Wolff, C.J. (Eds.), Handbook of work and organizational psychology: Vol. 2 work psychology. Psychology Press, Hove, United Kingdom, pp. 145–182.

Campbell, D.J., 1988. Task complexity: a review and analysis. Acad. Manage. Rev. 13 (1), 40–52. https://doi.org/10.2307/258353.

Campbell, J.P., McCloy, R.A., Oppler, S.H., Sager, C.E., 1993. A theory of performance. In: Schmitt, J., Borman, W.C. (Eds.), Personnel Selection in Organizations. Jossey-Bass, San Fransciso, CA, pp. 36–69.

Carver, C.S., Scheier, M.F., 1981. Attention and self-regualtion: A control theory approach to human behavior. Springer, New York.

Carver, C.S., Scheier, M.F., 2011. Self-regulation of action and affect. In: Vohs, K., Baumeister, R.F. (Eds.), Handbook of Self-Regulation: Research, Theory, and Applications, second ed. Guildford Press, New York, NY, pp. 3–21.

Cassar, V., Tattersall, A., 1998. Occupational stress and negative affectivity in Maltese nurses: Testing moderating influences. Work Stress 12 (1), 85–94.

Chrisopoulos, S., Dollard, M.F., Winefield, A.H., Dormann, C., 2010. Increasing the probability of finding an interaction in work stress research: a two-wave longitudinal test of the triple-match principle. J. Occup. Organ. Psychol. 83, 17–37. https://doi.org/10.1348/096317909X474173.

Christian, M.S., Bradley, J.C., Wallace, J.C., Burke, M.J., 2009. Workplace safety: a meta-analysis of the roles of person and situation factors. J. Appl. Psychol. 94 (5), 1103–1127. https://doi.org/10.1037/a0016172.

Clarke, S., 2006. Safety climate in an automobile manufacturing plant: the effects of work environment, job communication and safety attitudes on accidents and unsafe behaviour. Pers. Rev. 35 (4), 413–430.

Clarke, S., 2012. The effect of challenge and hindrance stressors on safety behavior and safety outcomes: a meta-analysis. J. Occup. Health Psychol. 27, 387–397. https://doi.org/10.1037/a0029817.

Clarke, S.G., Cooper, C.L., 2000. The risk management of occupational stress. Health, Risk Soc. 2 (2), 173–187.

Cohen, S., Janicki-Deverts, D., Miller, G.E., 2007. Psychological stress and disease. JAMA 298 (14), 1685. https://doi.org/10.1001/jama.298.14.1685.

Cohen, S., Wills, T.A., 1985. Stress, social support, and the buffering hypothesis. Psychol. Bull. 98 (2), 310–357. https://doi.org/10.1037/0033-2909.98.2.310.

Cooper, C.L., 1996. The Handbook of Stress, Medicine and Health. CRC Press, Boca Raton, FL.

Cooper, C.L., Marshall, J., 1976. Occupational sources of stress: a review of the literature relating to coronary heart disease and mental ill-health. J. Occup. Psychol. 49, 455–471. https://doi.org/10.1111/j.2044-8325.1976.tb00325.x.

Cooper, M.D., Phillips, R.A., 2004. Exploratory analysis of the safety climate and safety behavior relationship. J. Saf. Res. 35 (5), 497–512.

Cox, T., Griffiths, A.J., Barlow, C.A., Randall, R.J., Thompson, L.E., Rial-Gonzalez, E., 2000. Organisational Interventions for Work Stress. HSE Books, Sudbury, U.K.

Dedobbeleer, N., Beland, F., 1991. A safety climate measure for construction sites. J. Saf. Res. 22 (2), 97–103.

DeJoy, D.M., Schaffer, B.S., Wilson, M.G., Vandenberg, R.J., Butts, M.M., 2004. Creating safer workplaces: assessing the determinants and role of safety climate. J. Saf. Res. 35 (1), 81–90.

Demerouti, E., Bakker, A.B., Nachreiner, F., Schaufeli, W.B., 2001. The job demands- resources model of burnout. J. Appl. Psychol. 86, 499–512. https://doi.org/10.1037/ 0021-9010.86.3.499.

Dollard, M.F., Bakker, A.B., 2010. Psychosocial safety climate as a precursor to conducive work environments, psychological health problems, and employee engagement. J. Occup. Organ. Psychol. 83, 579–599. https://doi.org/10.1348/096317909X470690.

Dollard, M.F., Dormann, C., Tuckey, M.R., Escartín, J., 2017. Psychosocial safety climate (PSC) and enacted PSC for workplace bullying and psychosocial health problem reduction. Eur. J. Work Organ. Psychol. 26 (6), 844–857. https://doi.org/10.1080/ 1359432X.2017.1380626.

Elliot, A.J., McGregor, H.A., 2001. A 2 x 2 achievement goal framework. J. Pers. Soc. Psychol. 80, 501–519. https://doi.org/10.1037/0022-3514.80.3.501.

Epstein, R., 1984. The principle of parsimony and some applications to psychology. Retrieved from. J. Mind Behav. 5 (2), 119–130. http://www.jstor.org/stable/43853318.

Fogarty, G.J., Mckeon, C.M., 2006. Patient safety during medication administration: the influence of organizational and individual variables on unsafe work practices and medication errors. Ergonomics 49 (5-6), 444–456.

Fugas, C.S., Silva, S.A., Meliá, J.L., 2012. Another look at safety climate and safety behavior: deepening the cognitive and social mediator mechanisms. Accid. Anal. Prev. 45, 468–477. https://doi.org/10.1016/j.aap.2011.08.013.

Gillen, M., Baltz, D., Gassel, M., Kirsch, L., Vaccaro, D., 2002. Perceived safety climate, job demands, and coworker support among union and nonunion injured construction workers. J. Saf. Res. 33 (1), 33–51.

Glendon, A.L., McKenna, E.F., 1995. Human Safety and Risk Management. Oxford University Press, London, UK.

Griffin, M.A., Clarke, S., 2011. Stress and well-being at work. In: Zedeck, S., (Ed.), APA handbook of industrial and organizational psychology, vol. 3: Maintaining, expanding, and contracting the organization. APA, Washington, DC. pp. 359–397.

Griffin, M.A., Neal, A., 2000. Perceptions of safety at work: a framework for linking safety climate to safety performance, knowledge, and motivation. J. Occup. Health Psychol. 5, 347–358. https://doi.org/10.1037/1076-8998.5.3.347.

Hackman, J.R., Oldham, G.R., 1976. Motivation through the design of work: test of a theory. Organ. Behav. Human Perf. 16 (2), 250–279.

Hall, G.B., Dollard, M.F., Coward, J., 2010. Psychosocial safety climate: development of the PSC-12. Int. J. Stress Manage. 17 (4), 353–383. https://doi.org/10.1037/ a0021320.

Halbesleben, J.R.B., 2010. The role of exhaustion and workarounds in predicting occupational injuries: a cross-lagged panel study of health care professionals. J. Occup. Health Psychol. 15 (1), 1–16. https://doi.org/10.1037/a0017634.

Hansez, I., Chmiel, N., 2010. Safety behavior: Job demands, job resources, and perceived management commitment to safety. J. Occup. Health Psychol. 15 (3), 267–278. https://doi.org/10.1037/a0019528.

Hayes, S.C., 1989. Rule-governed behavior: Cognition, contingencies, and instructional control. Plenum, New York, NY.

Hertel, G., Wittchen, M., 2008. Work motivation. In: Chimel, N. (Ed.), An introduction to work and organizational psychology: A European perspective. Blackwell Publishing, Malden, pp. 29–55.

Hesketh, B., Neal, A., 1999. Technology and performance. In: Ilgen, D., Pukalos, E. (Eds.), The changing nature of work performance: Implications for staffing, motivation, and development. Jossey Bass, San Francisco, CA.

Hofmann, D.A., Stetzer, A., 1996. A cross-level investigation of factors influencing unsafe behaviors and accidents. Pers. Psychol. 49 (2), 307–339. https://doi.org/10.1111/j. 1744-6570.1996.tb01802.x.

Idris, M.A., Dollard, M.F., 2011. Psychosocial safety climate, work conditions, and emotions in the workplace: a Malaysian population-based work stress study. Int. J. Stress Manage. 18 (4), 324–347. https://doi.org/10.1037/a0024849.

Idris, M.A., Dollard, M.F., Coward, J., Dormann, C., 2012. Psychosocial safety climate: conceptual distinctiveness and effect on job demands and worker psychological health. Saf. Sci. 50 (1), 19–28.

International Labour Organization, 2017. Safety and health at work. Retrieved from. http://www.ilo.org/global/topics/safety-and-health-at-work/lang–en/index.htm.

Johns, G., 2006. The essential impact of context on organizational behavior. Retrieved from. Acad. Manag. Rev. 31, 386–408. http://www.jstor.org/stable/20159208.

Johnson, R.E., Taing, M.U., Chang, C.-H., Kawamoto, C.K., 2013. A self-regulation approach to person-environment fit. In: Kristof-Brown, A.L., Billsberry, J. (Eds.), Organizational fit: Key issues and new directions. Wiley-Blackwell, pp. 74–98.

Jones, J.R., Hodgson, J.T., Clegg, T.A., Elliott, R.C., 1998. Self-reported working conditions in 1995: Results from a household survey. HSE Books, Sudbury, UK.

Kahn, R.L., Byosiere, P., 1992. Stress in organizations. In: In: Dunette, M.D., Hough, J.M.R., Triandis, H.C. (Eds.), Handbook of industrial and organizational psychology, vol. 4. Consulting Psychologists Press, Pan Alto, CA, pp. 571–650.

Kanfer, F.H., Karoly, P., 1972. Self-control: A behavioristic excursion into the lion's den. Behav. Ther. 3 (3), 398–416.

Karasek, R.A., 1979. Job demands, job decision latitude, and mental strain: implications for job redesign. Adm. Sci. Q. 24 (2), 285. https://doi.org/10.2307/2392498.

Karoly, P., 1993. Mechanisms of self-regulation: a systems view. Annu. Rev. Psychol. 44 (1), 23–52.

Katz, D., Kahn, R.L., 1966. The social psychology of organizations. Wiley, New York, NY.

Koestner, R., Bernieri, F., Zuckerman, M., 1992. Self-regulation and consistency between attitudes, traits, and behaviors. Pers. Soc. Psychol. Bull. 18 (1), 52–59.

Latham, G.P., Locke, E.A., 1991. Self regulation through goal setting. Organ. Behav. Human Decis. Process. 50 (2), 212–247.

Latham, G.P., Pinder, C.C., 2005. Work motivation theory and research at the dawn of the twenty-first century. Annu. Rev. Psychol. 56 (1), 485–516.

Lee, R.T., Ashforth, B.E., 1990. On the meaning of Maslach's three dimensions of burnout. J. Appl. Psychol. 75, 743–747. https://doi.org/10.1037/0021-9010.75.6.743.

Lee, F.K., Sheldon, K.M., Turban, D.B., 2003. Personality and the goal-striving process: The influence of achievement goal patterns, goal level, and mental focus on performance and enjoyment. J. Appl. Psychol. 88 (2), 256–265. https://doi.org/10.1037/ 0021-9010.88.2.256.

Lord, R.G., Diefendorff, J.M., Schmidt, A.M., Hall, R.J., 2010. Self-regulation at work. Annu. Rev. Psychol. 61 (1), 543–568.

Maslach, C., 1982. Understanding burnout: Definitional issues in analyzing a complex phenomenon. In: Paine, W.S. (Ed.), Job Stress and Burnout. Sage, Beverly Hills, CA, pp. 29–40.

Maslach, C., Jackson, S.E., Leiter, M.P., 1996. Maslach burnout Inventory Manual, third ed. Consulting Psychologists Press, Palo Alto, CA.

McAllister, C.P., Perrewé, P.L., 2018. About to burst: how state self-regulation affects the enactment of bullying behaviors. J Bus Ethics 153 (3), 877–888.

Mijakoski, D., Karadzinska-Bislimovska, J., Milosevic, M., Mustajbegovic, J., Stoleski, S., Minov, J., 2015. Differences in burnout, work demands, and team work between Croatian and Macedonian hospital nurses. Cognit., Brain, Behav. An Interdis. J. 19 (3), 179–200.

Miller, G.A., Galanter, E.H., Pribram, K.H., 1960. Plans and the Structure of Behavior. Holt, Reinhard, and Winston, New York.

Mischel, W., 1996. From good intentions to willpower. In: Gollwitzer, P.M., Bargh, J.A. (Eds.), The psychology of action: Linking cognition and motivation to behavior. Guilford Press, New York, NT, pp. 197–218.

Morgeson, F.P., Humphrey, S.E., 2006. The Work Design Questionnaire (WDQ): developing and validating a comprehensive measure for assessing job design and the nature of work. J. Appl. Psychol. 91, 1321–1339. https://doi.org/10.1037/0021-9010.91.6.1321.

Moyle, P., 1995. The role of negative affectivity in the stress process: tests of alternative methods. J. Organ. Behav. 16, 647–668. https://doi.org/10.1002/job.4030160705.

Muraven, M., Baumeister, R.F., 2000. Self-regulation and depletion of limited resources: does self-control resemble a muscle? Psychol. Bull. 126 (2), 247–259. https://doi. org/10.1037/0033-2909.126.2.247.

Nahrgang, J.D., Morgeson, F.P., Hofmann, D.A., 2011. Safety at work: a meta-analytic investigation of the link between job demands, job resources, burnout, engagement, and safety outcomes. J. Appl. Psychol. 96, 71–74. https://doi.org/10.1037/ a0021484.

Neal, A., Griffin, M.A., 1997. Perceptions of safety at work: Developing a model to link organizational safety climate and individual behavior. Paper presented to the 12th Annual Conference of the Society for Industrial and Organizational Psychology, St. Louis, MO.

Neal, A., Griffin, M.A., 2006. A study of the lagged relationships among safety climate, safety motivation, safety behavior, and accidents at the individual and group levels. J. Appl. Psychol. 91, 946–953. https://doi.org/10.1037/0021-9010.91.4.946.

Neal, A., Griffin, M.A., Hart, P.M., 2000. The impact of organizational climate on safety climate and individual behavior. Saf. Sci. 34 (1-3), 99–109.

Newell, A., Shaw, J.C., Simon, H.A., 1958. Elements of a theory of human problem solving. Psychol. Rev. 65 (3), 151–166.

Olafsen, A.H., 2017. The implications of need-satisfying work climates on state mind-fulness in a longitudinal analysis of work outcomes. Motiv. Emot. 41 (1), 22–37.

Richter, P., Hacker, W., 1998. Workload and Strain: Stress, Fatigue, and Burnout in Working Life. Asagner, Hiedelberg, Germany.

Safe Work Australia, 2015. Work-related mental disorders profile. Retrieved from. https://www.safeworkaustralia.gov.au/system/files/documents/1702/work-related-mental-disorders-profile.pdf.

Schaufeli, W.B., Bakker, A.B., 2003. The Utrecht Work Engagement Scale (UWES): Test Manual. Utrecht University, Utrecht.

Schaufeli, W.B., Bakker, A.B., 2010. Designing and measuring work engagement: brining clarity to the concept. In: Bakker, A.B., Leiter, M.P. (Eds.), Work Engagement: A Handbook of Essential Theory and Research. Psychology Press, New York, pp. 10–24.

Schaufeli, W.B., Salanova, M., González-Romá, V., Bakker, A.B., 2002. The measurement of engagement and burnout: a two sample confirmatory factor analytic approach. J. Happiness Stud. 3, 71–92. https://doi.org/10.1023/A:1015630930326.

Singer, J.L., Bonanno, G.A., 1990. Personality and private experience: Individual variations in consciousness and in attention to subjective phenomena. In: Pervin, L.A. (Ed.), Handbook of Personality Theory and Research. The Guilford Press, New York, NY, pp. 419–444.

Sitzmann, T., Ely, K., 2011. A meta-analysis of self-regulated learning in work-related training and educational attainment: what we know and where we need to go. Psychol. Bull. 137 (3), 421–442. https://doi.org/10.1037/a0022777.

Sutherland, V.J., Cooper, C.L., 1990. Understanding Stress. Chapman and Hall, London, UK.

Turner, N., Chmiel, N., Hershcovis, M.S., Walls, M., 2010. Life on the line: job demands, perceived co-worker support for safety, and hazardous work events. J. Occup. Health Psychol. 15 (4), 482–493. https://doi.org/10.1037/a0021004.

Vancouver, J.B., Weinhardt, J.M., Schmidt, A.M., 2010. A formal, computational theory of multiple-goal pursuit: Integrating goal-choice and goal-striving processes. J. Appl. Psychol. 95 (6), 985–1008. https://doi.org/10.1037/a0020628.

Van der Doef, M., Maes, S., 1999. The job demand-control (-support) model and psychological well-being: a review of 20 years of empirical research. Work Stress 13 (2), 87–114.

Wallace, J.C., Paul, J.B., Landis, R.S., Vodanovich, S.J., 2012. Occupational safety. In: Schmitt, N. (Ed.), The Oxford Handbook of Personnel Assessment and Selection. Oxford University Press, New York, NY, pp. 614–626.

Wolfgang, A.P., 1988. Job stress in the health professions: a study of physicians, nurses, and pharmacists. Behav. Med. 14 (1), 43–47.

Wood, W., 2000. Attitude change: persuasion and social influence. Annu. Rev. Psychol. 51 (1), 539–570.

Woodhead, E.L., Northrop, L., Edelstein, B., 2016. Stress, social support, and burnout among long-term care nursing staff. J. Appl. Gerontol. 35 (1), 84–105. https://doi.org/10.1177/0733464814542465.

Zohar, D., 1980. Safety climate in industrial organizations: theoretical and applied implications. J. Appl. Psychol. 65, 96–102. https://doi.org/10.1037/0021-9010.65. 1.96.

Zohar, D., 2000. A group-level model of safety climate: Testing the effect of group climate on microaccidents in manufacturing jobs. J. Appl. Psychol. 85 (4), 587–596. https:// doi.org/10.1037/0021-9010.85.4.587.

Zohar, D., 2011. Safety climate: conceptual and measurement issues. In: Quick, J., Tetrick, L. (Eds.), Handbook of Organizational Health Psychology. American Psychological Association, Washington, D.C., pp. 141–164.

CHAPTER 3

Assessing the measurement model

Research on physical and psychosocial safety climates has been predominately separate within the occupational health and safety space, with few researchers considering both types of safety climate. The Physical and Psychosocial Workplace Safety (PPWS) model, introduced in chapter 2 of this thesis, aims to provide a comprehensive approach for both researchers and practitioners. This paper focuses on developing and assessing the measurement model associated with this theoretical model. Study 1 is a series of exploratory factor analyses (EFA) conducted on a sample of participants (*n* = 941) from high-risk industries such as police, fire, and warehousing. The EFAs identified the factor structure for each construct in the PPWS model. After establishing the factor structure, a series of confirmatory factor analyses (CFAs) were conducted in Study 2. The CFAs continued the refinement process for the PPWS model. Model fit statistics were established at the component level (job demands, job resources, safety factors, and safety behaviors) of the PPWS model. CFAs were completed once each component obtained good model fit. This completed the development of the measurement model. The next step is testing the structural model, which is detailed in Chapter 4. There were several limitations, including potential concerns with the instruments used for construct measurement, samples of interest, and construct clarification.

Introduction

For over 40 years, workplace safety and safety climate have been a key focus in health and safety research (Zohar, 1980). Workplace safety has predominantly focused on physical safety (Beus et al., 2016) with the introduction of psychosocial safety climate in 2010 (Dollard & Bakker, 2010). This created the opportunity to merge the two research paths into one comprehensive approach focusing on both physical and psychosocial safety. There are instances where that merger exists in the literature (e.g., Bronkhorst & Vermeeren, 2016; McLinton et al., 2019; Zadow et al., 2016), but those studies are limited with researchers predominately considering them as individual paths (e.g., Beus et al., 2016) instead of an integrated predictor of workplace safety.

The Physical and Psychosocial Workplace Safety (PPWS) Model (Yaris et al., 2020) was created to address the gap in the research where physical and psychosocial safety are considered separately and provide clear direction on how to research both types of safety together. This model draws from leading theoretical approaches to create a comprehensive approach to physical and psychosocial safety. The goal of this paper is to begin the validation process for the PPWS model, with Study 1 focusing on developing the model constructs stemming from item scores through a series of exploratory factor analyses, followed by confirmatory factor analyses in Study 2. This is a foundational approach building on the conceptual introduction of the constructs in Yaris et al. (2020). This will provide researchers and practitioners with a holistic approach to understanding physical and psychosocial safety.

Physical and Psychosocial Workplace Safety Model

Derived from the model of safety performance (Neal & Griffin, 1997) and job demands-resources (JD-R) model of workplace safety (Nahrgang et al., 2011), the PPWS model provides an integrative approach to workplace safety. The model of safety performance (Neal & Griffin,

1997) is a leading theoretical representation that has predominately focused on physical safety. The JD-R model of workplace safety (Nahrgang et al., 2011) is one of the earliest approaches to psychosocial safety, drawing from the JD-R model (Demerouti et al., 2001).

The PPWS model, as shown below in Figure 3.1, explores job demands, job resources, safety factors, and safety behaviors. See Chapter 2 of this thesis for a full theoretical discussion around the development of the PPWS model. Safety factors are suggested to mediate the relationship between job demands and resources and safety behaviors. Job demands are multi-dimensional aspects of the organization that, over time, may lead to deteriorated health and well-being through continued effort and exertion (Bakker & Demerouti, 2007; Idris & Dollard, 2011). Conversely, job resources alleviate job demands and help reduce the physical and/or psychological cost to the individual (Demerouti et al., 2001). The job demands and resources in the PPWS model are reflective of physical and psychological elements.

The PPWS model considers four job demands; 1. Risks and hazards, 2. Physical demands, 3. Complexity, and 4. Occupational stress. Risks are the probability of harm occurring and the extent of the consequences (Clarke & Cooper, 2000; Glendon & McKenna, 1995). Hazards are objects and/or situations found in the workplace or environment that could cause harm (Clarke & Cooper, 2000). Physical demands are considered strenuous schedules, workloads, or conditions which, over time, may require the individual to maintain sustained physical effort (Nahrgang et al., 2011). Complexity focuses on intricate work which may require prolonged physical or cognitive effort (Bakker & Demerouti, 2007; Campbell, 1988; Demerouti et al., 2001; Nahrgang et al., 2011). Last, occupational stress is experienced from inadequate coping with physical and psychological stressors in the workplace (Cooper, 1996; Woodhead et al., 2016). These create a multifaceted perspective of this aspect of the JD-R Model within the PPWS framework.

Regarding job resources, the PPWS model considers; 1. Autonomy, 2. Social support, 3. Safety knowledge, 4. Physical safety climate, and 5. Psychosocial safety climate. Autonomy focuses on the degree of freedom an individual has in managing work tasks (Lee et al., 2003; Hackman & Oldham, 1976; Morgeson & Humphrey, 2006). Social support is an environmental component focused on the amount of advice and assistance available from colleagues (Howard et al., 2019; Morgeson & Humphrey, 2006). Safety knowledge refers to the information an individual possesses around health and safety (Burke et al., 2002) and how well an individual knows how to perform tasks safely (Griffin & Neal, 2000). Safety climate describes the shared perceptions of the organization's policies, practices, and procedures surrounding employees' health and well-being (Zohar, 1980). Physical safety climate focuses on the physical aspects (Beus et al., 2016), while psychosocial safety climate emphasizes the psychological aspects of health and safety (Hall et al., 2010). The PPWS model suggests these job demands and resources are antecedents of safety behaviors, mediated by safety factors.

The proposed safety factors include burnout, engagement, motivation, attitude, and control. Burnout and engagement are derived from the JD-R model (Demerouti et al., 2001) and JD-R model of workplace safety (Narhgang et al., 2011). The JD-R model focuses on the health impairment and motivational processes where diminished resources lead to burnout and an increase in resources supports greater engagement (Bakker et al., 2005; Demerouti et al., 2001; Dollard & Bakker, 2010).

Motivation, attitude, and control are included in the model as safety factors supported by self-regulation theory (Bandura, 1988; Karoly, 1993; Sitzmann & Ely, 2011). Motivation focuses on an individual's willingness to engage in safety behaviors (Neal et al., 2000; Neal & Griffin, 2006). Positive attitudes towards safety help decrease an individual's involvement in accidents (Clarke, 2006) and improve group norms (Fugas et al., 2012). Last, control is seen when individuals believe they have the resources and opportunities to be safe (Ajzen, 2002; Fugas et al., 2012). Safety factors, supported by self-regulation theory, help individuals work towards the goal of increased safety behaviors.

Safety behaviors focus on supporting and maintaining a safe workplace and contribute to an environment that encourages safety (Bronkhorst, 2015; Griffin & Neal, 2000). Griffin and Neal (2000) proposed two different types of safety behaviors: safety compliance and safety participation. When individuals follow an organization's rules, regulations, and procedures relating to safety, they are compliant. Safety participation focuses on individuals being engaged and participating in safety-related activities (Clarke, 2012; Neal et al., 2000). The PPWS model considers both physical and psychosocial safety behaviors under the compliance and participation focus (Bronkhorst, 2015; Griffin & Neal, 2000). While the theoretical relationships have been articulated previously, the measurement model based on the PPWS model has not been empirically tested. Therefore, establishing the measurement model and laying the foundation to test the PPWS with employee data is necessary in model validation.

Study 1

Study 1 focuses on assessing the factor structure and reliability of the instruments selected to measure each construct in the PPWS. Exploratory factor analyses were conducted for each job demand and resource, safety factor, and safety behaviors, as shown below in Figure 3.1.

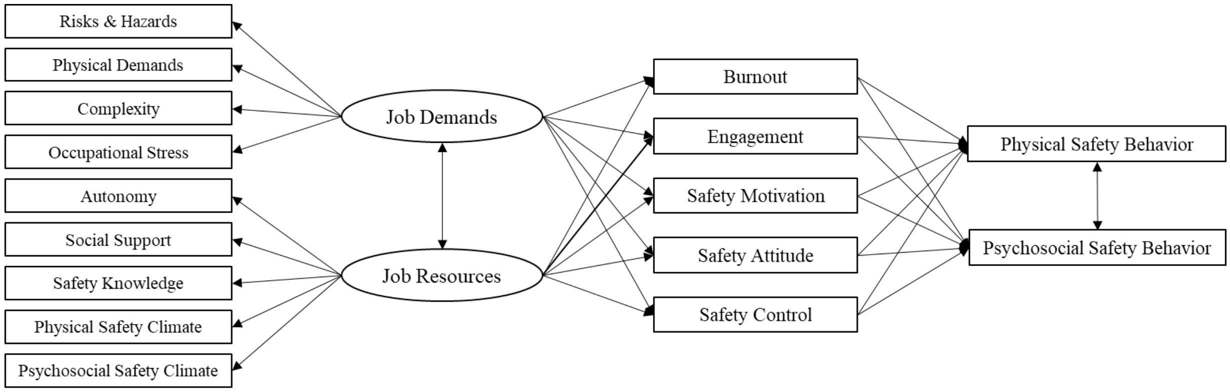

Figure 3.1. Physical and psychosocial workplace safety model (Yaris et al., 2020)

Method

This study used a cross-sectional design. The convenience sample consisted of 941 participants with 93.61% living in the US, 5.63% in Australia, and .76% did not indicate their country of residence. Participants selected age ranges from 18 to 63 or older; specifically, 27-35 (30.96%), 36-44 (22.77%), 45-53 (19.78%), 18-26 (17.55%), 54-62 (7.66%), and 63 or older (1.28%). The majority of participants (85.44%) responded “White or Caucasian”, 7.54% responded “Black or African American”, 4.78% responded “Asian (e.g., Asian Indian, Filipino, Japanese, Korean, Vietnamese, or other Asian)”, .85% responded “American Indian or Alaska Native,” .53% responded “Pacific Islander (e.g., Native Hawaiian, Guamanian, Chamorro, or other Pacific Islander)”, and .85% opted not to respond. Additionally, 9.35% identify as Hispanic, Latino, or Spanish origin and 1.06 % identify as Aboriginal or Torres Strait Islander origin. The majority (50.48%) of participants said they were married, 21.79% selected single, 18.59% said they were not married, but in a relationship, 8.29% were divorced, .53% were widowed, and .32% opted to not respond. Participants also identified which industry or occupation they belong to which are shown below in Table 3.1.

Table 3.1

Participant (n = 941) demographics by industry

Industry	*n*	%
Other	337	35.82
Public Sector	214	22.74
Education	151	16.05
Healthcare	114	12.11
Construction	58	6.16
Warehousing	38	4.04
Transportation	20	2.13
Agriculture	5	.53
Mining	4	.43

Of the participants, 337 indicated "Other" for their industry or occupation. These participants were given the option for a free response and 328 of those participants provided a response. Nine participants did not provide additional industry information. A breakdown of the responses is shown in Table 3.2.

Table 3.2

Other industry breakdown (n = 328)

Industry	*N*	%
Professional Services	166	50.61
Retail & Customer Services	55	16.77
Hospitality	44	13.41
Public Sector	21	6.40
Industrial Services	16	4.88
Media/Communications	10	3.05
Non-profit	3	.91
Security Services	3	.91

Participants were initially recruited via convenience and snowball techniques in targeted high-risk industries such as mining, construction, and fire across the US and Australia. Organizations were targeted through authors' personal and professional networks and by reaching out directly to organization leadership to request participation. These participants were offered an incentive in the form of a randomly drawn gift card. There were six gift cards total, three $50 gift cards for US participants and three 50AUD gift cards for Australian participants. This resulted in a small sample size (n = 235) or 26.95% of total sample. Sample size was enhanced by recruiting additional participants through Mechanical Turk (Mturk; Amazon Mechanical Turk, 2018). As Mturk is a paid service, participants were not offered an additional incentive but were compensated for their time. Mturk criteria was set to residence in Australia or the US and must be currently employed. All participants completed an online survey hosted on Qualtrics on either a computer, tablet, or mobile phone. All data were anonymous and incentive information was stored separately.

Procedure

Study 1 examines the factor structure and reliability with cross-sectional data of the measures selected for the constructs contained in the PPWS. Participants responded to measures of risks and hazards, physical demands, complexity, occupational stress, autonomy, social support, safety knowledge, physical safety climate, psychosocial safety climate, burnout, engagement, motivation, attitude, control, and safety behaviors. Participants took, on average, 32 minutes to complete the measures. The measure contained the same items in the same order for all participants. Before conducting this research and administering the measures, ethics approval (2016/148) was obtained.

Chapter 3: Assessing the measurement model

Measures

Each measure is described below in detail. All items are shown the Results and Appendices where the results are discussed. Participants responded to all survey items using a 5-point Likert scale (from 1 = "Strongly disagree" to 5 = "Strongly agree") unless otherwise indicated.

Job Demands

Risks and hazards. Risks and hazards were measured with five items from the Work Design Questionnaire (WDQ, α = .87; Morgeson & Humphrey, 2006). Three items were added, "There is a high risk of accidents in this job," "Overall, this job has more risks than others" and "This job is dangerous," to capture risks more thoroughly. This resulted in a total of eight items measuring risks and hazards. Items were scored so that the higher the level of agreement is indicative of the presence of more risks and hazards.

Physical demands. The WDQ (Morgeson & Humphrey, 2006) was used to measure physical demands (α = .95). One item was excluded, "This job requires a great deal of muscular endurance" given the focus on endurance, leaving two items to measure physical demands. No items were reverse coded. Higher scores indicate higher levels of physical demands.

Complexity. The WDQ (Morgeson & Humphrey, 2006) assessed complexity as a single factor, four-item measure (α = .87). Three items were retained for this research with the item, "The job comprises relatively uncomplicated tasks," being excluded. All three items were reversed so higher scores were indicative of higher complexity.

Occupational Stress. The updated eight-item Stress in General Scale (SIG, α = .78; Yankelevich et al., 2011) was used to measure occupational stress. All items were retained and participants responded with either 1 = “yes”, 2 = “no”, or 0 = “?/Cannot decide.” One item, “Calm”, was reverse coded. A higher score indicated higher levels of occupational stress.

Job Resources

Autonomy. Autonomy was measured with three items from the WDQ (α = .85; Morgeson & Humphrey, 2006) with higher scores reflecting higher autonomy. No items were reversed.

Social Support. The WDQ (Morgeson & Humphrey, 2006) has six items measuring social support (α = .82) higher scores reflecting greater social support. No items were reversed.

Safety knowledge. Safety knowledge was measured as a single factor with four items (α = .73, Griffin & Neal, 2000). Participants responded to all survey items using a 7-point Likert scale (from 1 = “Strongly disagree” to 7 = “Strongly agree”). One item was reversed, “I do not know how to reduce the risk of accidents and incidents in the workplace”, and higher scores reflect greater levels of safety knowledge.

Physical and Psychosocial Safety Climate. The Psychosocial Safety Climate (PSC-12; Hall et al., 2010) was used to measure psychological health and safety in the individual’s workplace. The items measure the psychological health and safety in the individual’s workplace. The four factors are organization participation (α = .80), organizational communication (α = .77), management priority (α =.90), and management commitment (α = .88; Hall et al., 2010).

The PSC-12 was adapted for physical climate by Bronkhorst (2015) and Idris et al. (2012). Two items, “In my organization, the prevention of stress involves all levels of the organization” and “Senior management show support for stress prevention through involvement and commitment” were not adaptable for physical safety climate resulting in a 10-item measure for physical safety climate. For physical safety climate Cronbach’s alphas are management commitment, .89, management priority, .87, organizational communication, .91, and organizational participation, .86, (Bronkhorst, 2015) which all indicate good to excellent internal consistencies. Items were adjusted and used to measure physical health and safety in the individual's workplace or physical safety climate. The same facets and response scale were applied. No items were reversed. For both scales, higher scores indicate a stronger safety climate.

Safety Factors

Burnout. Burnout was measured using the Burnout Measure: Short Version ($\alpha = .92$; Malach-Pines, 2005). The Burnout Measure: Short Version (Malach-Pines, 2005) contains 10 items with participants responding to all items using a 7-point scale (from 1 = "Never" to 7 = "Always). Higher scores indicate greater levels of burnout through frequency of experienced indicators.

Engagement. The 18-item Affective ($\alpha = .85$), Continuance ($\alpha = .83$), and Normative ($\alpha = .77$) Commitment Scale (Allen & Meyer, 1990; Meyer et al., 1993) was used to measure engagement given the affective connection engaged employees have with their organization (Bakker et al., 2008). Each scale has six items and higher scores reflect facet commitment. Participants responded to all survey items using a 7-point Likert scale (from 1 = "Strongly disagree" to 7 = "Strongly agree"). The four negatively worded items were reversed for analyses.

Safety motivation. The willingness of an individual to apply effort to perform safely, or safety motivation, is measured as a single factor with three items ($\alpha = .86$; Neal et al., 2000; Neal & Griffin, 2006). No items were reversed and higher levels of agreement indicated greater levels of safety motivation.

Safety attitudes. Safety attitudes were measured using a semantic differential scale where higher scores aligned with more favorable safety attitudes. It is a single factor, three-item measure (α = .76; Fugas et al., 2012), adapted from Davis et al. (2002) measure of attitudes. Participants were instructed to respond to a 5-point response scale with different anchors (*detrimental-beneficial, irrelevant-relevant,* and *inappropriate-appropriate*) depending on the item. No items were reverse coded.

Safety control. Connor and McMillian's (1999) measure of perceived behavioral control was adapted to three items measuring safety control (Fugas et al., 2012). Internal consistency was measured using composite reliability (.59). Items are scored on a 7-point scale with responses varying according to the item. The anchors are very little control-complete control, extremely difficult-extremely easy, and strongly disagree-strongly agree. No items were reverse scored and higher scores indicting a higher sense of perceived safety control.

Safety Behaviors

Safety behavior. Safety behavior was measured for physical and psychosocial safety behaviors. Each comprised two facets, safety compliance and safety participation. Physical safety compliance (α = .94) and participation (α = .89) are measured with six items, three items for each facet (Griffin & Neal, 2000; Neal et al., 2000; Neal & Griffin, 2006). The same items were adapted to measure psychosocial safety behaviors (Bronkhorst, 2015). Three items measured psychosocial safety compliance and three measured psychosocial safety participation. For example, the physical safety compliance item "I ensure the highest levels of physical safety when I carry out my job" was extended to "I ensure the highest levels of psychological safety when I carry out my job" to measure psychosocial safety compliance. Higher scores indicate higher safety behaviors.

Statistical analyses

The analyses were performed using SPSS 27 for Windows. The goals of the analyses are to reduce the overall number of items, establish job demands and job resources, and explore the adapted measures (e.g., physical safety climate) to support the proposed PPWS model. First, an exploratory factor analysis (EFA) on each construct was conducted to identify the factor structure using a maximum likelihood estimation method with an oblique rotation applied to the extracted factors to enhance interpretability. The number of factors to retain was determined through Kaiser's criterion, i.e., eigenvalues > 1, reviewing the scree plot for drop off indicates the number of interpretable factors, and considering the percentage of variance accounted for by each extracted factor. Factor loading benchmarks suggest that poor is |.32| fair is |.45| and good is |.55| (Comrey & Lee, 1992). Stevens (1992) suggested a cut off of |.40|. Hair et al. (1998) suggested that a factor loading of |.30| can achieve practical significance if the sample is greater than or equal to 350. Therefore, a cut off greater than or equal to |.30| is applied to standardized factor loadings. As possible, a more stringent cut off of |.50| is applied. Cronbach's alpha coefficients were calculated to verify the internal consistencies of the individual measures' scores.

Two tests of sampling adequacy were considered through the EFAs. These are the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and Bartlett's test of sphericity (Tabachnick & Fidell, 2007). These measure how suited the data is for factor analysis and the relationships between the pairs of variables by exploring the correlations in the correlation matrix. They look to see if there are bivariate correlations and the relatedness of the correlations to determine if factor analysis is appropriate. A KMO score of .60 or greater and a significant Bartlett's test indicate that the data is suitable for factor analysis (Tabachnick & Fidell, 2007).

