Journal of Business and Psychology (2021) 36:1–15
https://doi.org/10.1007/s10869-019-09658-3

ORIGINAL PAPER

Being Present in Enhancing Safety: Examining the Effects of Workplace Mindfulness, Safety Behaviors, and Safety Climate on Safety Outcomes

Kuo-Yang Kao[1] · Candice L. Thomas[2] · Christiane Spitzmueller[3] · Yueng-hsiang Huang[4]

Published online: 28 November 2019

Abstract

Due to the high personal and organizational costs associated with safety incidents, it is essential that we understand the trait predictors of safety behaviors which in turn impact occupational accidents and injuries. This study helps address this need by assessing the relationship between trait mindfulness and workplace injuries, as well as examining a mediating mechanism (safety behaviors) and situational moderator (safety climate) of this relationship. Using hierarchically nested data from employees within a large company in the petroleum distribution industry (N = 706 employees within 142 groups), our results suggest that trait mindfulness is related to workplace injuries, safety compliance, and safety participation and that this relationship between trait mindfulness and workplace injuries is mediated by safety compliance. Moreover, group-level safety climate moderates the effects of trait mindfulness on safety compliance and safety participation such that the best safety behavior occurs when both safety climate and trait mindfulness are high. These results indicate that trait mindfulness is an important trait predictor of safety behaviors and that it is a helpful personal resource necessary for a successful safety-focused organization.

Keywords Mindfulness · Safety climate · Safety behavior · Safety compliance · Safety participation · Injuries

Workplace accidents and injuries are crucial issues for organizations and occupational safety researchers because they result in tens of thousands of deaths and disabilities worldwide. For example, there were 23,147 deaths due to fatal occupational injuries globally in 2015 (International Labour Organization, 2015). According to a study by Wiegmann and Shappell (2001), most of those workplace fatal accidents and injuries were caused by human error. Recent research supports the importance of individual differences in promoting safety at work: using traits for selection and staffing decisions has been shown to enhance occupational safety (Beus, Dhanani, & McCord, 2015; Clarke & Robertson, 2005). Accordingly, to help reduce workplace accidents and injuries, it is important to identify individual differences that influence the likelihood of engaging in unsafe behaviors (e.g., Beus et al., 2015) and potentially screen out accident-prone employees who tend to cause safety incidents (Clarke & Robertson, 2005). Due to the important role of situational awareness in the safety process (Stanton, Chambers, & Piggott, 2001), employee mindfulness is likely a trait that is particularly relevant for promoting workplace safety. Zhang and Wu (2014) suggested that mindfulness, serving as an individual difference, was associated with employee safety behaviors. Building off of this preliminary work on mindfulness and safety, we seek to better understand how, why, and when trait mindfulness influences occupational injuries.

✉ Kuo-Yang Kao
kkao@nctu.edu.tw

Candice L. Thomas
candice.thomas@health.slu.edu

Christiane Spitzmueller
cspitzmu@central.uh.edu

Yueng-hsiang Huang
Huangyu@ohsu.edu

[1] Department of Management Science, National Chiao Tung University, 1001 University Rd, Hsinchu, Taiwan 30010

[2] Department of Psychology, Saint Louis University, Saint Louis, MO, USA

[3] Department of Psychology, University of Houston, Houston, TX, USA

[4] Oregon Institute of Occupational Health Sciences, Oregon Health and Science University, Portland, OR, USA

The little research on mindfulness and occupational safety that has been published supports the importance of trait mindfulness in the safety process: trait mindfulness has been found to be related to increased safety behaviors (Valley & Stallones, 2017; Zhang, Ding, Li, & Wu, 2013; Zhang & Wu, 2014) and decreased workarounds, cognitive failures, and safety failures (Dierynck, Leroy, Savage, & Choi, 2017; Valley & Stallones, 2017). From this research, mindfulness has emerged as an important individual difference factor that contributes to safety outcomes above and beyond commonly used individual difference selection criteria such as intelligence and conscientiousness (Zhang & Wu, 2014). Specifically, Zhang and Wu (2014), using a sample of power plant control operators in the nuclear industry in China, found that trait mindfulness was related to higher safety compliance and safety participation. They further identified intelligence and experience as individual difference moderators on the relationship between mindfulness and safety behavior: the highest safety behavior was observed for people who were high on trait mindfulness and high on intelligence and job experience. The work of Zhang and Wu (2014) provides initial support for the importance of trait mindfulness in occupational safety.

However, before trait mindfulness can be successfully incorporated into safety selection and training programs, we need to better understand the situational factors that best support mindful employees and the impact of mindfulness on more distal safety outcomes (e.g., injuries). Building off of the findings from Zhang and Wu (2014), the current paper aims to make three primary contributions. First, we aim to replicate the positive relationship between trait mindfulness and safety behaviors within a different population and industry and using a different—and shorter—measure of trait mindfulness. Second, in order to gain a clearer understanding of the mechanism that underlies the relationship between trait mindfulness and workplace injuries, in line with self-determination theory (Deci & Ryan, 1985), we expand Zhang and Wu's (2014) findings and examine the mediating role of safety behaviors underlying the relationship between trait mindfulness and workplace injuries. As a result, our study advances our understanding of both the proximal (safety behaviors) and distal (occupational injuries) impacts of trait mindfulness on employee safety. Through this, we hope to show not only that trait mindfulness is related to higher safety behavior enactment, but that it is also related to safety behaviors in a way that is impactful for reducing occupational injuries. Third, given that trait mindfulness refers to an individual attention to and awareness of present environments/events, we extend the findings by Zhang and Wu (2014) to examine situations under which the different levels of trait mindfulness in safety behaviors is strengthened or weakened. Specifically, drawing on social information processing theory (Salancik & Pfeffer, 1978), we examine a group-level contextual moderator, safety climate, referring to a perception of safety priority in a group (Zohar, 2000), on the relationships between trait mindfulness and safety behaviors. Overall, we propose a cross-level moderated mediation model (Edwards & Lambert, 2007; Preacher, Rucker, & Hayes, 2007) that is depicted in Fig. 1.

By looking at the role of safety climate in these relationships, we can provide better recommendations for both supporting mindful employees and promoting the success of safety climate interventions. Although recent research supports a relationship between trait mindfulness and safety-related behaviors and outcomes (Dierynck et al., 2017; Valley & Stallones, 2017; Zhang & Wu, 2014), we continue to know relatively little about the contextual boundary conditions of personality/safety outcome relationships. For instance, to what extent can contextual factors, such as positive safety climate, compensate for personality traits that render certain employees more risk-, injury-, and accident-prone? In other words, employees who have different types of personal characteristics may respond differentially to a contextual factor such as safety climate (Beus et al., 2015; Clarke & Robertson, 2005). Thus, more work is needed to understand the contextual boundary conditions, such as safety climate, of the mindfulness/safety relationship.

Trait Mindfulness

Trait mindfulness refers to a quality of consciousness and is defined as "a receptive attention to and awareness of present events and experience" (Brown & Ryan, 2003). Trait mindfulness reflects disposition-based differences in mindfulness across people (Brown & Ryan, 2003). Specifically, a mindful person tends to pay attention to what is happening in the moment, including both internal (e.g., thoughts or perception) and external stimuli (e.g., physical environments or social interaction) (Brown, Ryan, & Creswell, 2007). Meta-analytic research has indicated that trait mindfulness—which is empirically distinct from the Big Five personality variables—provides incremental variance, particularly above and beyond consciousness, in individuals' psychological well-being and behaviors (Giluk, 2009). For instance, research has found that trait mindfulness is positively related to vitality, positive affect, life satisfaction, and sleep quality (e.g., Allen & Kiburz, 2012; Brown & Ryan, 2003; Howell, Digdon, & Buro, 2010; Howell, Digdon, Buro, & Sheptycki, 2008; Weinstein, Brown, & Ryan, 2009) as well as is negatively related to anxiety, depression, aggression, suppression, and hostility (e.g., Howell et al., 2008; Tamagawa et al., 2013). A recent review by Good et al. (2016) integrating mindfulness research into the work domain suggests that mindfulness may play a significant role in influencing behaviors in the work context. In line with this, recent research suggests that mindfulness is linked to work behaviors and workplace outcomes such as

