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THE IMPACT OF CO-WORKERS ON SAFETY OUTCOMES: COMPARING MODELS OF MEDIATION, MODERATION, AND INCREMENTAL EFFECTS

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THE IMPACT OF CO-WORKERS ON SAFETY OUTCOMES:
COMPARING MODELS OF MEDIATION, MODERATION,
AND INCREMENTAL EFFECTS

A Dissertation
Presented to
the Graduate School of
Clemson University

In Partial Fulfillment
of the Requirements for the Degree
Doctor of Philosophy
Industrial/Organizational Psychology

by
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ABSTRACT

The current study examined the role of co-worker support for safety within the broader context of perceived safety climate predicting safety behavior and outcomes for the mobile worker population of team truck drivers. Namely, the mediation, moderation, and incremental direct effects of co-worker support for safety were tested. The current study examined 366 team truck drivers from a single trucking company. Results indicated that co-worker support for safety did not moderate the relationship between safety climate perceptions and behavior and injury outcomes. However, co-worker support for safety did partially mediate the relationship between safety climate perceptions and safety behavior. Additionally, the model testing the 4-path mediation from organization-level safety climate perceptions → supervisor-level safety climate perceptions → co-worker support for safety → employee safety behavior → crash outcomes was significant. In a test of the incremental effects of co-worker support for safety, co-worker support was found to explain an additional 7% of the variance in safety behavior beyond the predictors of organization- and supervisor-level safety climate. Finally, tests of safety behavior and crashes between solo and team truck drivers were not significant. However, comparisons of the predicted outcomes at different levels of support did show differences between the two groups, although not always in the expected direction. Overall, the results show that co-worker support for safety is an important component in predicting employee safety outcomes. Future safety interventions may find usefulness in assessing and strengthening not only safety climate at the organization and supervisor level, but also the safety supportive behaviors of employees themselves.

DEDICATION

This dissertation is dedicated to my children.

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CHAPTER ONE

INTRODUCTION

Globally, it is estimated that over 2.3 million deaths occur each year as the result of occupational injuries and illnesses; that is roughly 6,300 deaths each day (ILO, 2013). In the United States, there were 4,485 work-related fatalities in 2013 (U.S. Bureau of Labor Statistics [BLS], 2015) and over 3.0 million non-fatal workplace injuries (BLS, 2014). These statistics show an incidence rate of 3.3 non-fatal accidents per 100 full-time workers annually. Therefore, examining the antecedents and determinants of safety-related behaviors should be a top priority in occupational research today.

The figures are striking and demonstrate how important safety is in any organization, particularly those where the risk of injury to self or others is quite high. However, it is important to note that these numbers may not be completely representative of all accidents and injuries at work. For example, the BLS data only include full-time workers and other studies have shown that significant under-reporting of accidents and injuries may occur (Probst, Brubaker, & Barsotti, 2008).

Additionally, organizations continue to incur costs related to these workplace injuries and accidents. The 2014 Liberty Mutual Safety Index (Liberty Mutual, 2015) estimates that the direct U.S. workers compensation costs of the 10 most disabling workplace injuries totaled \$59.58 billion in 2012. However, indirect costs associated with workplace injury (e.g., wages paid not covered by workers comp, lost productivity related to hiring/training a new employee to fill in for the injured employee, lost time due to work stoppage, administrative costs) are generally thought to be even greater than the

direct costs. One study (Stanford, 1981) valued those indirect costs to be 1.1 – 4.5 times the direct costs of the accident/injury. A more recent study directly asked corporate financial decision makers to estimate the ratio of indirect to direct costs of employee work-related injuries (Huang, Leamon, Courtney, Chen, & DeArmond, 2011). The median response was a ratio of \$2:1, indicating that corporate financial decision makers expected to spend \$2 in indirect costs for every \$1 in direct costs for worker accidents. These statistics show the monetary value of prioritizing worker safety.

Some of the first steps taken to improve worker safety involved changes to the work environment and physical space where employees work, and researchers have suggested that most of the accepted engineering approaches to safety have already been implemented by companies (see Saari, 1990). However, an organizational and psychosocial approach to worker safety is still an area where substantial outcomes can be seen. Safety climate research is one such area that combines an organizational and psychosocial approach to worker safety outcomes. Safety climate is a specific organizational climate that reflects employee perceptions of the relative priority of safety within a given organization (Huang, Zohar, Robertson, Garabet, Lee, & Murphy, 2013). Safety climate has been studied in a variety of contexts and industries, including mining (Griffin & Neal, 2000), healthcare (Neal & Griffin, 2006), military (Zohar & Luria, 2004), utility (Huang, Zohar, Robertson, Garabet, Murphy, & Lee, 2013), construction (Goldenhar, Williams, & Swanson, 2003), trucking (Huang et al., 2013), manufacturing (Zohar, 2002), and food production (Probst & Brubaker, 2001). Recent meta-analyses have shown safety climate to be one of the strongest leading indicators of safety behavior

both within a given work unit and across organizations (Beus, Payne, Bergman, & Arthur, 2010; Christian, Bradley, Wallace, & Burke, 2009; Nahrgang, Morgeson, & Hofmann, 2011).

Variables Affecting The Impact Of Safety Climate

Research directly examining variables that may affect how or when safety climate impacts safety outcomes is a relatively new field. Zohar (2010) has recently called for an increase in studies examining moderators and mediators of the safety climate-outcome relationship. As the boundary conditions of the effect of safety climate are beginning to be explored, the role co-workers play is an area that has yet to be systematically integrated into safety climate research. Additionally, current research regarding the role of co-workers is equivocal in whether co-workers are another dimension of safety climate (Hayes, Perander, Smecko, & Trask, 1998; Lu & Shang, 2005; Neal, Griffin, & Hart, 2000) or a separate entity.

Social psychology has shown that the mere presence of others can affect behavior (Zajonc, 1965). Findings that take on more importance when we consider that “others” within the work environment (i.e., co-workers) may affect performance (Guerin & Innes, 1982). Research examining the context in which organizational phenomena occur has been called for by both Rousseau and Fried (2001) and Johns (2006). Contextualization in this case refers to taking into account, or studying directly, the “bigger picture.” Johns (2006) notes that context can have such varied effects as shaping meaning, affecting statistical range restriction, reversing signs in statistical relationships, or changing causal direction. Rousseau and Fried (2001) argued that any research into organizational

behavior requires contextualization because it can enhance the accuracy of models and increase certainty in using those models to make predictions.

Johns (2006) refers to two types of context: omnibus context and discrete context. Omnibus context refers to the macro-environment, such as location (including national culture), occupation, the reason for the research project, and the temporal environment. Discrete context can be thought of as the facet factors which, altogether, make up omnibus context. The author breaks up discrete context into task context, social context, and physical context. Johns notes that one way social context may have an effect is through social “norms, communication, [and] persuasion” (p. 394). Johns submits that important social context variables can be discerned by examining classic social psychology research (e.g., the presence of social models). It can be argued that co-workers act as social models for employee behavior within the workplace.

The Current Study

The current study addressed gaps in the safety climate literature, specifically the role of co-workers in determining safety performance and safety outcomes, particularly for lone or mobile workers. The current study compared the direct (incremental), moderating, and mediating effects of co-worker support for safety. Zohar (2010) called for increased tests of the boundary conditions of the safety climate-safety outcome relationship in order to test under what conditions the relationship is strongest or weakest. This study contextualized the relationship between safety climate and safety outcomes through increased understanding of the role of co-workers as a moderator.

The base model used in the current study is a three-path mediation model, linking employee perceptions of safety climate at the organization level (OSC) to employee perceptions of safety climate at the supervisor level (also called group-level safety climate; GSC), employee safety behaviors, and employee accidents and injuries (see Figure 1). While safety climate is itself a type of specific climate, it can be broken down even further into organization-level safety climate (i.e., OSC) or group/supervisor-level safety climate (i.e., GSC). While the term “level” is currently used with a popular type of analysis (i.e., multi-level modeling), the safety climate literature uses the term “level” to refer to a referent within a hierarchical organization. The current study remains consistent with past research and operationalized organization-level safety climate to be safety climate perceptions with the organization as the referent and supervisor-level safety climate to be safety climate perceptions with the supervisor as the referent. A more detailed discussion of safety climate takes place in Chapter 2.

The model in Figure 1 has received support for the individual relationships (i.e., organization-level perceptions predicting supervisor-level perceptions, see Zohar & Luria, 2005; safety climate predicting safety behavior, see Clarke, 2006; and safety behavior predicting accidents and injuries, see Christian et al., 2009) represented within the model. However, the model has not been thoroughly examined to address the role of co-workers. Figure 2 shows the full conceptual model used in the current study, including the competing mediating and moderating effects of co-worker support for safety. Figures 3-10 show simple models which address different ways co-worker support for safety may fit into the base model of Figure 1. From a hierarchical standpoint, co-workers may

bridge the gap between management and employees behavior. Understanding what, if any, influence co-workers have on employee behavior, particularly safety behavior, can help researchers and practitioners design more effective interventions.

Co-worker support for safety, which is the degree to which employees perceive their co-workers supporting workplace safety (Tucker, Chmiel, Turner, Hershcovis, & Stride, 2008), is the co-worker related construct that was studied. The current project tested how perceived co-worker support for safety functions in relation to the overarching model of safety climate. The effects of co-workers were examined as:

1. The mechanism through which safety climate produces outcomes (mediation effect; see Figures 4, 6, 8, and 10).
2. The factor on which the magnitude of the relationship between safety climate and safety behavior is dependent (moderation effect; see Figures 3, 5, 7, and 9).
3. Having an effect on safety outcomes above and beyond safety climate perceptions at the organization and supervisor level (incremental effect; see Figure 11).

Additionally, this study contributes to the lone and mobile worker literature. It has been hypothesized that lone workers constitute a unique population and relationships that have been found to exist in other populations (e.g., traditional in-house employees) may not function in the same ways with lone workers. For example, Huang and colleagues (2013) found that truck drivers, considered a type of lone worker due to the fact that they work away from a central office and have limited contact with their supervisors, do not have shared perceptions of supervisor-level safety climate, a tenet often emphasized in safety “climate” research (see Zohar & Luria, 2005).

The current study assessed the role of co-workers in a specific truck driver population: team drivers. Team drivers are truck drivers who drive with another driver in the same vehicle. These teammates operate the truck sequentially so the truck continuously runs and more miles can be driven. Generally, truck drivers are compensated on a “pay by mile” system, meaning the number of miles driven (and not time) is the main factor in salary. Additionally, it is a benefit to the driver if those miles are driven in the shortest amount of time, thereby giving the driver the opportunity to take on a new load, for which they are paid by the miles driven. However, Federal Department of Transportation (DOT) safety regulations exist to limit the number of hours a trucker can drive in a given day (i.e., can drive a maximum of 11 consecutive hours after a 10 hour break) or in a given week (i.e., cannot drive more than 60/70 hours in a 7/8 day period unless a break of at least 34 hours has been taken; see Federal Motor Carrier Safety Administration guidelines). Team drivers may have an advantage in that driver 2 can drive the truck while driver 1 takes the mandated rest period and vice versa, possibly resulting in a lower incidence of driving incidents (Hanowski, Perez, & Dingus, 2005). The role of such a teammate on safety outcomes has not been studied in the truck driving safety climate literature.

In summary, the current study extended the literature through providing additional tests of the mediating effect of supervisor-level safety climate perceptions. The safety climate literature was also extended for the population of lone workers, specifically truck drivers and team truck drivers. Additionally, and the main focus of the current study, the

current study added to the literature in the area of the role co-workers play in employee safety outcomes.

Dissertation Structure

The following chapters provide a review of the relevant literature as it pertains to employee safety climate perceptions and how co-workers can impact safety outcomes. Chapter 2 reviews the evolution of organizational climate from a broad construct to facet specific climates and provide an overview of the safety climate literature, including climate formation and safety-related outcomes. Chapter 3 focuses on the intersection of lone and remote workers, co-workers, and safety outcomes. Hypothesis development is constructed in Chapter 4. A discussion of the methods used to obtain the data for the current study is found in Chapter 5, followed by the results of data analysis in Chapter 6, and a discussion of the findings, along with implications and suggested applications, in Chapter 7.

CHAPTER TWO

ORGANIZATIONAL CLIMATE

The organizational climate and culture literature is the basis on which more specific climates, including safety climate, are founded. Schneider, Ehrhart, and Macey (2013) describe culture and climate as constructs that allow those studying organizational behavior to understand how people describe and experience their work. Organizational climate is the shared beliefs and perceptions of employees within a given organization (Schneider et al., 2011, 2013; Zohar & Hofmann, 2012). Organizational culture can be described as the shared norms, values, and assumptions that set expectations for acceptable behavior with an organization and are taught to new employees through socialization (Zohar & Hofmann, 2012; Verbeke, Volgering, & Hessels, 1998). Organizational climate can be seen as the manifestation of organizational culture. Organizational culture has both deep and surface elements. Deep elements are the basic values and assumptions that are ingrained and unquestioned, while the surface elements include the manifestations of the deep elements (Zohar & Hofmann, 2012). Surface elements, sometimes called artifacts, provide a bridge from the somewhat unobservable deep elements of culture to the more observable and more accessible to measure elements of organizational climate (Schein, 1990).

The concept of an overall, or molar, climate within an organization has been studied extensively over the past few decades. This organizational climate can be thought of an aggregation of individual perceptions across the organization in question. In other words, climate is composed of the shared perceptions of the policies, procedures

and practices within a given organization (Schneider et al., 2011). Policy can be thought of as the goals an organization maintains. Procedure is the strategy implemented to achieve these goals, and practice is the means through which procedure is implemented (Zohar, 2003).

The early organizational climate research faced two problems. First, the issue of at what level should and were data being collected and analyzed was a concern. In a review of early climate research, Schneider et al. (2011) discussed how even though most research focused on the organizational (and thus group) nature of the construct, most studies were in fact conducted at the individual level of analysis. This issue was somewhat resolved when James and Jones (1974) acknowledged that climate research may also be measured and analyzed at the individual level, called psychological climate.

Second, an increasing number of dimensions were being added to the construct to reflect the many perceptions employees could have about a given organization. Researchers were then attempting to link the myriad dimensions of molar climate perceptions with specific employee and organizational outcomes, leading to equivocal findings (Zohar & Hofmann, 2012). Researchers (see Schneider, 1975) recognized that the broad and general nature of most of the organizational climate measures meant that they were ill-suited to predict specific outcomes. Schneider and colleagues (2011) conceptualized the issue as one of “bandwidth and focus”, such that studies on the topic would be strengthened if researchers reduced the dimensions of organizational climate and focused specifically on the research question. That is, the predictive ability of

organizational climate could be improved if the climate measures were tailored to the outcomes of the research question.