Maximum likelihood estimation was used for all EFAs (Kline, 2016). Additionally, an oblique rotation, specifically direct oblimin, was used. The oblique rotation allows for correlations between the extracted factors (Kline, 2016). From a theory-driven perspective, factors are anticipated to correlate among the individual measures and latent variables. Factor analysis will identify if the factor solutions are also data driven (Tabachnick & Fidell, 2007). Correlations between the extracted factors for each EFA are provided to support the use of the oblique rotation. Tabachnick and Fidell (2007) discuss a minimum correlation of .32 to support an oblique rotation. If the correlation fails to reach that minimum correlation, orthogonal or other rotations should be used. However, Brown (2006) discusses that oblique rotations are more realistic and represent how the factors are interrelated. Additionally, the oblique rotation will result in a solution that is essentially the same as the orthogonal solution with uncorrelated factors. Furthermore, when factors are constrained to be uncorrelated, this can result in poor model fit during the CFA process. Therefore, taking Brown's (2006) points into consideration, in addition to the theory supporting the factors correlating, oblique rotations will consistently be used, even if the factor correlations fail to achieve the .32 benchmark proposed by Tabachnick and Fidell (2007).

Results

The percentage of missing values was 11%. The missing values analyses revealed that data were Missing Completely at Random (MCAR) with Little's (1988) test failing to achieve significance, χ^2 (1996) = 2094.34, p = .06. As it was not significant, Expectation-Maximization, a form of maximum likelihood estimation, was used to create a new data set where all missing values are replaced with estimated values (Dempster et al., 1997). This is done through maximizing the complete data log likelihood function (Dempster et al., 1997). This estimator holds value in being unbiased (Graham, 2003), simple (Dempster et al., 1997), stable (Couvreur, 1996), and straightforward and efficient (Dong & Peng, 2013).

Descriptive statistics and item correlations are found in Appendix A. A series of EFAs were conducted on the data. EFAs were conducted on the latent variables, job demands and job resources, the individual safety factors, and safety behaviors. Sampling adequacy was assessed with KMO and Bartlett's test of sphericity. Number of factors was determined by eigenvalues, scree plots, and variance explained as described above in Statistical Analyses.

This first series of EFAs explored the factorability of the latent variable, job demands, comprised risks and hazards, physical demands, complexity, and occupational stress. The goal was to determine the factor structure based on participants' scores on the latter measures and reduce the number of items in instances of items demonstrating poor fit with their latent factor.

Risks and hazards

Risks and hazards were assessed first. KMO measure of sampling adequacy demonstrated a coefficient value of .89, above the benchmark of .60, and Bartlett's test of sphericity was statistically significant, χ^2 (28) = 5362.66, p < .001. The initial analysis resulted in a two-factor solution, explaining 76.19% of the variance, a factor correlation coefficient of .52, and a measure coefficient alpha of .91. The factor correlation supports the use of an oblique rotation. Two items under the risks and hazards factor, "The job takes place in an environment free from health hazards (e.g., chemicals, fumes, etc.)" and "The job occurs in a clean environment," had factor loadings greater than .30 on multiple factors. These items were removed and a second EFA was conducted. See Appendix B.

The next iteration of risks and hazards resulted in a KMO coefficient value of .84 and Bartlett's test of sphericity, χ^2 (15) = 3819.77, p < .001, thereby suggesting adequate factorability of the item scores. The six items identified a two-factor solution explaining 81.97% of the variance with a correlation coefficient of .45 and a measure coefficient alpha of .87. There were no cross-loadings greater than .3 and all factor loadings were greater than .7. The two-factor solution is the final solution for risks and hazards, as shown below in Table 3.3.

Table 3.3

Final factor loadings, variance explained, and factor alpha for risks and hazards

Item	Factor 1	Factor 2
There is a high-risk of accidents in this job	.929	-.005
The job is dangerous	.905	-.053
Overall, this job has more risks than others	.888	-.033
The job has a low risk of accident	.797	.148
The climate at the work place is comfortable in terms of temperature and humidity	-.049	.733
The work place is free from excessive noise	.081	.729
Alpha	.94	.70
Percent variance explained	61.96	20.01

Physical Demands

Physical demands were measured with two items. With two items, an EFA is not appropriate given negative degrees of freedom. However, reliability was assessed and resulted in a correlation of .93 suggesting the two items are highly correlated and, thus, acceptable. Additionally, the PPWS proposed the individual job demands are reflective of the construct, job demand, so an additional EFA is conducted below where the two items measuring physical demands are identified as one factor.

Complexity

The EFA for complexity resulted in a KMO coefficient value of .60 and Bartlett's test of sphericity, χ^2 (3) = 1270.47, $p < .001$, which was sufficient to continue exploring an EFA solution of the factor scores. The three-item solution explained 70.72% of the variance and all factor loadings were greater than .40 with a coefficient alpha of .79. As a three-item latent factor meets the minimum requirement for identification with zero degrees of freedom (a just-identified model), model fit for the latent factor could not be examined beyond the item loadings outlined in Table 3.4, as the chi-square test of model adequacy is not interpretable due to $df = 0$.

Table 3.4

Final factor loadings, variance explained, and factor alpha for complexity

Item	Factor 1
The tasks on the job are simple and uncomplicated	.980
The job involves performing relatively simple tasks	.841
The job requires that I only do one task or activity at a time	.448
Alpha	.79
Percent variance explained	70.72

Occupational Stress

Next, an EFA was conducted on the eight stress items. KMO measure of sampling adequacy coefficient value was .84 and Bartlett's test of sphericity achieved significance, χ^2 (28) = 1660.98, $p < .001$, supporting conducting an EFA. The initial solution identified two factors explaining 54.18% of the variance with a correlation coefficient of -.54 and a coefficient alpha of .66. One item, "Many things stressful," cross-loaded on both factors and was removed. Results shown in Appendix C.

After removing "Many things stressful," KMO's measure of sampling adequacy was .78 and Bartlett's test of sphericity found significance, χ^2 (21) = 1160.24, $p < .001$. The next EFA was conducted on seven items. A two-factor solution was identified again explaining 54.77% of the variance with a correlation coefficient of -.52 and Cronbach's Alpha of .59. One item, "Calm," had a factor loading of less than .5. Using a .5 cutoff to strength and reduce the number of items, “Calm” was removed. Additionally, “Calm” was the only reversed coded item in this scale. Results are shown in Appendix C.

The third EFA resulted in a one-factor solution. KMO’s measure of sampling adequacy was .76 and Bartlett’s test of sphericity found significance, χ^2 (15) = 1030.51, $p < .001$. This solution explained 42.76% of the variance with a coefficient alpha of .73. Applying the same .5 factor loading cutoff, two items, “Overwhelming” and “Demanding,” were removed. Results are shown in Appendix C.

The final EFA resulted in one-factor, four-item solution. KMO’s measure was .73, above the .6 cutoff, and Bartlett’s test of sphericity found significance, χ^2 (6) = 566.05, $p < .001$, supporting this EFA. The solution explained 51.59% of the variance with a coefficient alpha of .69. The final solution is shown below in Table 3.5.

Table 3.5

Final factor loadings, variance explained, and factor alpha for occupational stress

Item	Factor 1
Nerve-wracking	.634
Hassled	.588
Pressured	.585
More stressful than I'd like	.575
Alpha	.69
Percent variance explained	51.59

Job demands

Given the PPWS conceptualizes job demands as a latent variable, the final factor structures for the individual components (risks and hazards, physical demands, complexity, and occupational stress) are assessed as job demands. As job demands are comprised of the four components, the number of factors to extract was set to four. The initial EFA resulted in four-factor solution explaining 69.87% of the variance with a coefficient alpha of .86. KMO’s measuring of sampling adequacy was .84 and Bartlett's test of sphericity achieved significance, χ^2 (105) = 8085.11, $p < .001$. One item, "The climate at the work place is comfortable in terms of temperature and humidity," did not have any factor loadings greater than .30. The factor correlation table is shown below in Table 3.6. While some factor correlations fell short of the proposed .32 benchmark (e.g., physical demands with stress; Tabachnick & Fidell, 2007), the oblique rotation is maintained for subsequent analyses given the support from Brown (2006) provided above in Statistical Analyses. The results of the initial EFA are found in Appendix D.

Table 3.6

Factor Correlation Table: Job Demands, first iteration

1. Risks and hazards	-		
2. Complexity	.25	-	
3. Physical demands	-.64	-.02	-
4. Stress	.32	.32	-.07

Note. n = 941, factors assessed at the .32 benchmark for oblique rotation (Tabachnick & Fidell, 2007)

The next iteration, also set to the four-factor solution, explained 71.21% of the variance with a coefficient alpha of .86. KMO's measuring of sampling adequacy was .84 and Bartlett's test of sphericity achieved significance, χ^2 (91) = 7731.01, $p < .001$, supporting the EFA. Three additional items, "The work place is free from excessive noise," "The job requires that I only do one task or activity at a time," and "Pressured" were removed due to factor loadings < .5. These were from the risks and hazards, complexity, and stress scales, respectively. The EFA supports the four-factor solution with the factor structure shown in Appendix D.

The third and final iteration explained 80.57% of the variance with a measure coefficient alpha of .86. KMO's coefficient was .82 and Bartlett's test of sphericity achieved significance, χ^2 (55) = 6894.36, $p < .001$, supporting the EFA. The factor correlation matrix is shown below in Table 3.7 and the final factor structure is shown in Table 3.8.

Table 3.7.

Factor Correlation Table: Job Demands, final

1. Risks and hazards	-		
2. Complexity	.26	-	
3. Physical demands	-.74	-.09	-
4. Stress	.21	.24	-.12

Note. n = 941, factors assessed at the .32 benchmark for oblique rotation (Tabachnick & Fidell, 2007)

Table 3.8

Final factor loadings, variance explained, and factor alpha for job demands

Item	Factor 1	Factor 2	Factor 3	Factor 4
There is a high-risk of accidents in this job	.944	-.063	.002	.021
Overall, this job has more risks than others	.893	.012	.024	-.037
The job has a low risk of accident	.860	.011	.014	.042
The job is dangerous	.762	.056	-.146	-.022
The tasks on the job are simple and uncomplicated	-.017	.975	-.009	.025
The job involves performing relatively simple tasks	.004	.848	.016	-.017
The job requires a lot of physical effort	-.003	-.027	-.981	-.008
The job requires a great deal of muscular strength	.067	.024	-.833	.019
Hassled	-.076	-.047	-.012	.705
Nerve-wracking	.029	.048	-.100	.573
More stressful than I'd like	.054	.019	.076	.518
Alpha	.94	.90	.93	.63
Percent variance explained	43.40	17.71	13.06	6.40

This next series of EFAs explores the factorability of the latent variable, job resources, comprised autonomy, social support, safety knowledge, and physical and psychosocial safety climate. The goal is to determine the factor structure and reduce the number of items, as before. The individual components of job resources are assessed followed by the latent variable, mirroring the process completed for job demands.

Autonomy

KMO measure of sampling adequacy was .72, above the benchmark of .6, and Bartlett's test of sphericity achieved significance, χ^2 (3) = 1620.00, p < .001. With three-items, the EFA resulted in one-factor solution explaining 80.94% of the variance and a coefficient alpha of .88. This final solution is shown below in Table 3.9.

Table 3.9

Final factor loadings, variance explained, and factor alpha for autonomy

Item	Factor 1
The job allows me to plan how I do my work	.901
The job allows me to decide on the order in which things are done on the job	.895
This job allows me to make my own decisions about how to schedule my work	.742
Alpha	.88
Percent variance explained	80.94

Social Support

Next, an EFA was conducted on the six-item measure for social support. KMO measure of sampling adequacy was .82, above the benchmark of .6, and Bartlett's test of sphericity achieved significance, χ^2 (15) = 2398.92, p < .001. This initial EFA resulted in a two-factor solution explaining 72.64% of the variance, a correlation coefficient of .63, and a coefficient alpha of .83. The two-factor represented social opportunities and interest for others. There were no high cross-loadings (> .3) or low factor-loadings (< .5) in this initial solution so it is accepted as final. See Table 3.10.

Table 3.10

Final factor loadings, variance explained, and factor alpha for social support

Item	Factor 1	Factor 2
I have the chance in my job to get to know other people	.922	-.059
I have the opportunity to meet with others in my work	.854	-.025
I have the opportunity to develop close friendships in my job	.626	.216
People I work with take a personal interest in me	.005	.816
People I work with are friendly	.022	.722

My supervisor is concerned about the welfare of the people that work for him/her	-.008	.533
Alpha	.86	.71
Percent variance explained	55.86	16.78

Safety Knowledge

The third job resource, safety knowledge, was comprised of four items. KMO measure of sampling adequacy was .75 and Bartlett's test of sphericity achieved significance, χ^2 (6) = 1416.11, $p < .001$, indicating suitability for the EFA. This resulted in a one-factor solution explaining 62.20% of the variance and a coefficient alpha of .73. One item, "I do not know how to reduce the risk of accidents and incidents in the workplace," had a factor loading of less than .5. To reduce the overall number of items, and given this is the only reverse coded item, it was removed for a more parsimonious approach. See Appendix E for EFA results.

The next EFA for safety knowledge is supported by KMO's measure of sampling adequacy of .72 and a significant Bartlett's test of sphericity, χ^2 (3) = 1316.05, $p < .001$. This resulted in a one-factor, three-item solution explaining 77.98% of the variance and a coefficient alpha of .86. See Table 3.11.

Table 3.11

Final factor loadings, variance explained, and factor alpha for safety knowledge

Item	Factor 1
I know how to use safety equipment and standard work procedures	.898
I know how to maintain or improve workplace health and safety	.792
I know how to perform my job in a safe manner	.767
Alpha	.86
Percent variance explained	77.98

Physical Safety Climate

An EFA was conducted on the 10-item physical safety climate measure, adapted from the 12-item psychosocial safety climate measure. The KMO score of .95 and significant Bartlett's test of sphericity, χ^2 (45) = 8456.29, p < .001, support sample adequacy for factor analysis. This resulted in a one-factor solution explaining 70.88% of the variance (α = .95). This final solution is shown below in Table 3.12.

Table 3.12

Final factor loadings, variance explained, and factor alpha for physical safety climate

Item	Factor 1
Senior management clearly considers the physical health of employees to be of great importance	.880
Physical well-being of staff is a priority for this organization	.879
In my workplace senior management acts quickly to correct problems/issues that affect employees' physical health	.843
There is good communication here about physical safety issues which affect me	.841
Senior management considers employee physical health to be as important as productivity	.833
Senior management acts decisively when a concern of an employees' physical status is raised	.805
My contributions to resolving occupational health and safety concerns in the organization are listened to	.800
Information about workplace physical well-being is always brought to my attention by my manager/supervisor	.797
Employees are encouraged to become involved in physical safety and health matter	.785
Participation and consultation in physical health and safety occurs with employees', unions and health and safety representatives in my workplace	.749
Alpha	.95
Percent variance explained	70.88

Psychosocial Safety Climate

The 12-item psychosocial safety climate was assessed next with an EFA to understand the underlying factor structure. KMO measure of sampling adequacy was .96 and Bartlett's test of sphericity achieved significance, χ^2 (66) = 9087.65, p < .001, indicating suitability for the EFA. This initial EFA resulted in a one-factor solution explaining 64.33% with a coefficient alpha of .95. This solution is accepted as final, as shown in Table 3.13.

Table 3.13

Final factor loadings, variance explained, and factor alpha for psychosocial safety climate

Item	Factor 1
Senior management clearly considers the psychological health of employees to be of great importance	.882
Psychological well-being of staff is a priority for this organization	.879
Senior management considers employee psychological health to be as important as productivity	.860
Senior management show support for stress prevention through involvement and commitment	.834
There is good communication here about psychological safety issues which effect me	.808
In my workplace senior management acts quickly to correct problems/issues that affect employees' psychological health	.790
My contributions to resolving occupational health and safety concerns in the organization are listened to	.787
Senior management acts decisively when a concern of an employees' psychological status is raised	.757
Information about workplace psychological well-being is always brought to my attention by my manager/supervisor	.750
Employees are encouraged to become involved in psychological safety and health matter	.742
Participation and consultation in psychological health and safety occurs with employees', unions and health and safety representatives in my workplace	.721
In my organization, the prevention of stress involves all levels of the organization	.504
Alpha	.95
Percent variance explained	64.33

Job Resources

As with job demands, the overall factor structure based on the individual components above is assessed for factorability. The latent variable job resources comprised autonomy, social support, safety knowledge, physical safety climate, and psychosocial safety climate. The EFAs were conducted using the factor structures identified above and the number of factors was set to five. Sample adequacy was supported with a KMO score of .96 and significant Bartlett's test of sphericity, χ^2 (561) = 25784.37, $p < .001$. This initial EFA resulted in a five-factor solution explaining 68.77% of the variance ($\alpha = .95$). The correlation matrix did not support an oblique rotation with correlations less than .32, as shown in Table 3.14. Two social support items, "My supervisor is concerned about the welfare of the people that work for him/her" and "People I work with are friendly," were the only items with factor loadings less than .5. Additionally, "My supervisor is concerned about the welfare of the people that work for him/her" loaded on psychosocial safety climate. In order to reduce the number of items due to poor loading on the latent factor, both items were removed and a second EFA was conducted. Similar to job demands, the oblique rotation was maintained for consistency despite factor correlations failing to achieve the .32 benchmark (Brown, 2006; Tabachnick & Fidell, 2007). See Appendix F.

Table 3.14

Factor Correlation Table: Job Resources, first iteration

1. Psychosocial safety climate	-			
2. Safety knowledge	.22	-		
3. Autonomy	-.38	-.21	-	
4. Social support	.36	.36	-.21	-
5. Physical safety climate	-.80	-.32	.33	-.39

Note. n = 941, factors assessed at the .32 benchmark for oblique rotation (Tabachnick & Fidell, 2007)

Sample adequacy was supported with the second EFA through a KMO score of .95 and a significant Bartlett's test of sphericity, χ^2 (496) = 24614.23, p < .001. The five-factor solution explained 70.34% of the variance with a coefficient alpha of .95. Factor correlations are shown below in Table 3.15. One social support item, "People I work with take a personal interest in me," had a factor loading less than .50 and was removed. See Appendix F.

Table 3.15

Factor Correlation Table: Job Resources, second iteration

1. Psychosocial safety climate	-			
2. Safety knowledge	.21	-		
3. Autonomy	-.37	-.20	-	
4. Social support	.33	.34	-.17	-
5. Physical safety climate	-.80	-.32	.32	-.37

Note. n = 941, factors assessed at the .32 benchmark for oblique rotation (Tabachnick & Fidell, 2007)

This third EFA resulted in the final structure. The KMO score of .95 and significant Bartlett's test of sphericity, χ^2 (465) = 24162.14, $p < .001$, supported sample adequacy for factor analysis. The final five-factor solution explained 71.27% of the variance (α = .96). Factor correlations are shown below in Table 3.16. The job resources series of EFAs removed three social support items which, as shown above in Table 10, were the second factor. Job resources supports social support as a one-factor, three-item measure. See Table 3.17 for final factor structure of the latent variable, job resources.

Table 3.16

Factor Correlation Table: Job Resources, final

1. Psychosocial safety climate	-			
2. Safety knowledge	.22	-		
3. Autonomy	-.37	-.20	-	
4. Social support	.29	.34	-.15	-
5. Physical safety climate	-.80	-.32	.31	-.33

Note. n = 941, factors assessed at the .32 benchmark for oblique rotation (Tabachnick & Fidell, 2007)

Table 3.17

Final factor loadings, variance explained, and factor alpha for job resources

Item	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
Senior management clearly considers the psychological health of employees to be of great importance	.893	.029	.014	.010	.016
Senior management considers employee psychological health to be as important as productivity	.889	-.021	-.010	-.023	.024
Psychological well-being of staff is a priority for this organization	.884	-.017	.010	.002	-.004
There is good communication here about psychological safety issues which effect me	.819	-.041	.040	-.019	-.017
Senior management show support for stress prevention through involvement and commitment	.818	-.018	.003	-.041	-.042
In my workplace senior management acts quickly to correct problems/issues that affect employees' psychological health	.755	.022	.006	-.015	-.047
Senior management acts decisively when a concern of an employees' psychological status is raised	.717	.109	-.018	.001	-.013
Information about workplace psychological well-being is always brought to my attention by my manager/supervisor	.699	-.075	.026	.007	-.089
My contributions to resolving occupational health and safety concerns in the organization are listened to	.698	-.019	.011	.064	-.096
Participation and consultation in psychological health and safety occurs with employees', unions and health and safety representatives in my workplace	.694	-.050	-.012	.010	-.035
Employees are encouraged to become involved in psychological safety and health matter	.682	-.027	-.004	.036	-.064
In my organization, the prevention of stress involves all levels of the organization	.528	.093	-.069	.020	.093
I know how to use safety equipment and standard work procedures	-.014	.886	.047	-.022	-.061
I know how to perform my job in a safe manner	-.003	.775	-.029	.004	.010
I know how to maintain or improve workplace health and safety	.047	.747	-.007	.058	-.046

The job allows me to decide on the order in which things are done on the job	.024	.000	-.901	.001	.044
The job allows me to plan how I do my work	.034	.033	-.887	.013	.030
This job allows me to make my own decisions about how to schedule my work	-.045	-.043	-.739	-.010	-.105
I have the chance in my job to get to know other people	-.029	.044	.016	.878	.011
I have the opportunity to meet with others in my work	-.044	.051	-.039	.818	-.028
I have the opportunity to develop close friendships in my job	.069	-.069	.016	.770	-.002
There is good communication here about physical safety issues which effect me	-.064	.039	.028	-.008	-.894
Senior management clearly considers the physical health of employees to be of great importance	.016	.021	-.009	-.050	-.871
Physical well-being of staff is a priority for this organization	.073	-.023	-.028	-.018	-.822
Information about workplace physical well-being is always brought to my attention by my manager/supervisor	.005	-.037	.018	-.010	-.819
Senior management considers employee physical health to be as important as productivity	.041	-.032	-.031	-.044	-.815
Employees are encouraged to become involved in physical safety and health matter	-.021	.021	.031	.054	-.789
In my workplace senior management acts quickly to correct problems/issues that affect employees' physical health	.060	.065	-.040	-.028	-.768
Senior management acts decisively when a concern of an employees' physical status is raised	.008	.095	-.022	.030	-.748
Participation and consultation in physical health and safety occurs with employees', unions and health and safety representatives in my workplace	.032	-.038	-.033	.059	-.709
My contributions to resolving occupational health and safety concerns in the organization are listened to	.064	.016	-.034	.084	-.708
Alpha	.95	.86	.88	.86	.95
Percent variance explained	45.54	8.85	6.82	5.48	4.57

This next series of EFAs explores the factor structure of safety factors. Safety factors is a grouping variable, rather than a latent variable so each safety factor will be assessed individually. The goal is a continuation of above, identifying the factor structure and reducing items.

Burnout

Burnout is assessed using 10 items. Sample adequacy was identified with a KMO score of .94 and a significant Bartlett's test of sphericity, χ^2 (45) = 6095.78, $p < .001$. This initial EFA resulted in a one-factor solution explaining 60.04% of the variance with a coefficient alpha of .92. The factor matrix for the one factor solution is shown below in Table 3.18.

Table 3.18

Final factor loadings, variance explained, and factor alpha for burnout

Item	Factor 1
Helpless	.874
Trapped	.863
Hopeless	.856
Depressed	.842
"I've had it"	.761
Worthless/Like a failure	.743
Physically weak/sickly	.662
Disappointed with people	.621
Difficulties sleeping	.607
Tired	.544
Alpha	.92
Percent variance explained	60.04

Engagement

Sample adequacy was found to be sufficient for engagement with a KMO score of .92 and Bartlett's test of sphericity achieving significance, χ^2 (153) = 9570.35, $p < .001$. As with the original measurement model and theory as proposed by Meyer et al. (1993), the initial EFA identified a three-factor solution explaining 62.50% of the variance and a coefficient alpha of

.85. The factor correlations failed to achieve the suggested .32 correlation for an oblique rotation as shown in Table 3.19. Three items, "This organization has a great deal of personal meaning for me," "I would be very happy to spend the rest of my career with this organization," and "I do not feel any obligation to remain with my current employer," had factor loadings greater than .3 on multiple factors. These items were removed. See Appendix G.

Table 3.19

Factor Correlation Table: Employee engagement, first iteration

1. Normative	-	
2. Continuance	.09	-
3. Affective	.57	-.21

Note. n = 941, factors assessed at the .32 benchmark for oblique rotation (Tabachnick & Fidell, 2007)

After removing those three items, the KMO score of .88 and the significant Bartlett's test, χ^2 (105) = 7408.21, $p < .001$, supported factor analysis. This EFA also yielded a three-factor solution explaining 64.22% of the variance and a coefficient alpha of .80. Factor correlations are shown in Table 3.20. A robust cut off of .5 was applied to factor loadings in this iteration. This resulted in the removal of three additional items, "I really feel as if this organization's problems are my own," "Right now, staying with my organization is a matter of necessity as much as desire," and "If I had not already put so much of myself into this organization, I might consider working elsewhere." See Appendix G.

Table 3.20

Factor Correlation Table: Employee engagement, second iteration

1. Normative	-	
2. Continuance	.10	-
3. Affective	.53	-.23

Note. n = 941, factors assessed at the .32 benchmark for oblique rotation (Tabachnick & Fidell, 2007)

Sample adequacy was still supported for engagement with a KMO score of .86 and Bartlett's test of sphericity, χ^2 (66) = 6489.96, $p < .001$. This resulted in a three-factor solution explaining 72.03% of the variance and a coefficient alpha of .80. Factor correlations are shown in Table 3.21. This resulted in a parsimonious three factor solution with all factor loadings greater than .5, as shown below in Table 3.22.

Table 3.21

Factor Correlation Table: Employee engagement, final

1. Normative	-	
2. Continuance	.11	-
3. Affective	.57	-.17

Note. n = 941, factors assessed at the .32 benchmark for oblique rotation (Tabachnick & Fidell, 2007)

Table 3.22

Final factor loadings, variance explained, and factor alpha for employee engagement

Item	Factor 1	Factor 2	Factor 3
I would not leave my organization right now because I have a sense of obligation to the people in it	.818	-.044	.037
I would feel guilty if I left my organization now	.787	.031	-.100
I owe a great deal to my organization	.722	-.053	.128
This organization deserves my loyalty	.700	-.097	.208
Even if it were to my advantage, I do not feel it would be right to leave my organization now	.688	.085	-.077
Too much of my life would be disrupted if I decided I wanted to leave my organization now	.047	.793	.161
It would be very hard for me to leave my organization right now, even if I wanted to	.112	.721	.169
I feel that I have too few options to consider leaving this organization	-.089	.700	-.182
One of the few negative consequences of leaving this organization would be the scarcity of available alternatives	-.056	.580	-.185
I do not feel like "part of the family" at my organization	.013	.002	.890
I do not feel a strong sense of "belonging" to my organization	-.010	-.006	.874
I do not feel "emotionally attached" to this organization	.069	.022	.846
Alpha	.87	.78	.91
Percent variance explained	40.41	21.55	10.07

Motivation

Motivation was measured as one factor with three items. KMO score of .71 and a significant Bartlett's test of sphericity, χ^2 (3) = 1137.61, p < .01, support factor analysis with sample adequacy. The EFA supported a one-factor solution, explaining 75.02% of the variance with a coefficient alpha of .83. The results are shown below in Table 3.23.

Table 3.23

Final factor loadings, variance explained, and factor alpha for safety motivation

Item	Factor 1
I believe that it is important to reduce the risk and accidents and incidents in the workplace	.846
I feel that it is important to maintain safety at all times	.846
I feel that it is worthwhile to put in effort to maintain or improve my personal safety	.683
Alpha	.83
Percent variance explained	75.02

Safety attitude

Like motivation, safety attitude is one factor with three items. A KMO score of .71 and significant Bartlett's test of sphericity, χ^2 (3) = 1479.19, p < .001, support factor analysis. As expected, a one-factor solution was identified explaining 79.18% of the variance with a coefficient alpha of .87. Factor structure is shown below in Table 3.24.

Table 3.24

Final factor loadings, variance explained, and factor alpha for safety attitude

Item	Factor 1
In my job, actively participating in safety is…	.904
In my job, actively participating in safety rules is….	.873
In my job, compliance with safety rules is…	.715
Alpha	.87
Percent variance explained	79.18

Safety control

The last safety factor, safety control, is also one factor with three items. A KMO score of .64 is slightly above the generally accepted benchmark of .6 and, with Bartlett's test of sphericity achieving significance (χ^2 (3) = 301.33, p < .01), sample adequacy supports factor analysis. The EFA identified a one-factor solution explaining 56.26% of the variance with a coefficient alpha of .60. All of the factor loadings are greater than .5, so the solution is accepted. Factor structure is shown below in Table 3.25.

Table 3.25

Final factor loadings, variance explained, and factor alpha for safety control

Item	Factor 1
For me, working safely is…	.634
I feel I don't have control over the safety performance on my job	.575
It depends on me to work in a safe way	.551
Alpha	.60
Percent variance explained	56.26

Safety Behaviors

Psychosocial safety behaviors

The EFA for psychosocial safety behaviors supported a two-factor solution. Sample adequacy was supported with a KMO coefficient of .83 and a significant Bartlett's test, χ^2 (15) = 4770.92, p < .001. Oblique rotation was supported by a factor correlation coefficient of .63. The two-factor solution explains 86.20% of the variance with a coefficient alpha of .91. Factor alphas and final factor structure are shown below in Table 3.26.

Table 3.26

Final factor loadings, variance explained, and factor alpha for psychosocial safety behaviors

Item	Factor 1	Factor 2
I use the correct psychological safety procedures for carrying out my job	.980	-.024

I use all the necessary psychological safety equipment to do my job	.880	-.010
I ensure the highest levels of psychological safety when I carry out my job	.848	.057
I put in extra effort to improve the psychological safety of the workplace	-.063	.977
I voluntarily carry out tasks or activities that help to improve workplace psychological safety	.011	.872
I promote the psychological safety program within the organization	.164	.709
Alpha	.93	.90
Percent variance explained	69.02	17.18

Physical safety behaviors

The next EFA explored the factor structure of physical safety behaviors. A KMO coefficient of .80 and a significant Bartlett's test of sphericity, χ^2 (15) = 4423.64, p < .001, support factor analysis with sample adequacy. Oblique rotation was supported by a factor correlation coefficient of .49. The two-factor solution explains 85.88% of the variance with a coefficient alpha of .87. Factor alphas and final factor structure are shown below in Table 3.27.

Table 3.27

Final factor loadings, variance explained, and factor alpha for physical safety behaviors

Item	Factor 1	Factor 2
I use the correct physical safety procedures for carrying out my job	.928	-.035
I use all the necessary physical safety equipment to do my job	.896	.004
I ensure the highest levels of physical safety when I carry out my job	.886	.044
I put in extra effort to improve the physical safety of the workplace	-.041	.963
I voluntarily carry out tasks or activities that help to improve workplace physical safety	-.035	.884
I promote the physical safety program within the organization	.095	.752
Alpha	.93	.90
Percent variance explained	62.37	23.52

Study 1 Discussion

Chapter 3: Assessing the measurement model

The intent of Study 1 is to identify the factor structure of each construct to proceed with Study 2, confirmatory factor analyses. The EFAs were intended to reduce the number of items as well as confirm the underlying factor structure given the intent to use the items in a broader survey and with the limited work for some of the measures (e.g., safety control). These goals were achieved. The individual measures resulted in Cronbach's alpha ranging from satisfactory (> .60) to excellent (> .90; Taber, 2018). Variance explained for each measure also reached about the 60% threshold (Hair et al., 2018) except for safety control which was right below at 56.26% explained. This measure of control was used by Conner and McMillan (1999) as perceived behavioral control over cannabis/marijuana use with an alpha of .90. Fugas et al. (2012) adapted the measure to explore perceived safety control. They found, given the exploratory nature of the instrument, the composite reliability of .59 to be acceptable, despite being slightly below the .70 generally accepted threshold (Hair et al., 1998). Given that this research was also exploratory in nature, the variance explained and the coefficient alpha of .60, are supporting the continued use of the safety control measure. Study 2 will provide further clarification on the future use of the measure.

Physical and psychosocial safety climate were extracted as one-factor solutions. This was unexpected as the PSC-12 was developed as a four-factor measure (Hall et al., 2010). Physical safety climate was subsequently adapted to account for the same four factors (Bronkhorst, 2015; Idris et al., 2012). The four factors are organization participation, organizational communication, management priority, and management commitment. The EFA suggests the items measure one construct. To adapt the PSC-12 to physical safety, references to psychological health and well-being were replaced to specify physical. This was applied to 10 out of the 12 items. Two items, focused specifically on stress, were removed for the physical safety climate measure. This may be a possible explanation for the one facet with physical safety climate. Subsequent studies should apply other physical safety climate measures rather than the adapted one or validate the adapted measure. This might provide insight into confirming convergent validity and the robustness of the adapted measure. For psychosocial safety climate, a deeper understanding of the validation and use of the PSC-12 should be explored.

Interestingly, the measure for employee engagement contains three factors, affective, normative, and continuance commitment with six items for each factor (Allen & Meyer, 1990; Meyer et al., 1993). This was selected, as mentioned above, based on the affective connection individuals have with their organization (Bakker et al., 2008). However, the final EFA solution maintained only three of the six items for affective factor. Two items were retained for continuance commitment and five items for normative commitment. Normative commitment focuses on how much an individual feels they ought to stay with the organization (Allen & Meyer, 1990; Meyer et al., 1993).

Study 1 laid the foundation for testing the PPWS and for Study 2 by providing a factor structure for each construct. Study 2 continues to lay the foundation for testing the PPWS by conducting a series of confirmatory factor analyses for each construct. This provides the measurement model to assess the structural model.

Study 2

Study 2 is a series of confirmatory factor analyses (CFAs) to refine and assess the constructs (Kline, 2016) in the PPWS model. CFAs play a pivotal role in path or structural analyses (Brown, 2006), which is the next step is assessing the full PPWS model. Study 1 took an exploratory approach to understand the underlying factor structure. CFAs specify the factors and relationships to each latent variable. Therefore, the final factor structures reported above in Study 1 are the proposed relationships for each CFA.

Method

The participants, procedures, and measures are all the same from Study 1. The final items used are reported in each table for the EFAs.

Statistical analyses

The analyses were performed using Mplus (Muthén & Muthén, 2017) and SPSS for Windows. Scale scores were calculated using the Mean function under Compute Variable in SPSS. Each CFA was run individually in Mplus to assess fit statistics. CFAs were conducted using Robust Maximum Likelihood (MLR) estimator to account for any violations of normality assumptions (Li, 2015).

The global model fit indices assessed were chi-square good of fit, root mean square error of approximation (RMSEA), Tucker Lewis Index (TLI), and Comparative Fit Index (CFI). Given the larger sample size, chi-square was anticipated to achieve significance across the CFAs, indicating a poor fit. Larger samples cause chi-square to be more sensitive to minor deviations from good fit. Therefore, RMSEA, TLI, and CFI were considered as well for model fit diagnostic coefficients. Good fit is indicated with RMSEA scores lower than .08 with the lower bound of a 90% confidence interval between .00 and .05 and the upper bound at or around .08. TLI and CFI indicate good fit with scores greater than .90 (Bentler, 1990; Kline, 2016; Steiger, 1990). As this is the same dataset, Cronbach's alphas and missing values analysis are carried over from Study 1.

Model specification was based on the results of Study 1. Re-specification for each CFA was based on the CFA results, modification indices, and theory. The addition or removal of paths was based on two criteria. Modification indices were assessed for the largest reduction in chi-square, so long as they aligned with theoretical fit, with the emphasis on theory (Thompson, 2000).

Results

A series of CFAs using MLR estimation were conducted, based on the identified factor structure in Study 1. Global model fit indices were assessed for model fit and adequacy. This includes chi-square, RMSEA, CFI, and TLI.

The full PPWS Model, as shown in Figure 3.2, was split for the CFAs. The first focused on the latent variables, job demands and resources, the second on the five safety factors, and the third on safety behaviors.

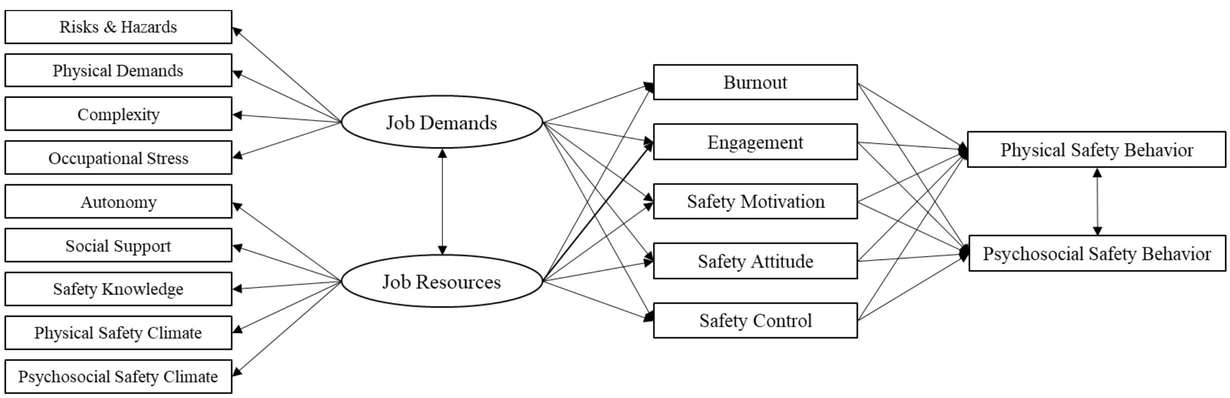

Figure 3.2. Proposed PPWS model (Yaris et al., 2020)

Job Demands

The first CFA identified a negative residual variance with the latent variable, risks and hazards. Therefore, the variance was fixed to zero. After fixing risks and hazards' variance to zero, the CFA resulted in good model fit, χ^2 (41, n = 941) = 217.80, p < .001, TLI = .95, CFI = .96, RMSEA = .07 [.06, .08]. CFA results are shown below in Figure 3.3. A description of the items with the item code is found in Appendix H.