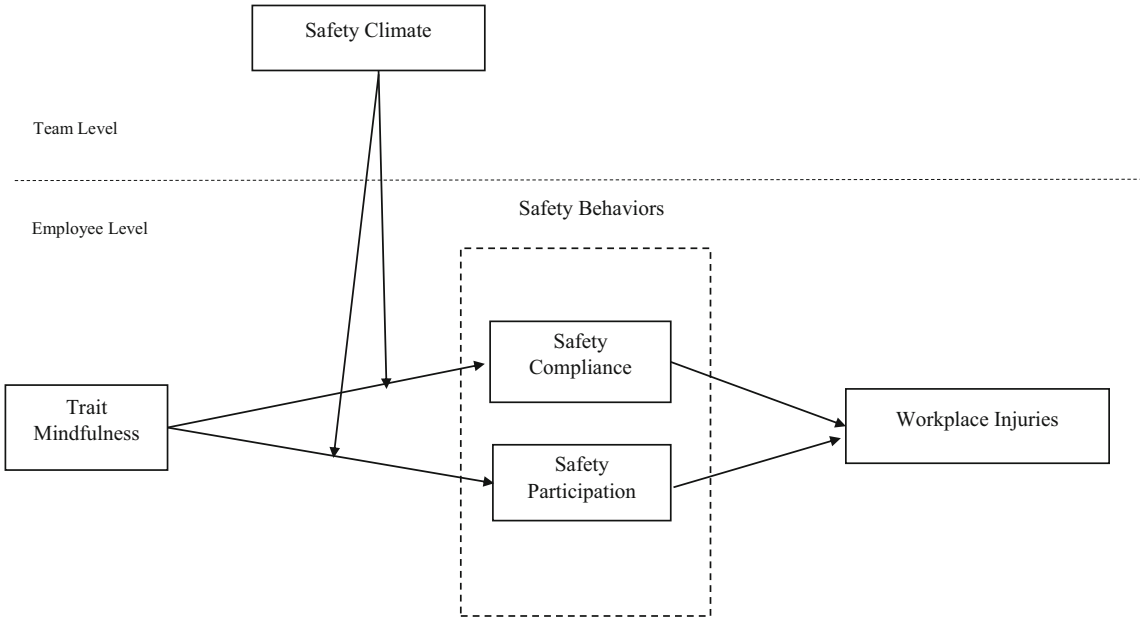

Fig. 1 Moderated mediation model investigating the links between trait mindfulness, safety climate, and safety performance

task performance and safety behaviors (Glomb, Duffy, Bono, & Yang, 2011; Zhang et al., 2013; Zhang & Wu, 2014).

Self-determination Theory and Mindfulness

Self-determination theory (SDT) posits that individuals have an inherent tendency to develop and grow toward their fullest capacity (Deci & Ryan, 1985). As such, individuals tend to seek challenges, strive for their own interests, and pursue social connections to ensure ongoing psychological growth, to uphold integrity, and to maintain their well-being (Ryan & Deci, 2000). SDT postulates that the satisfaction of the needs for autonomy, relatedness, and competence is an energizing state that leads to psychological health and well-being (Kasser & Ryan, 1999; La Guardia, Ryan, Couchman, & Deci, 2000) and that social contexts and interpersonal relationships provide support of these three basic needs. Specifically, conditions where individuals' psychological needs are met facilitate personal growth, health, and well-being; conditions where individuals' psychological needs are not met hinder motivation and ultimately lead to negative psychological and physical health symptoms (Deci, Connell, & Ryan, 1989). In general, SDT suggests a link between the psychological needs and motivation which, in turn, influences individuals' behaviors (Gagné & Deci, 2005; Ryan & Deci, 2000).

Research on mindfulness suggests that the key component of mindfulness is attention/awareness (Brown & Ryan, 2003; Good et al., 2016; Levesque & Brown, 2007). Particularly, mindful people report high awareness of internal (e.g., thoughts and emotions) and external streams (e.g., sensation) that happen in the present moment (Brown et al., 2007). According to SDT, clear awareness is vital to satisfy and clarify our basic psychological needs (Ryan, Huta, & Deci, 2008). Through its impact on attentional stability, control, and efficiency, mindfulness is associated with increased self-regulation and reduced automaticity which, in turn, influence subsequent behaviors that are consistent with an individual's needs and values (Good et al., 2016; Deci & Ryan, 1985). SDT, therefore, provides a theoretical foundation to demonstrate why mindfulness may be related to safety behaviors and workplace injuries.

Trait Mindfulness and Safety Outcomes

Workplace Injuries

Research on mindfulness suggests that mindfulness can impact attention and motivation, and can particularly enable employees to effectively regulate thoughts, emotion, and behaviors (Brown et al., 2007; Good et al., 2016; Masicampo & Baumeister, 2007). That is, mindfulness is related to enhanced attentional awareness as well as autonomous regulation and volition of a behavior (Ryan et al., 2008). Zooming in on the attentional awareness component, research has demonstrated that mindful people tend to make more accurate judgements, display high problem-solving abilities, and have high task performance (Dane & Brummel, 2014; Kiken & Shook, 2011). Herndon (2008) indicated that trait mindfulness is associated with decreased cognitive failures (e.g., distraction, overlooking and carelessness) which, in turn, lead to high task performance and fewer accidents. Trait mindfulness, therefore, is likely associated, directly, with decreased safety

incidents due to this increased risk perception accuracy and risk avoidance (Herndon, 2008). Based on this, we propose the following hypothesis:

Hypothesis 1: Trait mindfulness will be directly negatively related to workplace injuries.

Safety Behavior

Safety behaviors comprise two separate groups of behavior that contribute to occupational safety (Christian, Bradley, Wallace, & Burke, 2009; Neal & Griffin, 2006): (a) safety compliance refers to required behaviors that individuals display to keep a workplace safe, such as wearing helmets and following safety procedures, and (b) safety participation refers to extra-role behaviors that aim to develop a safe environment and improve workplace safety, such as helping co-workers with safety-related issues and attending voluntary safety meetings. Employees in high-risk industries and professions need to value occupational safety and tend to regulate their safety behaviors (i.e., safety compliance and safety participation) (Kao, Spitzmueller, Cigularov, & Wu, 2016; Probst, Brubaker, & Barsotti, 2008). Trait mindfulness has been shown to be an important component of enhanced safety behaviors (Zhang & Wu, 2014).

Through self-reflection and self-awareness, individuals are able to recognize their own values and needs and make those values and needs consistent with their behavior (Schultz & Ryan, 2015). When mindful people are aware of or pay attention to what is really occurring at a specific moment, they are in a better position to make their own meaningful choices and to act in a goal-directed manner. In contrast, when employees have limited regulatory capacity (low mindfulness), they tend to participate in unexpected organizational behaviors (e.g., risky decision-making, workplace deviance, unsafe behavior, and interpersonal conflicts) (Christian & Ellis, 2011; Kao et al., 2016). In a similar vein, the degree of attention (i.e., mindfulness) influences safety-oriented behaviors. Accordingly, drawing on SDT (Deci & Ryan, 1985) and the findings from Zhang and Wu (2014), we expect that trait mindfulness is associated with increased safety behaviors.

Trait Mindfulness and Workplace Injuries: Indirect Effect Through Safety Behaviors

We propose that trait mindfulness—in addition to the direct relationship between trait mindfulness and employee injuries—also influences injuries indirectly through increased safety behavior. Given that research has found a positive relationship between mindfulness and safety behaviors, we expect it to relate to distal safety outcomes (i.e., workplace injuries) through these proximal safety relationships (i.e., increased safety behaviors). As safety behaviors have been consistently identified as a key antecedent of decreased workplace injuries (e.g., Burke & Signal, 2010), it is likely that trait mindfulness influences the occurrences of workplace injuries both directly and indirectly (via safety behaviors). Through the tenants of SDT, mindfulness can work to increase self-regulation and autonomous motivation for enacting safety behaviors, which can decrease workplace accidents and injuries (Zohar, Huang, Lee, & Robertson, 2015). The more safety compliance and safety participation employees engage in (i.e., adherence to safety rules and regulations and participation in safe activities), the less likely it will be that they will experience a negative safety incident and experience an occupational injury (Christian et al., 2009). Accordingly, in line with SDT, we argue that trait mindfulness is associated with workplace injuries through safety behaviors. Therefore, we hypothesize the following:

Hypothesis 2: Trait mindfulness will be indirectly related to workplace injuries via safety behaviors: (a) safety compliance and (b) safety participation.

The Contextual Moderator of Safety Climate

Safety climate, which refers to the shared employee perceptions of organizational safety policies, procedures, and practices, can have a significant influence on occupational safety (Griffin & Neal, 2000; Zohar, 2000). Safety climate thus serves as a social-cognitive construct, part of group-level epistemology (e.g., collective sense-making; Zohar, 2000; Zohar & Luria 2004), in which employees interpret and make sense of their organizations in regards to occupational safety norms and expectations. Given that safety climate reflects the priority of safety and the specific safety-related behaviors likely to be supported and rewarded, the shared perception of safety climate is derived from cues based on managerial policies and practice (Zohar, 2000). In strong safety climate contexts, organizations have safety goals (i.e., decreasing workplace accidents and injuries) and strategies and means of attaining these goals. A strong safety climate is associated with strong perceptions of safety values and priority among employees in the workplace (Zohar, 2003). Moreover, organizational climate is generally related to specific policies, procedures, and practices such that perceptions of an organizational climate can guide employees and inform them of expectations for desirable behavior that should be performed (Schneider, 1990). Due to this, high safety climates likely bolster the impact of employee safety predictors on safety behavior by providing contextual cues to the employee that safe behaviors are prioritized and expected. In fact, safety climate serves contextual boundary conditions that can influence the effect of individual factors (e.g., safety knowledge) on safety behaviors (e.g., Jiang, Yu, Li, & Li, 2010).

