Individual employee's perceptions of “Group-level Safety Climate” (supervisor referenced) versus “Organization-level Safety Climate” (top management referenced): Associations with safety outcomes for lone workers

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ABSTRACT

Research has shown that safety climate is among the strongest predictors of safety behavior and safety outcomes in a variety of settings. Previous studies have established that safety climate is a multi-faceted construct referencing multiple levels of management within a company, most generally: the organization level (employee perceptions of top management’s commitment to and prioritization of safety) and group level (employee perceptions of direct supervisor’s commitment to and prioritization of safety). Yet, no research to date has examined the potential interaction between employees’ organization-level safety climate (OSC) and group-level safety climate (GSC) perceptions. Furthermore, prior research has mainly focused on traditional work environments in which supervisors and workers interact in the same location throughout the day. Little research has been done to examine safety climate with regard to lone workers. The present study aims to address these gaps by examining the relationships between truck drivers’ (as an example of lone workers) perceptions of OSC and GSC, both potential linear and non-linear relationships, and how these predict important safety outcomes. Participants were 8095 truck drivers from eight trucking companies in the United States with an average response rate of 44.8%. Results showed that employees’ OSC and GSC perceptions are highly correlated ($r = 0.78$), but notable gaps between the two were observed for some truck drivers. Uniquely, both OSC and GSC scores were found to have curvilinear relationships with safe driving behavior, and both scores were equally predictive of safe driving behavior. Results also showed the two levels of climate significantly interacted with one another to predict safety behavior such that if either the OSC or GSC scores were low, the other’s contribution to safety behavior became stronger. These findings suggest that OSC and GSC may function in a compensatory manner and promote safe driving behavior even when either OSC or GSC scores are low. The results of this study provide critical insight into the supplementary interaction between perceptions of OSC and GSC. Recommendations for future research, as well as practical recommendations for organizational intervention, are discussed.

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1. Introduction

Occupational safety concerns have tremendous financial and societal consequences. In the United States, there were 4485 work-related fatalities in 2013 (Bureau of Labor Statistics, 2015) and over 3.0 million non-fatal workplace injuries (Bureau of Labor Statistics, 2014). Occupational safety statistics are even more dire in the trucking transportation industry, where the accident rate is high. The fatality rate among those in the truck transportation industry accounts for roughly 10% of the total number of fatal injuries to U.S. workers (Bureau of Labor Statistics, 2013). Additionally, truck-
ers experience an incidence rate of non-fatal injuries at 3.4 per 100 full-time workers (Bureau of Labor Statistics, 2013).

Although strides have been made in worker safety over the years, efforts to improve worker safety continue to be important. Some research (see Saari, 1990) has pointed out that companies have implemented many of the accepted engineering approaches to improve safety. However, an organizational and psychosocial approach may yield increasing safety gains. Safety climate is among the strongest predictors of safety behavior and safety outcomes in a variety of settings (Christian et al., 2009; Nahrgang et al., 2011). While there has been a resurgence in workplace safety research in recent years, there are still many gaps that need to be addressed in order to improve the health and safety of workers. One such gap regards how to improve safety among lone workers (e.g., truck drivers).

The National Health Service of the United Kingdom (NHS, 2009) defines lone working as “any situation or location in which someone works without a colleague nearby; or when someone is working out of sight or earshot of another colleague” (p. 4). Lone workers may constitute a subgroup where the recent safety literature may not be as applicable. For example, at least one study has shown that truck drivers (considered lone workers) may not share their perceptions of safety climate among their working groups (Huang et al., 2013); however, the study results showed that employees’ individual psychological safety climate perceptions have a significant impact on their behaviors and injuries.

Additionally, in recent years, research examining the multi-faceted nature of the safety climate construct has become more prevalent, referencing multiple levels of management within a company (in particular, top management and immediate supervisor) (Zohar and Luria, 2005). The studies examine employees’ perceptions of top management’s commitment to safety (which we refer to as organization-level safety climate) and their perceptions of their immediate supervisor’s commitment to safety (which we label as group-level safety climate). However, studies examining the relationship between organization-level and group-level safety climate perceptions are limited. The relative importance of employee perceptions of safety climate at the group- vs. organization-level has not been examined.

Perceptions of one management level or the other may be more predictive of employee safety behavior and other safety outcomes. It may be that group-related safety climate has a stronger influence on safety outcomes because of proximity to the individual. On the other hand, it is also possible that the company or organization level, when it comes to enacting safety practices and encouraging safe behaviors, would exert stronger influence over employees (e.g., sanctions, terminations). Research examining how important organization- and group-related perceptions are in predicting safety outcomes is particularly important so that those interested in improving worker safety may be better informed in terms of where targeted interventions will have the greatest impact.