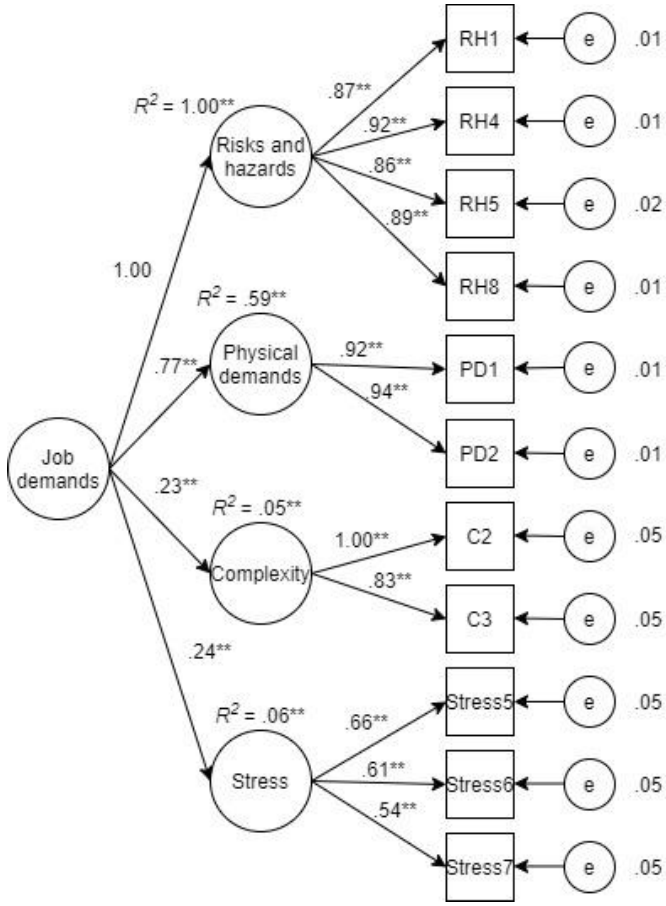

Figure 3.3. Standardized final CFA solution for job demands, *$p < .05$, **$p < .01$

Job Resources

For the CFA on job resources, a series of error covariance terms between indicators were added based on the model modification indices that suggested the highest improvement in model fit during each iteration. This resulted in two additions. The third CFA resulted in additional improvement with the addition of the correlation path, χ^2 (427, n = 941) = 1766.47, $p < .001$, TLI = .91, CFI = .92, RMSEA = .06 [.06, .06]. All factor loadings and correlations achieved significance. While there were modification indices to suggest moderate improvement in chi-square, they were relatively modest. Therefore, the final solution with good model fit is shown below in Figure 3.4. Each iteration is detailed below in Table 3.28.

Table 3.28

Job resources CFA models (n = 941)

Iteration	*df*	χ^2	RMSEA [90% CI]	CFI	TLI	Model fit
1: Base model	429	2036.21**	.06 [.06, .07]	.91	.90	Good
2: Correlate PHYSC1 with PHYSC2	428	1887.91**	.06 [.06, .06]	.91	.91	Good
3: Correlate PSC1 with PSC2	427	1766.47**	.06 [.06, .06]	.92	.91	Good

Note. PHYSC = physical safety climate, PSC = psychosocial safety climate item. The number denotes the item number for that measure. Full coding is in Appendix H.

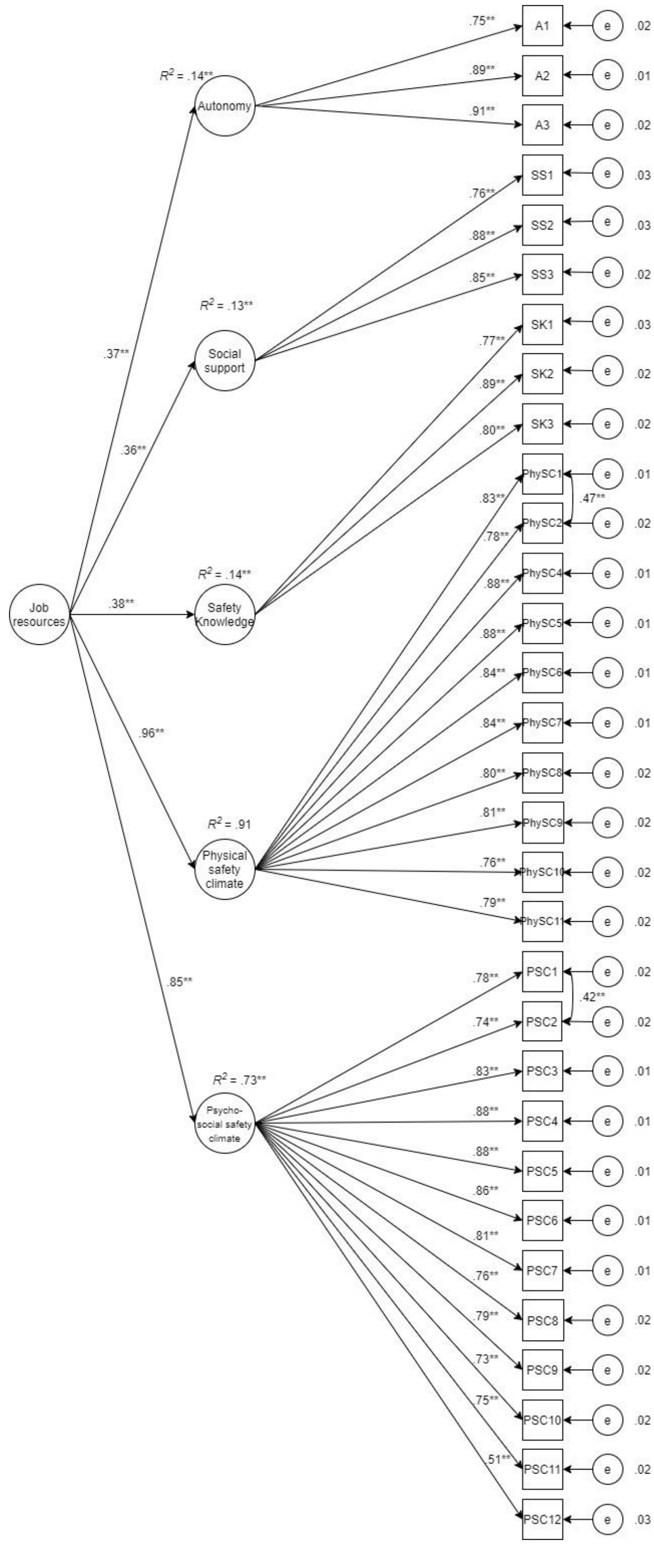

Figure 3.4. Standardized final CFA solution for job resources, *p < .05, **p < .01

Safety Factors

The CFA for safety factors followed the same iterative process used throughout this chapter to determine the final measurement model. To obtain good fit, a base model was analyzed with paths added or removed based on the theoretical foundation and modification indices. It was a nine-step process as detailed in Table 3.29. The final solution is found below in Figure 3.5.

Table 3.29

Safety Factor CFA models (n = 941)

Iteration	*df*	χ^2	RMSEA [90% CI]	CFI	TLI	Model fit
1: Base model	424	3351.16**	.09 [.08, .09]	.77	.74	Almost adequate
2: Remove items EE10 and EE12	367	2607.76	.08 [.08, .08]	.81	.79	Almost adequate
3: Correlate EE9 with EE8	366	2176.94	.07 [.07, .08]	.85	.83	Almost adequate
4: Correlate EE5 with EE4	365	1827.96	.07 [.06, .07]	.88	.86	Adequate
5: Correlate EE15 with EE14	364	1736.40	.06 [.06, .07]	.88	.87	Adequate
6: Correlate EE5 with EE3	363	1616.78	.06 [.06, .06]	.89	.88	Adequate
7: Correlate EE4 with EE3	362	1262.30	.05 [.05, .06]	.92	.91	Good
8: Correlate BO2 with BO1	361	1212.70	.05 [.05, .05]	.93	.92	Good
9: Correlate BO9 with BO7	360	1162.62	.05 [.05, .05]	.93	.92	Good

Note. EE = employee engagement, BO = burnout. The number denotes the item number for that measure. Full coding is in Appendix H.

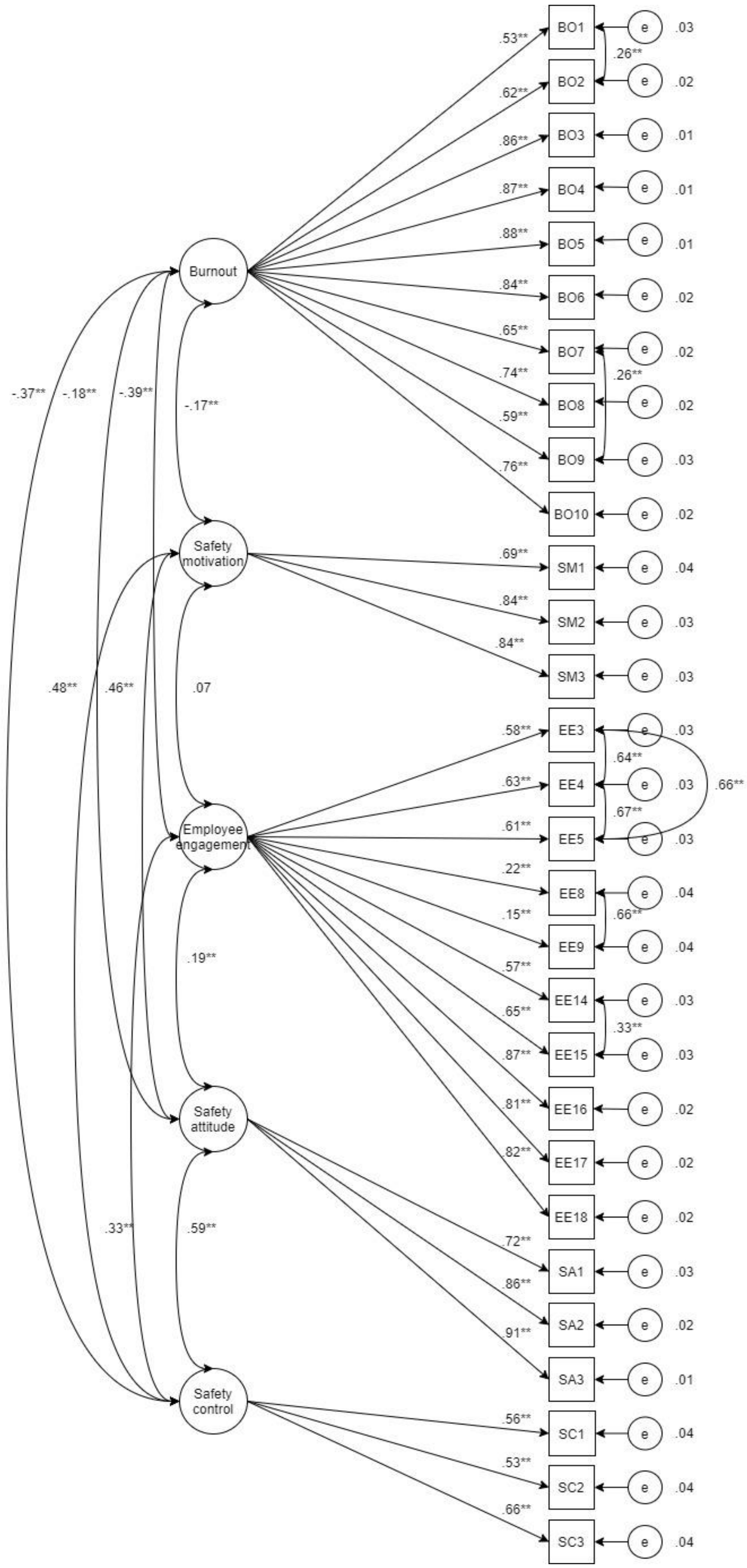

Figure 3.5. Standardized solution for safety factors, $*p < .05$, $**p < .01$

Safety Behaviors

The initial CFA for safety behaviors failed to support good model fit, χ^2 (53, n = 941) = 1765.44, p < .001, TLI = .51, CFI = .61, RMSEA = .19 [.18, .19]. Per modification indices a correlation path was added between SPPHY2 and SPPHY3. Both of these items assess physical safety participation. See Table 3.30 for the CFA iterations.

Table 3.30

Safety behaviors CFA models (n = 941)

Iteration	*df*	χ^2	RMSEA [90% CI]	CFI	TLI	Model fit
1: Base model	53	1765.44**	.19 [.18, .19]	.61	.51	Poor
2: Correlate SPPHY2 with SPPHY3	52	1368.74**	.16 [.16, .17]	.70	.61	Poor
3: Correlate SPP3 with SPP2	51	1008.44**	.14 [.13, .15]	.78	.71	Poor
4: Correlate SPPHY2 with SPPHY1	50	921.86**	. 14 [.13, .14]	.80	.73	Almost adequate
5: Correlate SPPHY3 with SPPHY1	49	696.42**	.12 [.11, .13]	.85	.80	Almost adequate
6: Correlate SPP2 with SPP1	48	613.32**	.11 [.10, .12]	.87	.82	Almost adequate
7: Correlate SPP3 with SPP1	47	418.20**	.09 [.08, .10]	.91	.88	Almost adequate to good

Note. SPPHY = physical safety participation, SPP = psychosocial safety participation. The number denotes the item number for that measure. Full coding is in Appendix H.

The final model (model 7) saw adequate to good fit, χ^2 (47, n = 941) = 418.20, p < .001, TLI = .88, CFI = .91, RMSEA = .09 [.08, .10]. Additional modifications were either not supported by theory or modest in fit improvement. The final factor structure is below in Figure 3.6.

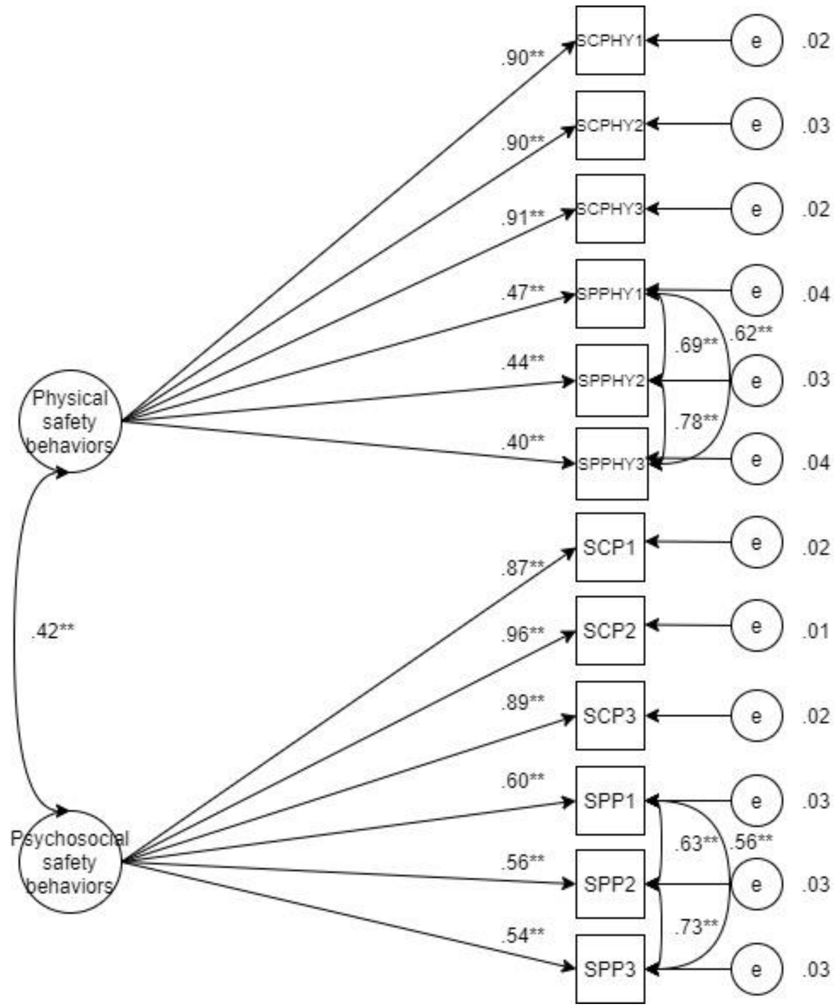

Figure 3.6. Final standardized factor structure for safety behaviors, *p < .05, **p < .01

Study 2 Discussion

The primary purpose of this paper was to establish the measurement model in preparation for exploring the structural model. The intent was to create valid and reliable factor structures while reducing items to help promote parsimony. This was achieved through numerous iterations of the CFAs exploring job demands, job resources, safety factors, and safety behaviors as individual components. Chapter 4 of this thesis details the assessment of the full structural model, combining all components.

All components of the PPWS model obtained adequate to good model fit after a series of CFAs. However, chi-square maintained significance, which could suggest some model misspecification (Crede & Harms, 2019). The model fit was determined by exploring all fit indices, including chi-square, with modification indices driving model re-specification. The factor structure identified in Study 1 for job demands was supported as is with a CFA. The final factor structure for job resources resulted in two correlation paths. Correlating items 1 and 2 for physical safety climate and items 1 and 2 for psychosocial safety climate reduced chi-square and improved model fit. Given the modifications suggested were correlating items within the same construct, the additional correlations were supported.

Nine models were assessed for safety factors to achieve model fit. Two items under employee engagement were removed. These items were the only negatively worded items which is one possible explanation for why the item loadings failed to achieve significance. The additional modifications for the models consisted of adding correlations between employee engagement and burnout items. As with job resources, the correlations were between items of the same construct. Given that the measures used for employee engagement (Allen & Meyer, 1990; Meyer et al., 1993) and burnout (Malach-Pines, 2005) were previously established, it was not unexpected that some items correlated.

Safety behaviors was particularly interesting to note as the initial CFA supported poor model fit. Few studies have considered physical safety participation and safety compliance adapted to psychosocial safety participation and safety compliance (e.g., Bronkhorst, 2015). The

PPWS model divides safety behaviors by physical and psychosocial. This is a new conceptualization of the safety behavior construct. The CFAs suggested that correlations paths are needed between safety participation items to improve model fit. Six correlations were added, three for physical safety participation and three for psychosocial. Even with these adjustments, model fit was adequate for RMSEA and TLI. The modification indices also suggested the greatest reduction in chi-square would be from correlating the physical safety participation items with the psychosocial safety participation items. Given the PPWS model divides safety behaviors between physical and psychosocial, not safety participation and compliance, those additions were not considered for the model. This does open the possibility that safety behaviors should be conceptualized as safety participation with both physical and psychosocial items and safety compliance with both physical and psychosocial items. This moves the emphasis onto the participation and compliance rather than whether they are physical or psychosocial in nature.

Conclusion

The implications of this research suggest that there is a way to merge physical and psychosocial safety into a comprehensive approach, leveraging the existing leading approaches. The model of safety performance (Neal & Griffin, 1997) and the JD-R model of workplace safety (Nahrgang et al., 2011) are both supported models with research and applied utility. An additional benefit is found in combining, and extending, those models to account for both physical and psychosocial safety and self-regulatory factors, the PPWS model moves towards a usable approach for application in research and industry. Through conducting the EFAs and CFAs, not only is the measurement model specified, the data collection process for practitioners is potentially streamlined. The reduction of items makes it easier for organizations to collect data with a shorter instrument or even take pulse surveys (Allen et al., 2020) to monitor progress. If organizations aim to improve safety behaviors and implement a structured program to do so, the pulse surveys help determine if programs are on track (Allen et al., 2020).

The next steps are to explore the full structural model and continue to determine the potential for high utility. As shown by the model fit for each component, misspecification is a possibility. Deeper understanding of the full model and assessing the structural model is needed. There are some causes for concern within Study 1 and Study 2. First, with Study 1, the EFA for safety control is on the lower end of acceptable. A similar result was observed in the study with Fugas et al. (2012) as well. Given the exploratory nature of the research, the lower end was acceptable. However, the measure should be assessed for improvements if it continues to be used as a measure of perceived safety control or another measure of control should be used. Second, as stated, the CFAs in Study 2 reached adequate to good fit. The models have room for improvement. The approach for the PPWS model development was designed to provide generalizability. However, between Mturk and group sizes, next steps could include focusing on a targeted approach and understanding the relationship between physical and psychosocial workplace safety by industry.

Additionally, generalizability has been emphasized as a priority of the PPWS model and approach. The sample used for Studies 1 and 2 contained numerous industries. The next step, for future directions, is to examine and compare the measurement equivalence of the proposed CFA models across industries. This will provide a deeper understanding into the generalizability and stability of the models across industries. Another consideration for future research is redefining the job demands to have a clean distinction between physical demands and cognitive demands.

Another consideration for future directions is whether job demands and job resources are reflective or formative constructs (Diamantopoulos & Siguaw, 2006; Jarvis et al., 2003). If formative, then an increase in one job demand (e.g., occupational stress) would not require an increase in the other individual job demands. This is shift in conceptualization is worth exploring.

There were also some limitations to this research. First, the sample is limited to Australia and the US with inconsistent sample sizes across groups. Second, convenience and snowball techniques determined the industries and occupations sampled. Mturk is more open-ended. Criteria were set to control for the participant groups of interest; however, retirees or unemployed individuals may have participated in the study. There was no way to verify the Mturk criteria beyond participant self-report. However, time spent on the survey was considered to potentially screen careless responding. Third, the survey and data collected were self-reported. Some concepts, such as psychosocial safety climate, are newer to research and organizations or the phrasing and concepts might be worded differently than what participants have experience with. It is important to consider the phrasing or unfamiliarity with concepts when creating the survey and potentially create definitions or provide more context to help the participants navigate the concepts. Fourth, the survey may need a key terms or definition page. This would help clarify terms such as "psychosocial safety climate" which may be unfamiliar or have organization specific definitions. Lastly, one goal of the PPWS model was to provide construct clarification. There is still room for improvement with this goal. For example, safety behaviors and whether or not the focus should be on physical and psychosocial or participation and compliance. Future studies can provide additional insights into the constructs to help provide that clarity.

References

Ajzen, I. (2002). Perceived behavioural control, self-efficacy, locus of control, and the theory of planned behavior. *Journal of Applied Social Psychology, 32,* 1-20. https://doi.org/10.1111/j.1559-1816.2002.tb00236.x

Allen, J., Jain, S., & Church, A. H. (2020). Using a pulse survey approach to drive organizational change. *Organizational Development Review, 52*(2), 62-68.

Allen, N. J., & Meyer, J. P. (1990). The measurement and antecedents of affective, continuance, and normative commitment to the organization. *Journal of Occupational Psychology, 63,* 1-18. https://doi.org/10.1111/j.2044-8325.1990.tb00506.x

Amazon Mechanical Turk. (2018). Mechanical Turk. Retrieved from https://www.mturk.com/

Bakker, A. B., & Demerouti, E. (2007). The job demands-resources model: State of the art. *Journal of Managerial Psychology, 22,* 309-328. Doi: 10.1108/02683940710733115

Bakker, A. B., Demerouti, E., & Euwema, M. C. (2005). Job resources buffer the impact of job demands on burnout. *Journal of Occupational Health Psychology, 2,* 170-180. https://doi.org/10.1037/1076-8998.10.2.170

Bakker, A. B., Schaufeli, W. B., Leiter, M. P., & Taris, T. W. (2008). Work engagement: An emerging concept in occupational health psychology. *Work and Stress, 22*, 187–200. https://doi.org/10.1080/02678370802393649

Beus, J. M., McCord, M. A., & Zohar, D. (2016). Workplace safety: A review and research synthesis. *Organizational Psychology Review*, *6*(4), 352-381. Doi: 10.1177/2041386615626243

Bronkhorst, B. (2015). Behaving safely under pressure: The effects of job demands, resources, and safety climate on employee physical and psychosocial safety behavior. *Journal of Safety Research, 55,* 63-72. https://doi.org/10.1016/j.jsr.2015.09.002

Bronkhorst, B., & Vermeeren, B. (2016). Safety climate, worker health and organizational health performance. *International Journal of Workplace Health Management, 9*(3), 279-289. https://doi.org/10.1108/ijwhm-12-2015-0081

Brown, T. A. (2006). *Confirmatory factor analysis for applied research*. The Guilford Press.

Burke, M. J., Sarpy, S. A., Tesluk, P. E., & Smith-Crowe, K. (2002). General safety performance: A test of a grounded theoretical model. *Personnel Psychology, 55,* 429-457. https://doi.org/10.1111/j.1744-6570.2002.tb00116.x

Campbell, D. J. (1988). Task complexity: A review and analysis. *The Academy of Management Review, 13*(1), 40-52. https://doi.org/10.2307/258353

Clarke, S. (2012). The effect of challenge and hindrance stressors on safety behavior and safety outcomes: A meta-analysis. *Journal of Occupational Health Psychology, 27*(4), 387-397. https://doi.org/10.1037/a0029817

Clarke, S. G., & Cooper, C. L. (2000). The risk management of occupational stress. *Health, Risk & Society, 2,* 173-187. https://doi.org/10.1080/713670158

Comrey, A. L., & Lee, H. B. (1992). *A first course in factor analysis* (2nd edition). Lawrence Erlbaum Associates.

Conner, M., & McMillian, B. (1999). Interaction effects in the theory of planned behaviour: Studying cannabis use. *British Journal of Social Psychology, 38,* 195-222. https://doi.org/10.1348/014466699164121

Cooper, C. L. (1996). *The handbook of stress, medicine and health*. Boca Raton, FL: CRC Press.

Couvreur, C. (1996). The EM Algorithm: A Guided Tour. *Proceedings of the 2d IEEE European Workshop on Computationally Intensive Methods in Control and Signal Processing, Czech Republic*, 115-120. doi: 10.1007/978-1-4612-1996-5_12

Crede, M., & Harms, P. (2019). Questionable research practices when using confirmatory practice analysis. *Journal of Managerial Psychology, 34*(1), 18-30. https://doi.org/10.1108/JMP-06-2018-0272

Davis, L. E., Ajzen, I., Saunders, J., & Williams, T. (2002). The decision of African American students to complete high school: An application of the theory of planned behavior. *Journal of Educational Psychology, 94*(4), 810-819. https://doi.org/10.1037/0022-0663.94.4.810

Demerouti, E., Bakker, A. B., Nachreiner, F., & Schaufeli, W. B. (2001). The job demands-resources model of burnout. *Journal of Applied Psychology, 86*, 499-512. Doi: 10.1037/0021-9010.86.3.499

Diamantopoulos, A., & Siguaw, J. A. (2006). Formative Versus Reflective Indicators in Organizational Measure Development: A Comparison and Empirical Illustration. *British Journal of Management, 17*(4), 263–282. https://doi.org/10.1111/j.1467-8551.2006.00500.x

Dollard, M. F. & Bakker, A. B. (2010). Psychosocial safety climate as a precursor to conducive work environments, psychological health problems, and employee engagement. *Journal of Occupational and Organizational Psychology, 83*, 579-599. Doi: 10.1348/096317909X470690

Dong, Y., & Peng, C.-Y., J. (2013). Principled missing data methods for researchers. *SpringerPlus, 2*(1), 222-239. https://doi.org/10.1186/2193-1801-2-222

Fugas, C. S., Silva, S. A., & Meliá, J. L. (2012). Another look at safety climate and safety behavior: Deepening the cognitive and social mediator mechanisms. *Accident Analysis and Prevention, 45,* 468-477. Doi: 10.1016/j.aap.2011.08.013

Glendon, A. L., & McKenna, E. F. (1995). *Human safety and risk management*. Oxford University Press.

Graham, J. W. (2003). Adding missing-data-relevant variables to FIML-based structural equation models. *Structural Equation Modeling, 10*(1), 80–100. https://doi.org/10.1207/S15328007SEM1001_4

Griffin, M. A., & Neal, A. (2000). Perceptions of safety at work: A framework for linking safety climate to safety performance, knowledge, and motivation. *Journal of Occupational Health Psychology, 5*(3), 347-358. https://doi.org/10.1037/1076-8998.5.3.347

Hackman, J. R., & Oldham, G. R. (1976). Motivation through the design of work: Test of a theory. *Organizational Behavior and Human Performance, 16*, 250-279. http://0-dx.doi.org.prospero.murdoch.edu.au/10.1016/0030-5073(76)90016-7

Hair, J. F., Tatham, R. L., Anderson, R.E., & Black, W. (1998). *Multivariate data analysis* (5th edition). Prentice-Hall.

Hair, J. F., Babin, B. J., Anderson, R. E., & Black, W. C (2018). *Multivariate data analysis* (8th edition). Cengage.

Hall, G. B., Dollard, M. F., & Coward, J. (2010). Psychosocial Safety Climate: Development of the PSC-12. *International Journal of Stress Management*, *17*(4), 353-383. https://doi.org/10.1037/a0021320

Idris, M. A.& Dollard, M. F. (2011). Psychosocial safety climate, work conditions, and emotions in the workplace: A Malaysian population-based work stress study. *International Journal of Stress Management, 18*(4), 324-347. https://doi.org/10.1037/a0024849

Idris, M. A., Dollard, M. F., Coward, J., & Dormann, C. (2012). Psychosocial safety climate: Conceptual distinctiveness and effect on job demands and worker psychological health. *Safety Science*, *50*, 19-28. https://doi.org/10.1016/j.ssci.2011.06.005

Jarvis, C. B., MacKenzie, S. B., & Podsakoff, P. M. (2003). A critical review of construct indicators and measurement model misspecification in marketing and consumer research. *Journal of Consumer Research, 30*(2), 199–218. https://doi.org/10.1086/376806

Kline, R. B. (2016). *Principles and practice of structural equation modeling* (4th edition.). The Guilford Press.

Lee, F. K., Sheldon, K. M., & Turban, D. B. (2003). Personality and the goal-striving process: The influence of achievement goal patterns, goal level, and mental focus on performance and enjoyment. *Journal of Applied Psychology, 88*(3), 256-265. doi: 10.1037/0021-9010.88.2.256

Li, C.-H. (2016). Confirmatory factor analysis with ordinal data: Comparing robust maximum likelihood and diagonally weighted least squares. *Behavior Research Methods, 18,* 936-949. doi: 10.3758/s13428-015-0619-7

Little, R. J. A. (1988). A test of missing completely at random for multivariate data with missing values. *Journal of the American Statistical Association, 83*(404), 1198-1202. doi: 10.1080/01621459.1988.10478722

Malach-Pines, A. (2005). The burnout measure, short version. *International Journal of Stress Management, 12*(1), 78-88. https://doi.org/10.1037/1072-5245.12.1.78

Meyer, J. P., Allen, N., & Smith, C. A. (1993). Commitment to organizations and occupations: Extension and test of a three-component conceptualization. *Journal of Applied Psychology, 78*(4), 538-551. https://doi.org/10.1037/0021-9010.78.4.538

McLinton, S. S., Afsharian, A., Dollard, M. F., & Tuckey, M. R. (2019). The dynamic interplay of physical and psychosocial safety climates in frontline healthcare. *Stress and Health: Journal of the International Society for the Investigation of Stress*, *35*(5), 650-664. https://doi.org/10.1002/smi.2898

Morgeson, F. P., & Humphrey, S. E. (2006). The Work Design Questionnaire (WDQ): Developing and validating a comprehensive measure for assessing job design and the nature of work. *Journal of Applied Psychology, 91,* 1321-1339. https://doi.org/10.1037/0021-9010.91.6.1321

Muthén, L.K., & Muthén, B.O. (2017). *Mplus User's Guide* (8th edition). Muthén & Muthén.

Nahrgang, J. D., Morgeson, F. P., & Hofmann, D. A. (2011). Safety at work: A meta-analytic investigation of the link between job demands, job resources, burnout, engagement, and safety outcomes. *Journal of Applied Psychology, 96,* 71-74. Doi: 10.1037/a0021484

Neal, A., & Griffin, M. A. (1997). Perceptions of safety at work: Developing a model to link organizational safety climate and individual behavior. Paper presented to the 12th Annual Conference of the Society for Industrial and Organizational Psychology, St. Louis, MO.

Neal, A., & Griffin, M. A. (2006). A study of the lagged relationships among safety climate, safety motivation, safety behavior, and accidents at the individual and group levels. *Journal of Applied Psychology, 91*, 946-953. https://doi.org/10.1037/0021-9010.91.4.946

Neal, A., Griffin, M. A., & Hart, P. M. (2000). The impact of organizational climate on safety climate and individual behavior. *Science Safety, 34,* 99-109. https://doi.org/10.1016/S0925-7535(00)00008-4

Steiger, J. H. (1990). Structural model evaluation and modification: An interval estimation approach. *Multivariate Behavorial Research, 25*(2), 173-180. https://doi.org/10.1207/s15327906mbr2502_4

Stevens, J. (1992). *Applied multivariate statistics for the social sciences* (2nd edition). Lawrence Erlbaum Associates, Inc.

Tabachnick, B. G., & Fidell, L. S. (2012). *Using multivariate statistics* (6th edition). Pearson Education.

Taber, K. S. (2018). The use of Cronbach's alpha when developing and reporting research instruments in science education. *Research in Science Education, 48,* 1273-1296. https://link.springer.com/article/10.1007/s11165-016-9602-2

Woodhead, E. L., Northrop, L., & Edelstein, B. (2016). Stress, social support, and burnout among long-term care nursing staff. *Journal of Applied Gerontology, 35*(1), 84-105. http://0-dx.doi.org.prospero.murdoch.edu.au/10.1177/0733464814542465

Yankelevich, M., Broadfoot, A., Gillespie, J. Z., Gillespie, M. A., & Guidroz, A. (2011). General job stress: A unidimensional measure and its non-linear relations with outcome variables. *Stress & Health, 28*(2), 137-148. https://doi.org/10.1002/smi.1413

Yaris, C., Ditchburn, G., Curtis, G. J., & Brook, L. (2020). Combing physical and psychosocial safety: A comprehensive workplace safety model. *Safety Science, 132,* 1-9. https://doi.org/10.1016/j.ssci.2020.104949

Zadow, A. J., Dollard, M. F., Mclinton, S. S., Lawrence, P., & Tuckey, M. R. (2016). Psychosocial safety climate, emotional exhaustion, and work injuries in healthcare workplaces. *Stress and Health, 33,* 558-569. DOI: 10.1002/smi.2740

Zohar, D. (1980). Safety climate in industrial organizations: Theoretical and applied implications. *Journal of Applied Psychology*, *65,* 96-102. Doi: 10.1037/0021-9010.65.1.96

CHAPTER 4

Assessing the structural model

Safety research tends to differentiate between physical and psychosocial safety. Several studies address both, but there remains to be a framework that accounts for both physical and psychosocial safety elements. The physical and psychosocial workplace safety (PPWS) model is a first attempt to fill that gap. The theoretical foundation (Chapter 2) and measurement model (Chapter 3) were established, making it appropriate for this chapter to test the structural model. Participants for Study 1 (n = 941) and Study 2 (n = 456) were recruited from high-risk industries (e.g., fire and law enforcement). Study 1 identified almost adequate fit, x^2 (80, n = 941) = 738.75, p < .001, SRMR = .08, TLI = .78, CFI = .85, RMSEA = .09 [.09, .10], across 19 iterations. Study 2 aimed to confirm the model from Study 1. The model fit saw slight improvement from Study 1 across five iterations, x^2 (85, n = 456) = 162.36, p < .001, SRMR = .08, TLI = .79, CFI = .85, RMSEA = .10 [.09, .11]. While fit was almost adequate and provides a foundation for considering physical and psychosocial safety in one model several considerations are to be noted. The model attempted to capture multiple high-risk industries across the United States and Australia. The intent was to be generalizable. However, due to the small representation in the final sample, a targeted approach would be beneficial for further validation of the model in high-risk industries. Another potential limiting factor concerns the selected job demands and resources. Different demands and resources could be considered for future iterations.

Chapter 4: Assessing the structural model

Introduction

Across all industries, employees face a multitude of workplace challenges that may lead to accidents, injuries or even death. The International Labour Organization (2019) estimates that, globally, there are over 340 million accidents, 160 million work-related illnesses, and 2.3 million fatalities annually. Progress has consistently been made in improving safety in workplaces (Hofmann et al., 2017), but as workplaces and the nature of the work changes so must the issues and variables that must be considered. For example, psychological constructs such as bullying are increasingly recognized as part of psychosocial safety climate (Law et a., 2011).

Psychosocial safety climate was introduced in 2010 focusing specifically on the psychological aspects of health and safety, including a climate of trust and respect regarding psychological well-being (Dollard & Bakker, 2010). This is important for the field of safety as 60% of employee absences could be traced to psychological problems, and job stress costs approximately $300 billion annually in the US (The American Institute of Stress, 2019). Additionally, stress-related health concerns lead to high turnover (Geisler et al., 2019) and are among the most frequently reported occupational health issue in Europe (European Agency for Safety and Health at Work, 2009), the United States (Goh et al., 2019), and Australia (Safe Work Australia, 2021b). Limited research has considered the interaction between physical and psychosocial aspects of safety, but much remains to be explored, including the development of a validated model (e.g., Bronkhorst & Vermeeren, 2016; McLinton et al., 2019; Zadow et al., 2016).

This paper aims to validate a proposed framework, the Physical and Psychosocial Workplace Safety Model (PPWS; Yaris et al., 2020), integrating the physical and psychosocial aspects of safety. This integration is key, as findings suggest physical and psychosocial safety climate work together to determine current injuries and the likelihood of future injuries (Zadow et al., 2016). The PPWS, as shown in Figure 4.1, aims to address the gaps in the literature between physical and psychosocial safety and present a comprehensive approach to workplace safety. It is important to identify what job demands and resources predict safety factors as well as how safety factors impact physical and psychosocial safety behavior. The purpose of this study is to validate the model fit with two cross-sectional data sets. Exploratory factor analyses and confirmatory factor analyses were previously conducted on the PPWS model to establish the measurement model (see Chapter 3 of this thesis).

Study 1

The PPWS models extends leading theoretical frameworks (Bakker & Demerouti, 2007; Demerouti et al., 2001; Dollard & Bakker, 2010; Nahrgang et al., 2011; Neal & Griffin, 1997), with processes supported by self-regulatory theory (SRT; e.g., attitude; Bandura, 1988), referred to as safety factors, to explain how those interactions impact an individual's safety behaviors. SRT proposes that thought, affect, attention, and behavioral processes guide individuals toward goal attainment (Bandura, 1988). If the outcome or goal is safety behaviors, safety factors help guide the individuals toward those safety behaviors and protect themselves from harm (Carver & Scheier, 2011). The Job Demand-Resource Model (JD-R Model) is the foundation for this extension given its flexibility (Schaufeli & Taris, 2013) and prevalence in psychosocial safety research (Dollard & Bakker, 2010; Zadow et al., 2019). For a full discussion around the JD-R Model and theoretical implications of the presented model, see Yaris et al. (2020) and Chapter 2 of this thesis. The objective of Study 1 is to assess model fit and refine the model. The theoretical model being examined is shown below in Figure 4.1.