Drawing on social information processing (SIP) theory (Salancik & Pfeffer 1978), individual perception and

behaviors are shaped by social information cues, such as job requirements and expectations, from social contexts. Thus, individuals tend to rely on the information acquired from their social environments to behave accordingly. Given that mindful employees demonstrate high awareness of situational cues (i.e., increased attentional awareness) which relates to safety behaviors (Zhang & Wu, 2014), these employees who work in an environment with a strong safety climate can receive salient information about the value of workplace safety, which may further strengthen their safety behaviors. SIP theory posits that the combination of the social context and the awareness of consequences is important to influence employees' work-related behaviors (Ferguson & Barry, 2011; Salancik & Pfeffer, 1978). Therefore, we expect a multiplicative effect of trait mindfulness and safety behaviors on workplace injuries. Specifically, we expect the effect of trait mindfulness on safety behaviors is more positive when safety climate is stronger than when it is weaker: in workplace settings with stronger safety climate, there is more likely to be strong situational cues promoting safety and mindful individuals will be more likely to pick up on and act on these cues. Therefore, we hypothesize the following:

Hypothesis 3: Safety climate will moderate the relationship between trait mindfulness and safety behaviors: (a) safety compliance and (b) safety participation. Specifically, the relationship between trait mindfulness and safety behaviors will be stronger when safety climate is strong compared to when safety climate is weak.

In line with SDT and SIP theories, it is also expected that the indirect effect of trait mindfulness on workplace injuries is stronger for employees with a stronger sense of safety climate. Mindful employees, who display high awareness of and attention to contextual cues, with a strong shared perception of safety climate, can clearly identify the safety-related policies, practices, and procedures, as well as the safety-related behaviors that are rewarded, supported, valued, and expected by the organization (Hofmann, Morgeson, & Gerras, 2003). If safety is emphasized, mindful employees with a strong sense of safety climate have fewer automatic mental processes and a greater present awareness of safety which may be relate to decreased frequencies of workplace injuries (through increased safety behaviors). Through determining the discrepancy between the current experience and the expected safety goals, employees manage and regulate displayed behaviors to be consistent with their perception of safety climate. Accordingly, we propose that strong safety climate is likely to strengthen the indirect relationship between trait mindfulness and workplace injuries. Thus, we hypothesize the following:

Hypothesis 4: Safety climate will moderate the indirect effect of trait mindfulness on workplace injuries (via employee safety compliance and safety participation). Specifically, the indirect relationship of trait mindfulness with workplace injuries via safety compliance and safety participation will be stronger when safety climate is strong compared to when safety climate is weak—where the worst safety outcomes would be experienced with low levels of both mindfulness and safety climate.

Method

Participants and Procedure

Hierarchically nested data (i.e., employees nested within branch offices of a company) were collected from employees within a large petroleum distribution company in Southern U.S. This company provides midstream services including pipeline operations, transportation, storage, and marketing of petroleum products. Web-based surveys were administered to employees via a survey link embedded within an email message. The survey took approximately 10–20 min to complete. Prior to survey administration, the researchers informed the participants of the research purpose and guaranteed the confidentiality of their responses. Only aggregate data were presented back to the organization; neither supervisors nor the organization were provided access to the employees' responses. To encourage participation, two additional reminder emails were sent to non-responders 4 days and 2 days before the survey closed. The survey was open for a total of nine full business days. We invited 840 full-time employees to participate in the survey. Finally, 706 complete responses (84% response rate), representing 142 work units (i.e., branch offices), were obtained. The majority of the participant were male (85.1 %, SD = .36), average age was 44.89 years (SD = 10.69), and average job tenure with the organization was 8.32 years (SD = 8.99).

Measures

With the exception of the control variables and injuries, the participants responded to each of the following items using a 5-point Likert-type response scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*).

Trait Mindfulness Trait mindfulness was assessed using a five-item Mindful Attention and Awareness Scale (Brown & Ryan, 2003). Example items were "I find myself doing things without paying attention" and "I do jobs or tasks automatically, without being aware of what I'm doing." This scale has been used in a wide array of populations and has demonstrated strong psychometric properties and validity inferences (Carlson & Brown, 2005; Cordon & Finney, 2008; MacKillop & Anderson, 2007). Cronbach's alpha for internal consistency reliability for this scale was .90.

Safety Compliance Safety compliance was assessed using 2 items adapted from Griffin and Neal (2000). These items were selected to match the characteristics of the company and asked about the individual's safety compliance using the following items: "I use all necessary safety equipment to do my job" and "I use the correct safety procedures for carrying out my job." Due to the limited number of items, the correlation was calculated to evaluate the reliability (r = .86).

Safety Participation Safety participation was assessed using 4 items adapted from Griffin and Neal (2000). These items asked about the individual's safety participation using the following sample items: "I put in extra effort to improve the safety of the workplace" and "I voluntarily carry out tasks or activities that help to improve workplace safety." Responses to the invert items were reverse-scored and averaged with other items, so that higher scale scores reflected more positive safety participation. Cronbach's alpha for this scale was .87.

Safety Climate Safety climate was assessed using 14 items from Zohar and Luria (2005) to match with organizational needs and occupational characteristics. We asked employees to evaluate safety climate based on their perception at their branch offices of the company. Example items were "This office tries to continually improve safety levels in each department" and "This office provides employees with a lot of information on safety issues." Cronbach's alpha for this scale was .95. Scores were aggregated across work group members to form a group-level safety climate score [ICC(1) = .17 and ICC(2) = .50]. Supporting aggregation, average r_{wg} value was .95, indicating adequate agreement among members within groups (Huang et al., 2013; James, Demaree, & Wolf, 1984). Although the ICC(2) value for safety climate is relatively low, research supports using multilevel analyses when variables, such as safety climate, are theoretically defined as group-level constructs and the average r_{wg} indicates good agreement (Chen & Bliese, 2002).

Workplace Injuries Workplace injuries were measured by 11 items from Kao et al.'s (2016) injury scale, which represents the most common workplace injuries in the construction occupation based on the Bureau of Labor Statistics Occupational Injury and Illness Classification Manual (OIICS; Bureau of Labor Statistics, 2012). One of the benefits of a self-report injury measure is that it is less likely that injuries are underreported using confidential self-reports to non-company personnel compared to official company injury records which, due to employee underreporting and lack of injury disclosure, may not accurately document all injuries that occurred (e.g., Probst, 2015; Probst et al., 2008). Participants were asked to indicate the frequency of the occurrence of specific injuries (i.e., strains or sprains; burns, fractured bone; dislocated joint; falls, slips, or trips at same level; contact with chemicals; contact with electricity; contact with thermal extremes; struck against or struck by a person or an object; had particles or objects enter into the eyes; caught in, under, or between machines/equipment; open wound, cut, puncture, or infection of the wound; and abrasions, scratches, or bruises) in the past 6 months on a 5-point scale (1 = never, 5 = frequently). Prior research supports the use of a 6-month timeframe because it increases the likelihood that participants remember the frequency and severity of workplace injuries (Halbesleben, 2010). This is also in alignment with Dormann and Griffin's (2015) recommendations for the use of time lags shorter than a year to maximize measurement precision and stability. Finally, the frequency of workplace injuries was accumulated from these 11 items.

Control Variables We controlled for gender, age, job tenure, and education levels that could be related to employees' safety behaviors and workplace injuries in all analyses (Åkerstedt & Kecklund, 2001; Chen, 2009; Lourens, Vissers, & Jessurun, 1999; Lu & Yang, 2011).

Analytic Strategy

Due to the data in the present study comprising a multilevel structure, we examined direct, indirect, moderating, and moderated mediating effects through hierarchical modeling techniques (Raudenbush & Bryk, 2002). First, we conducted a series of multilevel confirmatory factor analyses (CFAs) to examine the dimensionality and discriminant validity of our measures in the present study. Second, to test employee-level direct effects (Hypothesis 1) and indirect effects (Hypothesis 2), we employed random effect models by applying hierarchical linear modeling (HLM; Raudenbush & Bryk, 2002), which allows us to estimate each coefficient in the entire covariance matrix by default. Moreover, the recommended bootstrapping approach was used to estimate the indirect effect of trait mindfulness on workplace injuries (via safety behaviors) (MacKinnon, Lockwood, & Williams, 2004; Preacher & Hayes, 2008). Last, we tested the group-level moderating effect (Hypothesis 3) by means of HLM (Raudenbush & Bryk, 2002) and examined the moderated mediation effect (Hypothesis 4) through the multilevel path analysis (Bauer, Preacher, & Gil, 2006). To alleviate multicollinearity concerns, all employee-level variables (i.e., trait mindfulness, safety compliance, and safety participation) were person-mean centered to obtain unbiased estimates of the intra-individual-level hypotheses (Hypotheses 1 and 2) and, the group-level variable, safety climate, was grand-mean centered (Hypotheses 3 and 4).