The current study makes the following three contributions in addressing the aforementioned safety issues of truck drivers: 1) this study provides evidence, through use of distinct measures referencing both management levels, that employees do, in fact, perceive organization- and group-level safety climates separately and that those perceptions can sometimes be at odds; 2) it examines possible differences in truck drivers’ perceptions of organization-level safety climate (OSC) and group-level safety climate (GSC) and assesses which perception is more strongly related to safety outcomes; and 3) this study enhances the safety climate literature by considering possible interactive relationships between OSC and GSC, particularly when perceptions are matched (i.e., both are high) or mis-matched (i.e., perception of one is more or less positive than the other). These issues are addressed by our research questions.

1.1. Safety climate

Safety climate is often thought of as workers’ shared perceptions of their organization’s policies, procedures, and practices as they relate to the importance of safety within the organization (Griffin and Neal, 2000; Reichers and Schneider, 1990; Rentsch, 1990; Zohar, 1980, 2000, 2011). Policies are defined as strategic goals and means of attaining those goals; procedures provide practical guidelines for actions related to those goals, whereas practices relate to how these policies and procedures are actually enacted (Zohar, 2000). Research has shown that safety climate is a strong predictor of safety outcomes (Christian et al., 2009; Nahrgang et al., 2011).

1.2. Safety climate as a multi-faceted construct referencing two levels of management

Previous studies have supported that a comprehensive safety climate study should be a multi-faceted construct referencing two levels of management: organization-level (employees’ perceptions of the organization’s top management commitment to and prioritization of safety) and group-level (employees’ perceptions of their direct supervisors’ commitment to and prioritization of safety) (Zohar and Luria, 2005; Huang et al., 2013).

As a note: in the broader literature, beyond safety climate research, the term “level” often refers to an analytical approach (e.g., multi-level modeling); however, the safety climate literature has used the term “level” to specify a particular referent within an organization and not the statistical level of analysis. Because most organizations are hierarchically structured, individuals representing different levels of the organization (e.g., top managers and direct supervisors) may treat safety differently. Employees can differentiate between organization-level priorities and the priorities of their own unit (group level) (Zohar, 2000, 2011). According to Zohar and Luria (2005), instituted policies and procedures (as opposed to those that have been formally declared) form the primary referent of organization-level perceptions, while supervisory practices and supervisor implementation of organizational policies and procedures constitute the target of group-level perceptions. Thus, we consider both organization-level and group-level safety climate in the current study, using the term “level” to point to a particular referent to remain consistent with past safety climate research.

1.3. Shared safety climate vs. psychological safety climate

Based on the idea that climate represents shared perceptions, perceptions of all members of a group are typically aggregated to create one climate score that represents all group members in some way. Climate scholars suggest that aggregation should only occur if two criteria are met: (1) there is theoretical reason to consider climate within and across different groups and (2) statistical justification for aggregation is present in homogeneity or agreement statistics (Zohar et al., 2015; Bliese, 2000; Kozlowski and Klein, 2000). If both criteria are not met, climate should be operationalized as an individual construct and should be referred to as “psychological climate” (Zohar et al., 2015). In this case, each worker has his/her own score instead of all being lumped together under one score.

One important example of this situation is truck drivers (considered as part of the lone worker population). Not all workers have the opportunity to work in close contact with their supervisor or co-workers and, thus, may not develop shared perceptions to the same degree as other workers in traditional work settings. Lone workers, in particular, have limited contact with their co-workers—and sometimes with their supervisors, as well—thus reducing the number of opportunities to reconcile their individual perceptions with...
others’ perceptions. Because of the lack of interaction among lone workers, there is little theoretical justification for aggregating lone workers’ perceptions of climate (Zohar et al., 2015). Research by Huang and colleagues (2013) found that the safety climate perceptions of truck drivers were, in fact, not shared with other drivers under the same supervisor. There was not significant between-group variance (Bliese, 2000), so it was not meaningful in the truck driver population to aggregate their safety climate perceptions. Therefore, the current study uses individual perceptions of characteristics of the organization and supervisory practices as they relate to safety, known as psychological safety climate (Beus et al., 2010; Christian et al., 2009). Psychological safety climate has previously been shown in meta-analysis to predict injury outcomes (Christian et al., 2009).

1.4. The relationships between organization- and group-level safety climate and safety outcomes

Zohar and Luria (2005) found that GSC perceptions partially mediate the relationship between OSC perceptions and safety behavior. These findings suggest a linear effect and place greater importance on GSC perceptions, as they are more proximal to employees’ safety behavior. However, while the study showed the two levels of perceptions to be correlated, it is important to note that the correlation was not perfect. Therefore, for some participants, there may be significant differences in their perceptions of OSC and GSC. Safety climate research currently does not address the impact a difference in safety climate perceptions at the organization- and group-level can have on safety outcomes. Additionally, the models developed previously did not address the working situation of lone workers, such as truck drivers. Therefore, the differential impact of OSC and GSC on safety outcomes may be different for these types of workers.