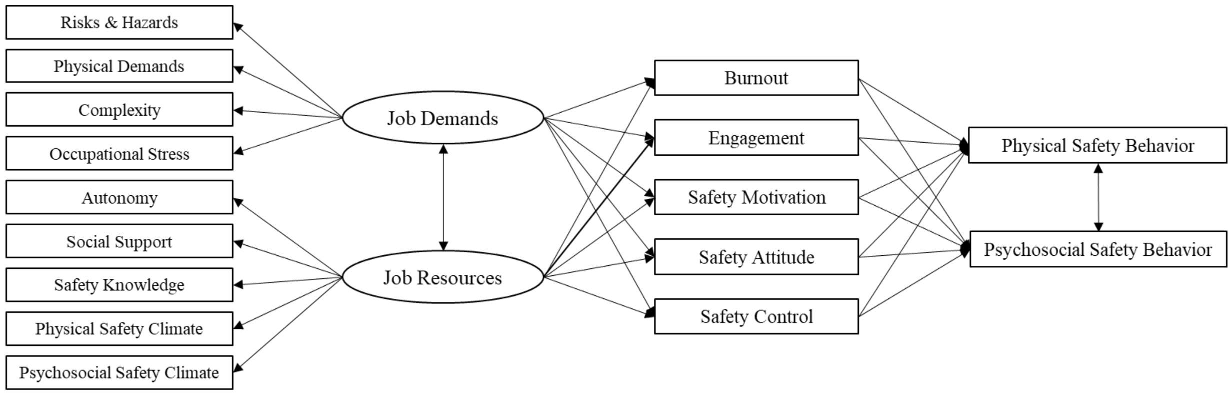

Figure 4.1. Proposed PPWS model, as presented in Chapter 2

Job Demands

Job demands are social, physical, and organizational aspects of the job that are not inherently negative but over time may negatively impact health and well-being through continued effort and exertion (Bakker & Demerouti, 2007; Idris & Dollard, 2011; Nahrgang et al., 2011). Previous research identifies risks and hazards, physical demands, complexity, and occupational stress as job demands (Bakker & Demerouti, 2007; Demerouti et al., 2001; Nahrgang et al., 2011; Turner et al., 2010). Risk, as the probability of harm and magnitude of the consequence, may be reduced through workplace efforts such as training, which suggests managers are committed to safety (Clarke & Cooper, 2000; Glendon & McKenana, 1995; Hansez & Chmiel, 2010). Hazards are intrinsic objects or situations in the workplace that cause harm, including, for example, chemicals, dust, fumes, motion, surfaces, and use of equipment and computer screens (Pandit et al., 2018; Clarke & Cooper, 2000; DeJoy et al., 2004; Demerouti et al., 2001; Glendon & McKenna, 1995; Jay et al., 2017; Sutherland & Cooper, 1990; Wolfgang, 1988). Poor hazard recognition and incorrect risk perceptions have been connected to a higher rate of accidents (Choudhry & Fang, 2008; Haslam et al., 2005; Tixier et al., 2014).

Physical demands include physically demanding schedules, workloads, work tasks, and workplace conditions that require the employee to sustain physical effort and/or skill (Nahrgang et al., 2011). Complexity refers to the intricacy of the work and involves the employee sustaining physical and/or cognitive effort due to complex work (Bakker & Demerouti, 2007; Campbell, 1988; Demerouti et al., 2001; Nahrgang et al., 2011). Both physical demands and complexity can result in psychological and physiological costs to the employee such as anxiety and fatigue (Bronkhorst, 2015).

Occupational stress is the individual's experience derived from inadequate coping with work-related stressors causing psychological and/or physical demands on the employee (Cooper, 1996; Cooper & Marshall, 1976; Woodhead et al., 2016). For there to be negative consequences the determinants of stress must be perceived as negative and the individual unable to cope adequately (Clarke & Cooper, 2000). Specifically, when coping strategies fail, they are perceived as being more negative and are, therefore, time-dependent from exposure to the stressors (Clarke & Cooper, 2000; Cox et al., 2000). Given that the perception of stress is personal, this supports stress as being dependent on individual differences, perceptions, and coping strategies that impact the individual's likelihood of experiencing and reporting stress symptoms (Cassar & Tattersall, 1998; Clarke & Cooper, 2000; Moyle, 1995). Conversely, if stressors are viewed positively through promotion-focused coping, the individual will not, by definition, experience negative outcomes (Clarke & Cooper, 2000; Zhang et al., 2019). This occurs when the individual focuses on coping behaviors aligned to achievement and growth (Zhang et al., 2019). Significant perceptions of stress can lead to personal effects such as burnout and other negative psychological outcomes (Clarke & Goetz, 1996).

Job Resources

Job resources are also social, physical, and organizational aspects but job resources alleviate job demands via work goal attainment, employee growth, and engagement (Bakker et al., 2005; Chrisopoulos et al., 2010; Demerouti et al., 2001). Job resources include autonomy, social support, safety knowledge and physical and psychosocial safety climate (Dollard & Bakker, 2010; Nahrgang et al., 2011), as shown above in Figure 4.1. Autonomy relates to how much freedom employees have in regulating work tasks, including scheduling, decision making, freely choosing their own goals, and work methods (Lee et al., 2003; Hackman & Oldham, 1976; Morgeson & Humphrey, 2006). In the safety context, autonomy provides the freedom for individuals to work as desired and positively influences goal achievement motivating the individual to perform safely and achieve safety objectives (Elliot & McGregor, 2001; Griffin & Neal, 2000; Lee et al., 2003; Nahrgang et al., 2011; Neal & Griffin, 2006).

Social support, as a job resource, refers to the amount of advice and assistance the employee receives from others (Morgeson & Humphrey, 2006). Social support reduces the psychological cost to the employee and the psychological consequences from stressful experiences and buffers the effects of burnout (Bakker et al., 2005; Cohen & Wills, 1985; Morgeson & Humphrey, 2006; Woodhead et al., 2016). Increased social support has been associated with fewer workplace injuries and reduced hazardous work events (Turner et al., 2010) and improved attitudes and well-being (Geisler et al., 2019). An additional advantage in focusing specifically on co-worker social support as a resource is that management level considerations are integrated in safety climate for both physical and psychosocial safety (Dedobbeleer & Beland, 1991; Griffin & Neal, 2000; Hall et al., 2010; Zohar, 1980).

Safety knowledge is the understanding of how to perform the work safely (Neal et al., 2000), including general health and safety knowledge and knowing how to effectively use personal protective equipment and reduce risks (Burke et al., 2002). If individuals do not understand how to work safely, they will not know how to perform the necessary behaviors (Neal et al., 2000). Therefore, employees must have high levels of safety knowledge in order to perform safely. While safety knowledge is an individual difference, it serves as a job resource given the organizational context; that is, whether or not the organization encourages and supports the acquisition and development of safety-related knowledge (Neal & Griffin, 2004). When employees possess and apply safety knowledge, they can perform safely and achieve work goals (Bakker & Demerouti, 2007; Demerouti et al., 2001). Safety knowledge also improves safety compliance and participation, and performance (Neal et al., 2000).

Safety climate refers to employees' shared perceptions of the organization's policies, procedures, and practices regarding the value and importance of physical and psychological safety within the organization and the protection of employee's physical and psychological health (Bronkhorst, 2015; Griffin & Neal, 2000; Hall et al., 2010; Zohar, 2011). This is an integrated definition that reflects the importance of physical and psychological well-being under the umbrella term, safety climate since both focus on protecting health. Physical and psychosocial safety climate are proposed as distinct job resources, given the research paths in the literature aiming to understand the relationship between the two. Psychosocial safety climate can also be further differentiated from physical safety through its association with health-related outcomes (e.g., depression and emotional exhaustion) beyond that of physical safety climate (Idris et al., 2012). Studies show that high psychosocial and physical safety climate can decrease unsafe behaviors (Hofmann & Stetzer, 1996; Yu & Li, 2020) or increase safe behaviors (Bronkhorst, 2015; Hofmann & Stetzer, 1996).

Psychosocial safety climate includes a climate of trust and respect regarding well-being (Dollard & Bakker, 2010). Organizations with a strong safety climate convey safety information effectively through training and meetings, resolve safety problems quickly, and treat safety training as an investment (Fugas et al., 2012). Law et al. (2011) found that employees reported fewer resources in organizations with low psychosocial safety climate and that psychosocial safety climate could also be considered an organizational resource as it moderates the relationship between hazards and psychological health outcomes. Furthermore, psychosocial safety climate supports employees and serves as a resource to alleviate job demands (Dollard et al., 2012).

Four domains are considered for both physical and psychosocial safety climate; 1) management support and commitment, 2) management prioritization of physical and psychological health and safety as an organizational goal, 3) organizational communication, and 4) organizational participation and involvement with health and safety personnel (Dedobbeleer & Beland, 1991; Griffin & Neal, 2000; Hall et al., 2010; Zohar, 1980). Management support and positive relationships with leaders promotes positive outcomes for employees, for example, improved job resources (Bono & Yoon, 2012; Wirtz et al., 2017) and reduced emotional exhaustion, which is a facet of burnout (Schaufeli & Van Dierendonck, 1993; Wirtz et al., 2017). Furthermore, research has shown that these factors also impact physical safety behavior (e.g., Cooper & Phillips, 2004; Neal et al., 2000; Zohar, 1980).

There is, however, ambiguity as to whether or not psychosocial safety climate is an antecedent to job demands and resources or in fact, a job resource (Dollard & McTernan, 2011;

Garrick et al., 2014). Given that psychosocial safety climate involves management support and providing an environment with resources focused on psychological well-being as well as reducing stress/hazards (e.g., bullying), psychosocial and physical safety climate is conceptualized as a job resource in the PPWS model that helps reduce job demands (Dollard & Bakker, 2010; Dollard & McTernan, 2011; Idris et al., 2012; Law et al., 2011). Additionally, positive safety climates have been found to have a positive association with engagement (Cooper & Phillips, 2004; Griffin & Neal, 2000; Hall et al., 2010; Law et al., 2011; Nahrgang et al., 2011; Neal et al., 2000; Zohar, 1980). Further to support psychosocial safety climate and physical safety climate as a job resource, Dollard et al. (2007) identified harassment and bullying as demands that cause psychological ill-health and sickness. Since psychosocial safety climate focuses on alleviating demands, for example, reducing bullying (Dollard & Bakker, 2010), those key demands (Dollard et al., 2007) are incorporated into this research via a resource pathway.

Safety Factors

Safety factors are supported as self-regulatory processes (Bandura, 1988) proposed to mediate the relationship between demands and resources and safety behaviors (Bronkhorst, 2015; Fugas et al., 2012; Neal et al., 2000). The specific processes comprising safety factors are burnout, engagement, safety motivation, safety attitude, and safety control (Fugas et al., 2012; Nahrgang et al., 2011; Neal & Griffin, 1997; Olafsen, 2017) and are derived from Bandura's self-regulation theory (SRT; Bandura, 1988), as shown in Figure 4.1. According to SRT (Bandura, 1988), thought, affect, attention, and behavioral processes move individuals towards goal setting and attainment (Hertel & Wittchen, 2008; Karoly, 1993; Latham & Locke, 1991; Mischel, 1996), maintaining well-being (Hayes, 1989; Kanfer & Karoly, 1972; Mischel, 1996; Muraven & Baumeister, 2000; Sitzmann & Ely, 2011), and reducing discrepancies between ideal and actual conditions (Johnson et al., 2013; Miller et al., 1960; Newell et al., 1958). When discrepancies are identified, individuals are motivated to take action to resolve them (Johnson et al., 2013; Miller et al., 1960; Newell et al., 1958). Applying self-regulatory processes to safety should facilitate safer working conditions. Self-regulation processes are further relevant to safety as it allows individuals to function effectively, gaining the skills and knowledge needed to stay safe (Sitzmann & Ely, 2011).

Excessive job demands have been shown to reduce employee engagement and positively relate to burnout (Chen & Chen, 2012; Nahrgang et al., 2011) as well as negatively contribute to the employee's health and well-being (Leitão et al., 2018). Conversely, job resources have consistently been found to positively relate to engagement (Halbesleben, 2010; Mauno et al., 2007; Saks, 2006; Xanthopoulou et al., 2009). In work environments where there are high physical and psychological workloads, high demands predict both physical (e.g., musculoskeletal pain) and psychological problems (e.g., depression) in employees (Airila et al., 2014). Studies have also consistently found job resources, like social support, promote positive attitudes, improved well-being and health (Bakker et al., 2014; Bliese et al., 2017), and alleviate job demands (Demerouti et al., 2001). Additionally, when coupled with low control, high demands result in stressful situations, exhaustion, and burnout (Bakker & Demerouti, 2007; Cascino & Melan, 2019; Demerouti et al., 2001; Karasek, 1979). McAllister and Perrewé (2018) found self-regulatory resources help limit aggressive behaviors and bullying, which are psychosocial safety aspects.

Safety Behaviors

Safety behaviors are focused on whether they are physical or psychosocial in nature and if they are safety participation or safety compliance (Bronkhorst, 2015; Griffin & Neal, 2000).

These behaviors are found in employee activities to create, support, and maintain physical and psychosocial safety in the workplace. Examples of physical safety behaviors include wearing personal protective equipment and operating machinery (Clarke, 2012; Griffin & Neal, 2000). Psychosocial safety behaviors, on the other hand, include updating work habits to reduce stress and creating procedures, such as incident report, to support psychosocial safety (Bronkhorst, 2015). Environments supportive of physical and psychosocial safety are created when these behaviors are valued across the organization (Bronkhorst, 2015; Griffin & Neal, 2000).

Next, physical and psychosocial safety behaviors include either safety participation or safety compliance behaviors. Behaviors such as participating in safety training or incident reports to improve safety are reflective of safety participation (Clarke, 2012; Neal et al., 2000). This is when an individual engages in safety-related activities. Safety compliance, on the other hand, is when an individual follows organization-specific safety rules, regulations, and procedures (Clarke, 2012; Neal et al., 2000). In the PPWS model, employees can be both physically and/or psychosocially compliant and/or participative. These behaviors are how individuals prevent accidents and injuries. Safety compliance directly affects accidents when a policy is followed or not followed (Clarke, 2012). That is, when an individual does not follow the proper safety procedures (safety compliance), it may directly cause an accident (Clarke, 2012; Neal & Griffin, 2006). Participating in safety-related activities (safety participation) does not directly prevent accidents or lack of participation does not directly cause an accident (Clarke, 2012; Neal et al., 2000).

An individual's engagement in being safety compliant is impacted by the extent to which an organization prioritizes safety, relative to other organizational goals (Zohar, 2000). Both physical and psychosocial safety climate influence the engagement in safety behaviors

(Bronkhorst, 2015). Autonomy, supportive environment, psychosocial safety climate, and physical safety climate have all been identified as positive predictors of physical and psychosocial safety behaviors. For example, when employees face high work pressure, they are less likely to use safety equipment or initiate incident reporting (Bronkhorst, 2015). This further supports the proposed model extension of having safety climate and job resources as antecedents to safety behavior.

Burnout negatively relates to goal attainment (i.e., safety behaviors; Olafsen, 2017). Burnout is associated with both negative physical and psychological injuries and outcomes (Zadow et al., 2016) such as fatigue, metabolism functions (Everly & Lating, 2019), or depression (Hakanen, Schaufeli, & Ahola, 2008). Safety motivation was found to have a direct relationship with safety behaviors as an individual's desire to perform the behaviors increased with higher levels of safety motivation (Griffin & Neal, 2000; Neal et al., 2000). Safety motivation was identified as one of the three determinants of safety performance, along with knowledge and skill (Griffin & Neal, 2000), through the meaning found in work environments (James & James, 1989) and is supported as a mediator between climate and safety behaviors (Griffin & Neal, 2000; Neal et al., 2000). Neal et al. (2000) found that when individuals have safety knowledge but are missing motivation, that individual is less like to behave safely.

Fugas et al. (2012) also proposed safety attitudes and control influence safety behavior. Perceived control directly impacts safety behavior as sometimes employees may feel procedures and rules are beyond their control, reducing the degree to which they are capable of and have the support needed to perform the behavior (Fugas et al., 2012). Individuals with positive safety attitudes are less like to experience or be involved in an accident (Barling et al., 2002; Clarke, 2006; Gillen et al., 2002; Hofman & Stetzer, 1996; Zohar, 2000). Further support for safety factors is found in the Theory of Planned Behavior (Ajzen, 1991) where positive attitudes towards workplace safety may promote greater intentions for safety compliance.

Control refers to individuals believing they have the capabilities, resources, and opportunities to perform safely (Ajzen, 2002; Fugas et al., 2012). This derived through self-knowledge (Bandura, 1988). Control theories and self-regulation have been linked since 1982 (Carver & Scheier). When an individual perceives control, they choose to work safely (Fugas et al., 2012).

Safety behaviors were selected as the outcome variable as they are leading indicators of safety performance (Beus et al., 2016). Lagging indicators of safety, such as accidents and fatalities, depend on safety behaviors. Accidents and fatalities occurring indicates poor safety but the lack of occurrence does not necessarily indicate the presence of safety (Beus et al., 2016; Wallace et al., 2012). The measure for physical safety participation and compliance (Griffin & Neal, 2000) was extended and adapted to include psychosocial safety. This balances both physical and psychosocial safety behaviors in the model and acknowledges them as critical outcomes.

> ***Hypotheses****:* Burnout, employee engagement, safety motivation, safety attitude, and safety control, i.e., the safety factors, fully mediate the relationships between job demands and job resources with safety behaviors. The specific relationships are presented in Figure 4.2.

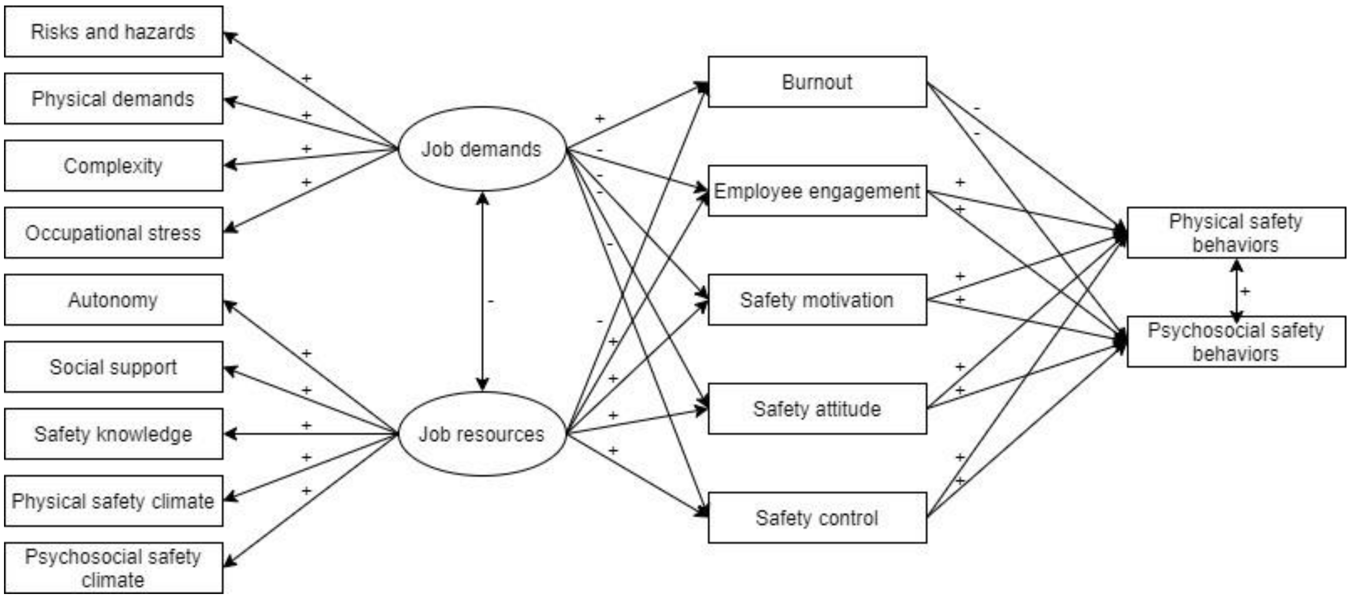

Figure 4.2. Hypothesized relationships for full mediation PPWS model

The measurement model for the PPWS model was previously identified through a series of confirmation factor analyses (CFA) in Chapter 3 of this thesis. The model was divided into four components, job demands, job resources, safety factors, and safety behaviors. This established the final factor structure. Study 1 of this Chapter focuses on assessing the full structural model.

Method

Convenience and snowball sampling techniques were initially applied to recruit participants. High-risk industries and occupations, for example, mining, construction, and agriculture, were targeted across the US and Australia. Personal and professional networks were leveraged to identify organizations. Additionally, organizations were contacted directly requesting participation. Six randomly drawn $50 USD or AUD gift cards were offered as an incentive. Three gift cards were given to each country. This sampling technique resulted in 26.95% (*n* = 235) of the total sample. Therefore, the paid service, Mechanical Turk (Mturk;

Amazon Mechanical Turk, 2018), was leveraged. Participants recruited via Mturk were not offered any additional incentives beyond compensation for their time. Criteria to participate included location (US or Australia) and currently employed. The survey was hosted in Qualtrics with participants able to participate via a computer, tablet, or mobile phone. All data were anonymous. Mturk payment information is housed through Mturk and incentive information, if participants opted to participate, was a separate Qualtrics survey with the data stored separately.

Participants were recruited in either the US (93.61%) or Australia (5.63%) with .76% not indicating location. Participants selected into the follow age ranges: 27-35 (30.96%), 36-44 (22.77%), 45-53 (19.78%), 18-26 (17.55%), 54-62 (7.66%), and 63 or older (1.28%). The majority of participants (85.44%) responded “White or Caucasian,” 7.54% responded “Black or African American,” 4.78% responded “Asian (e.g., Asian Indian, Filipino, Japanese, Korean, Vietnamese, or other Asian),” .85% responded “American Indian or Alaska Native,” .53% responded “Pacific Islander (e.g., Native Hawaiian, Guamanian, Chamorro, or other Pacific Islander),” and .85% did not indicate. Furthermore, 9.35% identify as Hispanic, Latino, or Spanish origin and 1.06 % identify as Aboriginal or Torres Strait Islander origin. As for marital status, 50.48% of participants indicated they are married, 21.79% selected single, 18.59% said they are not married, but in a relationship, 8.29% are divorced, .53% are widowed, and .32% opted not to respond. Last, participants indicated their industry or occupation, which is shown below in Table 4.1.

Table 4.1

Participant (n = 941) demographics by industry

Industry	*n*	%
Other	337	35.82

Public Sector	214	22.74
Education	151	16.05
Healthcare	114	12.11
Construction	58	6.16
Warehousing	38	4.04
Transportation	20	2.13
Agriculture	5	.53
Mining	4	.43

Additionally, 328 of the 337 participants who selected "Other" provided additional information on industry or occupation. That information is included below in Table 4.2.

Table 4.2

Other industry breakdown (n = 328)

Industry	*N*	%
Professional Services	166	50.61
Retail & Customer Services	55	16.77
Hospitality	44	13.41
Public Sector	21	6.40
Industrial Services	16	4.88
Media/Communications	10	3.05
Non-profit	3	.91
Security Services	3	.91

Looking at the descriptive statistics, there is overwhelming participation from the United States versus Australia. This is expected given there are approximately 150 million more people employed in the United States than Australia (ABS, 2021; BLS, 2021). However, this may impact potential response patterns due to cultural differences and workplace policies. The Occupational Safety and Health Administration (OSHA) sets and enforces healthy working condition standards in the United States (OSHA, 2021), while Safe Work Australia is responsible for Australian national policy around workplace health and safety and workers' compensation (Safe Work Australia, 2021a). The differences in policy and organizational culture impact and guide employee behavior (Schein, 2010), which includes safety behavior.

Age is also another factor that could impact responses. The majority of participants have several years of workplace experience. This study did not capture if all work experience is in high-risk industries. The more time spent in a high-risk environment, the more awareness the individual has of the safety concerns. Their motivation and attitude could also have been shaped by their workplace (Herzberg et al., 2017), thus impacting safety behaviors.

Procedure

Study 1 examines the structural model of the PPWS model with cross-sectional data. Participants responded to measures of risks and hazards, physical demands, complexity, occupational stress, autonomy, social support, safety knowledge, physical safety climate, psychosocial safety climate, burnout, engagement, motivation, attitude, control, and safety behaviors. Participants took, on average, 32 minutes to complete the survey. There was no randomization, all participants completed the same survey with the same items in the same order. Before conducting this research and administering the measures, ethics approval was obtained.

Measures

Measures for the variables, risks and hazards, physical demands, complexity, occupational stress, autonomy, social support, safety knowledge, physical safety climate, psychosocial safety climate, burnout, engagement, motivation, attitude, control, and safety behaviors, are described below. Chapter 3 details any items removed from the exploratory factor analysis (EFA) and CFA process. Participants responded to all survey items using a 5-point Likert scale (from 1 = "Strongly disagree" to 5 = "Strongly agree") unless otherwise indicated below.

Job Demands

Risks and hazards. Five items from the Work Design Questionnaire (WDQ, α = .87; Morgeson & Humphrey, 2006) were used to measure risks and hazards. Additionally, three items, "There is a high risk of accidents in this job," "Overall, this job has more risks than others" and "This job is dangerous," were added to capture risks and hazards more thoroughly. Three items were removed during the EFAs and CFAs: "The climate at the work place is comfortable in terms of temperature and humidity," "The job takes place in an environment free from health hazards (e.g., chemicals, fumes, etc.)," and "The job occurs in a clean environment." Higher levels of agreement indicated a higher perceived presence of risks and hazards.

Physical demands. The WDQ (Morgeson & Humphrey, 2006) contained three items used to measure physical demands (α = .95). One item was removed, "This job requires a great deal of muscular endurance" due to the focus on sustained effort. No items were reverse coded and higher levels of agreement indicate higher levels of physical demands. No items were removed from the EFAs or CFAs.

Complexity. Complexity was measured with four items (α = .87) from the WDQ (Morgeson & Humphrey, 2006). One item was removed, "The job comprises relatively uncomplicated tasks," with three items being retained. All three items were reverse coded so that higher levels of agreement were indicative of higher perceived complexity. All three items were also retained in post-EFAs and CFAs.

Occupational Stress. Occupational stress was assessed with the eight-item Stress in General Scale (SIG, α = .78; Yankelevich et al., 2010). Participants responded with either 1 = "yes", 2 = "no", or 0 = "?/Cannot decide." One item, "Calm", was reverse coded. A higher score indicated higher levels of occupational stress. Four items were removed during the EFAs and CFA process: "Demanding," "Calm," "Many things stressful," and "Overwhelming."

Job Resources

Autonomy. Three items from the WDQ were used to measure autonomy (α = .85; Morgeson & Humphrey, 2006) with higher scores reflecting higher autonomy. No items were reversed. All three items were retained after the factor analyses.

Social Support. Six items from the WDQ (Morgeson & Humphrey, 2006) were used to measure social support (α = .82). No items were reversed coded and higher levels of agreement indicated higher social support. All six items were retained for the structural model.

Safety knowledge. Four items were used to measure safety knowledge (α = .73, Griffin & Neal, 2000). Participants responded to the items using a 7-point Likert scale (from 1 = "Strongly disagree" to 7 = "Strongly agree"). One item, "I do not know how to reduce the risk of accidents and incidents in the workplace," was reverse coded and subsequently removed during the factor analyses. Higher levels of agreement reflect greater levels of safety knowledge.

Physical and Psychosocial Safety Climate. Psychological health and safety were measured using the Psychosocial Safety Climate (PSC-12; Hall et al., 2010) scale. Four factors were measured; organization participation (α = .80), organizational communication (α = .77), management priority (α =.90), and management commitment (α = .88; Hall et al., 2010).

For physical health and safety, the PSC-12 was adapted. PSC-12 has previously been adapted for physical safety climate by Bronkhorst (2015) and Idris et al. (2012). Two items were not adaptable and were removed, “In my organization, the prevention of stress involves all levels of the organization” and “Senior management show support for stress prevention through involvement and commitment,” resulting in a 10-item scale. The same four factors were measured; organization participation (α = .86), organizational communication (α = .91), management priority (α =.87), and management commitment (α = .89; Bronkhorst, 2015). No items were reversed and all items were retained after the factor analyses.

Safety Factors

Burnout. The 10-item Burnout Measure: Short Version (α = .92; Malach-Pines, 2005). The Burnout Measure: Short Version (Malach-Pines, 2005) was used to assess participants’ level of burnout. Participants responded to a 7-point response scale (from 1 = “Never” to 7 = “Always). No items were reverse coded and higher scores indicated a higher level of perceived burnout. All items were retained after the factor analyses and are used in this study.

Engagement. Engaged employees are shown to have an affective connection with their organization (Bakker et al., 2008). Therefore, the 18-item Affective (α = .85), Continuance (α = .83), and Normative (α = .77) Commitment Scale (Allen & Meyer, 1990; Meyer et al., 1993) was used to measure engagement. Participants responded to all survey items using a 7-point Likert scale (from 1 = “Strongly disagree” to 7 = “Strongly agree”). The four negatively worded items were reversed for analyses. Six items were reduced in the factor analysis across the three facets; “I would be very happy to spend the rest of my career with this organization,” “I really feel as if this organization’s problems are my own,” “This organization has a great deal of personal meaning for me,” “Right now, staying with my organization is a matter of necessity as much as desire," "If I had not already put so much of myself into this organization, I might consider working elsewhere," and "I do not feel any obligation to remain with my current employer."

Safety motivation. Safety motivation was measured with three items (α = .86**;** Neal et al., 2000; Neal & Griffin, 2006). No items were reverse coded and higher levels of agreement indicated greater levels of safety motivation. All three items were retained after the factor analyses.

Safety attitudes. Davis et al. (2002) used a series of evaluative semantic differential scales to measure attitudes in students around their intention to complete the year. The semantic differential scales were adapted by Fugas et al. (2012) to measure attitudes towards safety (α = .76). This resulted in three evaluative semantic differential scales with the anchors *detrimental-beneficial, irrelevant-relevant,* and *inappropriate-appropriate.* No items were reverse coded and all three were retained in the factor analyses.

Safety control. Safety control was assessed with an adaption of Conner and McMillian's (1999) measure of perceived behavioral control (Fugas et al., 2012). The composite reliability score was .59 and items were scored on a 7-point response scale. Anchors varied depending on the item; *very little control-complete control, extremely difficult-extremely easy,* and *strongly disagree-strongly agree.* Higher scores indicated a higher sense of perceived safety control and no items were reverse coded. All three items were retained in the factor analyses and are used in this study,

Safety Behaviors

Safety behavior. Physical safety compliance (α = .94) and participation (α = .89) are measured with six items, three items for each facet (Griffin & Neal, 2000; Neal et al., 2000; Neal

& Griffin, 2006). The items focus on physical safety behaviors. Therefore, the scales were adapted to measure psychosocial behaviors (Bronkhorst, 2015). No items were reversed and higher scores indicated higher levels of safety behaviors. The factor analyses did not support psychosocial safety participation. Therefore, the three items measure psychosocial safety participation, "I promote the psychological safety program within the organization," "I put in extra effort to improve the psychological safety of the workplace," and "I voluntarily carry out tasks or activities that help to improve workplace psychological safety," were removed for this study.

Statistical Analyses

The measurement models were previously established following the steps to complete EFAs and CFAs. This study tests the full structural model. The PPWS was addressed through structural equation modelling (SEM) as a confirmatory technique (Schreiber et al., 2006) using scale scores calculated in SPSS through the Mean function. Model fit was determined with root mean square error of approximation (RMSEA; Steiger, 1990) with 90% confidence intervals. Tucker-Lewis index (TLI; Tucker & Lewis, 1973) and comparative fit index (CFI; Bentler, 1990) were also reported to indicate overall incremental model fit. TLI and CFI should be greater than .90 and RMSEA, and its 90% confidence interval, should be below .80. However, SRMR, when chi-sq is rejected, indicates approximate fit with a coefficient of less than .08 (Hu & Bentler, 2009; Kline, 2016)

Results

Descriptive Statistics and Correlations

The descriptive statistics and correlations for the measures are shown below in Table 4.3. The correlations partially support the PPWS model and the underlying premise for (or logic for) the mediations. Physical demands, complexity, occupational stress, autonomy, social support, safety knowledge, psychosocial safety climate, physical safety climate, burnout, employee engagement, safety motivation, safety attitudes, and safety control have significant correlations with either or both psychosocial safety behaviors and physical safety behaviors. Risks and hazards is the only measure to not significantly correlate with either type of safety behaviors. It is also worth noting that physical demands was the only job demand to have a significant relationship with physical safety behaviors.

Table 4.3

Descriptive Statistics (n = 941)

Measure	*M*	*SD*	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. Risks and hazards	2.69	1.30	(.85)															
2. Physical demands	2.70	1.29	.72**	(.93)														
3. Complexity	3.48	1.01	.22**	.06	(.90)													
4. Occupational stress	1.38	.45	.18**	.12**	.23**	(.63)												
5. Autonomy	3.33	1.09	-.26**	-.18**	-.15**	-.25**	(.88)											
6. Social support	3.94	.82	.10**	.16**	.08**	-.05	.14**	(.86)										
7. Safety knowledge	4.21	.66	-.06	.05	.08*	-.09**	.18**	.33**	(.86)									
8. Psychosocial safety climate	3.15	.93	-.11**	-.01	-.20**	-.31**	.35**	.24**	.24**	(.95)								
9. Physical safety climate	3.37	.92	-.07*	.05	-.16**	-.29**	.32**	.32**	.35**	.78**	(.95)							
10. Burnout	3.08	1.19	.14**	.05	.10**	.45**	-.22**	-.26**	-.25**	-.40**	-.37**	(.92)						
11. Safety motivation	4.29	.64	.05	.06*	.13**	.02	.05	.33**	.61**	.13**	.23**	-.14**	(.83)					
12. Employee engagement	4.28	1.21	-.04	.07*	-.04	-.18**	.24**	.27**	.21**	.51**	.52**	-.34**	.10**	(.73)				
13. Safety attitudes	4.25	.82	.22*	.28**	.05	-.03	-.04	.22**	.36**	.28**	.35**	-.16**	.41**	.18**	(.87)			
14. Safety control	4.03	.75	-.17**	-.04	-.15**	-.15**	.21**	.19**	.41**	.29**	.35**	-.29**	.34**	.23**	.43**	(.60)		
15. Psychosocial safety behaviors	4.79	1.22	-.05	.07*	-.22**	-.13**	.23**	.23**	.29**	.54**	.43**	-.27**	.23**	.35**	.29**	.27**	(.91)	
16. Physical safety behaviors	5.32	1.06	.03	.13**	-.00	-.02	.10**	.27**	.53**	.34**	.42**	-.19**	.54**	.33**	.45**	.37**	.56**	(.87)

Note. Cronbach's alpha is on the diagonal, $*p < .05$, $**p < .01$.

Inferential Statistics

Missing data were identified at approximately 11% which is below the common missing rate of 15% to 20% (Enders, 2003). Data were Missing Completely at Random as Little's (1988) test failed to achieve significance, $\chi 2$ (1996) = 2094.34, p = .06. Since the data was MCAR, Expectation-Maximization, a form of maximum likelihood estimation, was used to generate the new data set with missing values replaced by estimated value through maximizing the complete data log likelihood function (Dempster et al., 1977). The value of EM for missing data is the estimator is unbiased (Graham, 2003), simple (Dempster et al., 1977), stable (Couvreur, 1996), straightforward (Dong & Peng, 2013), and more efficient than other methods requiring simulations (Dong & Peng, 2013).

The base structural model, as shown in Figure 4.3, was assessed with both direct and indirect effects. Residual variances and R^2 for full model are shown in Table 4.4 along with the correlations for safety factors. The residual variance indicates that which is unexplained by the dependent variable (Ullman & Bentler, 2013). R^2 indicates the amount of variance explained by the sample (Kline, 2016). These provide additional understanding of model fit beyond the fit indices. Regarding model fit, TLI, CFI, and RMSEA, through all models, failed to achieve good model fit per generally acceptable cut-offs and was identified to be mis-specified. Each model and model fit indices are shown below in Table 4.5. Structural model changes were made based on theory- and data-driven decisions meaning the modification indices were assessed for data-driven updates and as supported by the theory, were added or removed from the model (Kline, 2016).