Results

Means, standard deviations, reliabilities, and inter-correlations among the variables are presented in Table 1. Employees' trait

Table 1 Means, standard deviations, and bivariate correlations among studied variables

Variables	*M*	SD	1	2	3	4	5	6	7	8	9
Employee level											
1. Gender[a]	.85	.36	—								
2. Age	44.89	10.69	.32	—							
3. Education[b]	4.41	.99	− .11**	− .25***	—						
4. Tenure	8.32	8.99	.13***	.41***	− .18***	—					
5. Trait mindfulness	4.44	.84	.07	− .04	− .05	− .09	(.90)				
6. Safety compliance	4.28	.65	.11**	− .02	− .08*	.01	.25***	(.93)			
7. Safety participation	3.98	.79	.13**	.12**	− .13**	.12**	.17***	.53***	(.87)		
8. Injuries	1.15	.25	.15**	.07	− .17**	.04	− .13**	− .14**	− .03	—	
Group level											
9. Safety climate	3.81	.44	− .03	.01	.09*	− .06	.07	.14**	.02	− .22**	(.95)

Reliability coefficients are in parentheses along the diagonal. The correlations among level-1 variables are based on 706 workers (N = 706). The coefficients of supervisor safety attitudes as the group-level variable are based on 142 groups (N = 142). [a] Gender was coded as 0 = female, 1 = male. [b] Education was coded as 1 = completed grade school, 2 = some high school, 3 = completed high school, 4 = some college, 5 = completed college, 6 = graduate/professional degree. * $p < .05$. ** $p < .01$, *** $p < .001$

mindfulness was negatively correlated with work-related injuries ($r = -.13$, $p < .01$) and was positively related to safety compliance ($r = .25$, $p < .01$) and safety participation ($r = .17$, $p < .01$). These bivariate results provided preliminary support for Hypotheses 1 and 2.

Confirmatory Factor Analyses

We applied Dyer, Hanges, and Hall (2005) approach of multilevel confirmatory factor analyses (CFA) to verify the distinctiveness of employee-level and group-level factors. Consistent with our anticipations, a five-factor model (i.e., trait mindfulness, safety compliance, safety participation, workplace injuries at employee level, and safety climate at group level) indicated a reasonably adequate fit (χ^2 (280) = 706.75, $p < .001$; RMSEA = .046; CFI = .90; TLI = .89; SRMR $_{within}$ = .07; SRMR $_{between}$ = .05; see Table 2) and had a significantly better fit than a four-factor model in which safety compliance and safety participation loaded on one factor (i.e., safety behaviors) (χ^2 (283) = 936.75, $p < .001$; $\Delta\chi^2$ (3) = 230.00, $p < .001$; RMSEA = .06; CFI = .85; TLI = .83; SRMR $_{within}$ = .07; SRMR $_{between}$ = .05), and a three-factor model in which trait mindfulness, safety compliance, and safety participation loaded on one factor (χ^2 (285) = 1675.72, $p < .001$; $\Delta\chi^2$ (5) = 968.97, $p < .001$; RMSEA = .08; CFI = .67; TLI = .63; SRMR $_{within}$ = .10; SRMR $_{between}$ = .05). Accordingly, based on the above positive evidence for discriminant validity, we proceeded to use these five measures as proposed for examining our hypotheses.

Given that the data were collected from the same source, we proactively conducted the CFA marker technique suggested by Williams, Hartman, and Cavazotte (2010) to examine the presence and influence of common method variance (CMV; Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). We selected a measure of the perception of belongingness, which is related to occupational safety (Geller, Roberts, & Gilmore, 1996), as a marker variable measured with an eight-item scale of Malone, Pillow, and Osman (2012). Following the suggestions of Williams et al. (2010), a five-factor model was initially estimated, including an employee-level CFA model and the marker variable. Second, a baseline model was estimated where we fixed the correlation between the marker variable and the other study variables at zero; additionally, we set the value of factor loadings and the error terms of the marker variable to those values estimated from the CFA model with the marker variable in the first step. Third, a constrained model (Method C model) was assessed that refers to the fixed factor loadings from the marker variable to all indicators of the CFA model equally. If the constrained model performs better than the baseline model, the effects of CMV are probably present. The results showed that the chi-square difference between the Method C model and baseline model is insignificant (Method C model: $\chi2(413) = 1824.15$, $p < .001$; baseline model: $\chi^2(414) = 1827.86$, $p < .001$; $\Delta\chi^2(1) = 3.71$, $p = .05$), thus indicating that CMV likely was not high and did not bias the current study's research results.

Testing Employee-Level Direct and Indirect Effects

Table 3 presents the coefficient estimates of employee-level main effects for Hypothesis 1. Hypothesis 1 proposed a direct negative relationship between trait mindfulness and work-related injuries. Consistent with our expectation, trait mindfulness was negatively associated with work-related injuries ($\gamma = -.05$, SE = .02, $p < .01$), indicating that 7% of the explainable variation in workplace injuries was explained by

Table 2 Results of multilevel confirmatory factor analyses

Model	χ^2 (*d.f.*)	$\Delta\chi^2$ ($\Delta d.f.$)	RMSEA	CFI	GFI	SRMR $_{within}$	SRMR $_{between}$
1. Five-factor model	706.75(280)	–	.046	.90	.89	.07	.05
2. Four-factor model[a]	936.75 (283)	230.00*** (3)	.06	.85	.83	.07	.05
3. Three-factor model[b]	1675.72 (285)	968.97*** (5)	.08	.67	.63	.10	.05

The values of $\Delta\chi^2$ and $\Delta d.f.$ are differences between the five-factor model and the other models. *RMSEA*, root-mean-square error of approximation, *CFI*, comparative fit index, *GFI*, goodness-of-fit index, *SRMR*, standardized root-mean-square residual for the within-group (SRMR $_{within}$) and between-group (SRMR $_{between}$) matrices. [a] This model combines safety compliance and safety participation loaded on one factor. [b] This model combines trait mindfulness, safety compliance, and safety participation loaded on one factor. *** $p < .001$

trait mindfulness. Replicating the findings by Zhang and Wu (2014), we also found support for a positive relationship between trait mindfulness and safety behaviors: trait mindfulness was positively related to safety compliance ($\gamma = .28$, $SE = .04$, $p < .001$) and safety participation ($\gamma = .21$, $SE = .05$, $p < .001$). These results indicate that 13% of the variance in safety compliance and that 12% of the variance in safety participation was explained by trait mindfulness. That is, employees with higher levels of trait mindfulness reported higher levels of safety compliance and safety participation.

Hypothesis 2 proposed that there would be an indirect effect of trait mindfulness on work-related injuries through safety behaviors: (a) safety compliance and (b) safety participation. After controlling for both safety compliance and safety participation, the effect of trait mindfulness on workplace injuries became lower ($\gamma = -.04$, $SE = .02$, $p = .01$; see Table 3), indicating that 15% of the variance in workplace injuries was explained by all employee-level factors. To further assess the significance of the indirect effect, we applied the bootstrapping approach to estimate the indirect effects of trait mindfulness on workplace injuries (Preacher & Hayes, 2008). The bootstrapped unstandardized indirect effect of − .02 through safety compliance was significant based on its 95% CI [− .027, − .008] and the indirect effect of − .002 through safety participation was not significant based on its 95% CI [− .004, .009]. These results indicate that employees' trait mindfulness had a negative effect on work-related injuries that was partially explained by their safety compliance behaviors, providing partial support for Hypothesis 2.

Examining Cross-Level Moderating Effects of Safety Climate

Hypothesis 3 proposed that safety climate as a group-level factor would moderate the relationship between trait mindfulness and safety behaviors (a. safety compliance and b. safety participation). Results showed significant cross-level interaction effects on safety compliance ($\gamma = .29$, SE = .12, $p = .02$; see Table 4) and safety participation ($\gamma = .27$, SE = .13, $p = .04$; see Table 4). This indicates that safety climate explains 9% of the within-group variance and 42% of the between-group variance in predicting safety compliance and 1% of

Table 3 Hierarchical linear regression results for the relationships among mindfulness, safety compliance, safety participation, and injuries

	Injuries							
	Model 1	Model 2		Model 3		Model 4		
Predictor	Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE
Intercept	1.12***	.01	1.12***	.01	1.12***	.01	1.12***	.01
Step 1: Control variables								
Gender	.07**	.03	.08**	.03	.08**	.03	.08**	.03
Age	< .01	< .01	< .01	< .01	< .01	< .01	< .01	< .01
Tenure	< .01	< .01	< .01	< .01	< .01	< .01	< .01	< .01
Education	− .02	.01	− .02	.01	− .02*	.01	− .02*	.01
Step 2: Direct effect								
Mindfulness			− .05**	.02			− 04*	.02
Safety compliance					− .04*	.02	− .03†	.01
Safety participation					< .01	.02	< .01	.01
Level-1 R^2	.04	.11		.11		.15		
ΔR^2		.07		.001		.04		

$N = 706$. † $p = .05$, * $p < .05$. ** $p < .01$, *** $p < .001$

Table 4 Hierarchical linear modeling results for testing moderating effects of safety climate on the relationships between trait mindfulness, safety compliance, and safety participation

	Safety compliance				Safety participation			
	Model 1		Model 2		Model 3		Model 4	
Predictor	Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE
Intercept	4.29***	.03	4.29***	.03	3.99***	.03	3.98***	.03
Step 1: Control variables								
Gender	.09	.08	.10	.08	.10	.09	.10	.09
Age	< .01	< .01	< .01	< .01	.01	< .01	< .01	< .01
Tenure	< .01	< .01	< .01	< .01	.01	< .01	< .01	< .01
Education	− .04	.03	− .05*	.03	− .05	.03	− .05	.03
Level-1 Direct effect								
Mindfulness	.28***	.04	.29***	.04	.21***	.05	.23***	.05
Level-2 Direct effect								
Safety climate			.17*	.07			.01	.09
Interaction effect								
Trait mindfulness x Safety climate			.29*	.12			.27*	.13
Level-2 R^2	.33		.42		.54		.55	
ΔR^2			.09				.01	

Level-1 N = 706. Level-2 N = 142. * p < .05; ** p < .01, *** p < .001

the within-group variance and 55% of the between-group variance in predicting safety participation. Moreover, as indicated by simple slope tests (Aiken & West, 1991), both relationships between trait mindfulness and safety compliance and safety participation were stronger when safety climate was strong (t = 5.75, p < .001; t = 4.12, p < .001), compared to when safety climate was weak (t = 2.84, p = .010; t = 1.57, p = .12; see Figs. 2 and 3). Thus, Hypotheses 3a and 3b were supported.