Research Question 1: What is the relationship between organization-level safety climate (OSC) and group-level safety climate (GSC) perceptions?

1.4.1. The formation of differing perceptions

A focal research question of the current study regards the impact of differences in workers’ perceptions between organization- and group-level aspects of safety climate on individual safety outcomes. Therefore, it is important to first understand how differences in workers’ perceptions might come about. Research on the etiology of climates (Schneider and Reichers, 1983) provides three approaches that help explain how workers’ safety climate perceptions may be created: (1) the structural approach, (2) the symbolic interactionist approach, and (3) the attraction-selection-attrition approach. These approaches emphasize why individuals may develop different perceptions of organization- and group-level safety climate. The structural approach to the formation of climates focuses on the environment and the work context influencing workers’ perceptions of safety (Payne and Pugh, 1976). Aspects of the environment that might influence climate perceptions include equipment provided by the organization (e.g., truck), the structure of the organization, technology available to workers (e.g., in-vehicle computers), and training programs. Because these environmental aspects are typically provided by the company, as opposed to direct supervisors, environmental factors likely contribute to organization-level safety climate perceptions to a much greater degree than to group-level safety climate perceptions. In the case of lone workers, such as truck drivers, the objective environment (e.g., the condition of the company-owned truck, company rules regarding speeding) may be an important determinant in how they perceive the priority of safety at the organization level, while having little to no effect on perceptions of the priority of safety at the group level. Therefore, based on the structural approach, organization-level safety climate perceptions may be seen as more important than group-level safety climate in explaining safety outcomes.

Symbolic interaction and sensemaking are other ways in which climates may form. Symbolic interactionism (Schneider and Reichers, 1983) posits that members of the same group compare their perceptions and realities, modifying them according to others’ observations until a shared perception is formed. Social interactions between people (e.g., verbal communication) are thought to be the main medium through which this sensemaking occurs (Blumer, 1969). Zohar (2010) has also suggested that shared employee perceptions (the basis of climate) are formed through symbolic interaction and sensemaking. As lone workers, truck drivers rarely interact with other drivers from the same company; therefore, it is likely that truck drivers’ primary source of symbolic interaction and sensemaking is their direct supervisors, rather than coworkers. Thus, the symbolic interaction and sensemaking perspective point to an important mechanism in which group- and organization-level safety climate perceptions may differ. While symbolic interaction and sensemaking with direct supervisors may contribute some to perceptions of organization-level safety climate as they communicate about higher-level company policies, it seems much more likely that these interactions have a stronger impact on group-level safety climate perceptions. Supervisors’ enactment of safety policies may differ substantially from actual organizational policy (Zohar, 2000; Zohar and Luria, 2010), leading employees to have differing perceptions of the priority placed on safety at the group and organization levels as they communicate with their supervisors and engage in symbolic interaction and sensemaking behaviors. Thus, as truck drivers interact with their supervisors, they develop perceptions of safety climate on a group (supervisory) level that may contribute to safety outcomes.

The attraction-selection-attrition approach (Schneider, 1987) holds that organizational processes make it so employees are similar to each other and, therefore, have similar perceptions regarding safety within the organization. This perspective suggests that individuals are attracted to jobs and organizations that are in line with their wants and expectations, organizations select employees who “match” what the organization is looking for, and employees who do not “match” as well as they or the company would like may either quit or be fired (Schneider and Reichers, 1983). This approach may be particularly important for lone workers, such as truck drivers. Lone workers who care about safety may be attracted to working for particular companies because these companies have good safety reputations or, conversely, not apply to or decide to leave these companies if safety is neglected. Because attraction to an organization typically forms prior to interaction with any particular supervisor, attraction likely contributes to organization-level safety climate perceptions to a greater degree than to group-level safety climate perceptions. Additionally, it may be that employee perceptions of the priority the organization places on safety are formed based on organization-level decisions to select and later terminate certain applicants/employees. These hiring and termination decisions typically are made by higher-level supervisors (i.e., not drivers’ direct supervisors), thus contributing to drivers’ perceptions of organization-level safety climate differentially from perceptions of group-level safety climate. Overall, the attraction-selection-attrition approach would suggest that organization-level perceptions may be more important than group-level perceptions in explaining safety outcomes.