Schneider (1975) was one of the first to recommend that the broad term “organizational climate” instead be used as a climate in reference *to* something. If climate is defined as relating to the policies, procedures, and practices within an organization, then it is reasonable that an organization will have different policies, procedures, and practices depending on the specific goals it is working toward and the facets researchers intend to study (e.g., increasing innovation, decreasing on-the-job accidents, increasing customer satisfaction). Researchers now call these “facet-specific climates” (Zohar & Hofmann, 2012) or “strategic climates” (Schneider et al., 2011). Strategic climates inform employees within a given organization of the types of behaviors that are rewarded or supported and therefore, the behaviors in which the employees will engage (Zohar & Hofmann, 2012).

In an overview of the issues relating to climate research, Zohar and Hofmann (2012) described three models explaining the relationships between possible multiple climates within an organization: independent, interactive, and causal. Specific climates may be *independent* of one another, in that the effects of one climate do not affect a second (or third, etc.) climate. One such example given by Zohar and Hofmann is the model employed in a study by Baer and Frese (2003). In this study, the specific climates of initiative (a “pro-active, self-starting, and persistent approach” to one’s job; Baer & Frese, 2003, p. 48) and psychological safety (being able to express one’s self without worry that it will bring retribution) were studied with respect to their effects on company

performance. Analyses revealed that both climates have a significant impact on performance outcomes such as return on assets. *Interactive* climate is conceptualized as a statistical moderation model. That is, the effects of one climate on an outcome depend on levels of a second climate or one climate influences a second climate. Zohar and Hofmann propose that competing climates or domains will have an interactive effect. A third model, the *causal* climates model, posits that some climates are more important and impactful in determining organizational outcomes because they influence multiple other climates. For example, Zohar and Hofmann mention work ownership climate (the extent to which one sees aspects of work as part of their own identity) as being a causal climate in that if work ownership climate is high and employees feel aspects of the job are part of their identities, the climates for other important facets of the job (e.g., safety) will also be high. It should be noted that although a classification system exists for types of climates, very little research exists studying the effects can have on one another. Therefore, there is not much evidence for which type a given climate may be.

Attempting to provide a categorization scheme for climates, Kuenzi and Schminke (2009) noted four major groupings of organization-specific climates based on the type of motivation a climate activates in order to produce the outcomes associated with it. The authors note that climates can be focused on behavioral guidance (e.g., ethics, justice, and political climate), involvement (e.g., participation, support, and group affect climates), development (innovation and training climates), and core operations (e.g., service and safety climate). Safety climate and its related outcomes are a major focus of the current study.

The specific climate focused on organizational safety came about when Zohar (1980) was among the first to put Schneider's (1975) recommendations into practice. Zohar constructed and validated a measure of organizational safety climate based on a literature review of the major themes in the industrial safety literature. Zohar's literature review revealed multiple characteristics of safe organizations: management commitment to safety, rank and status of the safety officer, emphasis on safety training, communication between employees and management, frequent safety inspections, "good housekeeping" of the working environment, a mature workforce with low turnover, and promotion and recognition of safety.

Management commitment to safety was thought to be important because Zohar found published and anecdotal evidence that companies where top management was involved and in safety matters and gave priority to safety concerns at meetings had fewer accidents. Rank of the safety officer was another way companies could show they valued safety, with low accident company safety officers having a higher status. Emphasis on safety training was also thought to play a major role in determining safe companies as companies who treated safety training as a main component of their new employee trainings reported fewer accidents or was given periodically as a supplementary training. Communication between workers and management was considered especially important in safer organizations, along with frequent safety inspections. Good housekeeping, consisting of maintaining order in a plant or manufacturing environment and use of protective equipment, was also thought to set safe companies apart from those with more accidents. A stable workforce was also thought to

indirectly contribute to fewer accidents because companies with more tenured employees may better employee relations. Safety promotion and recognition was the last characteristic Zohar found in his literature review which might contribute to employee safety.

From these characteristics, Zohar developed a scale to measure the climate of safety in organizations. The scale consisted of seven dimensions: management commitment to safety, perceived effects of safe conduct on promotion (with safe behavior not hindering one's chances of promotion due to outcomes such as longer time to production), perceived effects of safe conduct on social status (with safe behavior not looked down upon), perceived organizational status of the safety officer, perceived importance and effectiveness of safety training, perceived level of risk at work, and perceived effectiveness of enforcement vs. guidance in promoting safety. Exploratory factor analysis revealed eight factors (in order of % variance explained): importance of safety training programs, management attitudes toward safety, effects of safe conduct on promotion, level of risk at work, effects of required work pace on safety, status of the safety officer, effects of safe conduct on social status, and status on the safety committee.

Subject matter experts then rated safety in each of 12 organizations. Correlational analyses showed significant relationships between employee safety climate scores and expert rankings. These results led Zohar to conclude that management commitment to safety was a major factor affecting safety, a construct that is still integral to measures of safety climate today (Christian et al., 2009). This inaugural study showed that there was indeed a relationship between measured safety climate and safety within

organizations. Additionally, the dimension effects of safe conduct on social status has been used by others to measure co-worker support (see Mueller, DaSilva, Townsend, & Tetrick, 1999).

Safety Climate

Safety climate is often thought of as employees' shared perceptions of their organization's policies, procedures, and practices as they relate to the importance of safety within the organization (Griffin & Neal, 2000; Zohar, 1980, 2000, 2011). However, employees must first recognize what the true policies, procedures, and practices of the organization are. Complicating these perceptions is the difference between the espoused and enacted policies and procedures surrounding safety (Zohar, 2011). Espoused policies and procedures are the formal statements made about how the company expects employees to behave with regards to safety. Enacted policies and procedures refer to the actual implementation of safety rules, usually by managers or supervisors (Zohar, 2011).

There are several reasons why espoused vs. enacted policies and procedures may be different. Managers and supervisors implement policy and procedure and it is accepted that there are more unique situations within an organization than there are company policies and it is up to the manager to apply organizational policies (Zohar, 2003). This application may not always be consistent, and it may be confounded by a low relative priority of safety within the organization (Zohar, 2010). Organizations have multiple goals related to their performance (which is where specific policies, practices, and procedures originate) and the comparative importance of those goals within a given

organization informs managers on their application of policy and procedure (Zohar, 2010). As an example, the relative priorities of production and safety are often cited as two important competing demands in terms of safety outcomes. Even if the organization espouses safety to be the most important priority, if the competing demand of production (e.g., delivering a product faster, taking shortcuts) is routinely given higher priority by upper management (e.g., do whatever it takes to deliver on time), supervisors will enact safety policies consistent with the higher priority.

For example, though a company policy may be that safety is the most important aspect of the company and all decisions should be made to conform to the highest safety standards, if managers are rewarded for having deliveries arrive on time or early then they will continue to push their subordinates to deliver on time or early, regardless of safety concerns. Additionally, espoused and enacted safety policies may differ based on characteristics of the supervisor (Huang et al., under review). Supervisors may act as gatekeepers of company safety information (Zohar & Luria, 2010), restricting the information they pass along to subordinates to be more in line with their own mental models of safety. Conversely, supervisors may act more as communicators (Huang et al., under review), even enforcing safety standards beyond the expectations of the company. For these reasons, only perceptions of enacted safety policy and procedure should be used to assess safety climate.

The multi-level nature of safety climate. Previous studies have provided support for safety climate as a multi-level construct comprising two levels: organization-level (employees' perceptions of the company's commitment to and prioritization of safety)

and group-level (employees' perceptions of their direct supervisors' commitment to and prioritization of safety). 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 – supervisor implementation of organizational policies and procedures - constitute the target of group-level perceptions.

While organizational climate had traditionally been considered at a single level of analysis (see Zohar & Luria, 2005), a multi-level view of safety climate should be used in order to reduce conceptual ambiguity. Each level refers to a different referent and employees can differentiate between company-level priorities and the priorities of their own unit (Zohar, 2000, 2011). It is important to note that while the organizational climate literature often uses the term “levels” of climate to mean “level of analysis” (Schneider et al., 2011), the safety climate literature refers to “levels” of safety climate as a short hand way to convey the referent in a safety climate measure. That is, organization-level safety climate measures use the organization as the referent while group-level safety climate measures use the supervisor as the referent. In order to avoid unnecessary confusion, the current manuscript will use the term supervisor-level safety climate from this point when referring to safety climate scales which use the supervisor as the referent.

It is thought that organization-level safety climate predicts supervisor-level safety climate due to the constraints organizational policy and procedures as they relate to safety place on supervisory practice (Zohar & Luria, 2005). That is, the very mechanism which gives rise to separate levels of organization and supervisor safety climate also provides a

strong predictive link between the two constructs. While the mediation effects of supervisor-level safety climate been tested and supported in previous research (see Zohar & Luria, 2005), the current study tested a replication of the relationship.

The formation of shared climate perceptions. Safety climate can be considered in terms of its degree of favorability within the organization (high/low or positive/negative) and its strength or variability (how much consensus exists among employees; strong/weak; Zohar, 2003). Four theories have been posited to identify the way employees come to share their perceptions of safety climate: the structural approach, the symbolic interactionist approach, the attraction-selection-attrition approach, and leadership (Zohar, 2010).

The structural approach to the formation of climates focuses on the environment and the work context influencing workers' perceptions of safety (Payne & Pugh, 1976). Aspects of the environment which may influence climate perceptions include the structure of the organization, technology available to workers (e.g., in-vehicle computers), and training programs. The structural approach holds that individuals form their perceptions of the importance of safety through these objective markers of the environment. For example, truck drivers spend a great deal of time interacting with their "environment" (e.g., truck), which may be largely provided by the company.

Symbolic interaction and sensemaking are other ways in which climates may form. Symbolic interactionism (Schneider & 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). Sensemaking, seen as a different label of symbolic interaction (Zohar, 2010), is the ongoing process of people interpreting ambiguous situations or situation that are at odds with expectations and attempting to make those situations less surprising (Brown, 2000). Zohar (2010) has also suggested that shared employee perceptions (the basis of climate) are formed through symbolic interaction and sense-making.

The attraction-selection-attrition approach (Schneider, 1987) holds that organizations hire similar employees 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 & Reichers, 1983). Workers who care about safety may be attracted to working for particular companies because these companies have good safety reputations or, conversely, leave if safety is neglected.

Another important aspect of the formation of climate is the impact of leadership. It is often said that leaders create climate (Lewin, Lippitt, & White, 1939). This saying is largely understood to mean that leaders can influence employee safety perceptions by implementing organizational policies and procedures, called supervisory practices (Zohar, 2010, 2011). Supervisory practices may inform safety climate perceptions through employee observations of how supervisors and managers prioritize safety in their

decisions (i.e., safety vs. production; Zohar, 2010). In fact, management commitment to safety has been the dimension included most often in safety climate research (Zohar, 2010).

Although shared perceptions have previously been identified as critical to understanding safety climate, not all workers have the opportunity to work in close contact with their supervisors or co-workers. An extreme example of not having an opportunity to interact with co-workers or supervisors is the lone or mobile worker. Lone workers are employees who work by themselves, without close or direct supervision (United Kingdom Health and Safety Executive, 2013). These lone workers may have limited contact with their co-workers and possibly their supervisors, reducing the number of opportunities to reconcile their individual perceptions.

Safety Climate Outcomes

Employee safety climate perceptions have been linked to a variety of employee outcomes, including accidents and injuries (Johnson, 2007), safety participation and compliance (Clarke, 2006), turnover (McCaughey, DelliFraine, McGhan, & Bruning, 2013), job satisfaction (Clarke, 2010), employee health and well-being (Oliver, Cheyne, Tomas, & Cox, 2002), and organizational commitment (P. C. Morrow & Crum, 1998). While studies have indicated that safety climate is related to outcomes beyond safety behavior and accidents/injuries, the current study will focus on safety-related outcomes. However, it is important to note the larger impact safety climate can have on an organization. The following section provides a summary of safety-related outcomes of safety climate.

Safety climate outcomes. Research has shown that safety climate is a strong predictor of safety outcomes (Christian, et al., 2009; Nahrgang, et al., 2011). Safety climate has been shown to have both direct and indirect effects on accidents and injuries (Clarke, 2006, 2010; Zohar, 1980, 2000). However, meta-analytic support has been found for the indirect relationship between safety climate and safety outcomes using safety behavior as a mediator (Christian et al., 2009).

Safety performance. Safety performance can be seen as a facet of job performance behaviors (Neal & Griffin, 2004), especially in jobs where maintaining certain levels of safety is germane to the task itself (e.g., mining, construction). The broad literature makes the distinction between safety compliance and safety participation, two aspects of safety performance. Safety compliance is essentially acting according to policy and procedure in terms of the safety aspects of one's job. For example, if wearing a hard hat is considered a regulation for working on a job site and an employee wears his or her hard hat, they are complying. Safety participation, on the other hand, deals with discretionary behaviors performed by an individual when he or she may not be rewarded for that behavior or the behavior may not contribute directly to the safety of that individual (Neal, et al., 2000). For example, if an employee attends non-required meetings about safety or joins a committee to promote safe behavior, that person is participating. Safety participation seems to be analogous to the concept of organizational citizenship behaviors, but with a specific intention (Clarke, 2006).

Safety climate is a known antecedent of both compliance and participation (Neal et al., 2000). Although many individual studies showed the relationship between safety

climate and safety performance (e.g., Griffin & Neal, 2000; Neal et al., 2003; Zacharatos, Barling, & Iverson, 2005), meta-analyses confirmed the relationship in a larger sample of studies. Clarke (2006) found that safety climate perceptions were significantly related to both safety compliance ($\rho = .43$) and safety participation ($\rho = .50$). In turn, safety compliance and participation were found to be significantly related to accident and injury outcomes (compliance, $\rho = .09$; participation, $\rho = .14$). Safety climate was also found to be related to accident and injury outcomes ($\rho = .22$). While Clarke did hypothesize that the relationships between the safety performance variables and accident and injury outcomes would be greater than the relationship between safety climate and accident and injury outcomes, support for the hypothesis was not found. It should be noted that Clarke collapsed (likely due to the number of studies) organization- and supervisor-level perceptions of safety climate into one “safety climate” variable, not allowing for tests of the causal or mediation relationship between organization- and supervisor-level safety climates.