To test moderated mediation effects (Hypothesis 4), we applied Bauer et al.'s (2006) approach to estimate the conditional indirect effect of trait mindfulness on work-related injuries via safety behaviors at high levels (+ 1 standard deviation) and low levels (− 1 standard deviation) of safety climate. Results indicated that both the indirect effects of trait mindfulness on workplace injuries (via safety compliance) at the high level and the low level of safety climate were not significant (estimate = .05, SE = .06, p = .47; estimate = − .01, SE = .03, p = .63). The bootstrapping results revealed that both indirect effects through safety compliance at the high level and the low level of safety climate were not significant based on the 95% CIs including zero [− .06, .15; − .06, .03]. Moreover, both the indirect effects of trait mindfulness on

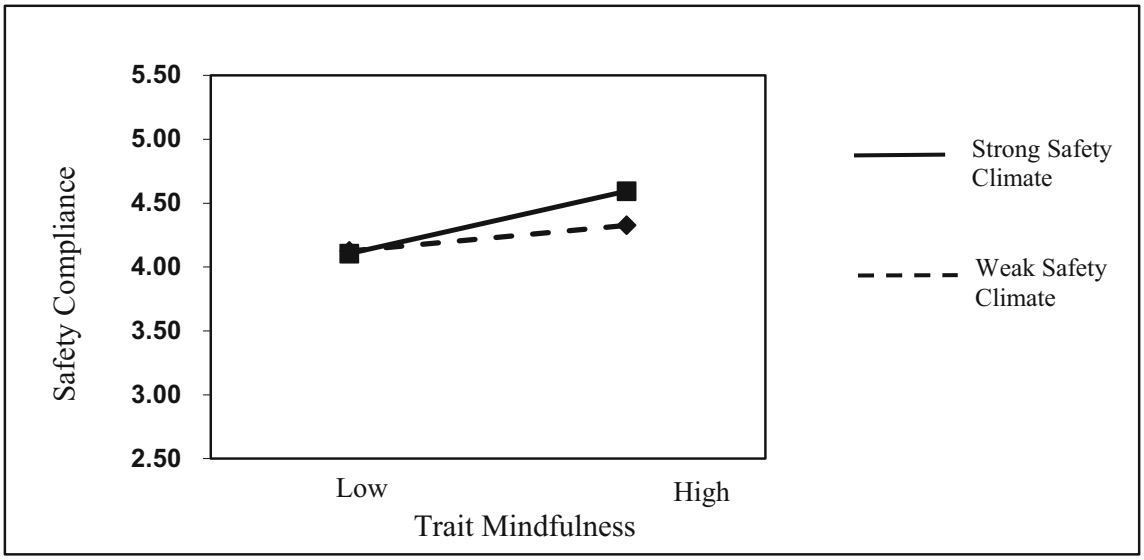

Fig. 2 The moderating effect of safety climate on the relationship between trait mindfulness and safety compliance

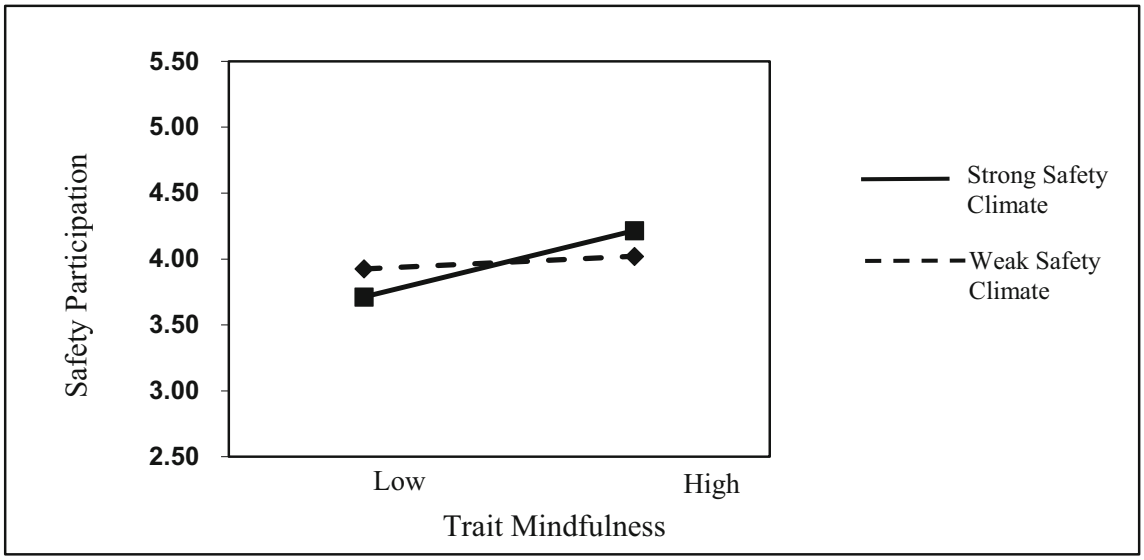

Fig. 3 The moderating effect of safety climate on the relationship between trait mindfulness and safety participation

workplace injuries (via safety participation) at the high level and the low level of safety climate were not significant (estimate = .06, SE = .07, p = .43; estimate = − .04, SE = .05, p = .51). The bootstrapping results indicated that the indirect effects through safety participant at the high level and the low level of safety climate were not significant based on the 95% CIs including zero [− .06, .17; − .12 .05]. Therefore, Hypothesis 4 was not supported.

Discussion

We examined role of trait mindfulness as a predictor of workplace injuries; assessed the mediating mechanism, safety behavior, through which mindfulness is related to safety outcomes; and examined the moderating role of a group-level conditional factor, safety climate, on these relationships. Overall, our results support our hypotheses: trait mindfulness is directly associated with workplace injuries, safety compliance, and safety participation and is indirectly related to workplace injuries through safety compliance. The direct effects of trait mindfulness on safety compliance and safety participation were found to be moderated by safety climate such that the most safety behaviors occurred when employees had high trait mindfulness and were embedded within groups with a strong safety climate.

Theoretical Implications

Overall, our results support mindfulness as an individual difference tool that employees can utilize to, proximally, improve safety behaviors and, distally, improve safety outcomes (i.e., occupational injuries). This extends the reach of the literature on the benefits of mindfulness to include occupational injuries and provides information on a mechanism (safety compliance) through which mindfulness is related to injuries. In addition, drawing on SDT (Deci & Ryan, 1985), the positive relationship of mindfulness on safety behaviors that we found within our study replicates, within a different occupational context, the findings of Zhang and Wu (2014) and bolsters prior research findings regarding the positive influence of mindfulness on job performance in general (e.g., Dane & Brummel, 2014; Glomb et al., 2011). SDT provides a theoretical rationale that posits that mindfulness is related to increased awareness of and attention to the current cues which can promote response to individual needs and influence subsequent behaviors. In tandem with the growing research on mindfulness in the workplace (e.g., Dane, 2011), our results help to establish mindfulness squarely within the occupational domain as a personal capacity that shows promise in helping employees and organizations.

In addition to replicating the trait mindfulness–safety behavior relationship identified by Zhang and Wu (2014), we apply SDT to expand on their work in three important ways: First, we examine the relationships between mindfulness with both safety behaviors and self-rated safety outcomes: accidents/injuries. Our results, supporting the indirect effect of mindfulness on accidents/injuries through safety compliance lend further support for the utility of mindfulness in organizations as something that can influence both employee behaviors as well as more distal organizational outcomes with important implications for employee health and organizational financial success. Our examination of safety behavior as a mediator adds empirical support for the theoretical rationale of how mindfulness is related to workplace injuries. Second, while Zhang and Wu (2014) assessed individual difference moderators, to, we integrate SDT (Deci & Ryan, 1985) and SIP theories (Salancik & Pfeffer, 1978) to examine the

influence of the interaction between individual and group-level contextual factors (trait mindfulness and safety climate) on safety behaviors and injuries. In combination, our results support the notion that trait mindfulness interacts with both individual (Zhang & Wu, 2014) and organizational factors (current study) to influence employee safety behaviors. Finally, we examine these relationships within the contracting realm of the energy industry; this expands generalizability of the role of mindfulness in safety beyond control room operators of energy power plants to a wider range of safety critical jobs.