It is clear from the different perspectives discussed above that the comparative importance of organization- and group-level perspectives for lone workers may be supported in either direction. Much of the current literature assumes employee perceptions of OSC and GSC are commensurate (Zohar and Luria, 2005), while some research does recognize the possibility of inconsistencies
1.4.2. Safety behavior as an outcome of safety climate

In the current study, we focus on safety behavior as an outcome of safety climate. While safety climate perceptions have been tied to a wide range of employee outcomes, such as job stress, turnover intentions, and job satisfaction (McCaughhey et al., 2013), safety behavior is known to be a key mediator between safety climate and other outcomes (e.g., Christian et al., 2009). Safety behavior, sometimes referred to as safety performance, often includes both safety compliance behaviors (i.e., core activities needed to maintain workplace safety) and safety participation behaviors (i.e., activities that help develop an environment that supports safety; Griffin and Neal, 2000). Targeting safety behavior specifically as an outcome provides an opportunity to increase understanding of the impact of safety climate, especially because safety behavior is a more proximal outcome to safety climate than are other safety outcomes, such as accidents and injuries (e.g., Christian et al., 2009). Previous research has also shown that safety climate predicts these safety behaviors (Neal et al., 2000; Clarke, 2006), but this research has not explored differences in the predictive ability between group-level safety climate and organization-level safety climate. Hence, the current study uses safety behavior as an outcome of safety climate.

Research Question 2: If differences in perceptions of OSC and GSC exist, which one is a stronger predictor of safety outcomes?

Research Question 3a: How do OSC and GSC perceptions interact to predict safety outcomes?

Finally, many previous studies have hypothesized a simple linear relationship between safety climate and safety outcomes. To the authors’ knowledge, however, no studies have examined non-linear relationships between OSC and GSC and safety outcomes. We argue that a possible curvilinear relationship should be examined for the following reasons. First, a linear relationship assumes that the dependent variable (Y) is directly proportional to the independent variable (X), but this may not be true in particular ranges of X and Y. For example, within the range of X above a certain value, the strength of the X-Y relationship may not be as strong as it is within the range of X below a certain value, due to a ceiling effect (e.g., Leigh, 2011). Hence, examination of a curvilinear relationship between safety climate and safety behavior by including higher order terms of safety climate in a modeling procedure has advantages over simple linear modeling (in terms of model fidelity and better exploration of the complicated nature of safety climate and its relationship with safety behavior). Second, a curvilinear relationship is frequently observed within a difference score modeling framework based on polynomial regression (Edwards, 2007; Edwards et al., 1998). Specifically, an inverted-U relationship between person-environment fit and performance has been supported (Edwards and Shipp, 2007) such that the best performance is expected when person and environment characteristics have no difference, compared to when either the person or environment is relatively higher or lower than the other.

Research Question 3b: Is there a non-linear relationship that best explains the impact of OSC and GSC on safety outcomes?

2. Method

2.1. Participants and procedure

This study utilized data collected for the development and validation of a trucking industry-specific safety climate scale (Huang et al., 2013). A total of 8095 truck drivers from eight companies in the United States took the paper-and-pencil-based or web-based survey, with an average response rate of 44.8%. Only a very small number of participants (i.e., 270 out of 8095 participants, or 3.3%) used paper and pencil surveys. Previous research on the same population (Huang et al., 2013) found no difference between these two methods; therefore, the total sample (N = 8095) was used in the current study. Further information about the trucking companies can be obtained from Huang et al. (2013). The 7466 individual surveys with fewer than 50% missing values in the safety climate scale items were used for analysis. The vast majority of the questionnaires (i.e., 98% out of the 7466 participants) had no or one missing value (Huang et al., 2013).

2.2. Measures

2.2.1. Trucking safety climate (TSC)

Trucking Safety Climate (TSC) was measured using a 40-item scale developed by Huang et al. (2013). The scale contains questions about both company policies and procedures and supervisory practices, measured on a 5-point scale ranging from Strongly Disagree (1) to Strongly Agree (5). The TSC scale contains 20 items referring to OSC (e.g., “Company cares more about my safety than on-time delivery;” “Company turns a blind eye when a supervisor bends some safety rules”) and 20 items referring to GSC (e.g., “Supervisors are strict about driving safely even when we are tired or stressed;” “Supervisor pushes me to keep driving even when I call in to say I feel too sick or tired”). Internal consistency was satisfactory with Cronbach’s α = 0.92 and 0.95, respectively.

2.2.2. Safety behavior

Safety behavior was measured by six self-reported items adapted from Huang et al. (2005) and utilized in Huang et al. (2013). The scale measures safety behaviors of truck drivers that include both compliance- and participation-oriented behaviors. A sample item is “I always comply with the posted speed limits.” The items were measured on a five-point Likert scale (1 = strongly disagree to 5 = strongly agree; α = 0.66).

2.3. Analytic strategies

In our prior published paper (Huang et al., 2013), we conducted homogeneity tests (i.e., Rwg(j), intra-class correlations ICC(1) and ICC(2)). Results in this prior paper showed that, although good within-group agreement was observed with median Rwg(j) values 0.94 and 0.95 for the organization- and group-level safety climate
scales, respectively, the between-group variance did not reach the satisfactory level for ICC(1) ranging from 0.02 to 0.06 and ICC(2) ranging from 0.12 to 0.36. The results did not justify the aggregation of individual/psychological safety climate scores to form shared safety climate perception for their work groups. Therefore, the current study uses individual perceptions of characteristics of the organization and supervisory practices as they relate to safety.