Neal and Griffin (2004) offered a mechanism by which safety climate may affect safety outcomes. Their model demonstrates how safety climate, organizational factors, and individual level antecedents (e.g., attitudes) influence individual safety knowledge and motivation, which in turn leads to safety performance. Neal and Griffin’s model of safety performance borrows heavily from Campbell’s model of performance (Campbell, McCloy, Oppler, & Sager, 1993), where employee knowledge, skill, and motivation are used to predict performance. Safety knowledge involves having the fundamental knowledge of how to use safety equipment and basic skills, such as being able to problem

solve in difficult situations. Safety motivation is a willingness to perform safe behaviors and can be influenced by the expected outcomes of performing the behavior (Neal & Griffin, 2006). High safety climate is thought to lead to increases in safety knowledge, skill, and motivation, which in turn predict safety performance behaviors, safety participation and safety compliance. In the literature, safety performance is often referred to as safety behaviors and the two subcomponents of participation and compliance are collapsed.

Christian and colleagues (2009) tested Griffin and Neal's (2000) model of safety performance with a meta-analytic path analysis. The results showed that individual-level safety climate was positively related to safety knowledge and motivation, knowledge and motivation were significantly related to performance, and safety performance was found to be significantly related to accidents and injuries. Psychological safety climate, the individual level of safety climate used in the current study, was found to be significantly related to safety performance ($\rho = .49$) and accident and injury outcomes ($\rho = .14$). Christian et al. (2009) did find support for stronger relationships between more proximal variables, which was similar to the hypothesis proposed (but not supported due to low sample sizes) by Clarke (2006).

Using safety behaviors as an outcome of safety climate may allow research to obtain a more accurate understanding of the impact of safety climate. Objective accidents and injuries tend to be low base rate events (Christian et al., 2009) and the resulting relationships can be weak (Zohar, 2000), possibly due to lack of statistical power. Additionally, safety behavior is a more proximal outcome than accidents and injuries.

The current study used measures of both self-reported safety behaviors and objective accident and injury outcomes.

Summary

The construct of organizational climate had previously been used in the literature as a way to predict a great many organizational outcomes. However, with lack of specificity in the predictor as compared to the outcome, inconsistent findings were common in the field. Zohar (1980) was the first to follow Schneider's (1975) recommendation that climate be specified as relating to the policies, procedures, and practices aligned with a given organizational goal (e.g., safety). Additionally, employees can perceive safety climate as it related to the enacted policies of the organization and the practices and procedures implemented by supervisors. Safety climate research has shown that safety climate is a leading indicator of employee safety outcomes.

CHAPTER THREE
CO-WORKERS' ROLE IN SAFETY: APPLICATION TO LONE
AND REMOTE WORKERS

Lone and Remote Workers

The National Health Service of the United Kingdom (NHS, 2005) 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). The Health and Safety Executive of the United Kingdom (HSE) defined lone workers are those who work away from direct supervision (HSE, 2015). Lone workers are a varied group and include both fixed and mobile workers (HSE, 2013). Fixed lone workers may work in kiosks or small shops, while mobile lone workers work away from a fixed base, such as repair workers, social workers, bus drivers, etc. Truck drivers fit into the mobile lone worker category. Note the definition of lone worker is not necessarily one person working by themselves, by employees working away from supervision. Remote workers, a term used in the United States, fall under the same category as lone workers in that they work removed from an in-person supervisor and rely on electronic communication (Barsness, Diekmann, & Seidel, 2005; Kurland & Bailey, 1999).

Lone workers may constitute a subgroup where the recent safety literature may not be as applicable. While shared perceptions have previously been identified as critical to understanding safety climate, not all workers have the opportunity to work in close contact with their supervisors or even co-workers. These lone workers may have limited contact with their co-workers and possibly their supervisors, reducing the number of

opportunities to reconcile their individual perceptions and participate in group sensemaking. For example, at least one study has shown that truck drivers (considered lone workers) lack shared perceptions of safety climate among their working (supervisor level) groups (Huang et al., 2013). There was not significant between-group variance in safety climate perceptions, so it was not meaningful to examine shared safety climate perceptions (see Bliese, 2000).

While most truck drivers do work alone, a portion of drivers work and drive with a teammate, called “team drivers”. Team drivers are dyads who operate the truck in serial so more miles can be covered (thereby earning more money under the “pay by mile” compensation system). Trucking company websites recruiting for team drivers offer two options in finding a teammate (for examples, see C.R. England, 2015; Schneider, 2015; U.S. Express, 2015). Drivers can use a matching program the company offers based on the number of miles they would prefer to drive, preferred gender of the teammate, and whether or not they smoke and if they would prefer a smoker or non-smoker for a teammate. Additionally, companies also offer drivers the option to choose their own teammate. Companies mention that in choosing a teammate, it is very important to be able to trust that person. Therefore, they also suggest teaming up with people you may already know, like someone from your hometown, a father-son team, or a friend you have made at a truck stop. While not explicitly mentioned in the recruiting materials but shown as testimonials on many company sites, team drivers may also be husband and wife pairs.

While both team drivers are almost always in the cab together, it is possible they do not have much of a chance to socialize. Federal Motor Carrier guidelines limit the

amount of time the driver who is not currently driving can spend in the front of the cab to two hours and count that time toward their required rest time. Therefore, it is possible that due to the limited contact with supervisors and other co-workers besides one teammate, team drivers may not have shared perceptions of safety climate.

One reason lone workers may lack shared perceptions of supervisor-level safety climate is that climate perceptions are thought to be formed through the symbolic interaction of employees within a given group, or co-workers (Schneider & Reichers, 1983). As discussed in Chapter 2, the symbolic interactionist view states that employees discuss events and continually modify their understanding until a consensus, or socially constructed reality, is reached (Schneider & Reichers, 1983). Without access to co-workers other than their teammate, it would be almost impossible for truck drivers to construct this shared reality. Therefore, instead of using truck drivers' shared perceptions of safety climate (i.e., aggregating individual climate perceptions and conducting multi-level analyses), the current study used individual perceptions of characteristics of the organization and supervisory practices as they relate to safety and analyze data at the individual level. This approach represents an examination of psychological safety climate (Beus et al., 2010; Christian et al., 2009).

Psychological Safety Climate

Psychological safety climate is a term used to describe individual-level perceptions of the importance of safety within an organization (Beus et al., 2010), or the formally and informally enforced and rewarded policies, practices, and procedures surrounding safety (Neal & Griffin, 2000). Much of the early research conducted on

safety climate used individual-level perceptions of safety (Zohar & Luria, 2005). Psychological safety climate has previously been shown in meta-analyses to be related to individual injury outcomes (Beus et al., 2010; Christian et al., 2009). Huang and colleagues (2013) showed that just as in multi-level analyses of safety climate, employees' individual psychological safety climate perceptions also have a significant effect on worker's safety behavior and injury outcomes. Huang and colleagues created the trucking safety climate scale and tested its reliability and validity in predicting accident and injury outcomes. The current study utilizes the trucking safety climate scales and adds information on the role of co-workers.

Co-Worker Support for Safety

In comparison to the safety climate literature, far less attention has been paid to the role co-workers play in determining employee safety behavior. While a construct referred to as "group-level" safety climate has been studied, this construct focuses on direct supervisors and their implementation of company policy and procedure, as opposed to the influence of members of any "group" of which the employee is a part (Zohar & Luria, 2005). Understanding the influence co-workers may have on employees, particularly when it comes to safe behavior at work, can be critical when the majority of one's work is done while on a team or in a group setting, such as team truck drivers.

Social Support

The social support literature is one area that can provide background on the concept of co-worker support for safety. Social support is broadly seen as help or assistance given to others or actions that are intended to be helpful (Langford, Bowsher,

Maloney, & Lillis, 1997; Sarason, Sarason, & Pierce, 1990). It has been argued that social support can attenuate the negative outcomes associated with demands at work (Karasek et al., 1998). Additionally, social support has been meta-analytically shown to buffer the negative effects of stressors on feelings of role overload, stress, and burnout (Humphrey, Nahrgang, & Morgeson, 2007). While the construct of social support is very broad, it can be classified into four major types: informational support, emotional support, instrumental support, and appraisal support.

Informational support is the support provided by giving an individual information during a time of stress (Langford et al., 1997). According to Cutrona and Russell (1990), this type of simple act can help individuals problem solve during times of stress and help themselves. Stewart and Barling (1996) found that increased informational support buffered the negative effects of job stress on job performance.

The construct of emotional support is similar to what we may think of with the lay term “giving support.” Emotional support involves giving empathy, care, and love to another (House, 1981). House described emotional support as the most important type of support, and this emphasis is reflected in many measures of co-worker support (e.g., “My co-workers care about me”). Within the work context, emotional support has been shown to decrease nurses’ reported job stress and increases in job performance (AbuAlRub, 2004).

Instrumental support is the giving of concrete and tangible assistance to another (House, 1981; Langford, et al., 1997). For example, instrumental support may include giving aid in the form of money or other tangibles, or performing tasks for another. While

instrumental support, like other forms of support, has been shown to lead to positive outcomes for individuals (e.g., Cutrona & Russell, 1990), studies have shown that receiving unwanted instrumental help can have negative stress-inducing outcomes (Deelstra et al., 2003).

Appraisal support, also called affirmational support (Kahn & Antonucci, 1980), is support provided by giving information related to self-evaluation rather than information helpful for problem solving (as in informational support; Langford et al., 1997). Kahn and Antonucci (1980) describe affirmational support as information given about how appropriate one's actions or statements are (e.g., a "good job" or "atta boy"-type statement).

However, research in practice has often used generic measures of support. (Barrera, 1986) has argued that support needs to be operationalized more clearly and specifically, similar to Schneider's (1975) suggestion that organizational climate only be used with a specific referent in mind. Barrera even went so far as to say the global measures of social support be "abandoned" (p. 414) in favor of more specific language due to the broad and vague nature of the construct. The current study followed Barrera's recommendation and specifically assessed co-worker support for safety.

With regard to the source of social support, previous research of social support at work has focused a great deal on the role of supervisor support. Supervisor support is the degree to which employees feel supervisors value their contribution to the organization and care about their well-being (Eisenberger, Stinglhamber, Vandenberghe, Sucharski, & Rhoades, 2002). This construct has been shown to be positively related to job satisfaction

(Steinhardt, Dolbier, Gottlieb, & McCalister, 2003), on the job learning (McCall, Lombardo, & Morrison, 1988), and organizational commitment (Scandura & Lankau, 1997). However, less attention has been given to the role of co-worker support.

Co-Worker Support

A recent meta-analysis has reviewed the literature relevant to the effects of co-workers on work-related outcomes. Chiaburu and Harrison (2008) examined co-worker support and co-worker antagonism. Co-worker support, similar to the social support literature, was defined as co-workers providing wanted resources to another employee (examples include helping with tasks, mentoring, and being kind). Co-worker antagonism, much the opposite of support, was defined as co-workers behaving in an unwanted way toward another employee (examples include incivility and interpersonal abuse).

Chiaburu and Harrison's (2008) research questions included examining if co-workers have an influence beyond supervisors and leaders and if co-workers have a positive relationship with job attitudes and a negative relationship with withdrawal behaviors. The authors' hypotheses regarding the relationships between co-worker influence and positive and negative outcomes were supported; co-worker support was found to be positively related to job satisfaction ($\rho = .40$), job involvement ($\rho = .35$), organizational commitment ($\rho = .32$), and negatively related to effort reduction ($\rho = -.23$), absenteeism ($\rho = -.08$), intent to quit ($\rho = -.27$), and turnover ($\rho = -.17$). In terms of individual effectiveness outcomes, co-worker support was negatively related to counterproductive work behaviors directed at the organization ($\rho = -.04$) and at an

individual ($\rho = -.07$), and positively related to organizational citizenship behaviors directed toward the organization ($\rho = .12$) and an individual ($\rho = .19$), and task performance ($\rho = .24$). Additionally, when taking the relationships between leader influences and employee outcomes into consideration, results revealed that co-worker support contributed above and beyond leader support in predicting job involvement (co-worker $\rho = .33$, leader $\rho = .06$), effort reduction (co-worker $\rho = -.22$, leader $\rho = -.04$), and absenteeism (co-worker $\rho = -.08$, leader $\rho = -.01$). For the outcome of task performance, co-worker and leader support predicted equally ($\rho = -.13$). In comparing results of the current meta-analysis with previous studies, the effects sizes for co-worker influences were found to be as large or larger than almost all of the effect sizes for leader influence.

The results of this meta-analysis are important for the current study for two reasons. First, this meta-analysis shows that co-worker support, even though very broadly defined in this study, does influence employee work outcomes, including task performance. Because safety is considered as part of a truck driver's performance, it is possible that co-worker support for a specific outcome (i.e., safe behavior) will also influence truck driver task performance. Second, the meta-analysis showed that co-workers do have an influence beyond the influence of leaders and supervisors. The current study also examined if and how co-workers extend their influence beyond the organization and supervisor. While past research has shown that company and management support for safety are critical, little research has showed interest in how co-workers add to safety-related behaviors beyond company and management support for

safety. Practically, if co-workers have an influence beyond leaders, then interventions to increase safety at work may benefit from a more holistic approach.

Theories Supporting Co-worker Influence

Multiple theories and theoretical frameworks can account for the influence of co-workers and co-worker support (specifically safety support) on employee safety outcomes. Broadly, Bandura's (1977) social learning theory posits that people can learn not only through the direct reinforcement of their behavior, but also through vicarious learning and watching the outcomes of another's behavior. In terms of vicarious learning, safety climate theorists argue that safety climate, being shared perceptions, provides norms and social cues for employee behavior. In a very basic sense, employees see others around them not only modeling safe behavior, but also being rewarded for being safe or reprimanded for acting unsafely (Casey & Krauss, 2013).

Turner and colleagues (2010) argue that social information processing theory is another broad theory that can explain how co-workers affect behavior. Social information processing theory (Salancik & Pfeffer, 1978) posits that in uncertain situations, people use contextual information to inform what actions they should take. In particular, social information processing theory focuses on the work environment as the social context. This theory suggests that employees will take cues from their own past behavior and their immediate social environment (Salancik & Pfeffer, 1978).