Although safety climate is consistently identified in safety research as a significant factor of increased safety behaviors, our results suggest that low mindfulness may limit the beneficial effects of safety climate. One explanation for this could be that for safety climate to be an effective driver of safety behaviors, employees need to attend to and act on the situational cues that are promoting safety. Within this framework, although the environment may be strongly supporting safety, an individual is unlikely to act in accordance with the climate if their situational awareness is low. Therefore, mindfulness, through its link to attentional awareness and self-regulation, may be necessary for safety climate to motivate employee behavior. Future research looking deeper into the mechanisms of these relationships is needed; however, our results suggest that interventions designed to increase safety behaviors should include both mindfulness and safety climate components to optimize effectiveness.

Practical Implications

Our findings highlight the importance of employee trait mindfulness in safety behaviors and accidents/injuries. Specifically, when embedded within work groups with strong safety climate, trait mindfulness was shown to be associated with increased safety behaviors and decreased accidents/injuries. While trait mindfulness is commonly considered a dispositional individual difference variable (Glomb et al., 2011), trait mindfulness can be improved through training (Carmody, Reed, Kristeller, & Merriam, 2008; Chambers, Lo, & Allen, 2008). Given the high costs associated with safety incidents (e.g., BLS, 2015), developing mindfulness may be a way for employees and employers to support safety behaviors and a decreased likelihood of accidents/injuries. The malleability of trait mindfulness through intervention, in conjunction with our findings, makes trait mindfulness an important individual difference variable for both selection and training to help optimize employee safety.

Our findings—in conjunction with the findings from Zhang and Wu (2014) and research supporting the relationship between mindfulness and employee performance (e.g., Dane & Brummel, 2014; Glomb et al., 2011; Zhang et al., 2013)—suggest that trait mindfulness may be a useful criterion for selection in safety-critical workplaces. Trait mindfulness is easy to measure via a short self-report questionnaire. The combined results of our study and Zhang and Wu's (2014) study suggest that the mindfulness/safety behavior relationship generalizes across longer (Walach et al., 2006; Zhang et al., 2013) and shorter (Brown & Ryan, 2003) scales as well as across cultural (China and the USA) and industry settings (nuclear plants and oil and gas industries). Furthermore, our moderation results suggest that the relationship between trait mindfulness and safety behavior is stronger when employees are embedded in teams with higher safety climates. From a selection perspective, this suggests that in work groups that have high safety climate, mindfulness may be a particularly impactful individual difference factor to select to promote safety behavior.

Limitations and Future Research

There are limitations to this study that should be discussed as well as several supplementary directions for research that will help make this line of inquiry more robust. To begin with, all measures were assessed at a single time period. Our results suggest that there is a relationship between trait mindfulness and safety behaviors and, ultimately, injuries. However, due to the use of a single measurement time point, the directionality of the model and mediation mechanism cannot be fully demonstrated without further, longitudinal support of how trait mindfulness is related to occupational safety over time. Yet, while longitudinal examination of these relationships is a needed next step in this area, we believe that our study provides important preliminary evidence of these relationships and that the directionality proposed is well supported by theory and past research. For example, trait mindfulness is a dispositional characteristic that, by nature, is stable over time (Brown & Ryan, 2003). This supports the use of trait mindfulness as a predictor in our model. Similarly, the temporal relationship between safety behaviors and injuries is well documented using longitudinal methods (e.g., Neal & Griffin, 2006). Taken together, although we were not able to assess the temporal structure of our hypotheses, our trait-behavior-outcome proposed model is well supported by management theory and prior longitudinal research. Our study demonstrated that these constructs are related to each other; past research and theory supports the validity of the directional relationships proposed in our model.

Our study also relies upon the use of self-report measures to assess the study variables. Self-report data can introduce common method variance (Podsakoff et al., 2003; Spector, 2006). Although future research should incorporate supervisor ratings of subordinate safety behavior and objective safety outcome data to gain a deeper understanding of the impact of mindfulness on the safety process, we believe that self-report methods are appropriate for assessing our research question

for five primary reasons: First, trait mindfulness and safety climate are commonly assessed using self-report methods and are conceptually defined as personal perceptions of the self (mindfulness) or environment (climate) that are best measured using self-report. Mindfulness involves internal mental processes and attention, so the employees themselves are the most appropriate source for measuring mindfulness. Safety climate is conceptualized as a group-level aggregation of individual employees' perceptions, so safety climate is best assessed by asking the group members about how they perceive the prioritization of safety in their organization. Furthermore, by aggregating these individual perceptions to a group level, we minimize the impact of any individual's self-report-based biases. In addition, the measure of injuries used in the current study includes minor injuries that may not be part of a formal safety reporting system. By asking individuals about their injuries instead of relying on organizational records, we likely captured a greater number of small injuries that would not have been reported formally.

Second, the relationship between safety behavior and objective measures of injuries and accidents is well established in previous safety research (e.g., Neal & Griffin, 2006; Hofmann & Morgeson 1999). Due to the established relationship between safety behavior and accidents/injuries using multi-method measurements, it is unlikely that the relationships we found are due solely to common method biases. Third, we rely on previously used measures with strong validity evidence and our results provide support for the reliability and factor structure of the measures used. This provides support for the construct validity for our measures and evidence against the strong presence of method effects (Conway & Lance, 2010). In addition, the scales for our predictors (mindfulness, safety behavior, and safety climate) and our outcome (injuries) used different response scale anchors/formats (the predictors indicated agreement, the outcome indicated frequency), which all help to reduce the likelihood of common method bias (Podsakoff et al., 2003). Fourth, to support the honest and open responding of our participants, our study procedures strongly emphasized the confidentiality of the individual responses and that no individual data would be shared with supervisors or organizational members. Reducing fears of the data being shared or used for organizational decisions can help decrease the likelihood of social desirability responding (Podsakoff et al., 2003). Finally, to assess the impact of common method bias on our results, we performed confirmatory factor analyses using a marker variable. Results from this supplementary analysis do not support the presence of strong common method bias. Overall, although the validity of our findings would be strengthened by future research linking mindfulness and safety behavior to objective indicators of injuries and accidents, we believe the methods used in the current study are appropriate and still provide initial support for the proposed model.

Finally, in this study, we examine the role of trait mindfulness, which can be thought of as a dispositional tendency towards active, non-judgmental, awareness (Brown et al., 2007; Glomb et al., 2011). We purposefully examined trait mindfulness within our study to build on the current research on mindfulness in the workplace and provide organizations with information on whether an employee's mindfulness, in general, could be used to help organizational performance, regardless of the momentary situational and attentional demands that might influence the employee's ability to be in a mindful state. However, another conceptualization of mindfulness is state mindfulness, or the variation of mindfulness from moment to moment that is typically highest during meditation practices (e.g., Robins, Keng, Ekblad, & Brantley, 2012; Sedlmeier et al., 2012). By looking at trait mindfulness instead of state mindfulness, we were unable to assess how mindfulness in a particular moment is related to behavioral decisions and injury occurrence. Instead, our study shows that dispositional tendencies towards mindfulness are associated with general higher levels of safety behaviors across situations. Now that we have established this link between trait mindfulness and safety, expanding on our findings by zooming in to look at the episodic relationships between state mindfulness, subsequent self-regulation, and safety behavior is an interesting next step for this research, with broad implications for interventions that target promoting mindfulness during safety critical encounters.

Conclusion

Using multi-level data from employees within safety-critical positions, this research develops theory surrounding the influence of trait mindfulness on accidents/injuries and the mechanisms and moderators associated with this relationship. Overall, our results highlight mindfulness as an important predictor of accidents/injuries and suggest that, particularly in work groups with strong safety climate, the promotion of trait mindfulness could be a useful tool for increasing employee safety behaviors and, ultimately, decreasing accidents/injury occurrences.

References

Aiken, L. S., & West, S. G. (1991). *Multiple regression: Testing and interpreting interactions*. Newbury Park, CA: Sage Publications.

Allen, T. D., & Kiburz, K. M. (2012). Trait mindfulness and work–family balance among working parents: The mediating effects of vitality and sleep quality. *Journal of Vocational Behavior, 80*(2), 372–379. https://doi.org/10.1016/j.jvb.2011.09.002.

Åkerstedt, T., & Kecklund, G. (2001). Age, gender and early morning highway accidents. *Journal of Sleep Research, 10*(2), 105–110. https://doi.org/10.1046/j.1365-2869.2001.00248.x.

Bauer, D. J., Preacher, K. J., & Gil, K. M. (2006). Conceptualizing and testing random indirect effects and moderated mediation in multilevel models: New procedures and recommendations. *Psychological Methods, 11*(2), 142–163. https://doi.org/10.1037/1082-989X.11.2.142.

Beus, J. M., Dhanani, L. Y., & McCord, M. A. (2015). A meta-analysis of personality and workplace safety: Addressing unanswered questions. *Journal of Applied Psychology, 100*(2), 481–498. https://doi.org/10.1037/a0037916.