To answer research question 1, study variables’ descriptive statistics and correlations were examined. Additionally, a z-score based case classification was utilized. Given that the OSC and GSC scores were based on two different scales, direct comparison of the two scores, such as a paired-samples t-test, was not available. Thus, the OSC and GSC scores were z-transformed (i.e., $z$-score = [raw score − mean]/standard deviation), and the number of respondents who reported the same or different z-score categories (i.e., $z$-score < −1; −1 ≤ $z$-score < 0; 0 ≤ $z$-score < 1; and 1 ≤ $z$-score) was investigated. We categorized our sample using a 1-SD range because, conventionally, scores that are one standard deviation above the mean can be viewed as “high” scores while scores that are one standard deviation below the mean can be viewed as “low” scores (for examples of this procedure see Hugenberg and Bodenhausen, 2004; Revelle, 2000).

In order to address research questions 2 and 3, polynomial regression (Edwards and Parry, 1993: Edwards, 2002) was conducted. Unlike ordinary least squares regression, polynomial regression includes nth order polynomial terms (e.g., $x^2$, $y^2$) and interaction term(s) of predictor variables (e.g., $x \times y$) in its equation, along with first order terms of two predictors. This allows for examination of curvilinear (e.g., quadratic, cubic, quartic) relationships between the predictors and dependent variable. A surface graph utilizes the coefficients obtained from the polynomial regression and allows for visualization of the complex interaction between the two predictors in a three-dimensional space, where the $x$ and $y$ axes indicate the two predictors and the $z$ axis displays the dependent (outcome) variable. Unique contributions of either of the predictors on the outcome variable can be examined by observing the shape of the line representing one predictor at different levels (i.e., low to high) of a second predictor. Specifically, if the strength or direction of the relationship between the predictor $x$ and the dependent variable $z$ varies across different levels of another predictor $y$, this indicates that the two predictors ($x$ and $y$) significantly interact to predict the dependent variable $z$. In the present study, first order terms of OSC and GSC perceptions, their interaction term, and second order terms of the OSC and GSC perceptions were included as predictors of safe driving behavior. In order to provide meaningful interpretation of the coefficients, the predictors were z-transformed for the polynomial regression analyses.

### 3. Results

**Research Question 1** asked, “What is the relationship between organization-level safety climate (OSC) and group-level safety climate (GSC) perceptions?” Table 1 presents descriptive statistics and correlations of the study variables relevant to this question. The means of OSC and GSC were 3.90 (SD = 0.73) and 3.97 (SD = 0.81), respectively. Employees’ OSC and GSC perceptions were highly correlated ($r = 0.78$), and both were moderately and equally correlated with safety behavior ($r = 0.44$). While OSC and GSC were often closely related, there were some instances where truck drivers perceived higher OSC and lower GSC or vice versa. When $z$-scores of the OSC and GSC scores were classified into four categories, ($z$-score < −1), −1 ≤ $z$-score < 0, 0 ≤ $z$-score < 1, and 1 ≤ $z$-score), only 58.7% of the truck drivers’ OSC $z$-score category was the same as the GSC $z$-score category (i.e., ratio of diagonal cases in Table 2). In other words, 41.3% of the truck drivers’ responses on the two safety climate scales were not within the same $z$-score categories. Specifically, 19.8% of the participants rated higher OSC than GSC, while 21.5% rated in the opposite direction. In sum, the OSC and GSC scores were closely related, but notable gaps between the two were observed for some truck drivers.

Although not presented in Table 1, we examined the relationships of safety behavior with participants’ age ($r = 0.09$) and company tenure ($r = −0.03$) to determine whether these individual differences need to be controlled for in our polynomial regression. The correlations were statistically significant ($p < 0.01$), but their effect sizes were quite small (Cohen, 1992). In fact, an ordinary least square regression analysis showed that age and company tenure could explain only 0.10% additional variance in safety behavior over the OSC and GSC (i.e., $R^2$ changed from 0.211 to 0.212). Thus, the two variables were not included in our polynomial regression for model parsimony.

**Research Question 2** asked, “Which variable (organization-level or group-level safety climate perceptions) is a stronger predictor of safety outcomes?” Results indicate that OSC and GSC are both predictive of employee safety behavior and are not significantly different from each other. The results of the polynomial regression and its graphical illustration in a three-dimensional space are presented in Table 3 and Fig. 1. Including the intercept, the first and second order terms of OSC and GSC, and the interaction term between OSC and GSC were all statistically significant and these variables predicted 23% of the variance in safety behavior (Table 3). Based on the estimated coefficients, surface graphs from two different angles are shown in Fig. 1. This finding suggests that both OSC and GSC scores have curvilinear (quadratic) relationships with safe driving behavior. At the same time, OSC and GSC interact with one another in the prediction of safety behavior.