Latané's (1981) social impact theory describes a more specific mechanism by which the social context (i.e., other individuals) can influence behavior. Social impact theory (SIT) contains three principles to describe how others impact one's "physiological

states and subjective feelings, motives and emotions, cognitions and beliefs, [or] values and behavior” (Latané, 1981; p. 343). SIT posits that social influence is a function of the strength, immediacy, number of others. The strength of others generally refers to the power, salience, or intensity of the source of social influence. Sources with more power over the individual or more intensity will have greater impact. Immediacy is the physical proximity or closeness of an individual and another. Latané (1981) suggests that the more proximal the source of the influence, the more social impact that source will have. Finally, the number of sources is also important. The more sources exerting the influence, the more impact the source will have. Social impact theory provides a possible explanation for both the mediating effects of co-workers on employee safety behavior and the incremental effects of co-worker safety support over manager safety support that have been found in the literature.

The Job-Demands-Resource model (JD-R; Bakker & Demerouti, 2007; Demerouti, Bakker, Nachreiner, & Schaufeli, 2001) and general occupational social support may also help explain how co-workers can have an influence on employee behavior. The JD-R model proposes that job-related factors can be classified into either job demands or job resources. Job demands are the factors require physical or psychological effort and are related to negative well-being outcomes. Job resources are the factors that help achieve goals, reduce demands, or stimulate growth (Bakker & Demerouti, 2007). Two processes are included in the JD-R model. Fundamentally, job demands lead to negative well-being outcomes through experienced strains, while job resources lead to positive outcomes through increased motivation. Job demands can also

moderate the positive outcome relationship just as job resources can moderate the negative outcome relationship. The JD-R model can aid in explaining how co-worker support for safety can moderate the relationship between supervisor safety climate and employee safety behavior.

Co-workers and Safety

A small amount of research has been conducted which examines co-workers in the context of safety at work. This research varies with respect to the importance and role of co-workers, with some studies mentioning co-workers as a dimension in a safety climate scale and others examining co-workers as a separate variable that may impact safety behavior. This following section provides a review of this literature.

Co-workers as a safety dimension. Studies have used co-worker support as a dimension within an overall safety climate scale. For example, Seo, Torabi, Blair, and Ellis (2004) created a new safety climate measure meant to address the inadequacies of previous measures. Seo and colleagues reviewed safety climate scales for the constructs and subdimensions they measured and found that the most common dimensions were leadership support (management commitment to safety), employee participation, work pressure, competence level, hazard level, perceived risk, *co-workers' safety support*, and perceived barriers to safety. Based on their findings, Seo and colleagues created a measure of safety climate that included six items that related to co-worker support within the 32-item measure of safety climate. The 2004 scale was then used in a 2005 study by Seo. Safety climate was calculated by averaging responses to all of the subdimensions,

including co-worker support. Seo (2005) found that safety climate was a leading indicator of safety behavior, but did not examine the unique influence of co-worker support.

Hahn and Murphy (2008) created a shortened 6-item measure of safety climate which included one item for each of three constructs: co-worker behavioral norms (example item “New employees learn pretty quickly that they are expected to follow good health and safety practices”), safety feedback, and worker involvement, and three items to measure management commitment. The safety climate scale was found to be negatively related to injury within a hospital setting.

Kines and colleagues (2011) developed the Nordic Safety Climate Questionnaire as a diagnostic tool in measuring safety climate based on organizational and safety climate theory. Kines and colleagues included two subdimensions related to co-workers: workgroup safety priority and commitment and trust in co-worker safety competence. The scale was found to be reliable and valid and highlights the importance of considering how co-workers affect safety outcomes.

Hayes, Perander, Smecko, and Trask (1998) assessed the constructs of job safety, co-worker safety, supervisor safety, management safety practices, and satisfaction with the safety program. The items relating to co-worker safety measured the degree to which the individuals one works with ignore safety rules, encourages others to be safe, etc. These items measured a construct quite different from either shared perceptions of policy and procedure or supervisor implementation of policy and procedure, yet the co-worker safety items were consistently one of the better predictors of compliance with safety behaviors. However, the authors framed their results heavily in terms of the effects of

management and supervisor safety. It is possible that at the time, the authors did not have an accepted framework available for discussing co-worker effects, but at that time the literature did provide a robust framework for management and supervisor effects.

Studies have also assessed the effects of co-workers using separate co-worker constructs. The constructs themselves are varied, but they are used in the context of safety outcomes. For example, in a Chinese sample, Jiang, Yu, Li, and Li (2010) found that employee perceptions of co-worker safety knowledge and behavior predicted employee safety behaviors and that this relationship was moderated by unit-level safety climate perceptions. For employees in units high in safety climate, the relationship between co-worker safety knowledge and behavior and safety behavior was stronger. This study provides additional evidence that the role of co-workers must be taken into account when examining how safety climate affects accident and injury outcomes.

Kath and colleagues (Kath, Marks, & Ranney, 2010) examined the effects of co-workers as a dimension of safety climate. The authors used the construct “safety peer pressure” from a modified version of Zohar’s 1980 measure, acknowledging that the pressure could have positive or negative outcomes depending on whether the pressure was to behave safely or unsafely. A sample item is “My co-workers expect other workers to behave safely”. Hierarchical analyses controlling for leader-member exchange, perceived organizational support, management attitudes toward safety, and safety job demands revealed that co-worker safety/safety peer pressure was not significant beyond the other variables in predicting upward safety communication (i.e., the willingness of employees to bring safety-related concerns to their superior’s attention). These results

indicate that co-workers may not influence how comfortable employees are in expressing their concerns when other organizational variables are considered. However, Kath and colleagues did not expect co-workers to influence communication with supervisors. They believed relationships between the employee and their supervisor should be more predictive because the supervisor has more control over the employee's work.

Co-worker support and safety outcomes. Research assessing the social support of co-workers, measured with items such as “You can count on colleague backup at work”, found that increases in co-worker social support predicted increased safety compliance behaviors (Turner, Stride, Carter, McCaughey, & Carroll, 2012). Additionally, co-worker social support was found to moderate the relationship between job control and safety participation, such that when emergency room personnel experienced higher levels of social support, the positive relationship between job control and safety participation was enhanced. However, the study did not find a significant direct relationship between co-worker social support and safety participation.

Gillen, Baltz, Gassel, Kirsch, and Vaccaro (2002) studied safety climate within the construction industry. The authors used the Job Content Questionnaire (JCQ), including the general co-worker support dimension, to measure employee strain and how it might affect safety climate perceptions. Correlational analyses showed that co-worker support was not related to injury severity, but increased co-worker support was significantly correlated with increased perceptions of workplace safety.

Co-worker support for safety. Some studies have followed Barrera's (1986) advice and used a co-worker support construct that is specific in its target. Examining the

trust, shared norms, and obligation facets of social capital theory on safety outcomes, Watson, Scott, Bishop, and Turnbeaugh (2005) proposed a model comparing the influences of trust in supervisor, co-worker safety norms, and management safety values on perceived safety of the work environment and at-risk behavior. Co-worker safety norms were defined as the unwritten rules that govern expectations for behavior and establish boundaries for accepted safe conduct. Analysis revealed that while co-worker norms, along with trust in the supervisor and management safety values, were predictive of increased perceptions of a safe work environment and decreased at-risk behavior, co-worker norms were more predictive of decreases in at-risk behavior than were management safety values.

However, three of the four items to measure co-worker norms focused on behaviors (e.g., “If members of my work crew noticed a safety hazard, they will take corrective action”) while only one item focused on what could traditionally be considered a “norm” (e.g., “Members of my work crew almost always wear their safety equipment”). These action-based items are more similar to what previous studies (and the current study) refer to as co-worker support for safety.

Co-worker support for safety has been examined by Casey and Krauss (2013), who studied South African miners’ safety and how error management climate may ultimately contribute to safety outcomes. The authors hypothesized a path model detailing relationships between error management climate (shared perceptions of organizational practices related to dealing with errors when they do occur, communicating about errors, and “sharing error knowledge”; p. 133), supervisor and co-

worker safety support, upward and within-team safety communication, safety behavior, and safety incidents. The authors measured co-worker safety support with three sub-dimensions: social pressure to work safely, team support, and safety cohesion. Path analysis revealed that the path from error management climate → co-worker safety support → within-team safety communication, leading to safety behaviors and safety outcomes was significant. Supervisor safety support did not show a significant path to safety behavior, but was found to exert an effect on upward safety communication. A direct path from co-worker safety support to safety behavior was also not supported. This study suggests a possible mechanism for co-worker support for safety to influence safety outcomes may be through within-team safety communication.

Morrow, McGonagle, Dove-Steinkamp, Walker, Marmet, and Barnes-Farrell (2010) studied a construct they called “co-worker safety” and its relationship, along with management safety and work-safety tension, to unsafe behaviors. Co-worker safety was measured using a modified version of Zohar’s (1980) safety climate subdimension “effect of safe behavior on social status”. The study authors predicted that all three facets of safety climate would be predictive of unsafe behaviors, but that co-worker safety would have the weakest effect because they believed co-workers do not have a direct influence on an employee’s job or pay. Hierarchical regression revealed that co-worker safety contributed the smallest change in R^2 , supporting their hypothesis. However, dominance analysis revealed that management safety (i.e., management commitment to safety) did not reliably dominate the effect of co-worker safety. These ambiguous results show that

more research is needed to understand the effects of management and co-workers on safety outcomes.

Specific co-worker support for safety has also been found to fully mediate the relationship between perceived organizational support for safety and safety voice, or employees voicing safety concerns (Tucker, et al., 2008). In a sample of bus drivers (who work alone for most of the day), perceived co-worker support for safety was found to predict employee safety voice even when organization support for safety was entered into the model. The authors note that while bus drivers spend much of their work day alone in their bus, they also have opportunities for “meaningful contact” (p. 323) with co-workers in the garage before or after a shift and during safety meetings. However, contact with supervisors can be limited. It is possible the effect of co-workers is in fact stronger than the effect of the organization (and organization agents), with whom the bus drivers may have little contact.

Turner and colleagues (2010) surveyed rail workers who often worked in small groups and were infrequently visited by a direct supervisor. Contact with top management was even more infrequent. These conditions are similar to the current study in that team truck drivers work closely with another person but have limited direct contact with supervisors and top management. The researchers studied how different sources of support would affect reported safety behavior in the previous 12-month period. Support from top management (often referred to as company level), direct supervisors, and co-workers was measured using sub-scales of Mueller et al.’s (1999) measure of safety climate. A sample item for perceived co-worker support for safety was “People in

my immediate work group who work safely try to emphasize it and make sure others do the same”. These support items can be classified as specific co-worker support *for safety* as opposed to general support from co-workers. Main effect analyses revealed that all sources of support, including co-worker support for safety, were predictive of lower hazardous work events. Interaction analyses revealed that all sources of support moderated the relationship between role overload and hazardous work events and that the magnitude of the interaction between role overload and co-worker support for safety was larger than the interactions between top management support or supervisor support and role overload and predicted additional variance. Due to the similarity of samples, it is possible the current study will find similar results.

However, not all studies have found support for the role of co-worker support for safety. Liu, Huang, Huang, Wang, Xiao, and Chen (2015) examined the relationships between safety climate and injuries using a Chinese manufacturing sample. Co-worker support was measured using items such as “Co-workers mention safety compliance” and “Co-workers focus on their own work safety”. Although the authors labeled the dimension “co-worker support”, which is often used in the literature to denote general support, the items used match more closely with the specific support construct “co-worker support *for safety*”. The authors created a measure of safety climate specifically for the study and in conducting an exploratory factor analysis of the items, the factor co-worker support was found to account for more variance (18.41%) than management commitment to safety (18.12%), safety supervision (15.63%), or safety training (10.52%). A path analysis showed that co-worker support for safety was indirectly related

to decreased injury outcomes through increased safety compliance and personal protective equipment use. However, co-worker support for safety was not found to be related to a dimension of safety behavior the study authors labeled “safety initiative” or proactive safety behavior. The authors suggested that the non-significant relationship may be the result of cultural differences in the Chinese sample they used and the more Western samples used by researchers who have found co-worker support for safety to predict safety behaviors.

Co-worker safety climate. Co-worker safety climate is another less used term that may also describe a support relationship from co-workers. Colley, Lincolne, and Neal (2013) examined different employee profiles of perceived organizational values (i.e., the perceptions employees have of a given organization’s values) and safety climate perceptions at the organization, supervisor, and co-worker level. Co-worker safety climate was measured using an adaptation of Zohar’s (2000) 10-item measure of supervisory safety climate. A sample item is “As long as work remains on schedule, my co-workers don’t care how this has been achieved”. Organizations were rated using the Competing Values Framework developed by Quinn and Rohrbaugh (1983), which divides organizational values into four competing categories: human relations (employee morale), open systems (innovation), internal processes (stability), and rational goals (productivity). Organizational profiles were created using a version of cluster analysis based on these categories. Of the four profiles, it was found that employees who perceive their organization as focusing concurrently on human relations and rational goals reported significantly higher levels of organizational, supervisory, and co-worker safety

climate and lower levels of first aid incidents and equipment damages (accidents). It is possible that organizations that must balance safety and productivity have higher safety climate in general. However, the study did not test if perceptions of safety climate at each level were different from each other.

In a study design similar to the current study, Brondino, Silva, and Pasini (2012) questioned the role of co-workers as “safety climate agents” (p. 1847) in transmitting safety climate from both the organization level and the group level to individual safety outcomes. The study authors took a multilevel approach for all levels of safety climate: organization-level safety climate, supervisor-level safety climate, and co-worker-level safety climate. Brondino and colleagues use the term co-worker safety climate to refer to perceptions of safety climate shared between 91 groups of blue-collar co-workers. The scale used was a modified version of Zohar and Luria’s (2005) group-level safety climate scale meant for supervisors and included the subdimensions of safety communication, safety systems, co-workers values, and safety mentoring (changed from safety training to reflect co-workers being at the same level within the organizational hierarchy). Sample items from each dimension include: “If it is necessary, my team members use explanations to get other team members to act safely” (safety mentoring), “My team members are careful about working safely also when we are tired or stressed” (safety values), “My team members are careful that the other members receive all the equipment needed to do the job safely” (safety systems), and “My team members talk about safety issues throughout the work week” (safety communication).

Brondino and colleagues (2012) conducted both individual-level and multi-level analyses. The hypothesized path model included a partial mediation model with organization-level safety climate (OSC) predicting supervisor-level safety climate (SSC), co-worker safety climate (CSC) and safety behavior; SSC predicting both CSC and safety behavior; and CSC predicting safety behavior. The results were equivocal at the group versus the individual level. OSC was predictive of safety behavior at the individual but not the group level, but did predict SSC and CSC at both levels. SSC was not predictive of safety behavior at either level, but the relationship between SSC and safety behavior was fully mediated by CSC at the individual level. Additional analyses conducted with only CSC as a mediator between OSC and safety behavior revealed CSC to partially mediate the relationship at the individual level, but fully mediate the relationship at the group level.