Brown, K. W., & Ryan, R. M. (2003). The benefits of being present: Mindfulness and its role in psychological well-being. *Journal of Personality and Social Psychology, 84*(4), 822–848. https://doi.org/10.1037/0022-3514.84.4.822.

Brown, K. W., Ryan, R. M., & Creswell, J. D. (2007). Mindfulness: Theoretical foundations and evidence for its salutary effects. *Psychological Inquiry, 18*(4), 211–237. https://doi.org/10.1080/10478400701598298.

Bureau of Labor Statistics. (2012). Occupational injury and illness classification manual. Retrieved from http://www.bls.gov/iif/oshoiics.htm

Burke, M. J., & Signal, S. M. (2010). Workplace safety: A multilevel, interdisciplinary perspective. In M. R. Buckley, J. R. B. Halbesleben, & Wheeler, A. R (Eds.), *Research in personnel and human resources management* (pp. 1-47). Bingley, England: Emerald Group Publishing Limited.

Carlson, L. E., & Brown, K. W. (2005). Validation of the Mindful Attention Awareness Scale in a cancer population. *Journal of Psychosomatic Research, 58*(1), 29–33. https://doi.org/10.1016/j.jpsychores.2004.04.366.

Carmody, J., Reed, G., Kristeller, J., & Merriam, P. (2008). Mindfulness, spirituality, and health-related symptoms. *Journal of Psychosomatic Research, 64*(4), 393–403. https://doi.org/10.1016/j.jpsychores.2007.06.015.

Chambers, R., Lo, B. C. Y., & Allen, N. B. (2008). The impact of intensive mindfulness training on attentional control, cognitive style, and affect. *Cognitive Therapy and Research, 32*(3), 303–322. https://doi.org/10.1007/s10608-007-9119-0.

Chen, C. (2009). Personality, safety attitudes and risky driving behaviors—Evidence from young Taiwanese motorcyclists. *Accident Analysis and Prevention, 41*(5), 963–968. https://doi.org/10.1016/j.aap.2009.05.013.

Chen, G., & Bliese, P. D. (2002). The role of different levels of leadership in predicting self-and collective efficacy: Evidence for discontinuity. *Journal of Applied Psychology, 87*(3), 549–556. https://doi.org/10.1037/0021-9010.87.3.549.

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*(5), 1103–1127.

Christian, M. S., & Ellis, A. J. (2011). Examining the effects of sleep deprivation on workplace deviance: A self-regulatory. *Academy of Management Journal, 54*(5), 913–934. https://doi.org/10.5465/amj.2010.0179.

Clarke, S., & Robertson, I. T. (2005). A meta-analytic review of the Big Five personality factors and accident involvement in occupational and non-occupational settings. *Journal of Occupational and Organizational Psychology, 78*(3), 355–376. https://doi.org/10.1348/096317905X26183.

Conway, J. M., & Lance, C. E. (2010). What reviewers should expect from authors regarding common method bias in organizational research. *Journal of Business and Psychology, 25*(3), 325–334. https://doi.org/10.1007/s10869-010-9181-6.

Cordon, S. L., & Finney, S. J. (2008). Measurement invariance of the Mindful Attention Awareness Scale across adult attachment style. *Measurement and Evaluation in Counseling and Development, 40*(4), 228–245.

Dane, E. (2011). Paying attention to mindfulness and its effects on task performance in the workplace. *Journal of Management, 37*(4), 997–1018. https://doi.org/10.1177/0149206310367948.

Dane, E., & Brummel, B. J. (2014). Examining workplace mindfulness and its relations to job performance and turnover intention. *Human Relations, 67*(1), 105–128. https://doi.org/10.1177/0018726713487753.

Deci, E. L., Connell, J. P., & Ryan, R. M. (1989). Self-determination in a work organization. *Journal of Applied Psychology, 74*(4), 580–590. https://doi.org/10.1037/0021-9010.74.4.580.

Deci, E. L., & Ryan, R. M. (1985). The general causality orientations scale: Self-determination in personality. *Journal of Research in Personality, 19*(2), 109–134. https://doi.org/10.1016/0092-6566(85)90023-6.

Dierynck, B., Leroy, H., Savage, G. T., & Choi, E. (2017). The role of individual and collective mindfulness in promoting occupational safety in health care. *Medical Care Research and Review, 74*(1), 79–96. https://doi.org/10.1177/1077558716629040.

Dormann, C., & Griffin, M. A. (2015). Optimal time lags in panel studies. *Psychological Methods, 20*(4), 489–505. https://doi.org/10.1037/met0000041.

Dyer, N. G., Hanges, P. J., & Hall, R. J. (2005). Applying multilevel confirmatory factor analysis techniques to the study of leadership. *The Leadership Quarterly, 16*(1), 149–167. https://doi.org/10.1016/j.leaqua.2004.09.009.

Edwards, J. R., & Lambert, L. S. (2007). Methods for integrating moderation and mediation: A general analytical framework using moderated path analysis. *Psychological Methods, 12*(1), 1–22. https://doi.org/10.1037/1082-989X.12.1.1.

Ferguson, M., & Barry, B. (2011). I know what you did: The effects of interpersonal deviance on bystanders. *Journal of Occupational Health Psychology, 16*(1), 80–94. https://doi.org/10.1037/a0021708.

Gagné, M., & Deci, E. L. (2005). Self-determination theory and work motivation. *Journal of Organizational Behavior, 26*(4), 331–362. https://doi.org/10.1002/job.322.

Geller, E. S., Roberts, D. S., & Gilmore, M. R. (1996). Predicting propensity to actively care for occupational safety. *Journal of Safety Research, 27*(1), 1–8.

Giluk, T. L. (2009). Mindfulness, Big Five personality, and affect: A meta-analysis. *Personality and Individual Differences, 47*(8), 805–811. https://doi.org/10.1016/j.paid.2009.06.02.

Glomb, T. M., Duffy, M. K., Bono, J. E., & Yang, T. (2011). Mindfulness at work. In J.Martocchio, H.Liao, & A.Joshi (Eds.), *Research in personnel and human resource management* (pp. 115–157). https://doi.org/10.1108/S0742-7301(2011)0000030005.

Good, D. J., Lyddy, C. J., Glomb, T. M., Bono, J. E., Brown, K. W., Duffy, M. K., et al. (2016). Contemplating mindfulness at work: An integrative review. *Journal of Management, 42*(1), 114–142. https://doi.org/10.1177/0149206315617003.

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.

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. https://doi.org/10.1037/a0017634.

Herndon, F. (2008). Testing mindfulness with perceptual and cognitive factors: External vs. internal encoding, and the Cognitive Failures Questionnaire. *Personality and Individual Differences, 44*(1), 32–41. https://doi.org/10.1016/j.paid.2007.07.002.

Hofmann, D. A., & Morgeson, F. P. (1999). Safety-related behavior as a social exchange: The role of perceived organizational support and leader-member exchange. *Journal of Applied Psychology, 84*(2), 286–296. https://doi.org/10.1037/0021-9010.84.2.286

Hofmann, D. A., Morgeson, F. P., & Gerras, S. J. (2003). Climate as a moderator of the relationship between leader-member exchange and content specific citizenship: Safety climate as an exemplar. *Journal of Applied Psychology, 88*(1), 170–178. https://doi.org/10.1037/0021-9010.88.1.170.

Howell, A. J., Digdon, N. L., & Buro, K. (2010). Mindfulness predicts sleep-related self-regulation and well-being. *Personality and Individual Differences, 48*(4), 419–424. https://doi.org/10.1016/j.paid.2009.11.009.

Howell, A. J., Digdon, N. L., Buro, K., & Sheptycki, A. R. (2008). Relations among mindfulness, well-being, and sleep. *Personality and Individual Differences, 45*(8), 773–777. https://doi.org/10.1016/j.paid.2008.08.005.

Huang, Y. H., Zohar, D., Robertson, M. M., Garabet, A., Murphy, L. A., & Lee, J. (2013). Development and validation of safety climate scales for mobile remote workers using utility/electrical workers as exemplar. *Accident Analysis & Prevention, 59*, 76–86.

International Labour Organization (2015). Safety and health at work: Cases of fatal occupational injury by economic activity. Retrieved from http://www.ilo.org/ilostat/faces/ilostat-home/home?_adf.ctrlstate = 9wwvwl5bf_4&_afrLoop = 500496557774601#!%40%40%3F_adf.ctrl-state%3D9wwvwl5bf_4

James, L. R., Demaree, R. G., & Wolf, G. (1984). Estimating within group interrater reliability with and without response bias. *Journal of Applied Psychology, 69*(1), 85–98. https://doi.org/10.1037/0021-9010.69.1.85.

Jiang, L., Yu, G., Li, Y., & Li, F. (2010). Perceived colleagues' safety knowledge/behavior and safety performance: Safety climate as a moderator in a multilevel study. *Accident Analysis & Prevention, 42*(5), 1468–1476. https://doi.org/10.1016/j.aap.2009.08.017.