These results offer an answer to our **Research Questions 3a and 3b**. “How do organization-level and group-level safety climate perceptions interact to predict safety outcomes?” and “Is

### Table 1

Descriptive statistics and correlations.

<table>
<thead>
<tr>
<th></th>
<th>OSC (z)</th>
<th>GSC (z)</th>
<th>Safety Behavior</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>3.90 (0.73)</td>
<td>3.97 (0.81)</td>
<td>4.36 (0.61)</td>
</tr>
<tr>
<td>S.D.</td>
<td>(0.92)</td>
<td>0.78 (0.95)</td>
<td>0.44 (0.66)</td>
</tr>
</tbody>
</table>

Notes: OSC: Organization-level Safety Climate; GSC: Group-level Safety Climate; Values on diagonal and in parentheses are Cronbach’s alpha. *p < 0.01.

### Table 2

Frequency table of z-score based case classification (total n = 7466).

<table>
<thead>
<tr>
<th>OSC (z)</th>
<th>−1 ≤ OSC (z) &lt; 0</th>
<th>0 ≤ OSC (z) &lt; 1</th>
<th>1 ≤ OSC (z)</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>GSC (z)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤ 1</td>
<td>847 (11.8%)</td>
<td>355</td>
<td>81</td>
<td>17.9%</td>
</tr>
<tr>
<td>−1 ≤ GSC (z) &lt; 0</td>
<td>296</td>
<td>1060 (14.7%)</td>
<td>517</td>
<td>26.5%</td>
</tr>
<tr>
<td>0 ≤ GSC (z) &lt; 1</td>
<td>92</td>
<td>502</td>
<td>1527 (21.2%)</td>
<td>36.4%</td>
</tr>
<tr>
<td>1 ≤ GSC (z)</td>
<td>26</td>
<td>79</td>
<td>793 (11.0%)</td>
<td>19.3%</td>
</tr>
<tr>
<td>Percentage</td>
<td>17.5%</td>
<td>28.5%</td>
<td>36.3%</td>
<td>17.6%</td>
</tr>
</tbody>
</table>

Notes: OSC: Organization-level Safety Climate; GSC: Group-level Safety Climate; Cases were classified based on z-transformed OSC and GSC scores; Values on diagonal are those participants whose organization-level safety climate z-score category was the same as the group-level safety climate z-score category (total n = 4227, 58.7%).
Table 3
Polynomial regression coefficients.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>B</th>
<th>SE</th>
<th>t</th>
<th>95% Confidence Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>4.31</td>
<td>0.01</td>
<td>475.21**</td>
<td>4.29 – 4.33</td>
</tr>
<tr>
<td>OSC</td>
<td>0.16</td>
<td>0.01</td>
<td>14.60**</td>
<td>0.14 – 0.18</td>
</tr>
<tr>
<td>GSC</td>
<td>0.17</td>
<td>0.01</td>
<td>15.34**</td>
<td>0.15 – 0.20</td>
</tr>
<tr>
<td>OSC²</td>
<td>0.04</td>
<td>0.02</td>
<td>4.25**</td>
<td>0.02 – 0.06</td>
</tr>
<tr>
<td>GSC²</td>
<td>0.06</td>
<td>0.01</td>
<td>5.90**</td>
<td>0.04 – 0.07</td>
</tr>
<tr>
<td>OSC × GSC</td>
<td>−0.05</td>
<td>0.01</td>
<td>−3.96**</td>
<td>−0.08 – −0.03</td>
</tr>
</tbody>
</table>

Notes: OSC: Organization-level Safety Climate; GSC: Group-level Safety Climate; z-transformed OSC and GSC scores were utilized; B: unstandardized coefficients; SE: standard error; **p < 0.01; Outcome/Dependent Variable: Safety Behavior; \( R^2 = 0.23 \).

there a non-linear relationship that best explains the impact of OSC and GSC on safety outcomes?" The relationship between GSC and employees’ safety behavior relationship was stronger when OSC was lower and weaker when OSC was higher. However, safety behavior of employees was always higher when OSC was high compared to when it was low. This suggests that GSC is compensatory to the positive effect of OSC. In other words, when OSC is low, GSC compensates for the lack of OSC on safety behavior. Further, the level of safety behavior was optimal when both OSC and GSC were high, but poorest when both OSC and GSC were low. These relationships can be more clearly represented by the two-dimensional projection (Fig. 2) of the surface graph depicting the overall impact of the OSC and GSC on employee safety behavior (Fig. 1).