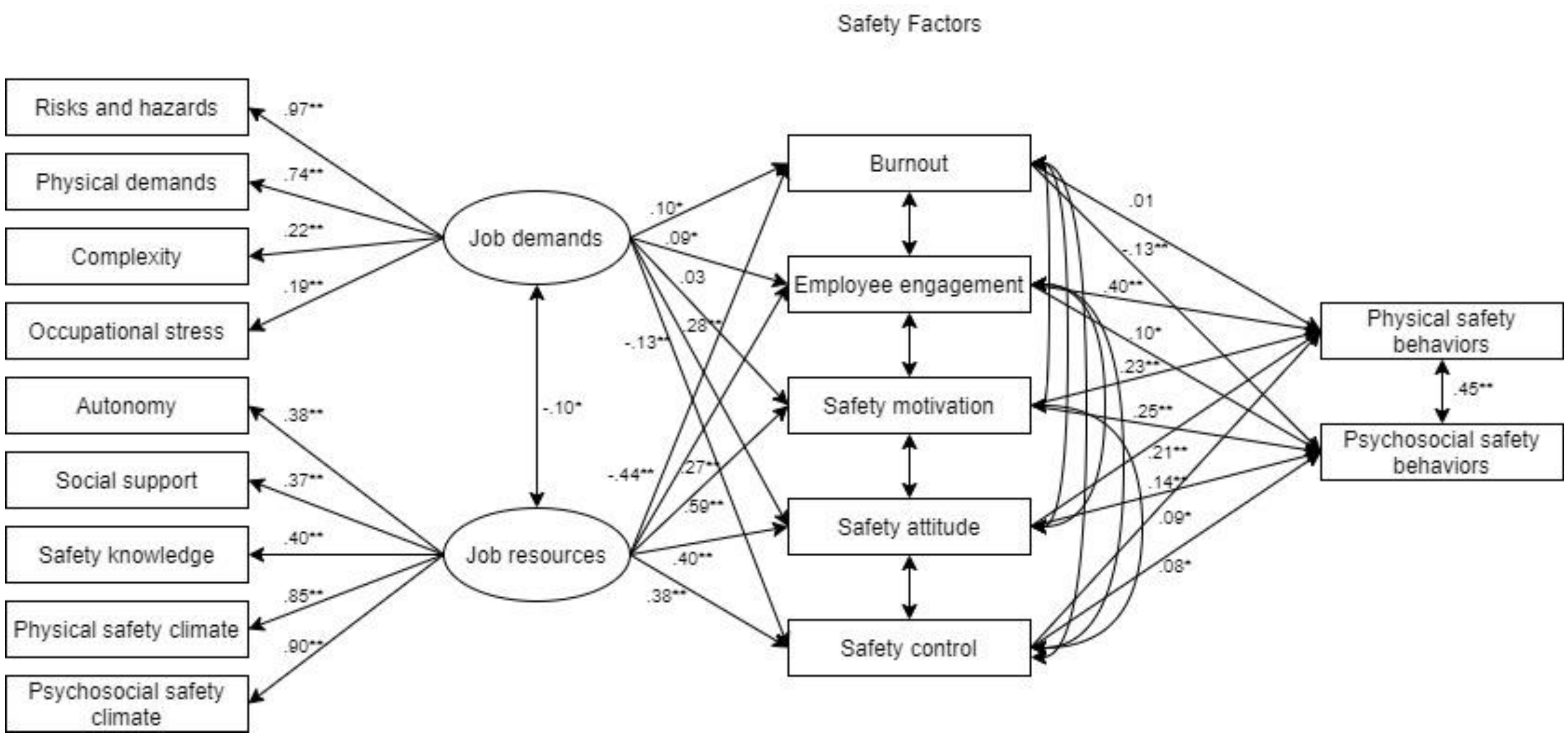

Figure 4.3. Base structural model with standardized loadings results, *$p < .05$, **$p < .01$

Table 4.4

Residual variances and R^2 for base model, correlations for safety factors

Construct	Residual variance	R^2	Burnout	Employee engagement	Safety motivation	Safety attitude	Safety control
Risks and hazards	.07	.93**					

Physical demands	.45	.55**					
Complexity	.95	.05*					
Occupational stress	.96	.04*					
Autonomy	.86	.14**					
Social support	.86	.14**					
Safety knowledge	.84	.16**					
Physical safety climate	.28	.72**					
Psychosocial safety climate	.19	.81**					
Burnout	.79	.21**	-				
Employee engagement	.92	.08**	-.04	-			
Safety motivation	.65	.35**	-.11*	-.08*	-		
Safety attitude	.78	.22**	-.03	.34**	-.07	-	
Safety control	.83	.17**	-.12*	.29**	.00	.39**	-
Psychosocial safety behaviors	.79	.21**					
Physical safety behaviors	.58	.42**					

Note. * indicates significance at the .05 level, ** indicates significance at the .001 level

Table 4.5

Time 1 (n = 941)

Iteration	*df*	χ^2	RMSEA [90% CI]	CFI	TLI	SRMR	Model fit
1: Base model	79	1178.26	.12 [.12, .13]	.76	.63	.11	Almost adequate
2: Removed correlations between burnout and (a) employee engagement and (b) safety attitude and between safety motivation and (a) safety attitude and (b) safety control	83	1187.40	.12 [.12, .13]	.76	.65	.11	Almost adequate

3: Added positive correlation between psychosocial safety climate and physical safety climate	82	1194.49	.12 [.11, .13]	.76	.64	.10	Almost adequate
4: Removed correlations between burnout and (a) safety motivation and (b) safety control and employee engagement and (a) safety attitude and (b) safety control	86	1140.46	.11 [.11, .12]	.77	.67	.10	Almost adequate
5: Added correlation between physical demands and risks and hazards	85	995.96	.11 [.10. .11]	.80	.72	.09	Almost adequate
6: Removed path from job demands to safety motivation	86	992.63	.11 [.10, .11]	.80	.72	.09	Almost adequate
7: Removed path from job demands to safety control	87	987.24	.11 [.10, .11]	.80	.73	.09	Almost adequate
8: Added path from psychosocial safety behaviors to safety motivation	86	917.43	.10 [.10, .11]	.82	.74	.08	Almost adequate
9: Added correlation between physical safety climate and safety knowledge	85	862.26	.10 [.10, .11]	.83	.76	.08	Almost adequate
10: Added correlation between stress and risks and hazards	84	832.03	.10 [.09, .10]	.83	.76	.08	Almost adequate
11: Added correlation between psychosocial safety climate and safety knowledge	83	812.36	.10 [.09, .10]	.84	.77	.08	Almost adequate
12: Removed paths from safety control to physical and psychosocial safety behaviors	84	813.33	.10 [.09, .10]	.84	.77	.08	Almost adequate

13: Added path from physical safety behaviors to safety motivation	84	805.11	.10 [.09, .10]	.84	.77	.08	Almost adequate
14: Removed path from burnout to psychosocial safety behaviors	85	806.91	.10 [.09, .10]	.84	.77	.08	Almost adequate
15: Added correlation between complexity and risks and hazards	84	791.49	.10 [.09, .10]	.84	.78	.08	Almost adequate
16: Added correlation between physical safety climate and autonomy	83	777.70	.09 [.09, .10]	.85	.78	.08	Almost adequate
17: Added correlation between psychosocial safety climate and autonomy	82	762.92	.09 [.09, .10]	.85	.78	.08	Almost adequate
18: Removed correlation between safety knowledge and complexity	81	749.74	.09 [.09, .10]	.85	.78	.08	Almost adequate
19: Removed correlation between social support and complexity	80	738.75	.09 [.09, .10]	.85	.78	.08	Almost adequate

Chapter 4: Assessing the structural model

Based on models 1 through 18, model 19 was the final model and model fit identified almost adequate fit, x^2 (80, n = 941) = 738.75, $p < .001$, SRMR = .08, TLI = .78, CFI = .85, RMSEA = .09 [.09, .10]. Model 19 reflects an accumulation of all modifications and changes, as outlined above in Table 4.5. However, the model was still mis-specified as identified in Table 4.5. The final structural model is shown below in Figure 4.4. Safety motivation has a bidirectional relationship with both types of safety behaviors. The loading for safety motivation as a predictor of physical and psychosocial safety behaviors are .70 and .86, respectively. The loading for physical safety behavior as a predictor of safety motivation is -.55 and psychosocial safety behavior as a predictor is -.69. Residual variances and R^2 for final model are shown below in Table 4.6.

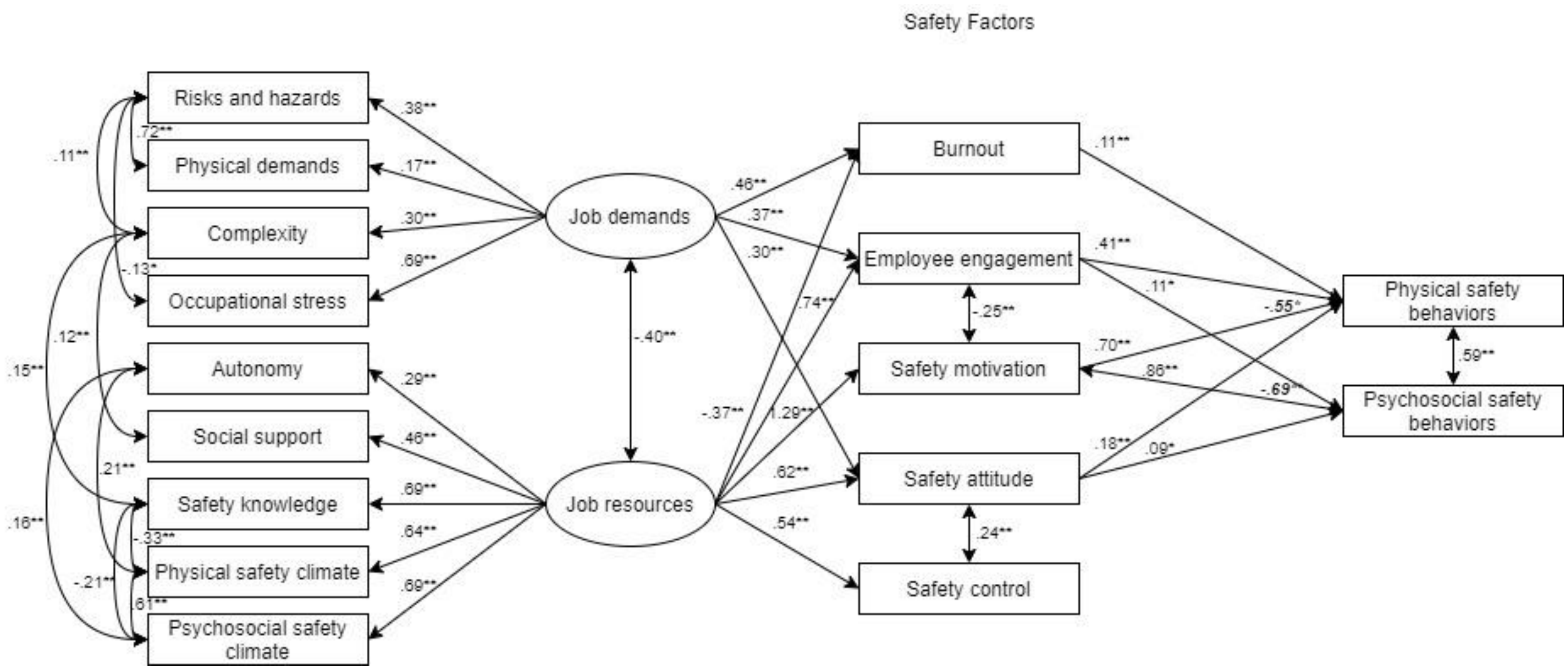

Figure 4.4. Model 19, final PPWS model for Study 1 with standardized results, *$p < .05$, **$p < .01$. Physical safety behavior and psychosocial safety behavior, as predictors of safety motivation, are indicated by bold and italics.

Table 4.6

Residual variances and R^2 for final model

Construct	Residual variance	R^2
Risks and hazards	.86	.14**
Physical demands	.97	.03
Complexity	.91	.09**
Occupational stress	.52	.48**
Autonomy	.91	.09**
Social support	.79	.21**
Safety knowledge	.53	.47**
Physical safety climate	.59	.41**
Psychosocial safety climate	.53	.47**
Burnout	.58	.42**
Employee engagement	.54	.46**
Safety motivation	1.38	undefined
Safety attitude	.68	.33**
Safety control	.71	.29**
Psychosocial safety behaviors	1.11	undefined
Physical safety behaviors	.78	.22**

Note. * $p < .05$, ** $p < .01$
Undefined elements are aligned to bi-directional relationships between safety motivation and psychosocial safety behaviors.

Study 1 Discussion

The intent of Study 1 was to validate the proposed framework for the PPWS model. The results provided tenuous support. The residual variances and undefined R^2 suggested the model could be mis-specified (Ullman & Bentler, 2013). Although almost adequate model fit was obtained, Study 2 will hopefully improve model fit of the PPWS model with deeper understanding from an additional data set.

Starting with job demands, all four indicators (risks and hazards, physical demands, complexity, and stress) were supported as indicators of the latent variable. However, physical demands had weak but significant factor loading and a low R^2, which failed to achieve significance. The findings suggest the potential for different job demands to be considered in subsequent studies. Next, autonomy, social support, safety knowledge, physical safety climate, and psychosocial safety climate were supported as indicators of the latent variable, job resources. Autonomy was also identified as a weak but significant factor. As shown in Figure 4.4, several correlation paths were added between the indicators. These paths indicate the correlations between errors or that the correlation between the unexplained variance of two variables (Kline, 2016; Ullman & Bentler, 2013). While correlations were predominately added within each latent variable (e.g., risks and hazards correlated with physical demands), there were some correlations between the latent variables (e.g., risks and hazards with autonomy). The relationship between job demands and job resources supports this as a theory-driven addition. The exact correlation paths added were based on modification indices. Specifically, job demands and resources are social, physical, and organization aspects of the job (Bakker & Demerouti, 2007). Previous research supports that job demands may become negative over time through continued exertion impacting health and well-being, while job resources are supporting factors that alleviates the negative impact (Bakker & Demerouti, 2007; Idris & Dollard, 2011; Nahrgang et al., 2011). Given the relationships between job demands and resources, it is possible the indicators would correlate and impact each other. Additionally, the error associated with measuring those indicators might also be correlated. The model adjustments were limited to correlations for this study despite the modification indices suggesting that indicators of job demands are also indicators of job resources and vice versa, as this is not supported by theory. This suggests that instead of job demands and resources, there may be an underlying construct or enough similarity between the indicators to reconsider the structure.

The next component of the structural model focuses on job demands and job resources as predictors of burnout, employee engagement, safety motivation, safety attitude, and safety control. Job demands and resources had the expected relationships with burnout. Job demands were expected to have a positive path with burnout while job resources has a negative path. This is because job demands can negatively impact health and well-being, if not mitigated, leading to burnout (Bakker & Demerouti, 2007; Idris & Dollard, 2011; Nahrgang et al., 2011). When mitigated by job resources, burnout is not experienced. Safety factors, such as burnout, can be conceptualized as either static or dynamic and, for the PPWS model, were conceptualized as static.

The inverse was expected for employee engagement, safety motivation, safety attitude, and safety control. Job demands would be a negative predictor of employee engagement, safety motivation, and safety attitude; that is, the more an individual experiences job demands, the less engaged or motivated and more negative attitude that individual would have. Job demands was not supported as a significant predictor of safety motivation or safety control and was identified as a positive predictor of employee engagement and safety attitude. Predictor is being used to refer to significant correlates on the basis that their inclusion in the model was determined by the body of evidence supporting their predictive relationships. Given that job demands are not inherently negative, but may take time to be perceived as such, perhaps individuals find job demands to be supportive of a positive attitude. This is supported in part by the evidence concerning stress. Studies found that stress, as an individual difference, is only negative when coping strategies fail and the individual perceives stress as a negative. Otherwise, the individual will not experience negative outcomes (Clarke & Cooper, 2000; Cox et al., 2000; Zhang et al., 2019). If individuals have enough job resources to mitigate the potential negative effects of job demands, they would not experience job demands negatively. Additionally, the sample for this research focuses on high-risk industries. These often involve self-selection in roles that are inherently more demanding or risky (e.g., fire fighters; Krčál et al., 2019) so individuals could have a higher tolerance for job demands and seek out opportunities with higher demands. In fact, personality may impact which roles an individual seeks out, including those with higher demands (Bakker et al., 2010; Roczniewska & Bakker, 2016).

It was also surprising to find that job demands were not supported as a predictor of safety control. Job demands and control have been relevant in the literature since the introduction of Karasek's (1979) model of job strain. The model of job strain explores mental strain based on the interaction of job demands and job decision latitude. Job decision latitude aligns with perceived job control (Almroth et al., 2021). Lastly, job resources were supported as a positive predictor of engagement, motivation, attitude, and control, as anticipated.

Safety control failed to have a significant relationship with either physical or psychosocial safety behaviors. Per the proposed structural model, safety climate should mediate the relationships between job demands and job resources with safety behaviors. Fugas et al. (2012) found support for perceived control as a mediator of organizational safety climate and compliance safety behaviors. This study failed to support similar findings. One explanation could be the items and approach used to measure safety control. The items were an adaption of Conner and McMillian's (1999) measure of perceived behavioral control. Reliability in both the initial adaptation for safety control (Fugas et al., 2012) and the current study were lower than ideal. The reliabilities were acceptable from an exploratory standpoint, but as this is continued to be explored, an improved measure is needed for safety control. Once that is established, safety control as a mediator of job demands and resources with safety behaviors should be reconsidered. Another possibility is the conceptualization of safety behaviors. This study divided safety behaviors based on if they were physical or psychosocial in nature. Perhaps, given there are safety participation and safety compliance for each, the focus should be on the type of the behaviors. The groupings would be based on whether the behaviors are participative or compliance-oriented. Additionally, the measure (Griffin & Neal, 2000; Neal et al., 2000; Neal & Griffin, 2006) used for safety behaviors was designed to capture physical safety participation and compliance. The measure of psychosocial safety behavior was adapted to include psychosocial safety. Alternatively, for future research, a new measure designed for psychosocial participation and compliance could add value and clarity around safety behaviors.

Continuing with safety behaviors, burnout was expected to negatively affect safety behaviors. In contrast, employee engagement, safety motivation, and safety attitude were expected to have positive relationships. First, burnout was not supported as a predictor of psychosocial safety behaviors, only physical safety behaviors with a weak but significant and positive path. Nahrgang et al. (2011) determined that burnout was positively related to accidents, injuries, and adverse events. Given safety behaviors are conceptualized as behaviors to prevent accidents, injuries, and adverse events, this supports a negative relationship between burnout and safety behaviors. Furthermore, burnout has consistently been supported as negatively impacting individual's health and performance, including preventing individuals from completing work-related tasks and behaviors (Bakker et al., 2004**;** Hakanen & Schaufeli, 2012; Maslach et al., 2001; Muhamad Nasharudin et al., 2020; Schaufeli & Bakker, 2004; Taris, 2006). Therefore, it was unexpected for burnout to have a positive path with physical safety behaviors. One potential explanation for this finding could relate to an individual having a proactive personality (Bateman & Crant, 1993). Individuals with a proactive personality will engage in proactive behaviors and change their environment through identifying opportunities and taking initiative (Crant, 1995). This allows these individuals to manage their stress and take action, as needed, to reduce stress (Bakker & de Vries, 2021). This suggests that if an individual is experiencing burnout, they would proactively seek out safety behaviors to reduce their negative experiences. As for not finding a supported path with psychosocial safety behaviors, more research is needed in this area to better understand the implications of this finding as higher levels of burnout have consistently been linked to reduced well-being (Lizano, 2015). Further considerations of the relationship are discussed below in relation to Study 2, see Figure 4.6 and Study 2 Discussion.

The next unexpected finding regarding safety behaviors was the relationship with safety motivation. The modification indices suggested adding paths from physical and psychosocial safety behaviors to safety motivation. This makes the relationship bidirectional and creates a feedback loop. Upon this addition, the final model supported higher safety motivation with improved safety behaviors but improved safety behaviors with lower safety motivation. That is, safety motivation has a positive relationship with safety behaviors, but safety behaviors have negative paths with safety motivation. Safety motivation has predominately been explored as an antecedent to safety behaviors (Griffin & Neal, 2000; Neal et al., 2000). Study 2 will explore this relationship further. One possible explanation is found in the theory of planned behavior which details the interaction of motivation (intention), attitudes, and control to explain behaviors (Ajzen, 1991). When looking at past behaviors, the repetition of behaviors can lead to the development of a habit. Habits are then performed repeated over time without the same need for motivation as non-habitual behaviors (Ajzen, 1991). If an individual is repeatedly performing the same safety behaviors, the theory of planned behaviors suggests that over time, the safety behaviors would become habitual, thus, requiring lower levels of motivation. Another possible explanation is focused on individuals being safety compliant. Safety compliance refers to the activities that individuals perform to sustain a safety workplace. These activities align to policies and procedures that must be maintained. On the other hand, safety participation refers to voluntary behaviors and individual may participate in (Griffin & Neal, 2000). Griffin and Neal found motivation to participation has a stronger path estimate than motivation to safety compliance. This could suggest that some motivation is needed for behaviors that have to be performed but less motivation than that driving voluntary engagement in safety behaviors. One last consideration is employee type. This sample did not capture information on if employees were permanent or temporary. Luria and Yagil (2010) found that temporary employees focused more on safety aspects such as safety knowledge, safety behaviors, and reactions to safety disciplines while permanent employees concentrated more on leadership, training, and perceived importance of safety. Temporary employees may not trust organizations the organizations to keep them safe and may prefer relying on themselves, thus, impacting motivation (Clarke, 2003; Luria & Yagil, 2010).

Otherwise, employee engagement and safety attitude aligned as expected with physical and psychosocial safety behaviors with weak but significant paths. Study 2 will provide additional insights into the relationships and potentially support for the foundation laid in Study 1.

Study 2

Study 2 focused on establishing the stability of the model identified in Study 1 with a different data set and working towards a specified model.

Method

Convenience and snowball sampling techniques were used to recruit participants in high-risk industries such as construction, police, and warehousing across the US and Australia. The same process was taken as in Study 1. These participants were offered the opportunity to win a randomly selected gift card as an incentive for participation. Six $50 gift cards were offered with three for each country. This resulted in 208 responses. To increase sample size, payment was offered through Mturk (Amazon Mechanical Turk, 2018) for responses. Mturk participants were not offered any additional incentives beyond compensation for their time. To qualify as a Mturk participant, criteria was set to Australia or the US and currently employed. This resulted in an additional 248 participants or 54.39% of the total sample size. All participants participated in an online survey hosted on Qualtrics on their computer, cell phone, or tablet. Survey data were anonymously collected and housed separately from incentive data.

Sampling resulted in 456 participants, with the majority living in the US (71.93%), 25.66% living in Australia, and 2.41% did not indicate their country of residence. Participants indicated age through ranges from 18 to 63 or older; 27 – 35 (29.39%), 36 – 44 (26.32%), 45 – 53 (18.86%), 18 – 26 (13.82%), 54 – 62 (9.21%), 63 or older (2.19%), and .22% did not indicate. Of the sample, 87.28% indicated “White or Caucasian,” 5.26% responded “Black or African American,” 5.26% responded “Asian (e.g., Asian Indian, Filipino, Japanese, Korean, Vietnamese, or other Asian),” .44% responded “American Indian or Alaska Native,” .44% responded “Pacific Islander (e.g., Native Hawaiian, Guamanian, Chamorro, or other Pacific Islander),” and 1.32% did not indicate. Furthermore, 90.79% do not identify as Hispanic, Latino, or Spanish origin, 7.68% indicated “Yes” for being of Hispanic, Latino, or Spanish origin, and 1.54% did not identify. Most participants do not identify as of Aboriginal or Torres Strait Islander origin (98.46%) with .66% of the participants not responding. For marital status, 51.97% of participants indicated they are married, 20.61% selected “Not married, in a relationship,” 17.98% indicated they were single, 8.55% selected “Divorced,” and .88% selected “Widowed.” Participants selected industry or occupation with responses shown below in Table 4.7.

Table 4.7

Participant (n = 456) demographics by industry

Industry	*n*	%
Construction	127	27.85
Other	109	23.90
Public Sector	101	22.15
Education	51	11.18
Healthcare	38	8.33
Warehousing	21	4.61
Transportation	6	1.32
Mining	2	.44
Agriculture	1	.22

Of the sample, 109 participants responded "Other" when asked about industry or occupation. Of the 109 participants, 3.67% did not indicate beyond "Other." A breakdown of the free responses is shown below in Table 4.8.

Table 4.8

Other industry breakdown (n = 109)

Industry	*N*	%
Professional Services	40	36.70
Retail & Customer Services	18	16.51
IT/Technology	12	11.01
Entertainment/Hospitality	12	11.01
Manufacturing	10	9.17
Public Sector	7	6.42
Non-profit	3	2.75

Media/Communications	3	2.75
Animal caregiver	2	1.83
Aviation	1	.92
Security Services	1	.92

Procedure

As with Study 1, Study 2 explores the structural model of the PPWS model with a second data set. Participants responded to measures of risks and hazards, physical demands, complexity, occupational stress, autonomy, social support, safety knowledge, physical safety climate, psychosocial safety climate, burnout, engagement, motivation, attitude, control, and safety behaviors. The average response time for participants across all groups was 34 minutes. Participants responded to the same items in the same order. Ethics approval was obtained before conducting this research.

Measures

The same measures were used as in Study 1.

Statistical Analyses

The same analyses were conducted in Study 2 as in Study 1 to confirm the structural model fit with a second data set. The baseline model for Study 2 is the final model from Study 1.

Results

Descriptive Statistics and Correlations

As with Study 1, correlations partially support the mediation model, as shown in Table 4.9. For job demands, risks and hazards, complexity, and stress found significant relationships with physical and psychosocial safety behaviors. Job resources and safety factors all obtained significant correlations with both safety behaviors.

Table 4.9

Descriptive Statistics (n = 456)

Measure	*M*	*SD*	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. Risks and hazards	2.78	1.26	(.84)															
2. Physical demands	2.68	1.27	.69**	(.92)														
3. Complexity	3.32	1.07	.28**	.14**	(.86)													
4. Occupational stress	1.30	.44	.22**	-.20**	.14**	(.64)												
5. Autonomy	3.60	.98	-.21**	-.27**	-.12**	.30**	(.87)											
6. Social support	4.07	.78	.02	.04	.02	-.13**	.32**	(.90)										
7. Safety knowledge	4.29	.64	-.01	.01	-.02	-.06	.24**	.41**	(.86)									
8. Psychosocial safety climate	3.61	.93	-.13**	-.10*	-.12**	-.32**	.47**	.45**	.42**	(.96)								
9. Physical safety climate	3.43	.93	-.07	.00	-.12**	-.33**	.44**	.37**	.28**	.81**	(.96)							
10. Burnout	2.80	1.16	.15**	.14**	.06	.42**	-.33**	-.35**	-.31**	-.45	-.51	(.93)						
11. Safety motivation	4.36	.68	.08	-.00	-.07	.00	.22**	.42**	.63**	.33**	.22**	-.21**	(.86)					
12. Employee engagement	4.48	1.12	.02	.10**	.04	-.19**	.22**	.42**	.18**	.47**	.51**	-.36**	.18**	(.83)				
13. Safety attitudes	4.40	.79	.25**	.26**	.13**	-.03	.11**	.40**	.45**	.34**	.31**	-.27**	.41**	.31**	(.86)			
14. Safety control	4.14	.73	-.24**	-.14**	-.11*	-.23**	.33**	.24**	.38**	.41**	.35**	-.30**	.36**	.17**	.36**	(.61)		
15. Psychosocial safety behaviors	5.05	1.26	.01	.14**	-.09	-.19**	.28**	.30**	.32**	.48**	.59**	-.31**	.25**	.33**	.34**	.32**	(.93)	
16. Physical safety behaviors	5.53	1.00	.05	.12**	.05	-.12*	.32**	.48**	.61**	.58**	.49**	-.29**	.58**	.37**	.52**	.43**	.59**	(.88)

Note. Cronbach's alpha is on the diagonal, $*p < .05$, $**p < .01$

Inferential Statistics

Approximately 7% of data were missing and identified as MCAR with Little's (1988) test non-significant, $\chi2$ (791) = 856.16, $p = .053$. As with Study 1, EM was used as estimation to create a new data set with the missing values replaced by estimated values (Dempster et al., 1997).

The baseline model indicated almost good model fit, x^2 (80, n = 456) = 479.14, $p < .001$, SRMR = .08, TLI = .77, CFI = .85, RMSEA = .11 [.10, .11], as shown below in Figure 4.5. The model, as it was in Study 1, is still mis-specified as identified by the unidentified R^2 and the model fit statistics.

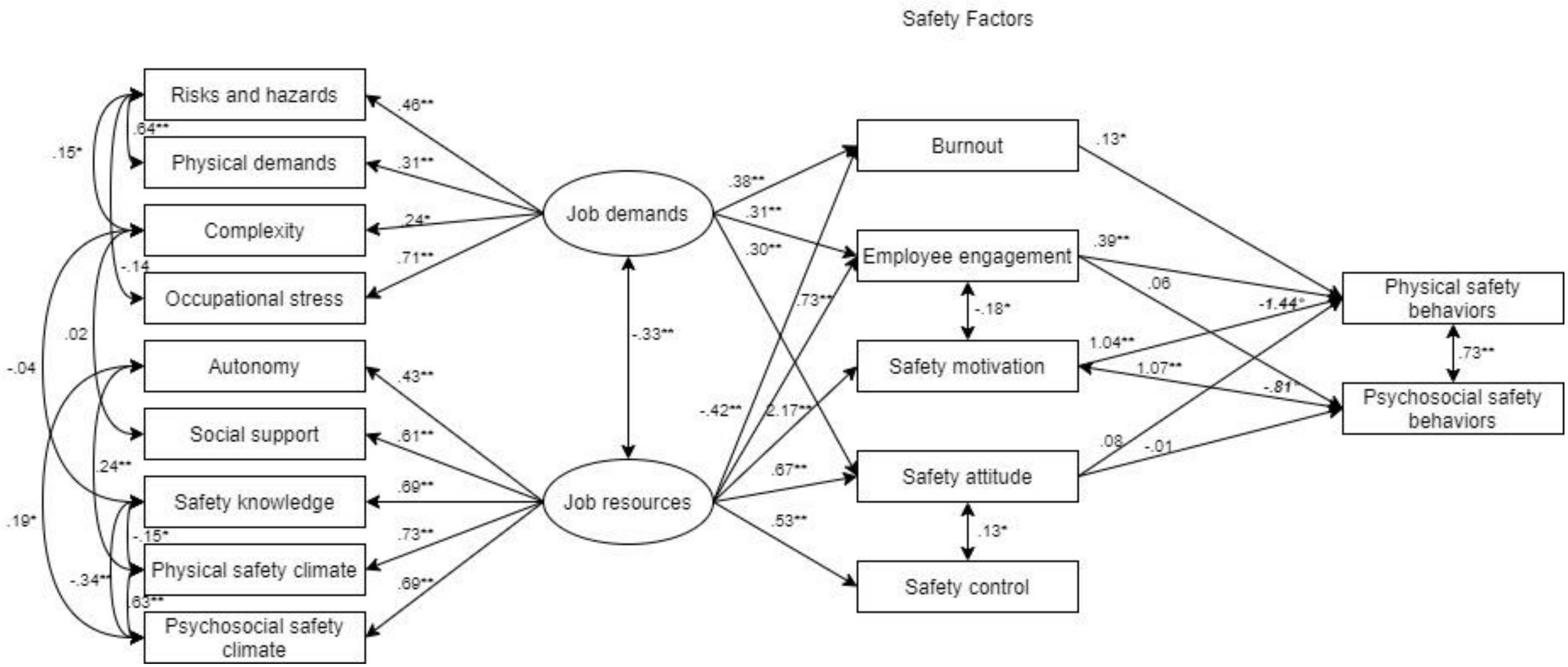

Figure 4.5. Base model identified in Study 1, *p < .05, **p < .01. Residual variances and R^2 are shown below in Table 4.10

Table 4.10

Residual variances and R^2 for base model

Construct	Residual variance	R^2
Risks and hazards	.79	.21*
Physical demands	.91	.10
Complexity	.94	.06
Occupational stress	.49	.51**
Autonomy	.81	.19**
Social support	.63	.37**
Safety knowledge	.52	.48**
Physical safety climate	.47	.53**
Psychosocial safety climate	.53	.47**
Burnout	.58	.42**
Employee engagement	.52	.48**
Safety motivation	2.04	Undefined
Safety attitude	.59	.41**
Safety control	.72	.28**
Psychosocial safety behaviors	1.42	Undefined
Physical safety behaviors	1.13	Undefined

Note. *$p < .05$, **$p < .01$

Modification indices were considered for model adjustments and re-specification. Each iteration is detailed below in Table 4.11.

Table 4.11

Time 2 (n = 456)

Iteration	*df*	χ^2	RMSEA [90% CI]	CFI	TLI	SRMR	Model fit
1: Base model	80	479.14	.11 [.10, .11]	.85	.77	.08	Almost adequate
2: Removed correlation between stress and (a) risks and hazards and (b) safety knowledge and social support and (a) complexity	83	483.11	.10 [.09, .11]	.85	.78	.08	Almost adequate
3: Added correlation between autonomy and physical demands	82	461.23	.10 [.09, .11]	.85	.79	.08	Almost adequate
4: Removed path from safety attitude to safety behaviors	84	461.21	.10 [.09, .11]	.85	.79	.08	Almost adequate
5: Removed path from employee engagement to psychosocial safety behavior	85	162.36	.10 [.09, .11]	.85	.79	.08	Almost adequate

Table 4.11 details the iterations to reach the final model, model 5. The final model resulted in slight improvement over fit from the baseline, x^2 (85, *n* = 456) = 162.36, $p < .001$, SRMR = .08, TLI = .79, CFI = .85, RMSEA = .10 [.09, .11]. The final structural model is shown below in Figure 4.6. Safety motivation maintained the bidirectional relationships with safety behaviors. The loading for safety motivation as a predictor of physical safety behavior was -1.74 and -.77 for psychosocial safety behaviors.

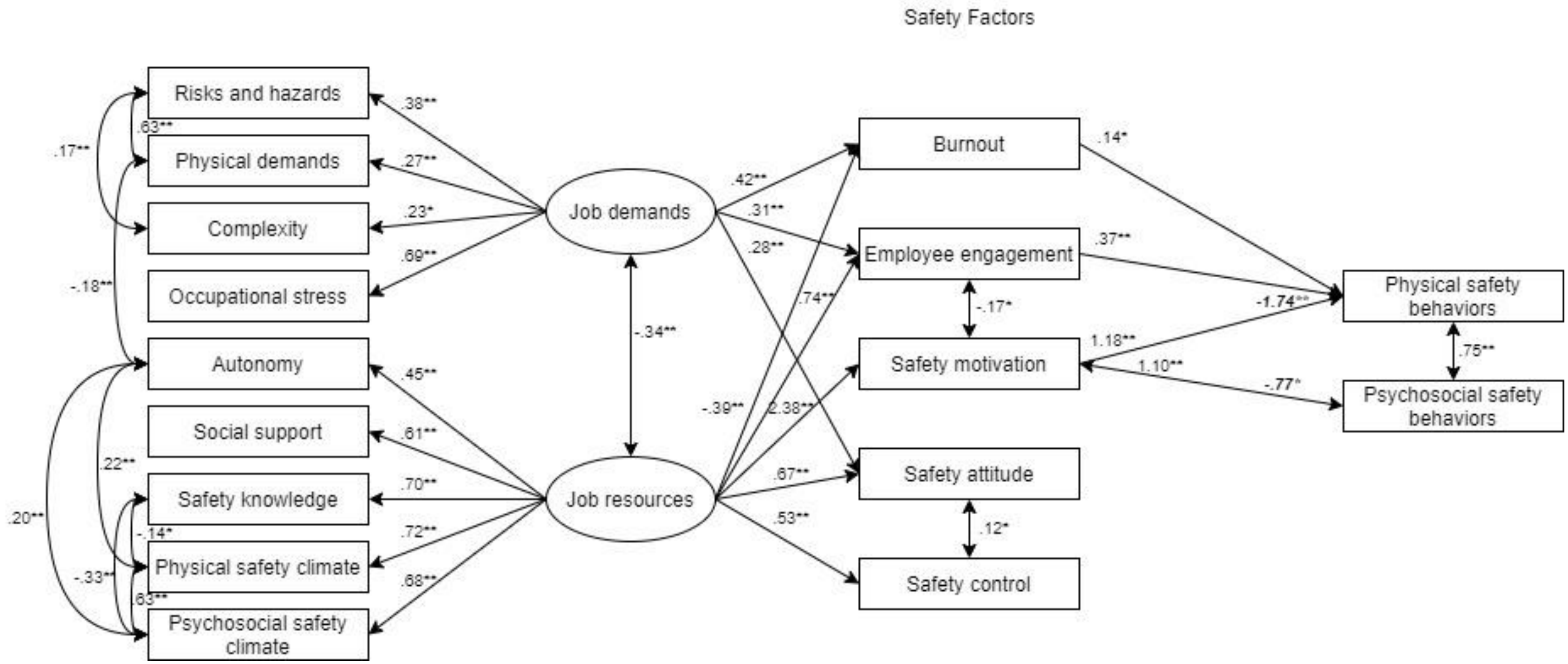

Figure 4.6. Model 5, final PPWS model, *$p < .05$, **$p < .01$ Physical and psychosocial safety behavior, as predictors of safety motivation, are indicated by bold and italics. Residual variances and R^2 for final model are shown below in Table 4.12.

Table 4.12

Residual variances and R^2 for final model

Construct	Residual variance	R^2
Risks and hazards	.86	.14*
Physical demands	.93	.07
Complexity	.95	.05
Occupational stress	.52	.48**
Autonomy	.80	.20**
Social support	.63	.37**
Safety knowledge	.52	.49**
Physical safety climate	.48	.52**
Psychosocial safety climate	.54	.46**
Burnout	.55	.45**
Employee engagement	.52	.48**
Safety motivation	2.37	Undefined
Safety attitude	.60	.40**
Safety control	.72	.28**
Psychosocial safety behaviors	1.46	Undefined
Physical safety behaviors	1.34	Undefined

Note. *$p < .05$, ** $p < .01$

Study 2 Discussion

The intent of Study 2 was to test the PPWS model, established in Study 1, with a second dataset to establish the stability of the model, test the generalizability across samples, and further improve model fit. As with Study 1, the results provided limited support and suggest that the model is mis-specified. While SRMR indicated good fit and RMSEA was close to good fit, the model maintained almost adequate fit. The indicators of job demands and resources were supported as predictors of the latent variables. Physical demands and complexity had weak but significant factor loadings. As in Study 1, physical demands failed to achieve a significant R^2 and complexity now also failed to contribute significantly. This supports the option for revising the job demands and resources construct. The modification indices suggest overlap between the indicators of each, which supports the potential for a different underlying construct. Alternatively, considering different job demands and resources would be a consideration. Several of the correlations between the job demands and resources were removed from the baseline model as they failed to achieve significance. Although there is an overlap and theoretical foundation for why predictors of job demands and predictors of job resources could correlate (Bakker & Demerouti, 2007), from a data perspective, they were removed to simplify the model. The exact paths removed are detailed above in Table 4.11.