Brondino and colleagues (2012) suggest that the effects of supervisor and co-worker safety climate perceptions may completely overlap or “cancel” the effects at the group level but that co-workers may partially transmit safety climate from the organization level to actual safety behavior at the individual level. However, it is also possible that in modifying the supervisor-level scale to accommodate co-workers, the researchers were somehow still measuring constructs related to supervisors. Also, though a construct specific to co-worker support for safety was not studied, safety climate research indicates that management/supervisor support for safety is the most important facet of safety climate (Beus et al., 2010). Relatedly, it is possible that an important aspect of co-worker safety climate is co-worker support for safety.

One important point of distinction that needs to be made in the literature is the difference between co-worker safety climate and co-worker support for safety. While there are currently very few references to “co-worker safety climate” in the literature, it is important that the two concepts not be inter-changed. Just as management support for safety is thought to be the most important dimension of safety climate, it is possible co-worker support for safety is a leading dimension of co-worker safety climate.

Summary

Team truck drivers are a unique population in that they work away from a home base and work without direct supervision. Additionally, while the two drivers are in the same truck together, they do not spend the entire time interacting. However, interactions between the two may provide important support for increased and sustained safety behavior. Co-worker support for safety is a specific type of co-worker social support. Co-worker support is related to improved employee job performance and several theories account for the impact of co-workers on performance behaviors. The construct of co-worker support for safety has been studied and generally found to be related to employee safety outcomes. However, co-worker support for safety has not been previously studied in the context of safety climate.

CHAPTER FOUR

HYPOTHESIS FORMATION AND RATIONALE

Co-workers are the largest group most employees interact with on a daily basis (Chiaburu & Harrison, 2013). A deeper understanding of the circumstances under which safety behavior is influenced is extremely important when it comes to psychosocial constructs that are regularly applied in industry settings. Not only do companies spend large amounts of money on programs that aim to increase safety, but the outcomes of such efforts can be measured in lives and disability, as well as in dollar amounts. A better comprehension of how co-workers influence safety may provide guidance in safety intervention research and practice.

The current study aimed to provide insight into how the people around employees affect safety behavior at work. Specifically, the role of co-worker support for safety was investigated as to its role as a mediator and/or moderator of the relationship between safety climate and safety behavior, and as a direct causal influence of safety behavior. See Figure 1 for the base model of the relationship between safety climate and accidents and injuries.

Concerning the mediating effects of co-worker support for safety, it is possible that co-workers transmit the safety climate message from higher levels in the company to fellow co-workers in order to have an effect on employee safety behavior. Previous research supports the transmission of the safety message from the company level to the supervisor level in affecting employee safety behavior (Zohar & Luria, 2005). Additionally, previous research has found that co-worker safety climate, a construct

closely related to co-worker support for safety, fully mediated the relationship between supervisor safety climate and safety behavior in a sample of blue collar workers (Brondino et al., 2012). A social learning theory perspective (Bandura, 1977), along with safety climate theory (Zohar, 1980) and social information processing theory, supports the idea that employees learn safe behavior from watching co-workers be rewarded for their own safe behavior under conditions of positive safety climate and then go on to model co-workers in their own behavior.

Additionally, co-worker support for safety may also exert its influence by supplying employees with necessary resources to overcome the stressors that may have a negative impact on employee safety behavior. The job-demands resource (JD-R) model (Bakker & Demerouti, 2007) and more broadly, a framework of occupational social support, suggest that job resources such as support can reduce the negative effects of a job demand. Previous research also supports the idea that a negative safety climate can act as a stressor (Golubovich, Chang, & Eatough, 2014). Co-worker support for safety has been shown to attenuate the negative impact of job demands on safety outcomes (Turner et al., 2010) while general co-worker support has shown similar results (Turner et al., 2012).

Hypothesis 1a: Co-worker support for safety will moderate the relationship between supervisor-level safety climate perceptions and self-reported safety behavior (See Figure 3).

Hypothesis 1b: Co-worker support for safety will partially mediate the relationship between supervisor-level safety climate perceptions and self-reported safety behavior (See Figure 4).

Hypothesis 2a: Co-worker support for safety will moderate the relationship between organization-level safety climate perceptions and self-reported safety behavior (See Figure 5).

Hypothesis 2b: Co-worker support for safety will partially mediate the relationship between organization-level safety climate perceptions and self-reported safety behavior (See Figure 6).

Hypothesis 3a: Co-worker support for safety will moderate the relationship between organization-level safety climate and crash outcomes (See Figure 7).

Hypothesis 3b: Co-worker support for safety will partially mediate the relationship between organization-level safety climate and crash outcomes (See Figure 8).

Hypothesis 4a: Co-worker support for safety will moderate the relationship between supervisor-level safety climate and crash outcomes (See Figure 9).

Hypothesis 4b: Co-worker support for safety will mediate the relationship between supervisor-level safety climate and crash outcomes (See Figure 10).

For the moderation hypotheses, it is expected that high co-worker support for safety will be able to diminish the negative effects of low safety climate perceptions and enhance the positive effects of high safety climate perceptions, both at the organization and supervisor level.

A replication hypothesis is also included in the current study. The role of supervisor-level safety climate as a mediator and transmitter of safety climate from higher levels within the organization (e.g., top management) to lower levels (e.g., employees) has been studied by Zohar and colleagues (Zohar & Luria, 2005), but is not a path commonly tested within the safety climate literature. The model of the supervisor as a communicator of information from higher levels within the organization, without altering or filtering the content of the message, supports the notion that supervisor-level safety climate can transmit the safety message (Huang et al., under review; Zohar, 2010). Therefore, the current study seeks to study the mediating effect of supervisor-level safety climate on safety behavior.

Hypothesis 5: Supervisor-level safety climate will partially mediate the relationship between organization-level safety climate and (a) co-worker support for safety and (b) safety behavior.

The current study also seeks to understand the relative importance of the source of the safety message on employee safety behavior. Social impact theory (Latané, 1981) suggests that a source of social influence will have the greatest impact when it is stronger or more powerful than other sources, physically closer, and greater in number than other sources. The sources of influence within a given organization can be seen as top management, supervisors, and co-workers. According to social impact theory, top management may have the least amount of influence on employee safety behavior because top managers are often far removed from employee involvement (physically distant), may have less authority over employee outcomes than direct supervisors, and are

relatively few in number. Direct supervisors may have the most power as a source of influence because they are directly responsible for things like employee performance appraisals.

However, co-workers are greater in number than direct supervisors and are physically closer than supervisors, especially in the case of team truck drivers where the teammate is present in the cabin. These circumstances would point to co-workers having an additional impact on employee safety behavior over either company-level or supervisor-level safety climate perceptions. Some previous research has found support for the incremental effects of co-worker support for safety (Turner et al., 2010) while other have not (Morrow et al., 2010; Watson et al., 2005). The current study tested the importance of co-workers as a source of influence on employee safety behavior.

Hypothesis 6: Co-worker support for safety will have an incremental effect on self-reported safety behaviors beyond the effects of both organization- and supervisor-level perceptions of safety climate (Figure 7).

The current study also compared the safety behavior and safety outcomes for team drivers reporting high co-worker support for safety, low co-worker support for safety, and solo drivers. Previous research has shown that solo drivers experience more incidents than team drivers (Hanowski et al., 2005), but safety behavior has not been examined, nor has the comparison between the three groups been made.

Hypothesis 7a: Team drivers experiencing high levels of co-worker support for safety will report increased safety behavior over team drivers experiencing low

levels of co-worker support for safety, and solo drivers (experiencing no co-worker support) will report the lowest levels of safety behavior.

Hypothesis 7b: Team drivers experiencing high levels of co-worker support for safety will report significantly lower rates of accidents and injuries than team drivers experiencing low levels of co-worker support for safety, and solo drivers (experiencing no co-worker support) will report the highest levels of accidents and injuries.

In summary, the present study extends the current literature by a) examining the conditions under which the relationship between safety climate and safety outcomes may be weaker or stronger, b) studying the role of co-workers in a remote working situation, and c) examining competing models of co-worker support for safety within a broader, comprehensive model of safety climate. I investigated these hypotheses using archival data obtained from truck drivers employed by a single, national trucking company.

CHAPTER FIVE

METHOD

Participants

Participants in the current study were truck drivers working for a single trucking company within the United States. The data were gathered as part of a larger project aimed at validating safety climate measures for the trucking industry (Huang et al., 2013). The larger project included two waves of data collection approximately three years apart. Prior studies that have used the collected data used wave 1 data only. The current study uses data from wave 2 only.

The total number of truck drivers eligible to complete the survey was 8,308. Sixty two percent completed the survey for a total sample of 5,162. Surveys where less than 50% of the data was complete were removed (77 surveys). A small percentage (9.5%) of the truck drivers completed both wave 1 and wave 2 data collections. In order to keep the two waves separate, the 485 participants who completed both waves were removed from the sample, resulting in a sample of 4,600 truck drivers.

For analyses comparing team drivers and solo drivers, the total sample size was 4,600 truck drivers. For analyses focusing on co-worker support, the study participant pool was further narrowed to those drivers the trucking company categorized as team drivers, meaning that truck loads were driven by two truck drivers trading off driving time so the vehicle could be almost continuously moving. The final sample of team drivers includes 366 team drivers.

The average age for team truck drivers was 48.3 years old ($SD = 10.78$) while the average age for solo truck drivers was 47.62 years old ($SD = 10.66$). In response to a question about how long they have been a truck driver (i.e., occupational tenure), solo truck drivers reported on average 11.84 ($SD = 9.39$) years in the occupation while team truck drivers reported 10.48 ($SD = 8.55$) years in the occupation.

All participants were non-unionized long-haul truck drivers. Driver gender was not gathered as part of this study, partly because the company wanted to protect the identities of any female respondents. On average, fewer than 10% of long haul truck drivers are women.

Data Collection Procedure

The survey was completed at the end of a required web-based safety training that the drivers complete every year. After the truck drivers completed the approximately 20-minute safety training, they were invited to complete the survey and were shown an informed consent document. If the driver agreed to participate, they were taken to the website where the survey was hosted.

The survey took about 15 minutes to complete. Participants were asked for their unique company ID to be used as an identifier to match their survey responses to company injury records, which were collected and matched six months after the survey. Five \$100 gift cards were provided via lottery as incentives to encourage participation and participants were asked to provide contact information (e.g., email or phone number) at the end of the survey if they would like to be entered into the lottery.

The company was provided with an executive summary of survey results, which were aggregated to the company level. The company had no access to the raw data or to which drivers agreed to participate in the survey.

Measures

Safety climate. Trucking industry-specific safety climate scales developed by Huang et al. (2013) were used to assess safety climate perceptions. The scale development process included a review of the scientific literature, a review of trucking companies' safety metric (e.g., crash rate, injury rate, risk scores), and semi-structured interviews with subject matter experts (i.e., truckers, supervisors, trucking industry insurance experts). An initial measure was formed which consisted of 100 items. Cognitive interviews were then conducted with truck drivers and supervisors in order to improve content and face validity. Based on results of the interviews, items were restricted or dropped, leaving 61 items using a standard 5-point Likert scale.

The 61-item measure was then pre-tested by an additional 64 truck drivers recruited from truck stops to ensure the changes made in the cognitive interview phase were clear and the survey could be completed in a reasonable amount of time. The revised 61-item measure was then used in data collection for eight trucking companies, totaling 8,095 participants. Exploratory factor analysis (EFA) was conducted with survey data from one (pilot) trucking company totaling 2,030 participants. Based on results from the EFA, the measure was trimmed to include 20 items measuring organization-level safety climate and 20 items measuring supervisor-level safety climate.

A confirmatory factor analysis (CFA) was then conducted using the factor structure suggested by the results of the EFA. CFA was first conducted on data from the pilot company and then the factor structure was validated using data from all eight trucking companies. For a more comprehensive review of survey development and item validation, see Huang et al. (2013).

The final scale consists of two 20-item subscales (total 40 items) measuring organization and supervisor safety climate. Both the organization-level and supervisor-level scales contain three sub-dimensions: proactive practices, driver safety priority, and supervisory care promotion (organization level) and safety promotion, delivery limits, and cell phone disapproval (supervisor level). Example items include: “My company uses any available information to improve existing safety rules (organization-level safety climate subscale)” and “My supervisor compliments employees who pay special attention to safety (supervisor-level safety climate subscale)”. Prior research has demonstrated strong psychometric properties of the overall scale and offered both construct validity and criterion-related validity evidence to support its use in trucking samples (Huang, Zohar, Robertson, Garabet, Lee, et al., 2013). Both the organization- and supervisor-level safety climates scales were found to be predictive of self-reported safe driving behaviors, injuries, and near-misses (Huang et al., 2013). See Appendix A for organization- and supervisor-level safety climate items.

Drivers communicated with their direct supervisors (i.e., dispatchers) through cell phones and in-vehicle communication systems. Even though multiple drivers shared the same supervisor, most drivers have little to no opportunity to interact with their fellow

co-workers and may not know the other drivers under their supervisor. This suggests that shared perceptions are unlikely among drivers. A prior study of the wave 1 data revealed ICC(1) values less than .10 and ICC(2) values less than .70 for organizational- and supervisor-level safety climate, both of which support not aggregating the data (Bliese, 2000; LeBreton & Senter, 2008). Additionally, in the current wave 2 study, supervisors had fewer than three direct reports in the vast majority of cases (97%). Finally, information linking team driver dyads was not available in the current study. For these reasons, data were examined at the individual level of analysis.

Perceived co-worker support for safety. Perceived co-worker support for safety was measured using a modified version of Tucker et al.'s (2008) scale of perceived co-worker support for safety. The original scale was developed for use with a bus driver sample and included the referents "co-worker" and "colleagues". An example item of the original scale is "My co-workers are ready to talk to fellow employees who fail to use safety equipment". Internal consistency reliability of $\alpha = .90$ was found for the original scale. In terms of criterion related validity, Tucker et al. found the original scale mediated the relationship between perceived organizational support for safety and employee safety voice. The referent of the original scale was modified for the current study to refer to "My teammate"; teammate being the term used for team drivers. Along with using a 5-point Likert scale with a not applicable option, participants were given specific instructions for answering this measure: "If you are currently a team driver, please answer the following questions about your [Company] teammate. If you are NOT a team driver, please choose 'not applicable'." Additionally, data screening procedures were

used to limit responses to only those the company identified as a team driver. See Appendix B.