Fig. 3A shows the estimated relationship between GSC and employee safe driving behavior when OSC was held constant at the mean. When OSC was higher, employees tended to report higher safe driving behavior. When GSC was below its mean, the curvilinear growth rate was almost flat, but when OSC was above its mean, the growth rate became more apparent. Similarly, Fig. 3B depicts the relationship between OSC and employee safe driving behavior when GSC was fixed to its mean. When OSC was higher, employees’ safe driving behavior tended to increase. When OSC was below its mean, the curvilinear growth rate was nearly flat, but when it was higher than its mean, the growth rate became more apparent.

Safety behavior along the congruence (i.e., the prediction when OSC and GSC match; OSC = GSC) and incongruence (i.e., the prediction when OSC and GSC mismatch; OSC = −GSC) lines was also examined. Fig. 4A shows that safety behavior increases as both OSC and GSC increase simultaneously. Fig. 4B shows that safety behavior is higher when either OSC or GSC is higher than the other (i.e., OSC > GSC or GSC < OSC), compared to when the two are equal to 0 (i.e., at their mean levels). These findings suggest that OSC and GSC may function in a compensatory manner and promote safe driving behavior even when either OSC or GSC scores are low.

4. Discussion

The objective of this study was to examine the possible differences in employee safety climate perceptions scores at the organization- and group-related levels and how the linear and non-linear relationships between these scores relate to employee safety outcomes, namely, safety behavior for lone workers. Additionally, the current study aimed to examine the possible interaction between the two levels of safety climate.

In terms of the main research questions addressed in this study, Research Question 1 asked what the relationship between OSC and GSC looks like for lone workers. It was found that truck drivers’ perceptions of OSC and GSC were correlated at \( r = 0.78 \), meaning the two are positively and strongly related. These results are not surprising, as the current literature largely assumes that perceptions of different levels are likely to resemble one another given the limited range of supervisory implementation of company policy and procedure (see Zohar and Luria, 2005). However, while the two safety climate levels are highly correlated, each addresses a conceptually different construct. The researchers aimed to further describe the relationship between the two and account for any differences. Results of classifying perceptions based on z-score bands showed that while the majority of truck drivers viewed OSC and GSC to be approximately equal, over 40% indicated a difference of one standard deviation or more. These results show that some truck drivers may have very different perceptions about how safety is prioritized at each level of the organization. Therefore, it appears that while many supervisors directly transmit organization-level safety policies (leading to a situation where policies espoused at the organization level are enacted appropriately by supervisors at the group level and no differences in safety climate are perceived between

Fig. 1. Polynomial regression surface figures.
Notes: OSC: Organization-level Safety Climate; GSC: Group-level Safety Climate; SB: Safety Behavior; OSC and GSC scores were z-transformed such that 0 indicates the mean of OSC or GSC. The score of 2 indicates that the score is 2 standard deviations above the mean. The score of −2 indicates that the score is 2 standard deviations below the mean.

Fig. 2. Interaction between organization- (OSC) and group-level safety climate (GSC) in prediction of safety behavior (SB).
Notes: OSC: Organization-level Safety Climate; GSC: Group-level Safety Climate; SB: Safety Behavior; OSC low: 1 standard deviation below mean; OSC high: 1 standard deviation above mean; OSC and GSC scores were z-transformed such that 0 indicates the mean of OSC or GSC. The score of 2 indicates that the score is 2 standard deviations above the mean. The score of −2 indicates that the score is 2 standard deviations below the mean.
the two), some supervisors’ enactment of safety policies may differ substantially from organizational policy or they may be imposing their own beliefs on their subordinates (Zohar, 2000; Zohar and Luria, 2010), thus leading to differences in perceptions.

If employees hold very different views on the importance of safety within their own organization, it is then important to discern which level of safety climate is most predictive of safety outcomes. Research Question 2 was explored within the context of the polynomial regression. Results indicated that OSC and GSC are both predictive of employee safety behavior and one is not a better predictor of employee safety outcomes than the other. This may mean that truck drivers are able to simultaneously take into account both organization and supervisor expectations.

Research Questions 3a and 3b tested the interaction between truck driver OSC and GSC scores using a polynomial regression to explore whether consensus between the two levels is more important than either one being higher than the other. The polynomial regression revealed that OSC and GSC each has a significant, positive curvilinear relationship with safety behavior. The results indicate the highest levels of safety behavior when both OSC and GSC are high. Therefore, we can say that optimal (most safe) conditions occur when both OSC and GSC are high. The least optimal or most unsafe conditions occur when both OSC and GSC perceptions are low. Interestingly, the interaction analyses showed that the relationship between GSC and safety behavior is dependent upon OSC perceptions. When GSC was low, high levels of OSC were able to act as a supplement and increase safety behavior. Similarly, when OSC was low, high levels of GSC were able to supplement the relationship and increase reported safety behaviors. These findings indicate that companies may be able to take advantage of the supplementary nature of OSC and GSC in predicting safety outcomes.