As with Study 1, job demands and resources were significant predictors of burnout, employee engagement, safety motivation, and safety attitudes. The same relationships were found from Study 1 for burnout, engagement, and motivation. Safety attitudes were no longer identified as having significant direct or indirect effects. This is interesting as safety attitudes was previously identified as a mediator of safety climate and safety behaviors (Fugas et al., 2012). Fugas et al. study considered organizational safety climate as the indirect predictor of safety behaviors which were self-reported safety compliance and proactive safety practices. This leaves room for future consideration of safety climate as a job resource and the conceptualization of safety behaviors. Christian et al. (2009) also noted that job attitudes indirectly influence safety behaviors. While job attitudes are not safety attitudes specifically, it does suggest an alternative path for attitude as a potential job resource. Additional research is needed to explore and understand the relationships between safety attitudes and safety behaviors.

Next, safety control was not supported as a significant predictor of safety behaviors in Study 1 and job demands were not supported as a predictor of safety control. The baseline model for Study 2 did not include those paths. Modification indices were assessed to see if safety control should be added back in for both direct and indirect effects but this was not supported by model fit improvement. As discussed in Study 1, this should be explored in greater detail as empirical support has consistently been found for job demands, safety control, and safety behaviors (Fugas et al., 2012; Karasek, 1979).

Burnout, engagement, and motivation were all positive, significant predictors of physical safety behaviors. Again, this was surprising as burnout was initially hypothesized to have a negative relationship with safety behaviors. However, there is variance in the research surrounding burnout and safety behaviors. For example, Li et al. (2013) found that emotional exhaustion failed to mediate the relationship between job demands and safety compliance (an aspect of safety behaviors). However, Li and et al. did find that emotional exhaustion mediated the relationship between job demands and injuries and near misses. This relates back to how safety behaviors are conceptualized. Safety compliance and participation are leading indicators of workplace safety, while accidents and near misses are lagging indicators (Beus et al., 2016; Griffin & Neal, 2000). As discussed in Study 1, one potential explanation for this positive finding is proactive personalities (Bateman & Crant, 1993). Again, these individuals will take actions and proactive manage stress (Bakker & de Vries, 2021). As they experience burnout, they are more inclined to participate in safety behaviors (e.g., safety compliance) to proactive manage stress.

As for psychosocial safety behaviors, engagement was no longer supported as a predictor. Only safety motivation was identified as a significant predictor of psychosocial safety behavior. This supports the need for more research into both physical and psychosocial safety, as studies support that employee engagement in safety-related activities resulted in an increase in safety participation (e.g., Williams, 2008). This also highlights the potential need to clarify and define employee engagement. The PPWS model focused on the affective elements of commitment and dedication as a focus on engagement, while other approaches focus on investing personal resources (e.g., cognitive) into their work (Kahn, 1990).

Physical and psychosocial safety behaviors continued to be supported as a negative predictor of safety motivation while safety motivation is a positive predictor of both safety behaviors. As mentioned in Study 1, safety motivation has traditionally been explored as an antecedent to safety behaviors (Griffin & Neal, 2000; Neal et al., 2000). As a self-regulatory process, safety motivation focuses on maintaining well-being, gaining the skills needed to be safe, and helps understand employee behavior (Sitzmann & Ely, 2011). Within the context of this research, the behavior would be safety participation and safety compliance. The analyses for both Studies 1 and 2 suggest that as safety behaviors improve, safety motivation decreases. This could suggest safety behaviors become habits after initially being effortful. Another potential explanation for this finding is the focus on valence or importance of safety behaviors (Chmiel & Hansez, 2016). The measure used for safety motivation measures the importance or valence, not an individual's willingness to invest in safety behaviors (Chmiel & Hansez, 2016; Griffin & Neal, 2000; Neal et al., 2000). As found in Study 1, the variance in this measure is limited. Additional studies (e.g., Clarke, 2013; Conchie, 2013; Hansez & Chmiel, 2010; Neal & Griffin, 2006) suggest that the type of safety behavior, that is, participation or compliance, may have different antecedents. These studies focus on the original safety behavior measure (Griffin & Neal, 2000; Neal et al., 2000; Neal & Griffin, 2006) and do not include psychosocial safety behaviors.

An additional possible explanation for the relationships between safety motivation and safety behavior involves goal setting. Goal-setting theories suggest that once the goal is obtained, individuals may set more difficult goals and improve performance (Demirkol & Nalla, 2018;

Latham & Locke, 1991). If the goal is safety compliance and participation, the result is dichotomous. The individual is either behaving safely or not. Therefore, if they are behaving safely, they might be less motivated (safety behaviors negatively regressing on safety motivation) because they have already achieved their goal and there is not a more difficult goal to work towards.

Conclusion

While the PPWS model failed to achieve strong model fit and needs re-specification, the model modifications were underpinned by the theoretical model and this research laid the foundation for integrating physical and psychosocial safety in one model. There are numerous benefits, limitations, and future directions from these findings to help refine the model. First, the PPWS model was assessed using a wide range of participants across a variety of industries. This enhances generalizability. However, given the overall model fit and findings, it may also be a limitation. The group sizes for this chapter were uneven with minimal representation in some industries challenging a truly generalizable model. Additionally, using the paid platform, Mturk, more participants were recruited but that meant there was less control over occupation and employment status.

Second, one goal of the PPWS model was to provide construct clarification. Job demands and resources, for example, are wide-ranging. There are numerous job demands and resources beyond those that the PPWS model considers. The correlations across both studies failed to support significant relationships between (a) risks and hazards and (b) complexity with safety behaviors. One option for future research is to consider different job demands and resources to fully understand the relationships, as well as look at occupation specific job demands and resources. Furthermore, safety behaviors also may be more clearly defined. The PPWS model considers physical and psychosocial safety compliance and participation as safety behaviors. Future research may break this down and consider physical compliance and participation separate from psychosocial compliance and participation. There might be ambiguity or error in safety behaviors due to the unfamiliarity of psychosocial safety behaviors within the sample. Furthermore, this might vary across industries and job roles. Physical safety is usually what comes to mind when thinking of safety since occupational health and safety concerning physical elements became a focus in the early 20th century (Swuste et al., 2010). Additionally, physical safety climate has a larger presence in the literature given its introduction 30 years before psychosocial safety climate (Dollard & Bakker, 2010; Zohar, 1980).

Third, certain measures used for this research could be reconsidered. Employee engagement, safety control, and safety motivation have room for modification. Employee engagement focused on the affective elements (Bakker et al., 2008) of organizational commitment using the 18-item commitment scale (Allen & Meyer, 1990; Meyer et al., 1993). This measured affective, continuance, and normative commitment. Chapter 3 findings identified that only three of the affective items remained in the final solution. The other retained items included two from continuance and five from normative. This suggests that more than employee engagement is being captured and an engagement measure could be developed or identified for the next iteration of this model. Safety control was measured using a fairly exploratory scale. Fugas et al. (2012) adapted the measure for safety and found low reliability. Given the exploratory nature of Fugas et al.'s (2012) study and the PPWS model, the measure was used. However, it still failed to find strong support. Therefore, a new safety control measure could add value as the safety control measure was adapted from Conner and McMillan's (1999) research. A scale developed specifically to measure safety control could provide greater conceptual clarification. Last, safety motivation, as mentioned above, measured the perceived importance of safety. Adding in items relating to the employee's willingness to put forth the effort to behave safely would strengthen the approach (Chmiel & Hansez, 2016). Safety participation, in particular, would benefit from understanding willingness as this captures going above and beyond to behave safely.

Fourth, longitudinal and intervention studies are needed for a deeper understanding of the model and the applied utility. Longitudinal studies should look at how job demands and resources change over time to improve safety factors and how changes in safety factors will increase safety behaviors. Interventions should fall between data collection points for longitudinal studies to full understand the impact on the outcome.

Fifth, this paper explored the PPWS model with a sample size from multiple countries and industries. To fully support practitioners, understanding the model and implications at the country and industry level is needed. There were more participants from the United States in both Studies 1 and 2 (93.61% and 71.93%, respectively) than from Australia. Additionally, some of the industries were not captured at both time points and/or had few participants (e.g., forestry, fishing). A more accurate representation of the industry and demands is required through country and industry-specific analyses to fully understand the applied utility of the PPWS model.

In conclusion, the PPWS model is a starting point for both researchers and practitioners to approach physical and psychosocial safety comprehensively despite failing to obtain fit or specification. Future research should focus on clarifying the constructs and establishing the generalizability and specificity of their inter-relationship. Practitioners can use the model to focus efforts on integrating physical and psychosocial safety, rather than the separation. There is clearly a need for a comprehensive approach and, while the PPWS model is still a work in progress, it is a steppingstone toward fulfilling that need.

References

Airila, A., Hakanen, J. J., Luukkonen, R., Lusa, S., Punakallio, A., & Leino-Arjas, P. (2014). Developmental trajectories of multisite musculoskeletal pain and depressive symptoms: The effects of job demands and resources and individual factors. *Psychology & Health, 29*(12), 1421-1441. doi: 10.1080/08870446.2014.945929

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes, 50*(2), 179–211. https://doi.org/10.1016/0749-5978(91)90020-T

Ajzen, I. (2002). Perceived behavioral control, self-efficacy, locus of control, and the theory of planned behavior. *Journal of Applied Social Psychology, 32,* 1-20. https://doi.org/10.1111/j.1559-1816.2002.tb00236.x

Allen, N. J., & Meyer, J. P. (1990). The measurement and antecedents of affective, continuance, and normative commitment to the organization. *Journal of Occupational Psychology, 63,* 1-18. https://doi.org/10.1111/j.2044-8325.1990.tb00506.x

Almroth, M., Hemmingsson, T., Wallin, A. S., Kjellberg, K., Burström, B., & Falkstedt, D. (2021). Psychosocial working conditions and the risk of diagnosed depression: A Swedish register-based study. *Psychological Medicine,* 1–9. https://doi.org/10.1017/S003329172100060X

Amazon Mechanical Turk. (2018). Mechanical Turk. Retrieved from https://www.mturk.com/

Bakker, A. B., Boyd, C. M., Dollard, M., Gillespie, N., Winefield, A. H., & Stough, C. (2010). The role of personality in the job demands-resources model: A study of Australian academic staff. *The Career Development International, 15*(7), 622–636. https://doi.org/10.1108/13620431011094050

Bakker, A. B., & Demerouti, E. (2007). The job demands-resources model: State of the art. *Journal of Managerial Psychology, 22*, 309-328. Doi: 10.1108/02683940710733115

Chapter 4: Assessing the structural model

Bakker, A. B., Demerouti, E., & Euwema, M. C. (2005). Job resources buffer the impact of job demands on burnout. *Journal of Occupational Health Psychology, 2,* 170-180. https://doi.org/10.1037/1076-8998.10.2.170

Bakker, A. B., Demerouti, E., & Sanz-Vergel, A. I. (2014). Burnout and work engagement: The JD–R approach. *Annual Review of Organizational Psychology and Organizational Behavior*, *1,* 389–411. https://doi.org/10.1146/annurev-orgpsych-031413-091235

Bakker, A. B., & de Vries, J. D. (2021). Job demands–resources theory and self-regulation: New explanations and remedies for job burnout. *Anxiety, Stress, & Coping*, *34*(1), 1-21. https://doi.org/10.1080/10615806.2020.1797695

Bakker, A. B., Schaufeli, W. B., Leiter, M. P., & Taris, T. W. (2008). Work engagement: An emerging concept in occupational health psychology. *Work and Stress*, *22*, 187–200. https://doi.org/10.1080/02678370802393649

Bandura, A. (1988). Self-regulation of motivation and action through goal systems. In V. Hamilton, G. Bower, and N. H. Frijda (Eds.), Cognitive perspectives on emotion and motivation (pp. 37–61). Kluwer Academic/Plenum Publishers. http://dx.doi.org.libproxy.murdoch.edu.au/10.1007/978-94-009-2792-6_2

Bateman, T. S., & Crant, M. J. (1993). The proactive component of organizational behavior: A measure and correlates summary. *Journal of Organizational Behavior, 14*(2), 103–119. https://doi.org/10.1002/job.4030140202

Bentler, P. M. (1990). Comparative fit indexes in structural models. *Psychological Bulletin, 107*(2), 238–246. https://doi.org/10.1037/0033-2909.107.2.238

Chapter 4: Assessing the structural model

Beus, J. M., McCord, M. A., & Zohar, D. (2016). Workplace safety: A review and research synthesis. *Organizational Psychology Review*, *6*(4), 352-381. Doi: 10.1177/2041386615626243

Bliese, P. D., Edwards, J. R., & Sonnentag, S. (2017). Stress and well-being at work: A century of empirical trends reflecting theoretical and societal influences. *Journal of Applied Psychology, 102*(3), 389–402. https://doi.org/10.1037/apl0000109

Bono, J. E., & Yoon, D. J. (2012). Positive supervisory relationships. In L. T. d. T. Eby & T. D. Allen (Eds.), *Personal relationships: The effect on employee attitudes, behavior, and well-being* (pp. 43–66). Routledge/Taylor & Francis Group.

Bronkhorst, B. (2015). Behaving safely under pressure: The effects of job demands, resources, and safety climate on employee physical and psychosocial safety behavior. *Journal of Safety Research*, *55*, 63-72. https://doi.org/10.1016/j.jsr.2015.09.002

Bronkhorst, B., & Vermeeren, B. (2016). Safety climate, worker health and organizational health performance. *International Journal of Workplace Health Management, 9*(3), 279-289. https://doi.org/10.1108/ijwhm-12-2015-0081

Burke, M. J., Sarpy, S. A., Tesluk, P. E., & Smith-Crowe, K. (2002). General safety performance: A test of a grounded theoretical model. *Personnel Psychology, 55*, 429-457. https://doi.org/10.1111/j.1744-6570.2002.tb00116.x

Campbell, D. J. (1988). Task complexity: A review and analysis. *The Academy of Management Review*, *13*(1), 40-52. https://doi.org/10.2307/258353

Carver, C. S., & Scheier, M. F. (1982). Control theory: A useful conceptual framework for personality–social, clinical, and health psychology. *Psychological Bulletin, 92*(1), 111–135. https://doi.org/10.1037/0033-2909.92.1.111

Carver, C.S., Scheier, M.F., 2011. *Self-regulation of action and affect.* In: Vohs, K., Baumeister, R.F. (Eds.), Handbook of Self-Regulation: Research, Theory, and Applications, second ed. Guildford Press, New York, NY, pp. 3–21.

Cascino, N., & Mélan, C. (2019). An exploration of job perceptions and health using an integrative approach: A sample of air traffic controllers working in a test flight center. *Aviation Psychology and Applied Human Factors, 9*(1), 42–52. https://doi.org/10.1027/2192-0923/a000156

Cassar, V., & Tattersall, A. (1998). Occupational stress and negative affectivity in Maltese nurses: Testing moderating influences. *Work and Stress, 12*, 85-94. https://doi.org/10.1080/02678379808256850

Chen, C.-F., & Chen, S.-C. (2012). Burnout and work engagement among cabin crew: Antecedents and consequences. *The International Journal of Aviation Psychology, 22*(1), 41-58. https://doi.org/10.1080/10508414.2012.635125

Chmiel, N., & Hansez, I. (2016). Jobs and safety behavior. In S. Clarke, T. M. Probst, F. Guldenmund, & J. Passmore (Eds.), *The Wiley Blackwell handbook of the psychology of occupational safety and workplace health* (pp. 133 – 154). John Wiley & Sons, Ltd.

Choudhry, R. M., & Fang, D. (2008). Why operatives engage in unsafe work behavior: Investigating factors on construction sites. *Safety Science, 46*(4), 566-584. https://doi.org/10.1016/j.ssci.2007.06.027

Chrisopoulos, S., Dollard, M. F., Winefield, A. H., & Dormann, C. (2010). Increasing the probability of finding an interaction in workstress research: A two-wave longitudinal test of the triple-match principle. *Journal of Occupational and Organizational Psychology, 83*, 17-37. https://doi.org/10.1348/096317909X474173

Chapter 4: Assessing the structural model

Christian, M. S., Bradley, J. C., Wallace, J. C., & Burke, M. J. (2009). Workplace safety: A meta-analysis of the roles of person and situation factors. *Journal of Applied Psychology, 94*, 1103-1127. Doi: 10.1037/a0016172

Clarke, S. (2003.) The contemporary workforce: implications for organizational safety culture. *Personnel Review, 32*, 40–57. https://doi.org/10.1108/00483480310454718

Clarke, S. (2006). The relationship between safety climate and safety performance: A meta-analytic review. *Journal of Occupational Health Psychology, 11*(4), 315–327. https://doi.org/10.1037/1076-8998.11.4.315

Clarke, S., & Goetz, D. (1996). Unrelieved job stress can lead to burnout. *Radiologic Technology, 68*(2), 159-160.

Clarke, S. G., & Cooper, C. L. (2000). The risk management of occupational stress. *Health, Risk & Society, 2,* 173-187. https://doi.org/10.1080/713670158

Cohen, S., & Wills, W. A. (1985). Stress, social support, and the buffering hypothesis. *Psychological Bulletin, 98*(2), 310-357. http://dx.doi.org/10.1037/0033-2909.98.2.310

Conner, M., & McMillian, B. (1999). Interaction effects in the theory of planned behavior: Studying cannabis use. *British Journal of Social Psychology, 38,* 195-222. https://doi.org/10.1348/014466699164121

Cooper, C. L. (1996). *The handbook of stress, medicine and health*. CRC Press.

Cooper, C. L., & Marshall, J. (1976). Occupational sources of stress: A review of the literature relating to coronary heart disease and mental ill-health. *Journal of Occupational Psychology, 49,* 455-471. https://doi.org/10.1111/j.2044-8325.1976.tb00325.x

Cooper, M. D., & Phillips, R. A. (2004). Exploratory analysis of safety climate and safety behavior relationships. *Journal of Safety Research, 35*, 497-512. Doi: 10.1016/j.jsr.2004.08.004

Couvreur, C. (1996). The EM Algorithm: A Guided Tour. *Proceedings of the 2d IEEE European Workshop on Computationally Intensive Methods in Control and Signal Processing, Czech Republic*, 115-120. doi: 10.1007/978-1-4612-1996-5_12

Pragues, Czech Republik: In Proc. 2d IEEE European Workshop on Computationaly Intensive Methods in Control and Signal Processing; 1996:115-120. 10.1.1.52.5949

Cox, T., Griffiths, A. J., Barlow, C. A., Randall, R. J., Thompson, L. E., & Rial-Gonzalez, E. (2000). *Organisational interventions for work stress.* HSE Books.

Crant, J. M. (1995). The proactive personality scale and objective job performance among real estate agents. *Journal of Applied Psychology, 80*(4), 532–537. https://doi.org/10.1037/0021-9010.80.4.532

Davis, L. E., Ajzen, I., Saunders, J., & Williams, T. (2002). The decision of African American students to complete high school: An application of the theory of planned behavior. *Journal of Educational Psychology, 94*(4), 810-819. https://doi.org/10.1037/0022-0663.94.4.810

Dedobbeleer, N., & Beland, F. (1991). A safety climate measure for construction sites. *Journal of Safety Research, 22*, 97-103. Doi: 10.1016/0022-4375(91)90017-P

DeJoy, D. M., Schaffer, B. S., Wilson, M. G., Vandenberg, R. J., & Butts, M. M. (2004). Creating safer workplaces: Assessing the determinants and role of safety climate. *Journal of Safety Research, 35*, 81-90. https://doi.org/10.1016/j.jsr.2003.09.018

Demerouti, E., Bakker, A. B., Nachreiner, F., & Schaufeli, W. B. (2001). The job demands-resources model of burnout. *Journal of Applied Psychology*, *86,* 499-512. Doi: 10.1037/0021-9010.86.3.499

Dong, Y., & Peng, C.-Y., J. (2013). Principled missing data methods for researchers. *SpringerPlus*, *2*(1), 222-239. https://doi.org/10.1186/2193-1801-2-222

Elliot, A. J., & McGregor, H. A. (2001). A 2 x 2 achievement goal framework. *Journal of Personality and Social Psychology, 80,* 501-519. https://doi.org/10.1037/0022-3514.80.3.501

Enders, C. K. (2003). Using the expectation maximization algorithm to estimate coefficient alpha for scales with item-level missing data. *Psychological Methods, 8*3(3). 322-337. doi: 10.1037/1082-989X.8.3.322

Everly, G. S., & Lating, J. M. (2019). *A clinical guide to the treatment of the human stress response.* Springer.

Fugas, C. S., Silva, S. A., & Meliá, J. L. (2012). Another look at safety climate and safety behavior: Deepening the cognitive and social mediator mechanisms. *Accident Analysis and Prevention, 45,* 468-477. Doi: 10.1016/j.aap.2011.08.013

Garrick, A., Mak, A. S., Cathcard, S., Winwood, P. C., Bakker, A. B., & Lushington, K. (2014). Psychosocial safety climate moderating the effects of daily job demands and recovery on fatigue and work engagement. *Journal of Occupational and Organizational Psychology*, *87*(4), 694-714. https://doi.org/10.1111/joop.12069

Geisler, M., Berthelsen, H., & Muhonen, T. (2019). Retaining social workers: The role of quality of work and psychosocial safety climate for work engagement, job satisfaction, and organizational commitment. *Human Service Organizations: Management, Leadership & Governance, 43*(1), 1-15. https://doi.org/10.1080/23303131.2019.1569574

Gillen, M., Baltz, D., Gassel, M., Kirsch, L., & Vaccaro, D. (2002). Perceived safety climate, job demands, and coworker support among union and nonunion injured construction workers. *Journal of Safety Research, 33*(1), 33–51. https://doi.org/10.1016/S0022-4375(02)00002-6

Glendon, A. L., & McKenna, E. F. (1995). *Human safety and risk management*. Oxford University Press.

Goh, J., Pfeffer, J., & Zenios, S. A. (2019). Reducing the health toll from U.S. workplace stress. *Behavioral Science & Policy, 5*(1), 1-13. doi:10.1353/bsp.2019.0001

Graham, J. W. (2003). Adding missing-data-relevant variables to FIML-based structural equation models. *Structural Equation Modeling, 10*(1), 80–100. https://doi.org/10.1207/S15328007SEM1001_4

Griffin, M. A., & Neal, A. (2000). Perceptions of safety at work: A framework for linking safety climate to safety performance, knowledge, and motivation. *Journal of Occupational Health Psychology, 5*(3), 347-358. https://doi.org/10.1037/1076-8998.5.3.347

Hackman, J. R., & Oldham, G. R. (1976). Motivation through the design of work: Test of a theory. *Organizational Behavior and Human Performance, 16*, 250-279. https://doi.org/10.1016/0030-5073(76)90016-7

Hakanen, J. J., & Schaufeli, W. B. (2012). Do burnout and work engagement predict depressive symptoms and life satisfaction? A three-wave seven-year prospective study. *Journal of Affective Disorders, 141*(2-3), 415-424. https://doi.org/10.1016/j.jad.2012.02.043

Halbesleben, J. R. B. (2010). A meta-analysis of work engagement: Relationships with burnout, demands, resources, and consequences. In A. B. Bakker (Ed.) & M. P. Leiter, *Work* *engagement: A handbook of essential theory and research* (pp. 102–117). Psychology Press.

Hall, G. B., Dollard, M. F., & Coward, J. (2010). Psychosocial Safety Climate: Development of the PSC-12. *International Journal of Stress Management, 17*(4), 353-383. https://doi.org/10.1037/a0021320

Hansez, I., & Chmiel, N. (2010). Safety behavior: Job demands, job resources, and perceived management commitment to safety. *Journal of Occupational Health Psychology, 15*(3), 267-278. Doi: 10.1037/a0019528

Haslam, R. A., Hide, S. A., Gibb, A. G. F., Gyi, D. E., Pavitt, T., Atkinson, S., & Duff, A. R. (2005). Contributing factors in construction accidents. *Applied Ergonomics, 36*(4), 401-415. https://doi.org/10.1016/j.apergo.2004.12.002

Hayes, S. C. (1989). R*ule-governed behavior: Cognition, contingencies, and instructional control*. Plenum.

Hertel, G., & Wittchen, M. (2008). Work motivation. In N. Chimel (Ed.), *An introduction to work and organizational psychology: A European perspective* (pp. 29-55). Blackwell Publishing.

Herzberg, F., Mausner, B., & Snyderman, B. B. (1993). *The motivation to work.* Routledge.

Hofmann, D. A., Burke, M. J., & Zohar, D. (2017). 100 years of occupational safety research: From basic protections and work analysis to a multilevel view of workplace safety and risk. *Journal of Applied Psychology, 102*(3), 375–388. https://doi.org/10.1037/apl0000114

Hofmann, D. A., & Stetzer, A. (1996). A cross-level investigation of factors influencing unsafe behaviors and accidents. *Personnel Psychology, 49*(2), 307–339. https://doi.org/10.1111/j.1744-6570.1996.tb01802.x

Chapter 4: Assessing the structural model

Hu, L.-t., & Bentler, P. M. (2009). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling: A Multidisciplinary Journal, 6,* 1-55. https://doi.org/10.1080/10705519909540118

Idris, M. A.& Dollard, M. F. (2011). Psychosocial safety climate, work conditions, and emotions in the workplace: A Malaysian population-based work stress study. *International Journal of Stress Management, 18*(4), 324-347. https://doi.org/10.1037/a0024849

Idris, M. A., Dollard, M. F., Coward, J., & Dormann, C. (2012). Psychosocial safety climate: Conceptual distinctiveness and effect on job demands and worker psychological health. *Safety Science, 50,* 19-28. https://doi.org/10.1016/j.ssci.2011.06.005

Jay, S. M., Gander, P. H., Eng, A., Cheng, S., Douwes, J., Ellison-Loschmann, L., McLean, N. P., & 'tMannetje, A. (2017). New Zealanders working non-standard hours also have greater exposure to other workplace hazards. *Chronobiology International, 34*(4), 519-526. https://doi.org/10.1080/07420528.2017.1307850

Johnson, R. E., Taing, M. U., Chang, C.-H., & Kawamoto, C. K. (2013). A self-regulation approach to person-environment fit. In A. L. Kristof-Brown & J. Billsberry (Eds.), *Organizational fit: Key issues and new directions* (pp. 74–98). Wiley Blackwell. https://doi.org/10.1002/9781118320853.ch4

Kahn, W. A. (2010). The essence of engagement: Lessons from the field. In S. L. Albrecht (Ed.), *Handbook of employee engagement: Perspectives, issues, research and practice* (pp. 20–30). Edward Elgar Publishing. https://doi.org/10.4337/9781849806374.00008

Kanfer, F. H., & Karoly, P. (1972). Self-control: A behavioristic excursion into the lion's den. *Behavior Therapy, 3,* 389-416. doi: 10.1016/S0005-7894(72)80140-0

Karasek, R. A. (1979). Job demands, job decision latitude, and mental strain: Implications for job redesign. *Administrative Science Quarterly, 24,* 285-308. https://doi.org/10.2307/2392498

Karoly, P. (1993). Mechanisms of self-regulation: A systems view. *Annual Review of Psychology, 44,* 23–52. https://doi.org/10.1146/annurev.ps.44.020193.000323

Kline, R. B. (2016). *Principles and practice of structural equation modeling* (4th edition.). The Guilford Press.

Krčál, O., Staněk, R., & Slanicay, M. (2019). Made for the job or by the job? A lab-in-the-field experiment with firefighters. *Research in Ergonomics, 73*(4), 271-276. https://doi.org/10.1016/j.rie.2019.08.001

Latham, G. P., & Locke, E. A. (1991). Self-regulation through goal setting. *Organizational Behavior and Human Decision Processes*, *50*(2), 212–247. https://doi.org/10.1016/0749-5978(91)90021-K

Law, R., Dollard, M. F., Tuckey, M. R., & Dormann, C. (2011). Psychosocial safety climate as a lead indicator of workplace bullying and harassment, job resources, psychological health and employee engagement. *Accident Analysis and Prevention, 43,* 1782-1793. Doi: 10.1016/j.aap.2011.04.010

Lee, F. K., Sheldon, K. M., & Turban, D. B. (2003). Personality and the goal-striving process: The influence of achievement goal patterns, goal level, and mental focus on performance and enjoyment. *Journal of Applied Psychology, 88*(3), 256-265. doi: 10.1037/0021-9010.88.2.256

Leitão, S., McCarth, V. J. C., & Greiner, B. A. (2018). Health and safety practitioners' health and wellbeing – The link with safety climate and job demand-control-support. *Accident Analysis and Prevention, 119,* 131-137, https://doi.org/10.1016/j.aap.2018.06.017

Li, F., Jiang, L., Yao, X., & Li, Y. (2013). Job demands, job resources and safety outcomes: The role of emotional exhaustion and safety compliance. *Accident Analysis & Prevention, 51,* 243-251. https://doi.org/10.1016/j.aap.2012.11.029

Little, R. J. A. (1988). A test of missing completely at random for multivariate data with missing values. *Journal of the American Statistical Association, 83*(404), 1198-1202. doi: 10.1080/01621459.1988.10478722

Lizano, E. L. (2015). Examining the impact of job burnout on the health and well-being of human service workers: A systematic review and synthesis. *Human Service Organizations: Management, Leadership, & Governance, 29*(3), 167-181. https://doi.org/10.1080/23303131.2015.1014122

Luria, G., & Yagil, D. (2010). Safety perception referents of permanent and temporary employees: Safety climate boundaries in the industrial workplace. *Accident Analysis and Prevention, 42,* 1423-1430. Doi: 10.1016/j.aap.2009.02.016

Malach-Pines, A. (2005). The burnout measure, short version. *International Journal of Stress Management, 12*(1), 78-88. https://doi.org/10.1037/1072-5245.12.1.78

Maslach, C., Schaufeli, W. B., & Leiter, M. P. (2001). Job burnout. *Annual Review of Psychology, 52,* 397-422. https://doi.org/10.1146/annurev.psych.52.1.397

Mauno, S., Kinnunen, U., & Ruokolainen. (2007). Job demands and resources as antecedent of work engagement: A longitudinal study. *Journal of Vocational Behavior, 70*(1), 149-171. https://doi.org/10.1016/j.jvb.2006.09.002

McAllister, C. P., & Perrewé, P. L. (2018). About to burst: How state self-regulation affects the enactment of bullying behaviors. Journal of Business Ethics, 153, 877-888. https://doi.org/10.1007/s10551-016-3424-z

McLinton, S. S., Afsharian, A., Dollard, M. F., & Tuckey, M. R. (2019). The dynamic interplay of physical and psychosocial safety climates in frontline healthcare. *Stress and Health: Journal of the International Society for the Investigation of Stress*, *35*(5), 650-664. https://doi.org/10.1002/smi.2898

Meyer, J. P., Allen, N., & Smith, C. A. (1993). Commitment to organizations and occupations: Extension and test of a three-component conceptualization. *Journal of Applied Psychology, 78*(4), 538-551. https://doi.org/10.1037/0021-9010.78.4.538

Miller, G. A., Galanter, E., & Pribram, K. H. (1960). *Plans and the structure of behavior*. Henry Holt and Co. https://doi.org/10.1037/10039-000

Mischel, W. (1996). From good intentions to willpower. In P. M. Gollwitzer & J. A. Bargh (Eds.), *The psychology of action: Linking cognition and motivation to behavior* (pp. 197-218). Guilford Press.

Morgeson, F. P., & Humphrey, S. E. (2006). The Work Design Questionnaire (WDQ): Developing and validating a comprehensive measure for assessing job design and the nature of work. *Journal of Applied Psychology, 91,* 1321-1339. https://doi.org/10.1037/0021-9010.91.6.1321

Moyle, P. (1995). The role of negative affectivity in the stress process: Tests of alternative methods. *Journal of Organizational Behavior, 16,* 647-668. https://doi.org/10.1002/job.4030160705

Muhamed Nasharudin, N. A., Idris, M. A., Loh, M. Y., & Tuckey, M. (2020). The role of psychological detachment in burnout and depression: A longitudinal study of Malaysian workers. *Scandinavian Journal of Psychology, 61*(3), 423-435. https://doi.org/10.1111/sjop.12622

Muraven, M., & Baumeister, R. F. (2000). Self-regulation and depletion of limited resources: Does self-control resemble a muscle? *Psychological Bulletin*, *126*, 247–259. doi:10.1037/0033-2909.126.2.247

Nahrgang, J. D., Morgeson, F. P., & Hofmann, D. A. (2011). Safety at work: A meta-analytic investigation of the link between job demands, job resources, burnout, engagement, and safety outcomes. *Journal of Applied Psychology, 96*, 71-74. Doi: 10.1037/a0021484

Neal, A., & Griffin, M. A. (1997). Perceptions of safety at work: Developing a model to link organizational safety climate and individual behavior. Paper presented to the 12th Annual Conference of the Society for Industrial and Organizational Psychology, St. Louis, MO.

Neal, A., & Griffin, M. A. (2004). Safety climate and safety at work. In J. Barling & M. R. Frone (Eds.), *The psychology of workplace safety* (pp. 15–34). American Psychological Association. https://doi.org/10.1037/10662-002

Neal, A., & Griffin, M. A. (2006). A study of the lagged relationships among safety climate, safety motivation, safety behavior, and accidents at the individual and group levels. *Journal of Applied Psychology, 91*, 946-953. https://doi.org/10.1037/0021-9010.91.4.946

Neal, A., Griffin, M. A., & Hart, P. M. (2000). The impact of organizational climate on safety climate and individual behavior. *Science Safety, 34,* 99-109. https://doi.org/10.1016/S0925-7535(00)00008-4

Newell, A., Shaw, J. C., & Simon, H. A. (1958). Elements of a theory of human problem solving. *Psychological Review, 65*(3), 151–166. https://doi.org/10.1037/h0048495

Occupational Safety & Health Administration (OSHA). (2021). *About OSHA.* https://www.osha.gov/index.php/aboutosha

Olafsen, A. H. (2017). The implications of need-satisfying work climates on state mindfulness in a longitudinal analysis of work outcomes. *Motivation and Emotion*, *41*(1), 22-37. doi: 10.1007/s11031-016-9592-4

Pandit, B., Albert, A., Patil, Y., & Al-Bayati, A. (2018). Impact of safety climate on hazard recognition and safety risk perception. *Safety Science, 114,* 44-53. doi: 10.1016/j.ssci.2018.11.020

Roczniewska, M., & Bakker, A. B. (2016). Who seeks job resources, and who avoids job demands? The link between dark personality traits and job crafting. *The Journal of Psychology: Interdisciplinary and Applied*, *150*(8), 1026–1045. https://doi.org/10.1080/00223980.2016.1235537

Safe Work Australia. (2021a, May 19). *About us.* https://www.safeworkaustralia.gov.au/about-us

Safe Work Australia. (2021b). *Mental health.* https://www.safeworkaustralia.gov.au/topic/mental-health

Saks, A. (2006). Antecedents and consequences of employee engagement. *Journal of Managerial Psychology*, *21*(7), 600-619. https://doi.org/10.1108/02683940610690169

Schaufeli, W. B., & Van Dierendonck, D. (1993). The construct validity of two burnout measures. *Journal of Organizational Behavior*, *14*(7), 631–647. https://doi.org/10.1002/job.4030140703

Schaufeli, W. B., & Bakker, A. B. (2004). Job demands, job resources, and their relationship with burnout and engagement: A multi-sample study. *Journal of Organizational Behavior*, *23*(3), 293-315. https://doi.org/10.1002/job.248

Schaufeli, W. B., & Taris, T. W. (2014). A critical review of the job demands-resources model: Implications for improving work and health. In G. F. Bauer & O. Hämmig (Eds.), *Bridging* *occupational, organizational and public health: A transdisciplinary approach* (pp. 43–68). Springer Science + Business Media. https://doi.org/10.1007/978-94-007-5640-3_4

Sitzmann, T., & Ely, K. (2011). A meta-analysis of self-regulated learning in work-related training and educational attainment: What we know and where we need to go. *Psychological Bulletin, 137*, 421-442. doi: 10.1037/a0022777

Steiger, J. H. (1990). Structural model evaluation and modification: An interval estimation approach. *Multivariate Behavorial Research, 25*(2), 173-180. https://doi.org/10.1207/s15327906mbr2502_4

Sutherland, V. J., & Cooper, C. L. (1990). *Understanding stress. A psychological perspective for health professionals*. Chapman and Hall.

Swuste, P., van Gulijk, C., & Zwaard, W. (2010). Safety metaphors and theories, a review of the occupational safety literature of the US, UK and the Netherlands, till the first part of the 20th century. *Safety Science, 48*, 1000-1018. doi: 10.1016/j.ssci.2010.01.020

Taris, T. W. (2006). Is there a relationship between burnout and objective performance? A critical review of 16 studies. *Work & Stress, 20*(4), 316–334. https://doi.org/10.1080/02678370601065893

The American Institute of Stress. (2019). *Workplace Stress*. Retrieved from https://www.stress.org/workplace-stress

Tixier, J,-P., Hallowell, M. R., Albert, A., van Boven, L., & Kleiner, B. M. (2014). Psychological antecedents of risk-taking behavior in construction. *Journal of Construction Engineering and Management, 140*(11), 1-55. https://doi.org/10.1061/(ASCE)CO.1943-7862.0000894

Tucker, L. R., & Lewis, C. (1973). A reliability coefficient for maximum likelihood factor analysis. *Psychometrika, 38*(1), 1–10. https://doi.org/10.1007/BF02291170

Turner, N., Chmiel, N., Hershcovis, M. S., & Walls, M. (2010). Life on the line: Job demands, perceived co-worker support for safety, and hazardous work events. *Journal of Occupational Health Psychology, 15*(4), 482-493. https://doi.org/10.1037/a0021004

Ullman, J. B., & Bentler, P. M. (2013). Structural equation modeling. In I. B. Weiner (Ed.), *Handbook of psychology, second edition* (pp. 661-690). John Wiley & Sons, Inc.

Wallace, J. C., Paul, J. B., Landis, R. S., & Vodanovich, S. J. (2012). Occupational safety. In N. Schmitt (Ed.), *The Oxford handbook of personnel assessment and selection* (pp. 614-626). Oxford University Press.

Williams, J. H. (2008). Employee engagement improving participation in safety. *Professional Safety, 53*(12), ASSE-08-12-40.