Safety behavior. Self-reported driver safety behavior was measured using a six-item scale adapted from Huang, Roetting, McDevitt, Melton, and Smith (2005) using a 5-point Likert scale. Example items are “I always comply with posted speed limits” and “I occasionally drive without getting enough sleep”. Previous studies using the modified version of this scale have found internal consistency reliability measures to range from $\alpha = .66$ (Huang et al., 2013) to $\alpha = .75$ (Zohar, Huang, Lee, & Robertson, 2014). See Appendix C.

Objective safety outcomes. Objective safety outcomes were gathered six months after survey data collection was complete. The objective data includes information for each survey respondent on events that happened in the six months after data collection was completed. Crashes and lost time injury are two such objective outcomes that were collected. Crashes are operationalized as accidents reported by each truck driver to the trucking company and are considered preventable incidents. The variable is not solely a measure of severe accidents, but rather a more holistic measure of all accidents experienced by a driver. A second objective outcome was also collected: lost time injury. Lost time injury measures the days away from work as the result of an occupational accident or injury. Lost time injury may also serve as a proxy for accident/injury severity, as more severe accidents and injuries usually involve more days away from work.

Analysis Strategy

Prior to hypothesis testing, the data were cleaned and screened for missing data. All predictor variables were mean centered to aid in interpretation of the results. Reliability and dimensionality of each scale was assessed. Data were analyzed using both general linear and logistic regression. All hypotheses using the prospective, objective outcome of crashes were tested using logistic regression. While crashes were reported on a count basis, because they are a low base rate phenomenon, crashes were categorized as yes/no events; the majority of truck drivers who did report a crash reported only one. Logistic regression is the most appropriate technique when testing dichotomous outcomes because logistic relationships between IVs and DVs are more often non-linear (Peng & So, 2002). Logistic regressions were tested using the Generalized Linear Model menu in SPSS.

Conditional hypotheses were tested using either general linear or logistic regression, with dichotomous outcomes using logistic and continuous outcomes using linear regression. Mediation hypotheses were tested using the PROCESS macro created by Hayes (2013) for SPSS. The PROCESS macro allows for testing complex moderation and mediation hypotheses, in addition to being able to recognize dichotomous variables and conduct logistic regressions when necessary. PROCESS estimates the indirect effect of mediation analyses through resampling estimates of the indirect effect and providing a confidence interval in order to give a significance value. Bootstrapping is not constrained by assumptions about the sample distribution and is therefore seen as a superior method

for testing mediation (Preacher & Hayes, 2008). Effect sizes for indirect effects were calculated as a percent of total effect that is due to the indirect effect.

Hypothesis 6, involving the incremental effects of co-worker support for safety over both organization- and supervisor-level safety climate, was tested using hierarchical linear regression, with variables added in steps to confirm that co-worker support for safety (to be added in step 3) explains additional variance beyond organization-level (step 1) and supervisor-level (step 2) safety climate perceptions.

Hypothesis 7a and b, involving differences in reported safety behavior and crashes and lost time injury between team drivers experiencing high and low support and solo drivers, were tested with linear regression for the safety behavior and lost time injury outcomes, and logistic regression for the crash outcome. Team driver vs. solo driver status was a dummy coded variable (i.e., drivers were categorized as 0 or 1). Predicted values of safety behavior, crashes, and lost time injury from the team truck drivers were compared to mean values for the solo truck drivers.

CHAPTER SIX

RESULTS

Descriptive Statistics

Means, standard deviations, correlations, and reliability coefficients are presented in Tables 1 and 2. Descriptive statistics for team drivers are presented in Table 1.

Descriptive statistics for solo drivers are presented in Table 2. Correlations between study variables were examined for both team and solo drivers to serve as a point of comparison.

Overall, the means and relationships between the two groups were found to be very similar. Both groups had high means (over 4.0 on a 5-point scale) for organization-level safety climate, supervisor-level safety climate, and safety behavior. Twenty-five percent of the solo truck drivers reported a crash and of those who reported experiencing a crash, 80% reported only one crash. However, the range was up to four crashes within the period for solo truck drivers. Of the team truck drivers, 22% reported experiencing a crash, with the majority (87%) of those reporting a crash reporting only one. The range of crashes for team truck drivers was 0-3. Based on the small percentage of the team truck drivers experiencing more than one crash (3%), the crash variable was transformed into a dichotomous yes/no variable.

Miles driven per year was included as a control variable in tests of hypotheses where miles driven would logically be related to the outcome (i.e., crashes). The outcome variable of lost time injury was removed from consideration due to its extremely low rate of occurrence. Only three participants reported having days away from work due to an injury, which does not provide sufficient variance for prediction. Two cases were

removed from the data as they were found to be outliers, with standardized residual values greater than 3.0 on the relationship between co-worker support for safety and crashes.

For team drivers, the focus of the current study, organization-level and supervisor-level safety climate were significantly and positive related ($r = .79, p < .01$). Both types of safety climate were also positively related to co-worker support for safety (organization-level: $r = .30, p < .01$; supervisor-level: $r = .35, p < .01$). The variable of safety behavior was also positively related to organization- ($r = .54, p < .01$) and supervisor-level safety climate ($r = .51, p < .01$), along with co-worker support for safety ($r = .44, p < .01$). The dichotomous variable of crashes, coded as 0 and 1 with 1 indicating an affirmative response, was found to be related to co-worker support for safety ($r = .13, p < .05$) safety behavior ($r = .11, p < .05$), however, the relationships were not in the expected direction. All predictor variables were mean centered in order to aid in interpretation.

Hypothesis Testing

Moderation analyses. The first series of hypotheses (1a-b through 4a-b) posited that co-worker support for safety would act as a moderator and mediator of the relationship between safety climate variables (both organization- and supervisor level safety climate) and safety outcomes (both safety behavior and crashes). The moderation effect of co-worker support for safety was examined first in order to determine the most appropriate analysis steps.

Hypothesis 1a was tested using linear regression. Supervisor-level safety climate, co-worker support for safety, and the interaction between the two variables were added to the model predicting safety behavior. Results indicated that while the main effects of both supervisor-level safety climate ($B = .31, SE = .04, p < .001$) and co-worker support for safety ($B = .23, SE = .04, p < .001$) were significant, the interaction term was not significant ($B = .001, SE = .04, p = .984$). These results indicate that co-worker support for safety did not moderate the relationship between supervisor-level safety climate and safety behavior. Therefore, Hypothesis 1a was not supported. The model summary and parameter estimates are shown in Table 3.

Hypothesis 2a was tested next, also using linear regression. Organization-level safety climate, co-worker support for safety, and the interaction between the variables were added to the model predicting safety behavior. Results indicated that the main effects of both organization-level safety climate ($B = .34, SE = .04, p < .001$) and co-worker support for safety ($B = .22, SE = .04, p < .001$) significantly predicted safety behavior. However, the interaction term was not significant ($B = -0.05, SE = .04, p = .244$), indicating that the relationship between organization-level safety climate and safety behavior was not dependent on co-worker support for safety. The model summary and parameter estimates are shown in Table 4.

Hypothesis 3a, the ability of co-worker support to moderate the relationship between organization-level safety climate and crashes was also tested. Logistic regression was used to test this relationship due to the binary nature of the crash outcome. For this analysis, miles driven per year was used as a control variable. In order to test the

moderating effect of co-worker support on the relationship between organization-level safety climate and crashes, miles driven per year, organization-level safety climate, co-worker support for safety, and the interaction between the two variables were included in the model. Miles driven per year was not a significant predictor of crashes ($B = .000005$, $SE = .000007$, $OR = 1.0$, $p = .445$). Organization-level safety climate was also not predictive of crashes ($B = .30$, $SE = .21$, $OR = 1.36$, $p = .142$). Co-worker support for safety was found to significantly predict crashes ($B = .50$, $SE = .28$, $OR = 1.65$, $p = .040$), albeit in the opposite direction that was hypothesized. Finally, no significant interaction between organization-level safety climate and co-worker support was found ($B = -.55$, $SE = .40$, $OR = .58$, $p = .155$). Parameter estimates are shown in Table 5.

Hypothesis 4a, that the interaction between supervisor-level safety climate and co-worker support for safety would predict crashes, was also examined using logistic regression. Miles driven per year was included as a control variable, but was not found to predict crashes ($B = 0.000005$, $SE = 0.000007$, $OR = 1.0$, $p = .507$). Supervisor-level safety climate was also not found to be predictive of crashes ($B = .07$, $SE = .21$, $OR = 1.08$, $p = .717$). Co-worker support for safety was again found to significantly, positively predict crashes ($B = .51$, $SE = .28$, $OR = 1.66$, $p = .042$), but the interaction between supervisor-level safety climate and co-worker support for safety was not significant ($B = -0.66$, $SE = .40$, $OR = .52$, $p = .081$). Parameter estimates are found in Table 6. The results of these logistics regressions show that while co-worker support for safety is a significant predictor of crashes in the opposite manner expected, it does not interact with safety climate variables.

Mediation analyses. Though no moderation hypotheses were supported, the dichotomous outcome of crashes was found to be related to the study variables. Therefore, the mediation model testing Hypotheses 1b, 2b, 3b, 4b and 5a-b, and the overall four-path mediation model, was tested using the PROCESS macro and 5,000 bootstrapped samples. Miles driven per year was included as a control variable in all models; all paths to and from the variable were found to be non-significant. Therefore, the control variable was removed from each of the final models for parsimony. All indirect effects can be seen in Table 7.

Hypothesis 1b, positing the partial mediating effect of co-worker support for safety on the relationship between supervisor-level safety climate and safety behaviors, was tested using the PROCESS macro. Supervisor-level safety climate significantly predicted co-worker support for safety ($B = .34, SE = .05, p < .001$) and co-worker support for safety significantly predicted safety behavior ($B = .23, SE = .04, p < .001$). Supervisor-safety climate also significantly predicted safety behavior ($B = .31, SE = .04, p < .001$), showing partial mediation. The indirect effect was significant ($B = .08, SE = .02, CI = .0399 - .1336$), showing the mediation was significant and accounts for 20.37% of the total effect. The indirect effect shows that for a one unit increase in supervisor-level safety climate, safety behavior is expected to increase by .08 units through co-worker support for safety. Therefore Hypothesis 1b was supported. Figure 12 shows the unstandardized coefficients for the significant paths.

Hypothesis 2b, the partial mediating effect of co-worker support for safety on the relationship between organization-level safety climate and safety behavior, was also

supported. Organization-level safety climate was found to be significantly related to co-worker support for safety ($B = .30, SE = .05, p < .001$) and co-worker support for safety was found to be significantly related to safety behavior ($B = .24, SE = .04, p < .001$). Organization-level safety climate was also found to be significantly related to safety behavior ($B = .34, SE = .04, p < .001$), showing partial mediation through co-worker support for safety. The indirect effect was significant ($B = .07, SE = .02, CI = .0352 - .1248$), and accounted for 17.25% of the total effect. The indirect effect shows that for a one unit increase in organization-level safety climate, safety behavior is expected to increase .07 units through co-worker support for safety. See Figure 13 for the model with the significant paths.

Hypothesis 3b, the partial mediating effect of co-worker support for safety on the relationship between organization-level safety climate and crash outcomes, was also tested using the PROCESS macro. Organization-level safety climate was found to significantly predict co-worker support for safety ($B = .30, SE = .05, p < .001$) and co-worker support for safety was found to significantly and positively predict crash outcomes ($B = .57, SE = .29, p = .044$). Organization-level safety climate was not significantly related to crash outcomes ($B = .17, SE = .20, p = .385$), showing complete mediation. The indirect effect was found to be significant ($B = .17, SE = .10, CI = .0433 - .4379$). The indirect effect shows that for a one unit increase in organization-level safety climate the odds of experiencing a crash increases by 1.19 units through co-worker support for safety. However, it should be noted that the relationship was not in the

expected direction. Therefore Hypothesis 3b not supported. See Figure 14 for the model with significant paths.

Hypothesis 4b, positing the partial mediating effect of co-worker support for safety on the relationship between supervisor-level safety climate and crash outcomes, was also not supported. Supervisor-level safety climate significantly predicted co-worker support for safety ($B = .34, SE = .05, p < .001$) and co-worker support for safety significantly and positively predicted crashes ($B = .67, SE = .29, p = .023$). Supervisor-level safety climate did not predict crash outcomes ($B = -0.06, SE = .19, p = .763$), showing complete mediation. The indirect effect was significant ($B = .23, SE = .12, CI = .0657 - .5300$). The indirect effect shows that for a one unit increase in supervisor-level safety climate the odds of experiencing a crash increase by 1.26 units through co-worker support for safety. However, it should be noted that the effect was not in the expected direction. Additionally, these results show insignificant suppression. See Figure 15 for the model with significant paths.

Hypothesis 5a posited that supervisor-level safety climate would partially mediate the relationship between organization-level safety climate and co-worker support for safety and was partially supported. Organization-level safety climate was significantly related to supervisor-level safety climate ($B = .81, SE = .03, p < .001$) and supervisor-level safety climate was significantly related to co-worker support for safety ($B = .29, SE = .08, p < .001$). Organization-level safety climate was not found to be related to co-worker support or safety ($B = .06, SE = .08, p = .457$), showing complete mediation. The

indirect effect was significant ($B = .24$, $SE = .09$, $CI = .0663 - .4302$) and accounted for 79.11% of the total effect. See Figure 16 for the model tested.

Hypothesis 5b, the partial mediating effect of supervisor-level safety climate on the relationship between organization-level safety climate and safety behavior, was tested using the PROCESS macro. Organization-level safety climate was significantly related to supervisor-level safety climate ($B = .81$, $SE = .03$, $p < .001$) and supervisor-level safety climate was significantly related to safety behavior ($B = .17$, $SE = .05$, $p = .002$).

Organization-level safety climate was significantly related to safety behavior ($B = .28$, $SE = .06$, $p < .001$), showing partial mediation. The indirect effect was found to be significant ($B = .14$, $SE = .05$, $CI = .0344 - .2418$), and accounted for 33.04% of the total effect. Therefore, Hypothesis 5b was supported. See Figure 17 for the model tested.