The results of this study have significant practical implications. The interactive relationship can be explained when looking at the safety climate characteristics of companies. When OSC is high, companies are more likely to have good safety-related policies and procedures in place to hire and train good supervisors. Conversely, companies with low OSC may put less emphasis on safety in their policies and procedures and may not offer safety training and support to supervisors. However, an individual supervisor’s commitment to safety may act as a buffer of the negative effect of low OSC. From these results we can see that in a company with low OSC, having a supportive supervisor is very important. However, it is also important to note that in companies with low OSC, supervisors may not get the support or training they need.

Fig. 3. A) Group-level safety climate (GSC) and safety behavior (SB) relationship holding organization-level safety climate to mean (0). B) Organization-level safety climate (OSC) and safety behavior (SB) relationship holding group-level safety climate to mean (0). Notes. OSC and GSC scores were z-transformed such that 0 indicates the mean of OSC or GSC. The score of 2 indicates that the score is 2 standard deviations above the mean. The score of –2 indicates that the score is 2 standard deviations below the mean.

Fig. 4. A) Safety behavior (SB) when organization-level safety climate (OSC) and group-level safety climate (GSC) are equal. B) Safety behavior (SB) when organization-level safety climate (OSC) and group-level safety climate (GSC) are in the opposite direction. Notes. OSC and GSC scores were z-transformed such that 0 indicates the mean of OSC or GSC. The score of 2 indicates that the score is 2 standard deviations above the mean. The score of –2 indicates that the score is 2 standard deviations below the mean.
from top management. Therefore, the results support the assertion that top management and frontline supervisors work in a supplementary fashion. Consequently, it is apparent that all companies, especially those whose employees may rate the OSC as low, should focus on creating a solid structure for safety, and policies and procedures that clearly mark safety as a priority. To achieve the most optimal safety outcomes, companies are encouraged to enhance GSC by, for example, hiring and/or training supervisors to be more committed to workplace safety.

An additional implication of the current study is that others within an organization can have an impact on safety outcomes. If top management or frontline supervisors can act to supplement safety weaknesses of the other, it holds that other groups may also have this kind of impact. Co-workers, for example, may also have the ability to act in a supplementary fashion to either organization- or group-level safety climate perceptions. Future studies may consider the interaction between co-workers and top management, especially for employees who regularly work in pairs or groups (e.g., utility workers).

This study also makes significant theoretical and scientific contributions. It has shown that many lone workers do perceive differences between organization-related and group-related safety climate. This study is one of the first to address such differences with lone workers. These findings may mean that researchers should not solely use an organization-level measure (or a group-level measure) of safety climate and assume that the relationships observed at one level will hold true at another level.

Additionally, the current study is the first to examine a non-linear relationship between OSC and GSC on safety behavior. The results have shown that the impact of safety climate on safety behavior is not consistent across all levels of safety climate; particularly, the relationship between GSC and safety behavior is strongest at the lowest levels of OSC. Similarly, the strongest relationship between OSC and safety behavior is at the lowest levels of GSC. Additional research should be conducted to further examine this curvilinear relationship, especially with traditional worker populations and other types of lone workers.

There are a few limitations of the current study that can potentially be addressed in future studies. Data were collected only at one time point and longitudinal relationships between variables could not be observed. However, in a prior paper from this project, the relationship between safety behavior and objective injuries was supported (Huang et al., 2013). Additionally, although the overall sample size is large, only eight trucking companies participated in the research; however, even with the relatively small number of participating companies, the current study still exceeds many other studies comparing only one or two companies. All data were obtained through self-reports of current employees of these organizations. It is possible that common method bias may have affected some of the relationships between variables. While socially desirable responding may be a source of some of this bias, respondents did not indicate uniformly high perceptions of both OSC and GSC (i.e., respondents did sometimes rate their safety climate perceptions as poor), indicating that socially desirable responding may not be a large issue in the current study. Finally, it should be noted that truck driving is a unique occupation, even for lone workers. Truck drivers can go long periods of time without seeing their supervisors or their coworkers. Therefore, future studies should assess these relationships with other populations of lone workers.

5. Conclusion

In conclusion, the present study showed that in a sample of lone workers, truck drivers can and do perceive some differences between OSC and GSC and that both are predictive of safety behav-

ior outcomes. GSC was found to have supplementary effects on safety behaviors when OSC was low and vice versa. Finally, a curvilinear interaction between OSC and GSC was observed. These results provide support for continued research of the levels of safety climate for lone workers.

This study, along with future research in this area, will guide researchers and practitioners on how to increase safety for lone workers. This type of research, especially for the trucking industry, is critical in our effort to understand, and thus improve, safety climate and safety behavior. Ultimately, increased attention in this subject area will ideally lead to fewer accidents, injuries, and fatalities in this high-risk employment sector.

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