Wirtz, N., Rigotti, T., Otto, K., & Loeb, C. (2017). What about the leader? Crossover of emotional exhaustion and work engagement from followers to leaders. *Journal of Occupational Health Psychology, 22*(1), 86–97. https://doi.org/10.1037/ocp0000024

Wolfgang, A. P. (1988). Job stress in the health professions: A study of physicians, nurses and pharmacists. *Behavioral Medicine, 14*, 43-47. https://doi.org/10.1080/08964289.1988.9935123

Woodhead, E. L., Northrop, L., & Edelstein, B. (2016). Stress, social support, and burnout among long-term care nursing staff. *Journal of Applied Gerontology, 35*(1), 84-105. doi: 10.1177/0733464814542465

Xanthopoulou, D., Bakker, A. B., Demerouti, E., & Schaufeli, W. B. (2009). Work engagement and financial returns: A diary study on the role of job and personal resources. *Journal of*

Occupational and Organizational Psychology, 82(1), 183–200. https://doi.org/10.1348/096317908X285633

Yankelevich, M., Broadfoot, A., Gillespie, J. Z., Gillespie, M. A., & Guidroz, A. (2011). General job stress: A unidimensional measure and its non-linear relations with outcome variables. *Stress & Health*, *28*(2), 137-148. https://doi.org/10.1002/smi.1413

Yaris, C., Ditchburn, G., Curtis, G. J., & Brook, L. (2020). Combing physical and psychosocial safety: A comprehensive workplace safety model. *Safety Science, 132*, 1-9. https://doi.org/10.1016/j.ssci.2020.104949

Yu, M., & Li, J. (2020). Psychosocial safety climate and unsafe behavior among miners in China: The mediating role of work stress and job burnout. *Psychology, Health & Medicine, 25*, 793-801. https://doi.org/10.1080/13548506.2019.1662068

Zadow, A. J., Dollard, M. F., Mclinton, S. S., Lawrence, P., & Tuckey, M. R. (2016). Psychosocial safety climate, emotional exhaustion, and work injuries in healthcare workplaces. *Stress and Health, 33*, 558-569. DOI: 10.1002/smi.2740

Zadow, A., Dollard, M. F., Parker, L., & Storey, K. (2019). Psychosocial safety climate: A review of the evidence. In M. F. Dollard, C. Dormann, & M. A. Idris (Eds.), *Psychosocial safety climate, a new work stress theory* (pp. 31-75). Springer, Cham. https://doi.org/10.1007/978-3-030-20319-1

Zhang, Y., Zhang, Y., Ng, T. W. H., & Lam, S. S. K. (2019). Promotion- and prevention-focused coping: A meta-analytic examination of regulatory strategies in the work stress process. *Journal of Applied Psychology, 104*(10), 1296–1323. https://doi.org/10.1037/apl0000404

Zohar, D. (1980). Safety climate in industrial organizations: Theoretical and applied implications. *Journal of Applied Psychology, 65*, 96-102. Doi: 10.1037/0021-9010.65.1.96

Chapter 4: Assessing the structural model

Zohar, D. (2000). A group-level model of safety climate: Testing the effect of group climate on microaccidents in manufacturing jobs. *Journal of Applied Psychology*, *85*(4), 587-596. https://doi.org/10.1037/0021-9010.85.4.587

Zohar, D. (2011). Safety climate: Conceptual and measurement issues. In J. Quick, & L. Tetrick (Eds.), *Handbook of organizational health psychology* (pp. 141-164). American Psychological Association.

CHAPTER 5

Conclusion and implications

Introduction

The purpose of this thesis was to establish an empirically founded comprehensive framework that reflects multiple aspects of safety climate, including antecedents and consequences. This was established by discussing the progression of safety climate research (Chapter 1), introducing the Physical and Psychosocial Workplace (PPWS) model (Chapter 2), establishing the measurement model (Chapter 3), and assessing the structural model (Chapter 4). This Chapter provides a discussion of the model and its implications.

Physical and psychosocial workplace safety model

Chapter 2 introduced the theoretical foundation for the PPWS model, as shown in Figure 5.1. The PPWS model intended to bridge the gap between physical and psychosocial safety climate research by adapting leading theoretical models. The model of safety performance (Neal & Griffin, 1997) has been heavily applied to physical safety research (e.g., Beus et al., 2016; Christian et al., 2009). The job demands – job resources (JD-R) model (Demerouti et al., 2001) provided the foundation for the JD-R model of workplace safety (Nahrgang et al., 2011), which was one of the earlier models in considering psychosocial safety climate. The PPWS model used those models as the foundation to create an integrated approach.

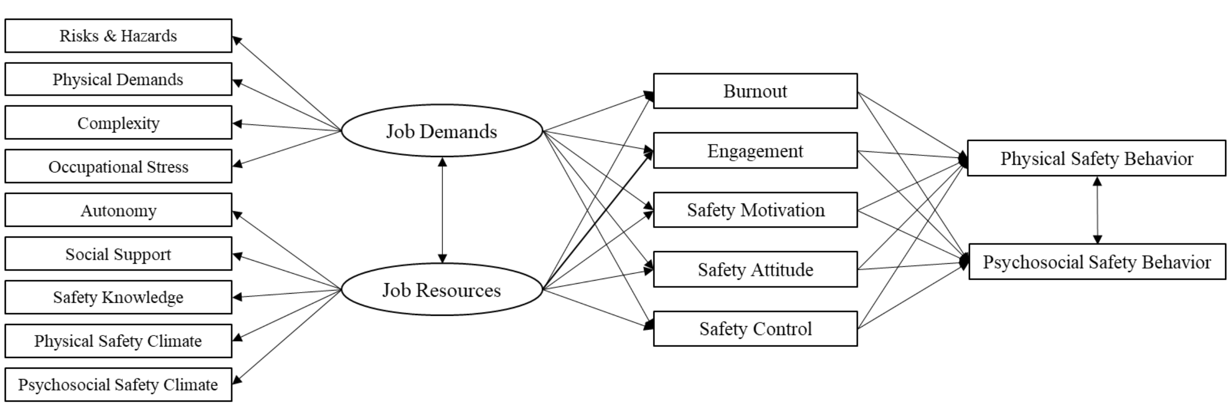

Figure 5.1. Initial PPWS model proposed in Chapter 2.

Chapters 3 and 4 discuss the exploratory and confirmatory analyses conducted to reach the final model. The final model, as shown below in Figure 5.2, reached almost adequate fit across a variety of fit indices. However, the model needs further development and re-specification. The purpose of this chapter is to discuss possible developments to improve the PPWS model and practical implications.

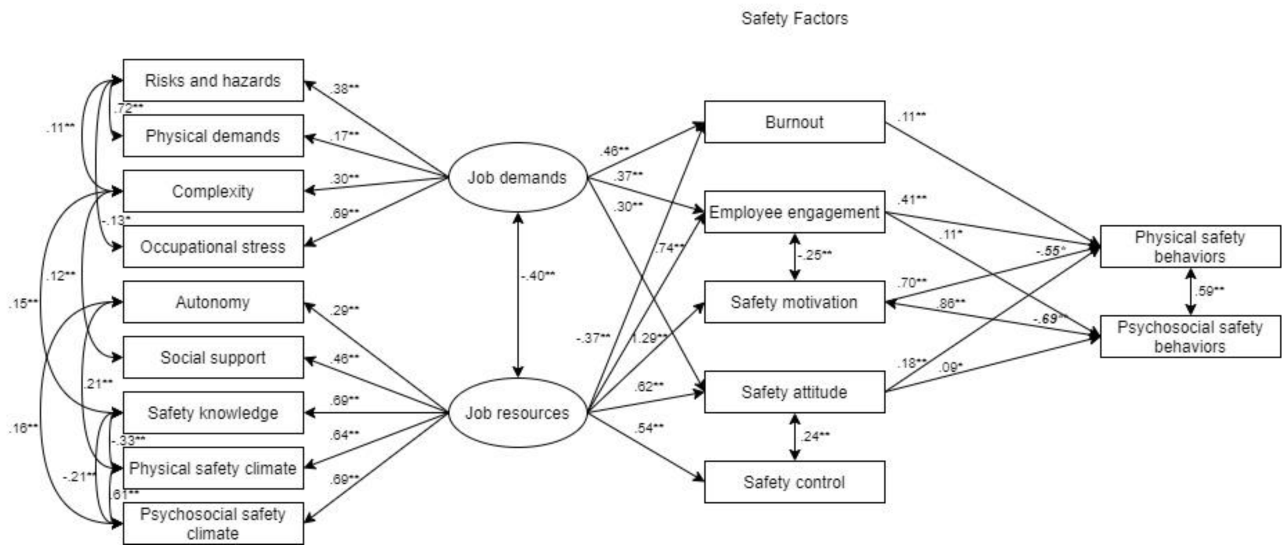

Figure 5.2. Final PPWS model, identified in Chapter 4, $*p < .05$, $**p < .01$. Safety motivation has bi-directional relationships with physical safety behaviors and psychosocial safety behaviors.

Model considerations

One goal of the PPWS model was to provide clear definitions and distinctions between variable conceptualization, particularly regarding safety climates and safety behaviors. The intent was to provide a parsimonious model. Therefore, the model of safety performance (Neal & Griffin, 1997) and JD-R model of workplace safety (Nahrgang et al., 2011) were used as the theoretical foundations. Other safety models (e.g., Fugas et al., 2012) were also considered. Looking at psychosocial safety climate first, the JD-R model was developed as a model of burnout (Demerouti et al., 2001). Studies found that, in the JD-R model, burnout develops with high job demands and low job resources across any occupation (Bakker & de Vries, 2020; Demerouti et al., 2001). One key aspect of the JD-R model is that it is generalizable across occupations. While every occupation has specific risk factors, they can be grouped into job demands and job resources (Demerouti et al., 2001). The PPWS model was developed to also be generalizable and proposed a series of additional job demands and resources. While the specific demands (risks and hazards, physical demands, complexity, and occupational stress) were met with support, the factor loadings had varying levels of magnitude. The factor loadings for physical demands and complexity were less than .3. This is lower than ideal benchmarks (Shi et al., 2018). However, sample size is a consideration, according to Hair et al. (2018). With the sample size obtained (n = 456) a factor loading of greater than or equal to .3 is sufficient. Ultimately, theory also drives the decision (Kline, 2016; Thompson, 2000) and the relationship of individual job demands to burnout varies in strength in different contexts (e.g., occupations or industries). This means that despite the demands being assessed across a wide range of occupations (as described in Chapter 4), different job demands, or occupational-specific demands should be considered, given the lower factor loadings. This would build a stronger foundation for the model moving forward and maintains the inherent flexibility of the JD-R model (Demerouti et al., 2001).

Physical and psychosocial safety climate

Nahrgang et al. (2011) extended the JD-R model to consider workplace safety with physical safety climate as part of the support environment under job resources and safety specific outcomes. Climate was conceptualized using Schneider's (1990) definition of climate focusing on the perceptions of events, practices, and procedures combined with the types of behaviors that are rewarded, supported, or expected. Therefore, safety climate concentrates on safety-related events, practices, and procedures and safety-oriented behaviors (Zohar, 1980) under Schneider's approach. Safety outcomes were identified as near-misses and injuries, adverse events, and unsafe behaviors. Li et al. (2013) also explored the JD-R model with near-misses and injuries as safety outcomes. Hansez and Chmiel (2010) considered situation and routine safety violations as outcome variables.

Dollard and Bakker (2010) introduced psychosocial safety climate in relation to the JD-R model. Psychosocial safety climate was found to predict job demands, psychological health problems, and employee engagement (Dollard & Bakker, 2010). Idris and Dollard (2011) also introduced psychosocial safety climate as an antecedent to job demands and resources impacting work performance through burnout and work engagement while Nahrgang et al. (2011) considered psychosocial safety climate as a job resource.

As the JD-R model has been extended to consider physical and psychosocial safety climate separately along with numerous safety outcomes (Dollard & Bakker, 2010; Lee et al., 2020), it was a logical starting point for an integrative approach. Research surrounding the JD-R model also identified the need for construct clarity and conceptualization (Fugas et al., 2012; Griffin & Neal, 2000; Nahrgang et al., 2011; Yaris et al., 2020). The PPWS model set out to provide a clear approach to how physical and psychosocial safety climate fits within the model and how to incorporate safety outcomes.

In aiming to achieve that goal, the findings of Chapter 4 suggest that physical and psychosocial safety climate should be explored beyond the context of job resources. Modification indices supported both physical and psychosocial safety climate having direct relationships with safety factors and/or safety behaviors. Exploring psychosocial safety climate as directly impacting outcomes is supporting in the literature (Dollard & Bakker, 2010).

Safety factors

Burnout, engagement, safety motivation, safety attitude, and safety control were hypothesized to be full mediators between job demands and resources with safety behaviors. This is supported by the JD-R model of workplace safety (Nahrgang et al., 2011) and self-regulatory processes (Bandura, 1988). The PPWS model intended to capture the health impairment and motivational processes (Demerouti et al., 2001) through burnout and engagement. The health impairment process suggests that job demands exhaust an individual's resources potentially leading to exhaustion and health problems. Conversely, the motivational process focuses on job resources as having motivational aspects leading to an individual's work engagement and performance (Demerouti et al., 2001). This is captured through the relationships between job demand and resources with burnout and engagement.

Adding to the model, self-regulation theory focuses on how individuals change their behaviors towards goal attainment based on personal and environmental factors (Bandura, 1988; Newman & Newman, 2020). In the context of the PPWS model, the goal is prediction of safety behaviors. As shown above in Figure 5.2, three of the proposed five safety factors maintained a significant relationship with job demands and accounted for the variance in job demands in the sample population. Given that job demands included personal (e.g., occupational stress) and environmental (e.g., risks and hazards) factors, the relationships were expected as job demands should impact safety motivation and control as they then influence safety behaviors (goal; Bandura, 1988; Xia et al., 2020).

Chapter 5: Conclusion and implications

A number of construct and measurement limitations were identified in the analyses conducted in Chapters 3 and 4. Therefore, it seems appropriate to revise the safety factors. Motivation is considered a component of engagement (Delaney & Royal, 2017). Attitude is suggested as an antecedent of employee engagement (Mohanan et al., 2012) and control impacts work engagement (De La Rosa, 2008; Vassos et al., 2013) through the job demand-control model (Karasek, 1979). This suggests that motivation, attitude, and control are conceptually similar to engagement or antecedents of engagement. Given the definitions and measures for engagement already can capture the specific elements for motivation, attitude, and control, there may be redundancy in the model. This can lead to a consolidation of constructs. Alternatively, motivation, attitude, and control could be explored in the PPWS framework as predictors of burnout and engagement.

Current measures of burnout and engagement include the Maslach Burnout Inventory (Maslach et al., 1997), Burnout Measure (Pines & Aronson, 1981), Copenhagen Burnout Inventory (Kristensen et al., 2005), the Utrecht Work Engagement Scale (UWES; Schaufeli et al., 2002), and the Intellectual, Social, Affective Engagement Scale (ISA Engagement Scale; Soane et al., 2012). The short version of the Burnout Measure (Malach-Pines, 2005) was used to measure burnout. When survey length is a concern, this measure is recommended when testing the PPWS model.

Engagement, however, needs revision. The 18-item Affective, Continuance, and Normative Commitment Scale (Allen & Meyer, 1990; Meyer et al., 1993) was used to measure engagement. This was selected based on the affective connection employees have with their organization (Bakker et al., 2008). Engagement is different from organizational commitment despite the affective commonality (Allen & Meyer, 1990; Schaufeli et al., 2002) and the findings resulted in only three of the affective items retained in the final model. Continuance commitment addresses the cost of leaving an organization and if an individual is willing to pay it. Last, normative commitment is an individual's perceived obligation to stay at an organization due to pressure or responsibility (Allen & Meyer, 1990). Normative and continuance commitment, while measured and retained in the PPWS model, do not fully capture engagement. The UWES defines and measures work engagement as a positive and fulfilling state of mind measured through vigor, dedication, and absorption in one's work. The UWES considers engagement as a positive affective-cognitive state (Schaufeli et al., 2002). Thus, engagement is considered at the work-level. This differs from the initial intent of the PPWS where affective commitment is an individual's attachment to an organization (Allen & Meyer, 1990). Soane et al. (2012) identified three conditions from leading engagement theories (Deci & Ryan, 1985; Kahn, 1990). Engagement is driven by a focused role, activation, and positive affect. The focused role refers to a defined, individual-level work role. Activation is the level of cognitive activity and effort while affect focuses on positive emotions (Soane et al., 2012). Therefore, the ISA Engagement Scale measures intellectual engagement, affective engagement, and social engagement. These three facets focus on the individual-level. Future research with the PPWS model should consider shifting from affective commitment at the organization level to a more robust consideration of engagement at the individual-level.

Safety motivation was measured using three items established by Neal et al. (2000) and Neal and Griffin (2006). Safety motivation is established as a construct and widely accepted across the literature (Beus et al., 2016; Jiang & Probst, 2015; Neal et al., 2000; Neal & Griffin, 2006). One consideration with safety motivation, particularly given the bi-directional relationship with physical and psychosocial safety behaviors would be to adapt the items for psychosocial safety motivation. Currently the items refer to “personal safety” or reducing risks, accidents, and incidents at work (Neal et al., 2000; Neal & Griffin, 2006).

Safety attitudes was measured using semantic differential scales adapted by Fugas et al. (2012) to be safety specific based upon the attitudes measured in Davis et al.’s (2002) study. This measure for safety attitudes consistently found good reliability across three items (Fugas et al., 2012; Yaris et al., 2020). There are a variety of other safety attitude instruments that are industry specific which could be generalized. For example, the Safety Attitudes Questionnaire was developed using, and is specific to, healthcare populations (Sexton et al., 2006) and the Employee Attitudes around Safety (Donald & Canter, 1994) was developed in the chemical industry. Both of those are high-risk industries and could be assessed for potential generalizability across all high-risk occupations. One concern with existing measures for safety attitudes is that the facets are inconsistent across industries (Cox & Cox, 1991; Ram & Chand, 2016). This provides support for and continued usage for the adapted measure (Fugas et al., 2012). As with safety motivation, the items could be adapted for psychosocial safety.

Safety control was also adapted by Fugas et al. (2012) to focus on safety based on Connor and McMillian’s (1999) measure of perceived behavioral control. This adapted instrument was not supported as a strong measure of safety control, per the psychometric properties (see Chapters 3 and 4). Huang et al. (2004) and Huang et al. (2006) used various items created by risk prevention professionals to measure safety control. For example, Huang (2004) used three items with a coefficient alpha of 0.70 while seven items with a coefficient alpha of 0.71 were used by Huang et al (2006). Shea et al (2016) also used the three items measure of employee safety control (Huang et al., 2004). However, there continues to be a lack of an established measure for safety control. Furthering validating the items used by Huang et al

(2004) and Huang et al (2006) is one option. Another option is to focus on different conceptualizations of safety control. Safety locus of control (Jones & Wuebker, 1985, 1993) is rooted in locus of control theory (Rotter, 1966). Locus of control is anchored with internal (perceiving events under one's own control) or external (perceiving events under other's or outside forces' control; Rotter, 1966). Safety locus of control has been prevalent in the literature since 1985 (Jones & Wuebker) addressing accidents (Wuebker, 1986) and various industries (aviation (Hunter, 2002), agriculture (Cigularov et al., 2009), and medical (Yimin et al., 2020)). Given the established nature of safety locus of control, this would be a stronger fit for the aims of the PPWS model to capture an individual's perceived level of control and worthwhile to explore.

Last, the grouping term, "safety factors," is potentially limiting. Burnout, engagement, safety motivation, safety control, and safety attitude were identified as processes (Bandura, 1988; Demerouti et al., 2001). Therefore, labelling them as "factors" potentially suggests they are fixed and can be updated in future iterations to reflect processes.

Safety behaviors

The PPWS model divided safety participation and safety compliance (Griffin & Neal, 2000) into physical and psychosocial safety behaviors. An alternative approach to consider would be maintaining the emphasis on whether the behaviors are participative or compliant. In this alternative approach, the safety participation would comprise both physical and psychosocial safety participation. Safety compliance would be the same. This an extension of Griffin and Neal's (2000) safety participation and safety compliance framework to include both physical and psychosocial elements. See Figure 5.3 below for the comparison.

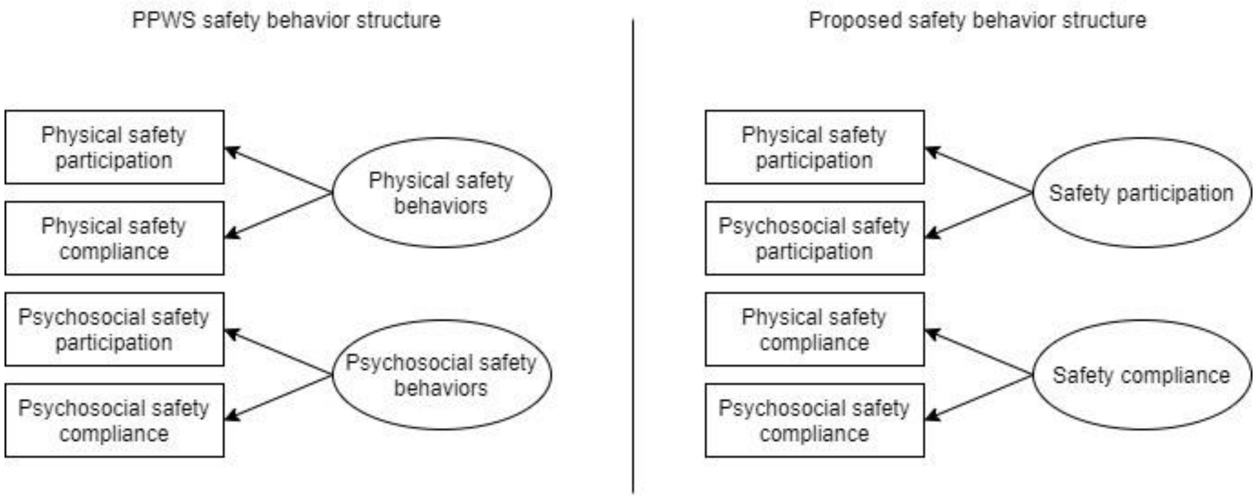

Figure 5.3. PPWS approach and proposed alternative approach for safety behaviors in the PPWS model.

Interestingly, safety attitudes and safety control were not identified as significant indicators of safety behaviors. In terms of accidents, safety attitude has an established relationship where poor attitudes are related to accident severity (Heinrich, 1931) and improving safety attitudes decreases unsafe behavior and accident frequency (Shin et al., 2014). Research has consistently supported the relationship between safety attitudes and safety behaviors (Li et al., 2019). Therefore, it was surprising when the PPWS model failed to support that relationship. Next steps should consider either expanding the PPWS model and having safety attitudes as antecedents to burnout and engagement, therefore, indirectly impacting safety behaviors or finding a more robust instrument to capture the construct.

Alternatively, reconceptualizing safety behaviors to focus on frequency of demonstrated behaviors or measures of specific behaviors is another avenue for future research. For example, prioritizing wearing PPE or getting rest would be examples of specific behaviors aligned to physical and psychosocial safety behaviors, respectively. This would also add value since “psychosocial safety” may be a term that is unfamiliar to many or means different things to different organizations. Therefore, asking participants about specific behaviors may fill the limitations identified with how safety behaviors was conceptualized and measured.

Implications

The PPWS model was a first attempt at combining physical and psychosocial safety into a comprehensive model that supports researchers and practitioners. Organizations have guidelines and policy addressing both physical and psychosocial safety (OSHA, 2021; Safe Work Australia, 2021) supporting the need for a comprehensive approach. While the model is still a work in progress, it has provided the foundation and insight to enable further development towards creating a parsimonious approach. Organizations would be able to measure each individual construct in the PPWS model to be able to drive interventions, and subsequently change, based on the findings. An additional benefit of the PPWS model is in familiarizing individuals with the concept of psychosocial safety and what steps can be taken to improve psychosocial safety behaviors.

One of the advantages of the PPWS model is that it enables organizations to identify where there may be specific strengths and weaknesses. Practitioners can use those insights to develop specific interventions and use construct specific surveys to evaluate the efficacy of specific interventions. These are akin to pulse surveys (Colihan & Waclawski, 2006). For example, if motivation is an area of focus, a motivation survey can be administered more frequently to measure change from the interventions to improve motivation.

The National Institute for Occupational Safety and Health (NIOSH) has a conceptual framework for worker well-being (Chari et al., 2018). Aligning the PPWS model to this paradigm of Total Worker Health would support future implications. Additionally, this would create a stronger foundation for supporting an individual's physical and psychological well-being in the workplace.

Conclusion

Although the PPWS model maintained almost adequate statistical fit in Chapter 4, it did provide direction and insights on future directions to develop an integrative approach for physical and psychosocial safety. Ideally, the model would have identified better fit but there is just as much to be gained from less-than-ideal model fit, especially considering it was only tested against one sample (Thompson, 1998). Providing construct clarification (e.g., employee engagement) is a starting point for model improvements and re-specification. Measures can also be adapted to fully include psychosocial safety climate. The PPWS provides value as a starting point to continue identifying an approach to understanding physical and psychosocial safety elements in one model.

References

Allen, N. J., & Meyer, J. P. (1990). The measurement and antecedents of affective, continuance, and normative commitment to the organization. *Journal of Occupational Psychology, 63,* 1-18. https://doi.org/10.1111/j.2044-8325.1990.tb00506.x

Bakker, A. B., & de Vries, J. (2020). Job demands-resource theory and self-regulation: New explanations and remedies for job burnout. *Anxiety, Stress, & Coping, 34*(1), 1-21. https://doi.org/10.1080/10615806.2020.1797695

Bakker, A. B., Schaufeli, W. B., Leiter, M. P., & Taris, T. W. (2008). Work engagement: An emerging concept in occupational health psychology. *Work and Stress, 22,* 187–200. https://doi.org/10.1080/02678370802393649

Bandura, A. (1988). Self-regulation of motivation and action through goal systems. In V. Hamilton, G. Bower, and N. H. Frijda (Eds.), Cognitive perspectives on emotion and motivation (pp. 37–61). Kluwer Academic/Plenum Publishers. https://doi.org/10.1007/978-94-009-2792-6_2

Beus, J. M., Payne, S. C., Bergman, M. E., & Arthur, W., Jr. (2010). Safety climate and injuries: An examination of theoretical and empirical relationships. *Journal of Applied Psychology, 95*(4), 713–727. https://doi.org/10.1037/a0019164

Chari, R., Chang, C.-C., Sauter, S. L., Sayers, E. L. P., Cerully, J. L., Schulte, P., Schill, A. L., & Uscher-Pines, L. (2018). Expanding the paradigm of occupational safety and health: A new framework for worker well-being. *Journal of Occupational and Environmental Medicine, 60*(7), 589–593. https://doi.org/10.1097/JOM.0000000000001330

Christian, M. S., Bradley, J. C., Wallace, J. C., & Burke, M. J. (2009). Workplace safety: A meta-analysis of the roles of person and situation factors. *Journal of Applied Psychology, 94*, 1103-1127. Doi: 10.1037/a0016172

Cigularov, K. P., Chen, P. Y., & Stallones, L. (2009). Error communication in young farm workers: Its relationship to safety climate and safety locus of control. *Work & Stress, 23*(4), 297–312. https://doi.org/10.1080/02678370903416679

Colihan, J. & Waclawski, J. (2006). Pulse surveys: A limited approach with some unique advantages. In A. Kraut (Ed.). *Getting action from organizational surveys: New concepts, technologies and applications,* (pp. 264–293). Jossey-Bass

Cox, S., & Cox, T. (1991). The structure of employee attitudes to safety: A European example. *Work & Stress, 5*(2), 93–106. https://doi.org/10.1080/02678379108257007

Davis, L. E., Ajzen, I., Saunders, J., & Williams, T. (2002). The decision of African American students to complete high school: An application of the theory of planned behavior. *Journal of Educational Psychology, 94*(4), 810-819. https://doi.org/10.1037/0022-0663.94.4.810

De La Rosa, G. M. (2008). *Job demands, control, and support: Looking at engagement* [Doctoral dissertation, Bowling Green State University]. OhioLINK.

Deci, E. L., & Ryan, R. M. (1985). *Intrinsic motivation and self-determination in human behavior*. Plenum.

Delaney, M. L., & Royal, M. A. (2017). Breaking engagement apart: The role of intrinsic and extrinsic motivation in engagement strategies. *Industrial and Organizational Psychology, 10*(1), 127-140. https://doi.org/10.1017/iop.2017.2

Demerouti, E., Bakker, A. B., Nachreiner, F., & Schaufeli, W. B. (2001). The job demands-resources model of burnout. *Journal of Applied Psychology, 86,* 499-512. Doi: 10.1037/0021-9010.86.3.499

Dollard, M. F. & Bakker, A. B. (2010). Psychosocial safety climate as a precursor to conducive work environments, psychological health problems, and employee engagement. *Journal of Occupational and Organizational Psychology, 83,* 579-599. Doi: 10.1348/096317909X470690

Donald, I., & Canter, D. (1994). Employee attitudes and safety in the chemical industry. *Journal of Loss Prevention in the Process Industries, 7*(3), 203-208. https://doi.org/10.1016/0950-4230(94)80067-7

Fugas, C. S., Silva, S. A., & Meliá, J. L. (2012). Another look at safety climate and safety behavior: Deepening the cognitive and social mediator mechanisms. *Accident Analysis and Prevention, 45,* 468-477. Doi: 10.1016/j.aap.2011.08.013

Griffin, M. A., & Neal, A. (2000). Perceptions of safety at work: A framework for linking safety climate to safety performance, knowledge, and motivation. *Journal of Occupational Health Psychology, 5*(3), 347-358. https://doi.org/10.1037/1076-8998.5.3.347

Hair, J. F., Babin, B. J., Anderson, R. E., & Black, W. C (2018). *Multivariate data analysis* (8th edition). Cengage.

Hansez, I., & Chmiel, N. (2010). Safety behavior: Job demands, job resources, and perceived management commitment to safety. *Journal of Occupational Health Psychology, 15*(3), 267-278. Doi: 10.1037/a0019528

Heinrich, H.W. (1931). *Industrial accident prevention; a scientific approach.* McGraw-Hill.

Huang, Y.-H., Chen, P. Y., Krauss, A. D., & Rogers, D. A. (2004). Quality of the execution of corporate safety policies and employee safety outcomes: Assessing the moderating role of supervisor safety support and the mediating role of employee safety control. *Journal of*

Business and Psychology, 18(4), 483-506. https://doi.org/10.1023/B:JOBU.0000028448.01394.bf

Huang, Y.-H., Ho, M., Smith, G. S., & Chen, P. Y. (2006). Safety climate and self-reporting injury: Assessing the mediating role of employee safety control. *Accident Analysis & Prevention, 38*(3), 425-433. https://doi.org/10.1016/j.aap.2005.07.002

Hunter, D. R. (2002). Development of an Aviation Safety Locus of Control Scale. *Aviation, Space, and Environmental Medicine, 73*(12), 1184–1188.

Idris, M. A.& Dollard, M. F. (2011). Psychosocial safety climate, work conditions, and emotions in the workplace: A Malaysian population-based work stress study. *International Journal of Stress Management, 18*(4), 324-347. https://doi.org/10.1037/a0024849

Jiang, L., & Probst, T. M. (2015). The relationship between safety–production conflict and employee safety outcomes: Testing the impact of multiple organizational climates. *Work & Stress, 29*(2), 171–189. https://doi.org/10.1080/02678373.2015.1032384

Jones, J. W., & Wuebker, L. (1985). Development and validation of the Safety Locus of Control Scale. *Perceptual and Motor Skills, 61*(1), 151–161. https://doi.org/10.2466/pms.1985.61.1.151

Jones, J. W., & Wuebker, L. J. (1993). Safety locus of control and employees' accidents. *Journal of Business and Psychology, 7*(4), 449–457. https://doi.org/10.1007/BF01013758

Kahn, W. A. (1990). Psychological conditions of personal engagement and disengagement at work. *Academy of Management Journal, 33*(4), 692–724. https://doi.org/10.2307/256287

Karasek, R. A. (1979). Job demands, job decision latitude, and mental strain: Implications for job redesign. *Administrative Science Quarterly, 24,* 285-308. https://doi.org/10.2307/2392498

Kline, R. B. (2016). *Principles and practice of structural equation modeling* (4th edition.). The Guilford Press.

Kristensen, T. S., Borritz, M., Villadsen, E., & Christensen, K. B. (2005). The Copenhagen Burnout Inventory: A new tool for the assessment of burnout. *Work & Stress, 19*(3), 192-207. https://doi.org/10.1080/02678370500297720

Lee, W., Migliaccio, G. C., Lin, K.-Y., & Seto, E. Y. W. (2020). Workforce development: Understanding task-level job demands-resources, burnout, and performance in unskilled construction workers. *Safety Science*, *123*, 1-14. https://doi.org/10.1016/j.ssci.2019.104577

Li, F., Jiang, L., Yao, X., & Li, Y. (2013). Job demands, job resources and safety outcomes: The role of emotional exhaustion and safety compliance. *Accident Analysis & Prevention, 51,* 243-251. https://doi.org/10.1016/j.aap.2012.11.029

Li, Y., Wu, X., Luo, X., Gao, J., & Yin, W. (2019). Impact of safety attitude on the safety behavior of coal miners in China. *Sustainability, 11*(22), 1-21. https://doi.org/10.3390/su11226382

Malach-Pines, A. (2005). The burnout measure, short version. *International Journal of Stress Management, 12*(1), 78-88. https://doi.org/10.1037/1072-5245.12.1.78

Maslach, C., Jackson, S. E., & Leiter, M. P. (1997). Maslach Burnout Inventory: Third edition. In C. P. Zalaquett & R. J. Wood (Eds.*), Evaluating stress: A book of resources* (pp. 191–218). Scarecrow Education.

Meyer, J. P., Allen, N., & Smith, C. A. (1993). Commitment to organizations and occupations: Extension and test of a three-component conceptualization. *Journal of Applied Psychology, 78*(4), 538-551. https://doi.org/10.1037/0021-9010.78.4.538

Mohanan, M., Sequeira, A. H., & Kumar, M. S. (2012). Employee engagement and motivation: A case study. *KHOJ- Journal of Indian Management Research and Practice*, (available online). http://dx.doi.org/10.2139/ssrn.2114214

Nahrgang, J. D., Morgeson, F. P., & Hofmann, D. A. (2011). Safety at work: A meta-analytic investigation of the link between job demands, job resources, burnout, engagement, and safety outcomes. *Journal of Applied Psychology, 96*, 71-74. Doi: 10.1037/a0021484

Neal, A., & Griffin, M. A. (1997). Perceptions of safety at work: Developing a model to link organizational safety climate and individual behavior. Paper presented to the 12th Annual Conference of the Society for Industrial and Organizational Psychology, St. Louis, MO.

Neal, A., & Griffin, M. A. (2006). A study of the lagged relationships among safety climate, safety motivation, safety behavior, and accidents at the individual and group levels. *Journal of Applied Psychology, 91*, 946-953. https://doi.org/10.1037/0021-9010.91.4.946

Neal, A., Griffin, M. A., & Hart, P. M. (2000). The impact of organizational climate on safety climate and individual behavior. *Science Safety, 34,* 99-109. https://doi.org/10.1016/S0925-7535(00)00008-4

Occupational Safety & Health Administration (OSHA). (2021). *About OSHA.* https://www.osha.gov/index.php/aboutosha

Pines, A. M., & Aronson, E. (1981). *Burnout. From tedium to personal growth.* Free Press.

Ram, T., & Chand, K. (2016). Effects of drivers' risk perception and perception of driving tasks on road safety attitude. *Transportation Research Part F: Traffic Psychology and Behaviour, 42*(1), 162-176. https://doi.org/10.1016/j.trf.2016.07.012

Rotter, J. B. (1966). Generalized expectancies for internal versus external control of reinforcement. *Psychological Monographs: General and Applied, 80*(1), 1–28. https://doi.org/10.1037/h0092976

Safe Work Australia. (2021, May 19). *About us.* https://www.safeworkaustralia.gov.au/about-us

Schaufeli, W. B., Salanova, M., González-Romá, V., & Bakker, A. B. (2002). The measurement of engagement and burnout: A two sample confirmatory factor analytic approach. *Journal of Happiness Studies, 3,* 71-92. https://doi.org/10.1023/A:1015630930326

Schneider, B. (1990). The climate for service: An application of the climate construct. In B. Schneider (Ed.), *Organizational climate and culture* (pp. 383–412). Jossey-Bass.

Sexton, J. B., Helmreich, R. L., Neilands, T. B., Rowan, K., Vella, K., Boyden, J., Roberts, P. R., & Thomas, E. J. (2006). The Safety Attitudes Questionnaire: Psychometric properties, benchmarking data, and emerging research. *BMC Health Services Research, 6,* Article 44.

Shea, T., De Cieri, H., Donohue, R., Cooper, B., & Sheehan, C. (2016). Leading indicators of occupational health and safety: An employee and workplace level validation study. *Safety Science, 85,* 293-304. https://doi.org/10.1016/j.ssci.2016.01.015

Shi, D., Lee, T., & Maydeu-Olivares, A. (2018). Understanding the model size effect on SEM fit indices. *Educational and Psychological Measurement, 78*(2), 310-334. https://doi.org/10.1177/0013164418783530

Shin, M., Lee, H.-S., Park, M., Moon, M., & Han, S. (2014). A system dynamics approach for modelling construction workers' safety attitudes and behaviors. *Accident Analysis and Prevention, 68,* 95-105. https://doi.org/10.1016/j.aap.2013.09.019

Soane, E., Truss, C., Alfes, K., Shantz, A., Rees, C., & Gatenby, M. (2012). Development and application of a new measure of employee engagement: The ISA Engagement Scale. *Human Resource Development International, 15*(5), 529–547. https://doi.org/10.1080/13678868.2012.726542

Thompson, B. (1998). The ten commandments of good structural equation modelling behavior: A user-friendly introductory primer on SEM [Conference presentation]. Office of Special Education Programs Project Directors' Conferences, Washington D. C. https://www.semanticscholar.org/paper/The-Ten-Commandments-of-Good-Structural-Equation-A-Thompson/04f16bb592254daa267153380ce54c54956afd8c

Thompson, B. (2000). Ten commandments of structural equation modeling. In L. G. Grimm & P. R. Yarnold (Eds.), *Reading and understanding more multivariate statistics* (pp. 261-283). American Psychological Association.