Although no formal hypothesis statement was made about the 3-path mediation relationship involving organization-level safety climate, supervisor-level safety climate, co-worker support for safety, and safety behavior, the model was also tested using the PROCESS macro. Organization-level safety climate was found to be significantly related to supervisor-level safety climate ($B = .81$, $SE = .03$, $p < .001$) and supervisor-level safety climate was found to be significantly related to co-worker support for safety ($B = .29$, $SE = .08$, $p < .001$). Organization-level safety climate was not found to be related to co-worker support for safety ($B = .06$, $SE = .08$, $p = .457$). In predicting safety behavior, organization-level safety climate ($B = .25$, $SE = .05$, $p < .001$), supervisor-level safety climate ($B = .11$, $SE = .05$, $p = .041$), and co-worker support for safety ($B = .22$, $SE = .04$, $p < .001$) were all found to be significantly related to safety behavior. The overall indirect

effect for the 3-path mediation model was found to be significant ($B = .05$, $SE = .02$, $CI = .0141 - .1067$) and accounted for 12.84% of the total effect. See Figure 18 for the model tested.

In a more conservative test of Hypotheses 1b, 2b, 3b, 4b and 5a-b, a test of the 4-path mediation model was conducted. Figure 19 shows the model to be tested (which is the same model as the conceptual model in Figure 2, without the moderation paths), while Figure 20 shows which paths were found to be significant. Parameter estimates for the 4-path mediation model are shown in Table 8 and the indirect effects and effect sizes are included in Table 7. Results of the PROCESS model showed that supervisor-level safety climate fully mediated the relationship between organization-level safety climate and co-worker support for safety, partially supporting Hypotheses 5a. Supervisor-level safety climate also partially mediated the relationship between organization-level safety climate and safety behavior, supporting Hypothesis 5b.

Co-worker support for safety partially mediated the relationship between supervisor-level safety climate and safety behavior, supporting Hypothesis 1b. Co-worker support for safety did not mediate the relationship between organization-level safety climate and safety behavior, as organization-level safety climate transmitted its effect through supervisor-level safety climate and a direct effect on safety behavior. Therefore, in the more conservative model, Hypothesis 2b was not supported. Hypothesis 3b was not supported as co-worker support for safety did not mediate the relationship between organization-level safety climate and crashes when controlling for the other variables entered into the model. Co-worker support for safety also did not mediate the relationship

between supervisor-level safety climate and crashes, not supporting Hypothesis 4b.

Finally, the four-path, partial mediation from organization-level safety climate to crashes was found to be significant even though not all paths within the model were significant ($B = .03$, $SE = .02$, $CI = .001 - .0905$). The indirect effect of the 4-path mediation model accounted for 8.59% of the total effect. The results of these analyses support the overall model proposed for the current study.

Incremental effect analyses. Hypothesis 6 posited that co-worker support for safety would have an incremental effect on safety behavior beyond the effects of organization- and supervisor-level safety climate. A linear regression was conducted in steps, controlling for miles driven per year. In model 1, miles driven per year was entered as the predictor of safety behavior. Miles driven was not found to predict safety behavior ($B = -.000002$, $SE = .0000000001$, $p = .250$), and was removed from subsequent models. Next, organization-level safety climate was added to the model and was found to significantly predict safety behavior ($B = .41$, $SE = .04$, $p < .001$). In the third step, supervisor-level safety climate was added to the model. Supervisor-level safety climate was found to significantly predict safety behavior beyond organization-level safety climate ($B = .18$, $SE = .06$, $p = .002$), and explained an additional 2% of variance in safety behavior. In the last step, co-worker support for safety was added to the model and was found to predict an additional 7% variance in safety behavior beyond the variance explained by both organization- and supervisor-level safety climate ($B = .22$, $SE = .04$, $p < .001$). Therefore, Hypothesis 6 was supported. Model summary statistics and parameter estimates can be found in Table 9.

Outcome difference analyses. Hypothesis 7a and 7b proposed significant differences in (a) safety behavior, (b) crashes, and lost time injury based on driver type (i.e., solo versus team drivers). The outcome of lost time injury was not examined due to lack of variance. In a test of Hypothesis 7a, a linear regression was conducted to determine if differences in safety behavior exist based on driver type. Results of the regression revealed that driver type did not predict safety behavior ($B = .04$, $SE = .04$, $p = .289$). However, co-worker support for safety was significantly related to safety behavior ($B = .34$, $SE = .04$, $p < .001$), and any differences in safety behavior between the two groups may depend upon co-worker support. Therefore, the regression equation for support predicting safety behavior was solved based upon different levels of support (i.e., 1-5 on the 5-point co-worker support for safety scale) and the predicted values were then compared to the mean of safety behavior for solo drivers ($M = 4.44$, $SD = 0.65$). In order to determine if the differences between the predicted values and the mean value were significantly different, a t-test was calculated. The predicted values of the regression equation revealed that team drivers with support were predicted to have significantly worse safety behavior than the average safety behavior of solo drivers, until team drivers received the highest levels of support. Under conditions of extremely high support (support =5 on a 5-point scale), team drivers were predicted to have significantly better safety behavior than the average safety behavior of solo drivers ($\hat{y} = 4.58$, $t = 4.77$, $p < .05$). Hypothesis 7a was partially supported in that team drivers with the highest level of support were predicted to have the better safety behavior. See Table 10 for parameter estimates and predicted values.

Hypothesis 7b, positing that team drivers with the most support would report the fewest crashes, was tested first with a logistic regression to determine if there were significant differences in crashes based on driver type. The results of the logistic regression revealed that driver type was not predictive of experiencing a crash ($B = -0.15$, $SE = 0.13$, $OR = .86$, $p = .185$). However, co-worker support for safety was found to be significantly related to the outcomes of crashes ($B = .64$, $SE = .28$, $OR = 1.90$, $p = .022$). While no differences in the average crashes across groups was found, it is possible support may explain additional differences between the two groups.

First, the logistic regression equation for driver type predicting crashes was solved to find the probability of experiencing a crash for solo drivers ($OR = .34$, probability = .25) and for team drivers ($OR = .29$, probability = .22). Next the regression equation for co-worker support for safety predicting crashes was solved based upon different levels of support (i.e., 1-5 on the 5-point co-worker support for safety scale) and the predicted values were then transformed from the logit form to the odds and probabilities and compared to the average odds and probabilities of solo drivers experiencing a crash. Contrary to Hypothesis 7b, team drivers were found to be more likely to experience a crash as the level of support they received increased. However, as support increased to the highest level, the probability of team drivers experiencing a crash (probability_{team} = .24) was not different than the average probability of solo drivers experiencing a crash (M probability_{solo} = .25). Hypothesis 7b was not supported. See Table 11 for parameter estimates and predicted values.

Summary

The current study proposed both a moderation and mediation effect of co-worker support for safety on safety related outcome variables. Hypothesis 1a, 2a, 3a, and 4a regarding the moderating effect of co-worker support for safety on the relationship between (1a) supervisor-level safety climate and safety behavior, (2a) organization-level safety climate and safety behavior, (3a) organization-level safety climate and crashes, and (4a) supervisor-level safety climate and crashes, were not supported.

Hypotheses 1b, 2b, 3b, and 4b, regarding the mediating effect of co-worker support for safety on the relationship between (1b) supervisor-level safety climate and safety behavior, (2b) organization-level safety climate and safety behavior, (3b) organization-level safety climate and crashes, and (4b) supervisor-level safety climate and crashes, were tested along with Hypothesis 5a-b, regarding the mediating effect of supervisor-level safety climate, in a four-path mediation model. The results of the model supported Hypothesis 1b, as co-worker support for safety mediated the relationship between supervisor-level safety climate and safety behavior.

Hypothesis 2b was not supported, as the effect of organization-level safety climate on safety behavior was transmitted through both supervisor-level safety climate and co-worker support for safety, in addition to organization-level safety climate having a direct relationship with safety behavior. Hypothesis 3b and 4b were also not supported as co-worker support for safety did not mediate the relationship between (3a) organization-level safety climate or (4b) supervisor-level safety climate and crashes. Hypothesis 5a and 5b were partially supported as supervisor-level safety climate did act as a mediator.

Hypothesis 6 regarding the incremental effect of co-worker support for safety beyond the effects of both organization- and supervisor-level safety climate was supported. Finally, Hypotheses 7a and 7b regarding the differences in (a) safety behavior and (b) crashes for solo vs. team drivers were partially supported. While a direct test of differences in safety outcomes by group was non-significant, team drivers experiencing the highest levels of support were predicted to exhibit increased safety behavior over solo drivers and the probability of team drivers experiencing a crash was also lower than the probability for solo drivers.

CHAPTER SEVEN

DISCUSSION

The current study examined the role of co-worker support for safety within the larger framework of the relationship between safety climate and safety outcomes. This study assessed if co-worker support for safety acts as a moderator and/or mediator of the safety climate-safety outcome relationship within team truck drivers. While co-worker support for safety did not appear to act as a moderator in the current study, many of the mediation hypotheses were supported. The results for each hypothesis are discussed below, followed by a discussion of the theoretical and practical implications of the findings. Study limitations and directions for future study are then addressed.

Discussion of Findings

The first set of hypotheses posited that co-worker support for safety would act as a moderator and mediator of the relationship between safety climate variables and subjective and objective safety outcomes. First, the moderation effects of co-worker support for safety were tested. Co-worker support for safety did not act as a moderator of the relationship between organization-level safety climate perceptions or supervisor-level safety climate perceptions and safety behavior or crashes. Hypotheses 1a, 2a, 3a, and 4a were not supported. Although the literature supports the idea that aid or assistance from co-workers can diminish the relationship between a work demand and safety outcomes (Turner et al, 2012), the current study was not consistent with these findings. Additionally, co-worker support for safety did not enhance the positive effects of a positive safety climate. One explanation for the current findings is that safety climate at

both the organization and supervisor levels was very high overall. This explanation is discussed further in the limitations section.

The second part of Hypotheses 1-4 proposed that co-worker support for safety would act as a mediator of the relationship between safety climate and safety outcomes. Co-worker support for safety was found to act as a partial mediator between supervisor-level safety climate and safety behavior (H1b) and a complete mediator of the relationship between supervisor-level safety climate and crashes (H4b). The results supporting Hypothesis 1b complement previous research by Casey and Krause (2013) and (Brondino et al, 2012), which showed that co-worker support for safety does mediate the relationship between safety climate and safety outcomes. The current research indicates that the indirect effect accounts for around 20% of variance of the total effect (i.e., direct and indirect effect). However, even though complete mediation was found in the test of Hypothesis 4b, the hypothesis was not supported. The direction of the relationship between co-worker support for safety and crashes was found to be positive, such that increases in co-worker support for safety were related to increases in crashes, contrary to what was expected and to a large majority of safety climate studies. Possible reasons for this relationship are discussed below.

For Hypotheses 2b and 3b, co-worker support for safety was found to act as a partial mediator in the relationship between organization-level safety climate and safety behavior (H2b), and a complete mediator in the relationship between organization-level safety climate and crashes (H3b). Hypothesis 2b was supported and complements previous findings by Brondino and colleagues (2012), which found that co-worker safety

climate mediated the relationship between organization-level safety climate and safety behavior. Although complete mediation was found, Hypothesis 3b was not supported. Again, the relationship between support and crashes was found to be opposite of the hypothesized direction, with increased support for safety being related to increased crashes.

The unexpected direction of the relationship between co-worker support for safety and crashes, in addition to the positive correlation between safety behavior and crashes is inconsistent with past research. Beus and colleagues (2010) did study the causal relationship between safety climate and injury outcomes meta-analytically. The studies included measured safety climate and injury at two different points in time, with some studies measuring safety climate first and injuries at another point in time, or injuries first and safety climate at another point in time. However, the samples included were varied and not necessarily similar to the sample in the current study.

The meta-analysis studied the magnitude of the safety climate - injury relationship and compared it to the magnitude of the injury - safety climate relationship. Results of the meta-analysis showed that the injury leading to safety climate perceptions relationship was stronger than the safety climate perceptions leading to injury relationship. Additionally, the researchers found that the injury leading to safety climate relationship was not moderated by the length of time between assessments, suggesting that the length of time between assessments of injuries and safety climate did not matter and injuries would have an enduring, negative effect on safety climate perceptions.

Similar reasoning could be applied to the current findings; the experience of a crash may have an effect on truck drivers' safety performance behaviors. Experiencing a crash may lead truck drivers to increase the amount of support they give to their fellow truck drivers, and may also increase their vigilance when it comes to safety behaviors. However, it is important to note that Beus et al. did find a *negative* relationship between injury and safety climate while the current study found a *positive* relationship between co-worker support for safety and crashes. It is possible that the experience of a crash impacts one's own behavior (i.e., increasing the support provided to others) more than one's perceptions of others' (i.e., top management and supervisors-level safety climate) behaviors. This rationale may be a why the current study found a positive relationship between support and crashes but not a negative relationship between safety climate and crashes.

The conscientiousness-job performance literature may also be relevant to better understanding why there was a positive relationship between co-worker support for safety and crash outcomes. Previous research has shown that the relationship between conscientiousness and job performance is not always positive (LaHuis, Martin, & Avis, 2005; Le, Oh, Robbins, Ilies, Holland, & Westrick, 2011). In two studies, LaHuis and colleagues (2005) found that conscientiousness positively predicted job performance for clerical workers at the low range of conscientiousness levels, but the relationship became flat and even slightly negative at the higher range of conscientiousness. Le and colleagues (2011) found similar results as LaHuis and colleagues (2005), but also found that the point at which the relationship between conscientiousness and job performance became

flattened or slightly negative differed based on job complexity. The inflection point was lower for jobs with less job complexity (as operationalized by O*NET).

Truck drivers have relatively low job complexity, possibly marking the inflection point between support for safety and crash outcomes much earlier than a more complex job. The results of the conscientiousness studies serve to show that more of a “good thing” is not necessarily better. While high levels of safety behavior may be seen as positive, it may be the case that a comparable pattern of results may be found at very high levels of safety behavior. Truck drivers in the current sample reported, on average, very high levels of both co-worker support for safety and safety behavior. Therefore, it is possible that extreme levels of support and safety behavior, the relationship between the variables and crashes becomes positive.

It is also of note that this unexpected relationship between co-worker support for safety and crashes is a relatively small relationship. Additionally, the relationship may be considered unstable. The relationship was only significant when outliers were removed from the dataset.

Finally, it should be noted that previous research (Probst & Brubaker, 2008) has found that companies with more positive safety climates engage in far less underreporting of accidents and injuries than companies with poor or negative safety climates. It is possible that the high safety climate scores of the current organization, in combination with high levels of co-worker support for safety, encourage drivers to report all accidents and injuries, thereby showing a positive relationship between safety behavior/support and crashes.