Kao, K., Spitzmueller, C., Cigularov, K., & Wu, H. (2016). Linking insomnia to workplace injuries: A moderated mediation model of supervisor safety priority and safety behavior. *Journal of Occupational Health Psychology, 21*(1), 91–104. https://doi.org/10.1037/a0039144.

Kasser, V. G., & Ryan, R. M. (1999). The relation of psychological needs for autonomy and relatedness to vitality, well-being, and mortality in a nursing home. *Journal of Applied Social Psychology, 29*(5), 935–954. https://doi.org/10.1111/j.1559-1816.1999.tb00133.x.

Kiken, L. G., & Shook, N. J. (2011). Looking up: Mindfulness increases positive judgments and reduces negativity bias. *Social Psychological and Personality Science, 2*(4), 425–431. https://doi.org/10.1177/1948550610396585.

La Guardia, J. G., Ryan, R. M., Couchman, C. E., & Deci, E. L. (2000). Within-person variation in security of attachment: A self-determination theory perspective on attachment, need fulfillment, and well-being. *Journal of Personality and Social Psychology, 79*(3), 367–384.

Levesque, C., & Brown, K. W. (2007). Mindfulness as a moderator of the effect of implicit motivational self-concept on day-to-day behavioral motivation. *Motivation & Emotion, 31*(4), 284–299. https://doi.org/10.1007/s11031-007-9075-8

Lourens, P. F., Vissers, J. M., & Jessurun, M. (1999). Annual mileage, driving violations, and accident involvement in relation to drivers' sex, age, and level of education. *Accident Analysis and Prevention, 31*(5), 593–597. https://doi.org/10.1016/S0001-4575(99)00015-9.

Lu, C., & Yang, C. (2011). Safety climate and safety behavior in the passenger ferry context. *Accident Analysis and Prevention, 43*(1), 329–341. https://doi.org/10.1016/j.aap.2010.09.001.

MacKillop, J., & Anderson, E. J. (2007). Further psychometric validation of the Mindful Attention Awareness Scale (MAAS). *Journal of Psychopathology and Behavioral Assessment, 29*(4), 289–293. https://doi.org/10.1007/s10862-007-9045-1.

MacKinnon, D. P., Lockwood, C. M., & Williams, J. (2004). Confidence limits for the indirect effect: Distribution of the product and resampling methods. *Multivariate Behavioral Research, 39*(1), 99–128. https://doi.org/10.1207/s15327906mbr3901_4.

Malone, G. P., Pillow, D. R., & Osman, A. (2012). The general belongingness scale (GBS): Assessing achieved belongingness. *Personality and Individual Differences, 52*(3), 311–316. https://doi.org/10.1016/j.paid.2011.10.027.

Masicampo, E. J., & Baumeister, R. F. (2007). Relating mindfulness and self-regulatory processes. *Psychological Inquiry, 18*(4), 255–258. https://doi.org/10.1080/10478400701598363.

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*(4), 946–953. https://doi.org/10.1037/0021-9010.91.4.946.

Podsakoff, P. M., MacKenzie, S. B., Lee, J., & Podsakoff, N. P. (2003). Common method biases in behavioral research: A critical review of the literature and recommended remedies. *Journal of Applied Psychology, 88*(5), 879–903. https://doi.org/10.1037/0021-9010.88.5.879.

Preacher, K. J., & Hayes, A. F. (2008). Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. *Behavior Research Methods, 40*(3), 879–891. https://doi.org/10.3758/BRM.40.3.879.

Preacher, K. J., Rucker, D. D., & Hayes, A. F. (2007). Addressing moderated mediation hypotheses: Theory, methods, and prescriptions. *Multivariate Behavioral Research, 42*(1), 185–227. https://doi.org/10.1080/00273170701341316.

Probst, T. M. (2015). Organizational safety climate and supervisor safety enforcement: Multilevel explorations of the causes of accident underreporting. *Journal of Applied Psychology, 100*(6), 1899–1907. https://doi.org/10.1037/a0039195.

Probst, T. M., Brubaker, T. L., & Barsotti, A. (2008). Organizational injury rate underreporting: The moderating effect of organizational safety climate. *Journal of Applied Psychology, 93*(5), 1147–1154. https://doi.org/10.1037/0021-9010.93.5.1147.

Raudenbush, S. W., & Bryk, A. S. (2002). *Hierarchical linear models: Applications and data analysis methods*. Thousand Oaks, CA, US: Sage Publications, Inc..

Robins, C. J., Keng, S., Ekblad, A. G., & Brantley, J. G. (2012). Effects of mindfulness-based stress reduction on emotional experience and expression: A randomized controlled trial. *Journal of Clinical Psychology, 68*(1), 117–131. https://doi.org/10.1002/jclp.20857.

Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist, 55*(1), 68–78. https://doi.org/10.1037/0003-066X.55.1.68.

Ryan, R. M., Huta, V., & Deci, E. L. (2008). Living well: A self-determination theory perspective on eudaimonia. *Journal of Happiness Studies, 9*(1), 139–170. https://doi.org/10.1007/s10902-006-9023-4.

Salancik, G. R., & Pfeffer, J. (1978). A social information processing approach to job attitudes and task design. Administrative Science Quarterly, 23(2), 224–253. https://doi.org/10.2307/2392563

Schneider, B. (1990). The climate for service: An application of the climate construct. In B. Schneider (Ed.), *Organizational climate and culture* (pp. 383–412). San Francisco: Jossey-Bass.

Schultz, P. P., & Ryan, R. M. (2015). The 'why,' 'what,' and 'how' of healthy self-regulation: Mindfulness and well-being from a self-determination theory perspective. In B. D. Ostafin, M. D. Robinson, B. P. Meier, B. D. Ostafin, M. D. Robinson, B. P. Meier (Eds.), *Handbook of mindfulness and self-regulation* (pp. 81-94). doi:https://doi.org/10.1007/978-1-4939-2263-5_7

Sedlmeier, P., Eberth, J., Schwarz, M., Zimmermann, D., Haarig, F., Jaeger, S., & Kunze, S. (2012). The psychological effects of meditation: A meta-analysis. *Psychological Bulletin, 138*(6), 1139–1171. https://doi.org/10.1037/a0028168.

Spector, P. E. (2006). Method variance in organizational research: Truth or urban legend? *Organizational Research Methods, 9*(2), 221–232. https://doi.org/10.1177/1094428105284955.

Stanton, N. A., Chambers, P. R., & Piggott, J. (2001). Situational awareness and safety. *Safety Science, 39*(3), 189–204. https://doi.org/10.1016/S0925-7535(01)00010-8.

Tamagawa, R., Giese-Davis, J., Speca, M., Doll, R., Stephen, J., & Carlson, L. E. (2013). Trait mindfulness, repression, suppression, and self-reported mood and stress symptoms among women with breast cancer. *Journal of Clinical Psychology, 69*(3), 264–277. https://doi.org/10.1002/jclp.21939.

Valley, M. A., & Stallones, L. (2017). Effect of mindfulness-based stress reduction training on health care worker safety: A randomized waitlist controlled trial. *Journal of Occupational and Environmental Medicine, 59*(10), 935–941.

Weinstein, N., Brown, K. W., & Ryan, R. M. (2009). A multi-method examination of the effects of mindfulness on stress attribution, coping, and emotional well-being. *Journal of Research in Personality, 43*(3), 374–385. https://doi.org/10.1016/j.jrp.2008.12.008.

Wiegmann, D. A., & Shappell, S. A. (2001). Human error perspectives in aviation. *The International Journal of Aviation Psychology, 11*(4), 341–357. https://doi.org/10.1207/S15327108IJAP1104_2.

Williams, L. J., Hartman, N., & Cavazotte, F. (2010). Method variance and marker variables: A review and comprehensive CFA marker technique. *Organizational Research Methods, 13*(3), 477–514. https://doi.org/10.1177/1094428110366036.

Zhang, J., Ding, W., Li, Y., & Wu, C. (2013). Task complexity matters: The influence of trait mindfulness on task and safety performance of nuclear power plant operators. *Personality and Individual Differences, 55*(4), 433–439. https://doi.org/10.1016/j.paid.2013.04.004.

Zhang, J., & Wu, C. (2014). The influence of dispositional mindfulness on safety behaviors: A dual process perspective. *Accident Analysis and Prevention, 70*, 24–32. https://doi.org/10.1016/j.aap.2014.03.006.

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

Zohar, D., Huang, Y. H., Lee, J., & Robertson, M. M. (2015). Testing extrinsic and intrinsic motivation as explanatory variables for the safety climate—safety performance relationship among long-haul truck drivers. *Transportation research part F: traffic psychology and behavior, 30*, 84–96.

Zohar, D., & Luria, G. (2005). A multilevel model of safety climate: cross-level relationships between organization and group-level climates. *Journal of Applied Psychology, 90*(4), 616–628. https://doi.org/10.1037/0021-9010.90.4.616.

Zohar, D., & Luria, G. (2004). Climate as a social-cognitive construction of supervisory safety practices: Scripts as proxy of behavior patterns. *Journal of Applied Psychology, 89*(2), 322–333. https://doi.org/10.1037/0021-9010.89.2.322