Vassos, M. V., Nankervis, K. L., Skerry, T., & Lante, K. (2013). Work engagement and job burnout within the disability support worker population. *Research in Developmental Disabilities, 34*(11), 3884-3895. https://doi.org/10.1016/j.ridd.2013.08.005

Wuebker, L. J. (1986). Safety locus of control as a predictor of industrial accidents and injuries. *Journal of Business and Psychology, 1*(1), 19–30. https://doi.org/10.1007/BF01014164

Xia, N., Xie, Q., Hu, X., Wang, X., & Meng, H. (2020). A dual perspective on risk perception and its effect on safety behavior: A moderated mediation model of safety motivation and supervisor's and coworkers' safety climate. *Accident Analysis and Prevention, 134,* 1-12. https://doi.org/10.1016/j.aap.2019.105350

Yaris, C., Ditchburn, G., Curtis, G. J., & Brook, L. (2020). Combing physical and psychosocial safety: A comprehensive workplace safety model. *Safety Science*, *132*, 1-9. https://doi.org/10.1016/j.ssci.2020.104949

Yimin, H., Payne, S. C., Yao, C., & Smallman, R. (2020). Improving workplace safety by thinking about what might have been: A first look at the role of counterfactual thinking. *Journal of Safety Research*, *72*, 153-164. https://doi.org/10.1016/j.jsr.2019.12.010

Zohar, D. (1980). Safety climate in industrial organizations: Theoretical and applied implications. *Journal of Applied Psychology*, *65*, 96-102. Doi: 10.1037/0021-9010.65.1.96

Appendix A

Descriptive statistics and item correlations by measure.

Table A1

Descriptive statistics and correlations for risks and hazards (n = 941)

Item	*M*	*SD*	1	2	3	4	5	6	7	8
The work place is free from excessive noise	3.06	1.30	-							
The climate at the work place is comfortable in terms of temperature and humidity	2.65	1.19	.54**	-						
Overall, this job has more risks than others	2.81	1.44	.34**	.24**	-					
There is a high-risk of accidents in this job	2.62	1.40	.36**	.26**	.80**	-				
The job has a low risk of accident	2.76	1.39	.44**	.32**	.72**	.82**	-			
The job takes place in an environment free from health hazards (e.g., chemicals, fumes, etc.)	2.91	1.44	.41**	.31**	.58**	.61**	.66**	-		
The job occurs in a clean environment	2.54	1.30	.47**	.42**	.57**	.62**	.67**	.71**	-	
The job is dangerous	2.58	1.45	.34**	.21**	.80**	.80**	.74**	.60**	.62**	-

Note. *$p < .05$, **$p < .01$

Table A2

Descriptive statistics and correlations for physical demands (n = 941)

Item	*M*	*SD*	1	2
The job requires a great deal of muscular strength	2.83	1.38	-	

The job requires a lot of physical effort	2.57	1.31	.86**	-

Note. *p < .05, **p < .01

Table A3

Descriptive statistics and correlations for complexity (n = 941)

Item	*M*	*SD*	1	2	3
The job requires that I only do one task or activity at a time	3.73	1.19	-		
The tasks on the job are simple and uncomplicated	3.44	1.21	.44**	-	
The job involves performing relatively simple tasks	3.26	1.22	.38**	.82**	-

Note. *p < .05, **p < .01

Table A4

Descriptive statistics and correlations for occupational stress (n = 941)

Item	*M*	*SD*	1	2	3	4	5	6	7	8
Demanding	1.77	.47	-							
Pressured	1.65	.53	.47**	-						
Calm	1.25	.57	-.29**	-.31**	-					
Many things stressful	1.65	.54	.41**	.52**	-.31**	-				
Nerve-wracking	1.39	.59	.38**	.38**	-.17**	.46**	-			
Hassled	1.33	.58	.18**	.30**	-.14**	.31**	.40**	-		
More stressful than I'd like	1.40	.61	.22**	.37**	-.17**	.40**	.33**	.35**	-	
Overwhelming	1.21	.57	.19**	.21**	-.06	.28**	.35**	.28**	.36**	-

Note. *p < .05, **p < .01

Table A5

Appendix A

Descriptive statistics and correlations for autonomy (n = 941)

Item	*M*	*SD*	1	2	3
This job allows me to make my own decisions about how to schedule my work	3.15	1.31	-		
The job allows me to decide on the order in which things are done on the job	3.36	1.18	.66**	-	
The job allows me to plan how I do my work	3.50	1.16	.67**	.81**	-

Note. *p < .05, **p < .01

Table A6

Descriptive statistics and correlations for social support (n = 941)

Item	*M*	*SD*	1	2	3	4	5	6
I have the opportunity to develop close friendships in my job	3.83	.97	-					
I have the chance in my job to get to know other people	4.01	.88	.67**	-				
I have the opportunity to meet with others in my work	3.98	.91	.64**	.74**	-			
My supervisor is concerned about the welfare of the people that work for him/her	3.69	1.11	.33**	.27**	.27**	-		
People I work with take a personal interest in me	3.67	.99	.51**	.43**	.42**	.43**	-	
People I work with are friendly	4.00	.77	.45**	.40**	.40**	.40**	.60**	-

Note. *p < .05, **p < .01

Table A7

Appendix A

Descriptive statistics and correlations for safety knowledge (n = 941)

Item	*M*	*SD*	1	2	3	4
I know how to perform my job in a safe manner	4.33	.70	-			
I know how to use safety equipment and standard work procedures	4.25	.75	.69**	-		
I know how to maintain or improve workplace health and safety	4.06	.80	.61**	.71**	-	
I do not know how to reduce the risk of accidents and incidents in the workplace	3.78	1.17	.24**	.26**	.31**	-

Note. *p < .05, **p < .01

Table A8

Descriptive statistics and correlations for physical safety climate (n = 941)

Item	*M*	*SD*	1	2	3	4	5	6	7	8	9	10
In my workplace senior management acts quickly to correct problems/issues that affect employees' physical health	3.48	1.10	-									
Senior management acts decisively when a concern of an employees' physical status is raised	3.55	1.06	.81**	-								
Physical well-being of staff is a priority for this organization	3.43	1.12	.75**	.69**	-							
Senior management clearly considers the physical health of employees to be of great importance	3.51	1.09	.75**	.70**	.84**	-						
Senior management considers employee physical health to be as important as productivity	3.25	1.15	.69**	.63**	.77**	.79**	-					

There is good communication here about physical safety issues which effect me	3.43	1.08	.70**	.66**	.71**	.73**	.69**	-				
Information about workplace physical well-being is always brought to my attention by my manager/supervisor	3.18	1.11	.64**	.61**	.67**	.65**	.65**	.74**	-			
My contributions to resolving occupational health and safety concerns in the organization are listened to	3.31	1.03	.67**	.65**	.68**	.66**	.63**	.69**	.69**	-		
Participation and consultation in physical health and safety occurs with employees', unions and health and safety representatives in my workplace	3.16	1.12	.59**	.57**	.62**	.60**	.61**	.66**	.67**	.68**	-	
Employees are encouraged to become involved in physical safety and health matter	3.44	1.08	.60**	.61**	.67**	.70**	.63**	.68**	.68**	.66**	.68**	-

Note. *p < .05, **p < .01

Table A9

Descriptive statistics and correlations for psychosocial safety climate (n = 941)

Item	*M*	*SD*	1	2	3	4	5	6	7	8	9	10	11	12
In my workplace senior management acts quickly to correct problems/issues that affect employees' psychological health	3.28	1.14	-											
Senior management acts decisively when a concern of an employees' psychological status is raised	3.37	1.07	.75**	-										

Appendix A

Senior management show support for stress prevention through involvement and commitment	3.27	1.14	.71**	.68**	-									
Psychological well-being of staff is a priority for this organization	3.17	1.20	.71**	.66**	.76**	-								
Senior management clearly considers the psychological health of employees to be of great importance	3.26	1.16	.72**	.67**	.73**	.83**	-							
Senior management considers employee psychological health to be as important as productivity	3.03	1.21	.66**	.63**	.70**	.76**	.80**	-						
There is good communication here about psychological safety issues which effect me	2.94	1.18	.60**	.59**	.65**	.68**	.68**	.71**	-					
Information about workplace psychological well-being is always brought to my attention by my manager/supervisor	2.74	1.15	.54**	.51**	.59**	.62**	.60**	.64**	.72**	-				
My contributions to resolving occupational health and safety concerns in the organization are listened to	3.13	1.06	.60**	.60**	.65**	.66**	.68**	.65**	.65**	.66**	-			
Participation and consultation in psychological health and safety occurs with employees', unions and health and safety representatives in my workplace	2.94	1.13	.51**	.49**	.58**	.59**	.59**	.62**	.62**	.65**	.61**	-		
Employees are encouraged to become involved in psychological safety and health matter	3.06	1.17	.51**	.50**	.58**	.62**	.61**	.63**	.66**	.66**	.64**	.68**	-	
In my organization, the prevention of stress involves all levels of the organization	3.49	1.24	.34**	.33**	.44**	.45**	.42**	.44**	.39**	.37**	.42**	.43**	.44**	-

Note. *p < .05, **p < .01

Table A10

Descriptive statistics and correlations for burnout (n = 941)

Item	*M*	*SD*	1	2	3	4	5	6	7	8	9	10
Tired	4.58	1.30	-									
Disappointed with people	4.08	1.36	.50**	-								
Hopeless	2.76	1.43	.43**	.54**	-							
Trapped	2.86	1.68	.46**	.54**	.75**	-						
Helpless	2.63	1.49	.42**	.50**	.80**	.77**	-					
Depressed	2.77	1.57	.46**	.51**	.71**	.71**	.73**	-				
Physically weak/sickly	2.56	1.43	.43**	.40**	.52**	.54**	.55**	.58**	-			
Worthless/Like a failure	2.31	1.49	.34**	.38**	.63**	.61**	.64**	.70**	.55**	-		
Difficulties sleeping	3.23	1.77	.47**	.41**	.46**	.49**	.49**	.54**	.55**	.50**	-	
"I've had it"	3.02	1.77	.47**	.53**	.62**	.70**	.65**	.61**	.52**	.55**	.46**	-

Note. *p < .05, **p < .01

Table A11

Descriptive statistics and correlations for employee engagement (n = 941)

Item	*M*	*SD*	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
I would be very happy to spend the rest of my career with this organization	4.49	1.92	-																	
I really feel as if this organization's problems are my own	4.04	1.74	.55**	-																
I do not feel a strong sense of "belonging" to my organization	4.50	1.80	.54**	.42**	-															

Appendix A

I do not feel "emotionally attached" to this organization	4.44	1.85	.58**	.46**	.77**	-								
I do not feel like "part of the family" at my organization	4.56	1.82	.54**	.42**	.78**	.79**	-							
This organization has a great deal of personal meaning for me	4.54	1.73	.64**	.56**	.59**	.69**	.62**	-						
Right now, staying with my organization is a matter of necessity as much as desire	4.93	1.59	-.06	-.05	-.15**	-.13**	-.15**	-.04	-					
It would be very hard for me to leave my organization right now, even if I wanted to	4.55	1.81	.17**	.19**	.09**	.12**	.10**	.20**	.37**	-				
Too much of my life would be disrupted if I decided I wanted to leave my organization now	4.63	1.79	.11**	.14**	.04	.08*	.05	.14**	.35**	.67**	-			
I feel that I have too few options to consider leaving this organization	4.24	1.84	-.25**	-.13**	-.30**	-.28**	-.31**	-.22**	.38**	.39**	.47**	-		
If I had not already put so much of myself into this organization, I might consider working elsewhere	3.68	1.79	-.17**	-.03	-.27**	-.25**	-.25**	-.10**	.22**	.24**	.28**	.42**	-	
One of the few negative consequences of leaving this organization would	4.13	1.86	-.22**	-.14**	-.27**	-.25**	-.27**	-.20**	.26**	.30**	.35**	.67**	.39**	-

be the scarcity of available alternatives																				
I do not feel any obligation to remain with my current employer	4.24	1.80	.46**	.38**	.48**	.54**	.50**	.47**	-.08*	.19**	.17**	-.12**	-.11**	-.12**	-					
Even if it were to my advantage, I do not feel it would be right to leave my organization now	3.89	1.75	.40**	.35**	.27**	.29**	.26**	.42**	.06	.29**	.23**	-.03	.04	-.04	.34**	-				
I would feel guilty if I left my organization now	3.74	1.89	.31**	.36**	.29**	.36**	.32**	.43**	.01	.22**	.19**	-.02	.04	-.02	.40**	.58**	-			
This organization deserves my loyalty	4.24	1.79	.57**	.52**	.54**	.57**	.56**	.66**	-.07*	.16**	.08*	-.21**	-.15**	-.17**	.50**	.50**	.54**	-		
I would not leave my organization right now because I have a sense of obligation to the people in it	4.18	1.78	.46**	.46**	.42**	.50**	.46**	.62**	-.05	.19**	.17**	-.13**	.02	-.13**	.48**	.52**	.63**	.67**	-	
I owe a great deal to my organization	4.01	1.74	.52**	.49**	.47**	.50**	.50**	.64**	-.06	.19**	.11**	-.15**	-.08*	-.10**	.47**	.45**	.53**	.72**	.67**	-

Note. *p < .05, **p < .01

Table A12

Descriptive statistics and correlations for safety motivation (n = 941)

Item	*M*	*SD*	1	2	3
I feel that it is worthwhile to put in effort to maintain or improve my personal safety	4.13	.79	-		
I feel that it is important to maintain safety at all times	4.35	.72	.58**	-	

I believe that it is important to reduce the risk and accidents and incidents in the workplace	4.39	.71	.58**	.72**	-

Note. *p < .05, **p < .01

Table A13

Descriptive statistics and correlations for safety attitude (n = 941)

Item	*M*	*SD*	1	2	3
In my job, compliance with safety rules is…	4.24	.91	-		
In my job, actively participating in safety rules is….	4.18	1.01	.62**	-	
In my job, actively participating in safety is…	4.33	.86	.65**	.79**	-

Note. *p < .05, **p < .01

Table A14

Descriptive statistics and correlations for safety control (n = 941)

Item	*M*	*SD*	1	2	3
I feel I don't have control over the safety performance on my job	3.70	1.12	-		
For me, working safely is…	4.23	.88	.37**	-	
It depends on me to work in a safe way	4.17	.99	.32**	.35**	-

Note. *p < .05, **p < .01

Table A15

Descriptive statistics and correlations for safety behaviors (n = 941)

Appendix A

Item	*M*	*SD*	1	2	3	4	5	6	7	8	9	10	11	12
I use all the necessary physical safety equipment to do my job	5.65	1.22	-											
I use the correct physical safety procedures for carrying out my job	5.70	1.13	.82**	-										
I ensure the highest levels of physical safety when I carry out my job	5.69	1.16	.81**	.82**	-									
I promote the physical safety program within the organization	5.03	1.52	.41**	.40**	.45**	-								
I put in extra effort to improve the physical safety of the workplace	4.93	1.49	.38**	.36**	.43**	.75**	-							
I voluntarily carry out tasks or activities that help to improve workplace physical safety	4.90	1.51	.37**	.34**	.36**	.69**	.82**	-						
I use all the necessary psychological safety equipment to do my job	4.82	1.43	.32**	.28**	.32**	.34**	.31**	.30**	-					
I use the correct psychological safety procedures for carrying out my job	4.92	1.39	.35**	.32**	.36**	.35**	.30**	.32**	.84**	-				
I ensure the highest levels of psychological safety when I carry out my job	4.97	1.42	.34**	.32**	.36**	.37**	.34**	.33*	.77**	.86**	-			
I promote the psychological safety program within the organization	4.61	1.54	.21**	.18**	.25**	.56**	.52**	.52**	.55**	.56**	.56**	-		
I put in extra effort to improve the psychological safety of the workplace	4.67	1.51	.21**	.19**	.22**	.53**	.56**	.58**	.47**	.52**	.54**	.76**	-	
I voluntarily carry out tasks or activities that help to improve workplace psychological safety	4.75	1.48	.22**	.19**	.20**	.52**	.57**	.63**	.46**	.52**	.49**	.70**	.81**	-

Note. $^{*}p < .05$, $^{**}p < .01$

Appendix B

Exploratory factor analysis (EFA) for risks and hazards:

Table B1

Initial EFA for risks and hazards

Item	Factor 1	Factor 2
There is a high-risk of accidents in this job	**.939**	-.040
The job is dangerous	**.919**	-.064
Overall, this job has more risks than others	**.915**	-.084
The job has a low risk of accident	**.784**	.167
The job takes place in an environment free from health hazards (e.g., chemicals, fumes, etc.)	**.510**	**.363**
The climate at the work place is comfortable in terms of temperature and humidity	-.076	**.701**
The work place is free from excessive noise	.077	**.650**
The job occurs in a clean environment	**.463**	**.469**
Percent variance explained	60.98	15.21

Note. Items with cross-loadings greater than .30 were removed for next iteration

Appendix C

EFA for occupational stress:

Table C1

Initial EFA for occupational stress

Item	Factor 1	Factor 2
Overwhelming	**.609**	.101
Nerve-wracking	**.562**	-.144
Hassled	**.559**	-.013
More stressful than I'd like	**.533**	-.112
Pressured	.143	**-.661**
Demanding	-.004	**-.627**
Many things stressful	**.322**	**-.498**
Calm	.057	**.485**
Percent variance explained	39.77	14.41

Note. Item "Many things stressful" was removed for next iteration

Table C2

Second iteration of EFA for occupational stress

Item	Factor 1	Factor 2
Overwhelming	**.612**	.101
Hassled	**.571**	-.016
Nerve-wracking	**.555**	-.130
More stressful than I'd like	**.538**	-.102
Pressured	.153	**-.670**
Demanding	.012	**-.623**
Calm	.036	**.456**
Percent variance explained	51.59	

Note. Item "Calm" was removed for the next iteration

Table C3

Third iteration of EFA for occupational stress

Item	Factor 1
Nerve-wracking	**.631**
Pressured	**.628**
More stressful than I'd like	**.582**
Hassled	**.545**
Overwhelming	**.485**
Demanding	**.481**

Percent variance explained	42.76

Note. Items "Overwhelming" and "Demanding" were removed for the final iteration, as shown in text

Appendix D

EFA for job demands:

Table D1

Initial EFA for job demands

Item	Factor 1	Factor 2	Factor 3	Factor 4
There is a high-risk of accidents in this job	**.897**	-.038	-.082	-.047
Overall, this job has more risks than others	**.851**	.036	-.057	-.097
The job has a low risk of accident	**.829**	.027	-.053	-.009
The job is dangerous	**.742**	.081	-.205	-.083
The work place is free from excessive noise	**.311**	.002	-.055	.294
The climate at the work place is comfortable in terms of temperature and humidity	.267	-.016	.043	.254
The tasks on the job are simple and uncomplicated	-.026	**.969**	-.057	-.032
The job involves performing relatively simple tasks	-.023	**.887**	-.039	-.067
The job requires that I only do one task or activity at a time	.070	**.403**	.134	.154
The job requires a lot of physical effort	.056	-.027	**-.946**	.048
The job requires a great deal of muscular strength	.140	.019	**-.772**	.073
Hassled	-.101	-.050	-.014	**.681**
Nerve-wracking	-.002	.048	-.112	**.577**
More stressful than I'd like	.004	.011	.053	**.548**
Pressured	.035	.196	-.059	**.464**
Percent variance explained	35.25	16.26	10.38	7.98

Note. Item "The climate at the work place is comfortable in terms of temperature and humidity" was removed for next iteration

Table D2

Second iteration of EFA for job demands

Item	Factor 1	Factor 2	Factor 3	Factor 4
There is a high-risk of accidents in this job	**.937**	-.068	-.020	-.019
Overall, this job has more risks than others	**.884**	.009	.000	-.065

The job has a low risk of accident	**.863**	.006	-.001	-.001
The job is dangerous	**.766**	.060	-.160	-.057
The work place is free from excessive noise	**.323**	.009	-.046	.233
The tasks on the job are simple and uncomplicated	-.036	**.974**	-.067	-.035
The job involves performing relatively simple tasks	-.033	**.891**	-.049	-.068
The job requires that I only do one task or activity at a time	.081	**.397**	.142	.153
The job requires a lot of physical effort	.037	-.012	**-.956**	.023
The job requires a great deal of muscular strength	.121	.030	**-.786**	.053
Hassled	-.079	-.061	-.007	**.664**
Nerve-wracking	.013	.028	-.102	**.595**
More stressful than I'd like	.025	-.013	.068	**.573**
Pressured	.050	.175	-.046	**.496**
Percent variance explained	36.81	17.35	10.91	6.15

Note. Items “The work place is free from excessive noise,” “The job requires that I only do one task or activity at a time,” and “Pressured” were removed for next and final iteration, as shown in text

Appendix F

Appendix E

EFA for safety knowledge

Table E11

Final factor loadings, variance explained, and factor alpha for safety knowledge

Item	Factor 1
I know how to use safety equipment and standard work procedures	**.888**
I know how to maintain or improve workplace health and safety	**.801**
I know how to perform my job in a safe manner	**.770**
I do not know how to reduce the risk of accidents and incidents in the workplace	**.322**
Percent variance explained	61.20

Note. Item "I do not know how to reduce the risk of accidents and incidents in the workplace" was removed for the next and final iteration, as shown in text

Appendix F

EFA for job resources:

Table F1

Initial EFA for job resources

Item	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
Senior management clearly considers the psychological health of employees to be of great importance	**.891**	.031	.014	.006	.013
Senior management considers employee psychological health to be as important as productivity	**.889**	-.018	-.011	-.024	.022
Psychological well-being of staff is a priority for this organization	**.883**	-.014	.010	.000	-.007
There is good communication here about psychological safety issues which effect me	**.820**	-.041	.040	-.010	-.016
Senior management show support for stress prevention through involvement and commitment	**.818**	-.015	.002	-.047	-.046
In my workplace senior management acts quickly to correct problems/issues that affect employees' psychological health	**.755**	.024	.006	-.017	-.050
Senior management acts decisively when a concern of an employees' psychological status is raised	**.716**	.110	-.018	.001	-.014
Information about workplace psychological well-being is always brought to my attention by my manager/supervisor	**.698**	-.074	.026	.013	-.088
My contributions to resolving occupational health and safety concerns in the organization are listened to	**.694**	-.019	.013	.071	-.095
Participation and consultation in psychological health and safety occurs with employees', unions and health and safety representatives in my workplace	**.692**	-.047	-.010	.001	-.039
Employees are encouraged to become involved in psychological safety and health matter	**.678**	-.025	-.002	.034	-.065

Appendix F

In my organization, the prevention of stress involves all levels of the organization	**.524**	.094	-.068	.019	.092
My supervisor is concerned about the welfare of the people that work for him/her	**.315**	-.019	-.092	.173	-.260
I know how to use safety equipment and standard work procedures	-.014	**.886**	.049	-.026	-.064
I know how to perform my job in a safe manner	-.004	**.775**	-.028	.010	.012
I know how to maintain or improve workplace health and safety	.042	**.749**	-.003	.057	-.045
The job allows me to decide on the order in which things are done on the job	.014	.000	**-.904**	-.010	.048
The job allows me to plan how I do my work	.021	.030	**-.899**	.011	.036
This job allows me to make my own decisions about how to schedule my work	-.053	-.046	**-.745**	-.011	-.100
I have the chance in my job to get to know other people	-.078	.053	.039	**.871**	.020
I have the opportunity to develop close friendships in my job	.021	-.081	.036	**.836**	.022
I have the opportunity to meet with others in my work	-.091	.058	-.017	**.821**	-.017
People I work with take a personal interest in me	.172	-.010	-.036	**.501**	-.070
People I work with are friendly	.128	.093	-.110	**.428**	-.044
There is good communication here about physical safety issues which effect me	-.064	.041	.030	-.007	**-.894**
Senior management clearly considers the physical health of employees to be of great importance	.016	.021	-.010	-.050	**-.874**
Physical well-being of staff is a priority for this organization	.071	-.022	-.028	-.021	**-.826**
Information about workplace physical well-being is always brought to my attention by my manager/supervisor	.005	-.035	.019	-.012	**-.821**
Senior management considers employee physical health to be as important as productivity	.041	-.030	-.031	-.049	**-.819**

Employees are encouraged to become involved in physical safety and health matter	-.026	.022	.033	.055	**-.791**
In my workplace senior management acts quickly to correct problems/issues that affect employees' physical health	.060	.068	-.040	-.035	**-.771**
Senior management acts decisively when a concern of an employees' physical status is raised	.004	.098	-.020	.027	**-.750**
Participation and consultation in physical health and safety occurs with employees', unions and health and safety representatives in my workplace	.027	-.035	-.030	.056	**-.709**
My contributions to resolving occupational health and safety concerns in the organization are listened to	.056	.015	-.031	.096	-**.705**
Percent variance explained	44.12	8.78	6.24	5.45	4.19

Note. Items "My supervisor is concerned about the welfare of the people that work for him/her" and "People I work with are friendly" were removed for the next iteration

Table F2

Second iteration of EFA for job resources

Item	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
Senior management clearly considers the psychological health of employees to be of great importance	**.889**	.031	.013	.007	.013
Senior management considers employee psychological health to be as important as productivity	**.888**	-.020	-.011	-.022	.023
Psychological well-being of staff is a priority for this organization	**.881**	-.015	.009	.000	-.008
There is good communication here about psychological safety issues which effect me	**.820**	-.042	.039	-.013	-.017
Senior management show support for stress prevention through involvement and commitment	**.817**	-.016	.002	-.045	-.045
In my workplace senior management acts quickly to correct problems/issues that affect employees' psychological health	**.753**	.023	.005	-.016	-.050

Senior management acts decisively when a concern of an employees' psychological status is raised	**.715**	.110	-.019	.001	-.015
Information about workplace psychological well-being is always brought to my attention by my manager/supervisor	**.698**	-.075	.025	.012	-.088
My contributions to resolving occupational health and safety concerns in the organization are listened to	**.695**	-.018	.011	.068	-.096
Participation and consultation in psychological health and safety occurs with employees', unions and health and safety representatives in my workplace	**.693**	-.049	-.012	.011	-.036
Employees are encouraged to become involved in psychological safety and health matter	**.680**	-.026	-.005	.038	-.064
In my organization, the prevention of stress involves all levels of the organization	**.526**	.094	-.069	.019	.092
I know how to use safety equipment and standard work procedures	-.013	**.885**	.047	-.024	-.062
I know how to perform my job in a safe manner	-.002	**.774**	-.030	.005	.010
I know how to maintain or improve workplace health and safety	.046	**.747**	-.007	.060	-.044
The job allows me to decide on the order in which things are done on the job	.021	.001	**-.902**	-.002	.045
The job allows me to plan how I do my work	.030	.033	**-.890**	.013	.032
This job allows me to make my own decisions about how to schedule my work	-.047	-.044	**-.741**	-.008	-.103
I have the chance in my job to get to know other people	-.058	.055	.022	**.877**	.020
I have the opportunity to meet with others in my work	-.071	.061	-.033	**.822**	-.019
I have the opportunity to develop close friendships in my job	.042	-.069	.021	**.802**	.013
People I work with take a personal interest in me	.183	.001	-.041	**.452**	-.086

Appendix F

There is good communication here about physical safety issues which effect me	-.064	.039	.029	-.007	**-.895**
Senior management clearly considers the physical health of employees to be of great importance	.016	.020	-.009	-.051	**-.873**
Physical well-being of staff is a priority for this organization	.072	-.023	-.028	-.020	**-.824**
Information about workplace physical well-being is always brought to my attention by my manager/supervisor	.005	-.037	.019	-.010	**-.820**
Senior management considers employee physical health to be as important as productivity	.041	-.032	-.031	-.044	**-.817**
Employees are encouraged to become involved in physical safety and health matter	-.024	.022	.032	.055	**-.789**
In my workplace senior management acts quickly to correct problems/issues that affect employees' physical health	.060	.066	-.040	-.032	**-.770**
Senior management acts decisively when a concern of an employees' physical status is raised	.005	.097	-.021	.029	**-.749**
Participation and consultation in physical health and safety occurs with employees', unions and health and safety representatives in my workplace	.029	-.038	-.032	.060	**-.708**
My contributions to resolving occupational health and safety concerns in the organization are listened to	.060	.015	-.034	.090	**-.707**
Percent variance explained	44.84	8.84	6.61	5.51	4.44

Note. Item "People I work with take a personal interest in me" was removed for the next and final iteration

Appendix G

EFA for employee engagement

Table G1

Initial EFA for employee engagement

Item	Factor 1	Factor 2	Factor 3
I would not leave my organization right now because I have a sense of obligation to the people in it	**.829**	-.047	.004
I would feel guilty if I left my organization now	**.769**	.030	-.113
I owe a great deal to my organization	**.758**	-.068	.084
This organization deserves my loyalty	**.733**	-.113	.165
Even if it were to my advantage, I do not feel it would be right to leave my organization now	**.691**	.080	-.089
This organization has a great deal of personal meaning for me	**.493**	-.009	.426
I really feel as if this organization's problems are my own	**.458**	.016	.236
Too much of my life would be disrupted if I decided I wanted to leave my organization now	.039	**.786**	.216
I feel that I have too few options to consider leaving this organization	-.119	**.734**	-.117
It would be very hard for me to leave my organization right now, even if I wanted to	.107	**.723**	.219
One of the few negative consequences of leaving this organization would be the scarcity of available alternatives	-.081	**.605**	-.135
Right now, staying with my organization is a matter of necessity as much as desire	-.034	**.490**	-.031
If I had not already put so much of myself into this organization, I might consider working elsewhere	.112	**.405**	-.277
I do not feel like "part of the family" at my organization	.045	-.023	**.853**
I do not feel a strong sense of "belonging" to my organization	.017	-.029	**.846**
I do not feel "emotionally attached" to this organization	.090	.006	**.842**

I would be very happy to spend the rest of my career with this organization	.375	-.038	**.417**
I do not feel any obligation to remain with my current employer	.345	.058	**.374**
Percent variance explained	38.15	17.31	7.03

Note. Items "This organization has a great deal of personal meaning for me," "I would be very happy to spend the rest of my career with this organization," and "I do not feel any obligation to remain with my current employer" were removed for the next iteration

Table G2

Second iteration of EFA for employee engagement

Item	Factor 1	Factor 2	Factor 3
I would not leave my organization right now because I have a sense of obligation to the people in it	**.829**	-.050	.017
I would feel guilty if I left my organization now	**.780**	.024	-.103
I owe a great deal to my organization	**.742**	-.064	.106
This organization deserves my loyalty	**.725**	-.108	.183
Even if it were to my advantage, I do not feel it would be right to leave my organization now	**.685**	.078	-.077
I really feel as if this organization's problems are my own	**.442**	.021	.238
Too much of my life would be disrupted if I decided I wanted to leave my organization now	.048	**.788**	.206
I feel that I have too few options to consider leaving this organization	-.115	**.729**	-.122
It would be very hard for me to leave my organization right now, even if I wanted to	.113	**.727**	.213
One of the few negative consequences of leaving this organization would be the scarcity of available alternatives	-.079	**.600**	-.137
Right now, staying with my organization is a matter of necessity as much as desire	-.038	**.490**	-.035
If I had not already put so much of myself into this organization, I might consider working elsewhere	.101	**.399**	-.272

I do not feel like "part of the family" at my organization	.072	-.004	**.853**
I do not feel a strong sense of "belonging" to my organization	.047	-.011	**.842**
I do not feel "emotionally attached" to this organization	.124	.018	**.816**
Percent variance explained	38.15	17.31	7.03

Note. Items "I really feel as if this organization's problems are my own," "Right now, staying with my organization is a matter of necessity as much as desire," and "If I had not already put so much of myself into this organization, I might consider working elsewhere" were removed for the next and final iteration

Appendix H

Item by item code

Table H1

Item code for each measure, (R) indicates reverse-scored items

Risks and hazards		
	RH1	The work place is free from excessive noise (R)
	RH2	The climate at the work place is comfortable in terms of temperature and humidity (R)
	RH3	Overall, this job has more risks than others
	RH4	There is a high-risk of accidents in this job
	RH5	The job has a low risk of accident (R)
	RH6	The job takes place in an environment free from health hazards (e.g., chemicals, fumes, etc.) (R)
	RH7	The job occurs in a clean environment (R)
	RH8	The job is dangerous
Physical demands		
	PD1	The job requires a great deal of muscular strength
	PD2	The job requires a lot of physical effort
Complexity		
	C1	The job requires that I only do one task or activity at a time (R)
	C2	The tasks on the job are simple and uncomplicated (R)
	C3	The job involves performing relatively simple tasks (R)
Occupational stress		
	Stress1	Demanding
	Stress2	Pressured
	Stress3	Calm (R)
	Stress4	Many things stressful
	Stress5	Nerve-wracking
	Stress6	Hassled
	Stress7	More stressful than I'd like
	Stress8	Overwhelming
Autonomy		
	A1	This job allows me to make my own decisions about how to schedule my work
	A2	The job allows me to decide on the order in which things are done on the job
	A3	The job allows me to plan how I do my work
Social support		
	SS1	I have the opportunity to develop close friendships in my job
	SS2	I have the chance in my job to get to know other people
	SS3	I have the opportunity to meet with others in my work
	SS4	My supervisor is concerned about the welfare of the people that work for him/her

	SS5	People I work with take a personal interest in me
	SS6	People I work with are friendly
Safety knowledge		
	SK1	I know how to perform my job in a safe manner
	SK2	I know how to use safety equipment and standard work procedures
	SK3	I know how to maintain or improve workplace health and safety
	SK4	I do not know how to reduce the risk of accidents and incidents in the workplace (R)
Physical safety climate		
	PhySC1	In my workplace senior management acts quickly to correct problems/issues that affect employees' physical health
	PhySC2	Senior management acts decisively when a concern of an employees' physical status is raised
	PhySC4	Physical well-being of staff is a priority for this organization
	PhySC5	Senior management clearly considers the physical health of employees to be of great importance
	PhySC6	Senior management considers employee physical health to be as important as productivity
	PhySC7	There is good communication here about physical safety issues which affect me
	PhySC8	Information about workplace physical well-being is always brought to my attention by my manager/supervisor
	PhySC9	My contributions to resolving occupational health and safety concerns in the organization are listened to
	PhySC10	Participation and consultation in physical health and safety occurs with employees', unions and health and safety representatives in my workplace
	PhySC11	Employees are encouraged to become involved in physical safety and health matter
Psychosocial safety climate		
	PSC1	In my workplace senior management acts quickly to correct problems/issues that affect employees' psychological health
	PSC2	Senior management acts decisively when a concern of an employees' psychological status is raised
	PSC3	Senior management show support for stress prevention through involvement and commitment
	PSC4	Psychological well-being of staff is a priority for this organization
	PSC5	Senior management clearly considers the psychological health of employees to be of great importance
	PSC6	Senior management considers employee psychological health to be as important as productivity
	PSC7	There is good communication here about psychological safety issues which effect me
	PSC8	Information about workplace psychological well-being is always brought to my attention by my manager/supervisor

	PSC9	My contributions to resolving occupational health and safety concerns in the organization are listened to
	PSC10	Participation and consultation in psychological health and safety occurs with employees', unions and health and safety representatives in my workplace
	PSC11	Employees are encouraged to become involved in psychological safety and health matter
	PSC12	In my organization, the prevention of stress involves all levels of the organization
Burnout		
	BO1	Tired
	BO2	Disappointed with people
	BO3	Hopeless
	BO4	Trapped
	BO5	Helpless
	BO6	Depressed
	BO7	Physically weak/sickly
	BO8	Worthless/Like a failure
	BO9	Difficulties sleeping
	BO10	"I've had it"
Engagement		
	EE1	I would be very happy to spend the rest of my career with this organization
	EE2	I really feel as if this organization's problems are my own
	EE3	I do not feel a strong sense of "belonging" to my organization (R)
	EE4	I do not feel "emotionally attached" to this organization (R)
	EE5	I do not feel like "part of the family" at my organization (R)
	EE6	This organization has a great deal of personal meaning for me
	EE7	Right now, staying with my organization is a matter of necessity as much as desire
	EE8	It would be very hard for me to leave my organization right now, even if I wanted to
	EE9	Too much of my life would be disrupted if I decided I wanted to leave my organization now
	EE10	I feel that I have too few options to consider leaving this organization
	EE11	If I had not already put so much of myself into this organization, I might consider working elsewhere
	EE12	One of the few negative consequences of leaving this organization would be the scarcity of available alternatives
	EE13	I do not feel any obligation to remain with my current employer (R)
	EE14	Even if it were to my advantage, I do not feel it would be right to leave my organization now
	EE15	I would feel guilty if I left my organization now
	EE16	This organization deserves my loyalty

Appendix H

	EE17	I would not leave my organization right now because I have a sense of obligation to the people in it
	EE18	I owe a great deal to my organization
Safety motivation		
	SM1	I feel that it is worthwhile to put in effort to maintain or improve my personal safety
	SM2	I feel that it is important to maintain safety at all times
	SM3	I believe that it is important to reduce the risk and accidents and incidents in the workplace
Safety attitude		
	SA1	In my job, compliance with safety rules is…
	SA2	In my job, actively participating in safety rules is….
	SA3	In my job, actively participating in safety is…
Safety control		
	SC1	I feel I don't have control over the safety performance on my job
	SC2	For me, working safely is…
	SC3	It depends on me to work in a safe way
Physical safety behavior		
	SCPhy1	I use all the necessary physical safety equipment to do my job
	SCPhy2	I use the correct physical safety procedures for carrying out my job
	SCPhy3	I ensure the highest levels of physical safety when I carry out my job
	SPPhy1	I promote the physical safety program within the organization
	SPPhy2	I put in extra effort to improve the physical safety of the workplace
	SPPhy3	I voluntarily carry out tasks or activities that help to improve workplace physical safety
Psychosocial safety behavior		
	SCP1	I use all the necessary psychological safety equipment to do my job
	SCP2	I use the correct psychological safety procedures for carrying out my job
	SCP3	I ensure the highest levels of psychological safety when I carry out my job
	SPP1	I promote the psychological safety program within the organization
	SPP2	I put in extra effort to improve the psychological safety of the workplace
	SPP3	I voluntarily carry out tasks or activities that help to improve workplace psychological safety