The second set of hypotheses stated that supervisor-level safety climate would act as a partial mediator of the relationships between organization-level safety climate and (H5a) co-worker support for safety and (H5b) safety behavior. Hypothesis 5a was partially supported; although partial mediation was hypothesized, complete mediation was found. That is, organization-level safety climate transmitted all of its effects on co-worker support for safety through supervisor-level safety climate. Hypothesis 5b was supported, as supervisor-level safety climate did partially mediate the organization-level safety climate-safety behavior relationship. The mediating role of supervisor-level safety climate has previously been hypothesized and shown in research by Zohar and Luria (2005), who found that group-level (supervisor-level) safety climate fully mediated the relationship between organization-level safety climate and safety behavior. Additionally, the view of supervisors as gatekeepers or communicators (Zohar & Luria, 2010; Huang et al., under review) of the safety message within an organization also support the findings that supervisor-level safety climate can transmit the safety message from higher levels within the organization to lower levels.

Although not specifically hypothesized, more conservative models of the first and second set of hypotheses were conducted. Tests of both a 3-path and a 4-path mediation model were performed. The 3-path mediation from organization-level safety climate to safety behavior and the 4-path mediation from organization-level safety climate to crashes were both found to be significant. The 3-path mediation model directly links organization-level safety climate to safety behavior, but also shows that much of the effect of organization-level safety climate is exerted through supervisor-level safety

climate and co-worker support for safety. Additionally, the 3-path mediation model also shows that while supervisor-level safety climate has a small, direct relationship with safety behavior, co-worker support for safety accounts for a large percent of the overall relationship. These results show that research that neglects the role of co-workers in disseminating and passing on the safety message is not studying the full relationship between safety climate and safety related outcomes. For example, if implemented safety climate interventions directed at the company and supervisors are not showing the expected changes in safety outcomes, it is possible the message is being altered by other employees.

The 4-path mediation model, which built on the 3-path mediation model and included crashes as the final outcome variable, shows many of the same results as the 3-path model. While none of the paths to crashes were significant, the indirect effect of the overall 4-path model is significant, showing that strong relationships in the model can make up for the marginal relationships (when the over variables within the model are controlled for) between co-worker support for safety and safety behavior leading to crashes. This significant indirect effect does show that the 4-path partial mediation is significant. However, it should be noted that in this more conservative model, Hypothesis 1b, the partial mediation of co-worker support for safety on the relationship between organization-level safety climate and safety behavior, is no longer significant. These results occur because both the 3-path and 4-path mediation models control for the mediating effect of supervisor-level safety climate, which fully mediated the relationship between organization-level safety climate and co-worker support for safety. These path

models show how important it is to consider the entire model together and not just relationships considered in isolation. Additionally, these results have implications for future safety climate research. It is important for researchers to measure safety climate perceptions at multiple points of reference and to include variables related to co-workers so that all relationships between the variables can be tested and practical assumptions are not made based on findings that change when other variables are accounted for (as was the case with Hypothesis 2b).

The last sets of hypotheses involved the incremental effect of co-worker support for safety and the differences in safety outcomes for solo vs. team truck drivers. In testing the incremental effect of co-worker support for safety beyond organization- and supervisor-level safety climate on safety behavior, Hypothesis 6 was supported. Organization-level safety climate accounted for 28% of the variance in safety behavior. Adding supervisor-level safety climate to the model resulted in an additional 2% of variance explained, beyond the variance explained by organization-level safety climate. Finally, adding co-worker support to the model resulted in an additional 7% of variance explained in safety behavior, beyond both organization- and supervisor-level safety climate. These results complement previous findings about the importance of general co-worker support beyond supervisor support (Chiaburu & Harrison, 2008) and specifically, the importance of co-worker support for safety (Turner et al, 2010). These results show that it not only matters what message supervisors and top managers are sending about safety, the safety message of co-workers can also be of considerable consequence. That is, all measured sources of the safety message are important and have an impact on

employee safety behavior, so all sources should be taken into consideration when planning safety interventions.

The final two hypotheses stated that differences exist in the (H7a) safety behavior and (H7b) crash outcomes of solo vs. team truck drivers, with team truck drivers expected to report increased levels of safety behavior and the lowest levels of crashes. Straight-forward tests of these hypotheses indicated that there were no significant differences in the average safety behavior and crashes reported by the two groups. However, because co-worker support for safety was found to be significantly related to both safety behavior and crashes, predicted values at different levels of support were compared to the average safety behavior and crash scores of solo truck drivers. Results revealed that team truck drivers with low through about average reported significantly worse safety behavior than solo truck drivers. However, at the highest level of support, team truck drivers reported significantly better safety behavior than solo truck drivers. Therefore, Hypothesis 7a was partially supported.

Additional comparisons of the expected probabilities for experiencing a crash showed that at low levels of support, team truck drivers were expected to experience fewer crashes than solo drivers. As support increased for the team truck drivers, so did the expected probabilities of experiencing a crash, until at the highest level of support, where there was little difference in the expected probabilities of crashes for the two groups. These second sets of comparisons are contrary to the expected findings, in that increased support was related to an increased probability of crashes. These findings show in more detail the issues examined in the discussion of Hypothesis 3b and 4b. It is

possible a reverse causal relationship between support and crashes is producing the contrary findings.

Theoretical and Practical Implications

The current study examined how co-worker support for safety affects the relationship between safety climate and safety outcomes. Although none of the moderation hypotheses were supported, many of the mediation hypotheses were supported. These findings highlight the important and often overlooked role of employees themselves in influencing the safety performance of their fellow co-workers. For example, safety climate research focuses almost exclusively on models of the safety climate-safety outcome relationship that do not include any variables related to co-workers (e.g., Christian et al., 2009; Clarke, 2006; Zohar & Luria, 2005; Zohar & Luria, 2010). Additionally, studies that have examined co-worker support for safety (e.g., Tucker et al., 2008; Morrow et al., 2010; Turner et al., 2010; Casey & Krauss, 2013) tended not to include safety climate as a predictor of the safety outcomes studied, but rather include either facets of safety climate (e.g., management support for safety) or other support constructs (e.g., general supervisor support).

Additionally, the current study provided a replication of previous findings of the mediating role of supervisor-level safety climate on the relationship between organization-level safety climate and safety related outcomes. Although it is known that employees can form separate safety climate perceptions with the organization and supervisor as referents, and is often described that way, it is not often that more than one level of safety climate is used as a predictor in a study and less often that mediation from

one level to another is included. Zohar and Luria (2005) tested a model of safety climate that included referents to climate perceptions at both the organization and group (supervisor) level and found that supervisor-level safety climate fully mediated the relationship between organization-level safety climate and safety behavior. The current study supports these findings and has also shown that supervisor-level safety climate can fully and partially mediate relationships between organization-level safety climate and safety related outcomes. Therefore, the current study has added important information to the general safety climate model.

Finally, the current study extends the remote worker literature with regard to safety and the influence of other employees working nearby. The Health and Safety Executive of the United Kingdom (HSE) has stated that those employees who work by themselves or away from close supervision are more vulnerable than those employees who work in a traditional environment (HSE, 2015). The current study has shown, through comparing the safety behavior and cash outcomes of solo and team drivers, that at the highest levels of support, team drivers report significantly increased safety behaviors over the average reported by solo drivers. However, these same analyses revealed that at lower-to-average levels of support, team drivers report significantly lower safety behavior than the average reported by solo drivers. These results are equivocal; having a teammate present can be harmful except in cases where the teammate provides extremely high support for safety. Therefore, we can see that the act of simply having another person present during work is not necessarily a protective factor.

In terms of practical implications, the current findings show that safety climate interventions aimed simply at top management or supervisors may be insufficient to produce lasting effects on the safety outcomes of an organization. The current study found that not only do co-workers transmit the safety message from higher levels within the organization, but co-worker support also has a relationship with employee safety behavior beyond the effects of both the organization and supervisors. Though the current study found an unexpected positive association between safety behavior and crashes, previous literature endorses the negative relationship between safety behavior and accidents (e.g., Neal & Griffin 2004; 2006). Therefore, interventions aimed at decreasing accidents and injuries should also include education for employees to support their fellow co-workers in addition to strategies aimed at top management and supervisors.

Additionally, companies may be able to look to interventions designed to increase co-worker support for safety if previous safety climate interventions have not been successful. That is, while the onus for safe working conditions and policies lies with the company, the current study shows that co-workers can and do have a relationship with safety behavior. Measuring constructs such as co-worker support for safety and co-worker safety climate over time may help companies see where improvements are needed.

Limitations and Future Directions

Despite the contributions made by the current study, there are some limitations that should be addressed in future research. First, the current study utilized a sample of team truck drivers, which may limit the generalizability of the findings. Team truck

driving is a unique occupation, even among truck drivers and other lone workers. For example, in an occupation where more time is spent as part of a work group the moderating effect of co-worker support for safety may be more in-line with findings in the support literature. Additionally, the moderating effect of co-worker support for safety may be more important in more high-stress occupations (e.g., trauma nurses). Therefore, the models tested in the current study should be replicated in many different occupations.

Next, the unexpected relationships found between safety behavior, co-worker support for safety, and crashes may be due to a methodological flaw. Co-worker support for safety may appear to be positively related to crashes because experiencing a crash is a sensitizing event. It is possible that experiencing a crash during the six months after the survey was completed is related to experiencing a prior crash. Experiencing a prior crash may then make the driver more aware of both their own safety behaviors and the behaviors of their team driver, causing the driver to offer more safety related support. The relationship between co-worker support for safety and crashes observed in the current study may actually be part of a feedback loop. The design of the current study does not allow for testing a model which would control for previous crashes and the resulting changes in safety behavior and co-worker support for safety over time. A future study could collect both predictor and outcome data at three or more time points in order to test the longitudinal relationships between the variables. If data were collected longitudinally, hierarchical linear modeling techniques could be used to account for the within and between person effects of experiencing a crash on co-worker support. It is likely that the within person effects would show that as a person experienced a crash and changed their

behaviors, future accidents would decrease and the relationship between co-worker support and crashes would be negative. However, when looking at the between person effects, as is the case in the current study, crashes are likely to remain a sensitizing event and the relationship between co-worker support and crashes may remain positive.

Future research should also assess disruptive or counter-productive to safety behaviors of co-workers. The current study found that solo drivers (who do not experience co-worker support for safety) report higher safety behavior on average than team drivers with low levels of support. However, the study did not assess if low levels of support are related to co-worker behaviors that would cause the driver to engage in unsafe behaviors, which may explain the lower safety behavior scores.

The time frame for collecting data may also need to be varied. Recent research has shown that safety climate may have a “shelf life” as short as three months as a predictor of severe incidents (Bergman, Payne, Taylor, & Beus, 2014). If safety climate can become a less powerful predictor of accident outcomes over time, then it is also possible that safety behavior or co-worker support for safety may also become less powerful in predicting outcomes. However, because both safety behavior and co-worker support for safety are more proximal predictors of accident outcomes than safety climate, it is possible they will remain relevant predictors for a longer period of time.

Another concern in the current study may be that the means for safety climate, safety behavior, and co-worker support for safety were all at the upper end of the 5-point scale on which they were measured. However, the high means may be artificially inflated due to socially desirable responding. The survey was administered at the end of a

company training program and in order to participate, drivers had to click a link and be moved to a survey site not associated with the company. However, even though it was stated that the survey had no link to the trucking company, drivers who participated may have assumed their responses would somehow be available to the company and distorted their responses to be more favorable. Even if the drivers did understand that their survey answers were in no way available to the company, research on socially desirable responding shows that participants engage in impression management even when only strangers are present (Mick, 1996). These findings mean that the drivers' answers would still be distorted because it is understood that higher safety climate is better, as is engaging in supportive behaviors with one's team mate. However, the current study did find significant relationships between study variables, which may indicate that social desirability may not be a substantial issue. Another explanation for the high scores on the safety climate, co-worker support for safety, and safety behavior scales may be that they are in fact true scores and are the result of a safe and safety conscious company.

An additional limitation faced by the current study is that team drivers could not be matched with their driver teammates. If drivers were able to be matched, it would have provided the potential for dyadic or hierarchical analysis of the measured variables. Future research would be strengthened if drivers could be matched with their teammate.

In terms of assigning a causal link between study variables, it should be noted that all variables except crash outcomes were collected at the same time and are considered cross-sectional. As with all cross-sectional data, causal relationships cannot be assumed. As mentioned above, future research should collect data at multiple time points to test for

causality. However, the majority of the relationships found in the current study do support the findings of past research, which has been conducted with longitudinal data.

Next, the outcome of crashes, while not necessarily an infrequent occurrence in the current sample with 22% experiencing a crash, can still be considered a low base rate occurrence. A larger sample may have provided additional data points for the outcome of crashes. Additionally, the outcome of lost time due to injury was not able to be analyzed in the current study because only three participants reported time away from work. In a much larger sample, it is likely more participants would report days away from work and the variable could be used as a proxy of injury severity.

It is also important to recall that not all crashes experienced by the sample are the fault of the driver. Therefore, additional error exists in the outcome of crashes within the current study. In future studies, it would be ideal to be able to differentiate between crashes where the truck was at fault and those where the driver was not at fault. However, even when an accident may not be deemed to be the fault of the truck driver, it does not necessarily mean the truck driver did not engage in an unsafe behavior.

Conclusion

This study examined the role of co-worker support for safety within the wider safety climate-safety outcome model. Co-worker support for safety is an important construct to study because current models of safety climate neglect to consistently consider the influence of other employees who work with and around a given employee. While the current study did not show that co-worker support for safety acts as a buffer for negative safety climate, results did show that co-worker support for safety is a mediator

of the effect of safety climate variables on safety behavior and that co-worker support for safety accounts for additional variance in safety behavior beyond organization- and supervisor-level safety climate. I encourage the research community to pay additional attention to the role of co-workers within the broader safety climate model so that the health and safety of all workers may be continuously improved.

APPENDICES

Appendix A

Measures of Safety Climate

Organization-level Safety Climate Measure and Sub-dimensions

Proactive Practices.

Uses any available information to improve existing safety rules
Tries to continually improve safety levels in each department
Invests a lot in safety training for workers
Creates programs to improve drivers' health and wellness (e.g., diet, exercise)
Listens carefully to our ideas about improving safety
Cares more about my safety than on-time delivery
Allows drivers to change their schedules when they are getting too tired
Provides enough hands-on training to help new drivers be safe
Gives safety a higher priority compared to other truck companies
Reacts quickly to solve the problem when told about safety concerns
Is strict about working safely when delivery falls behind schedule
Gives drivers enough time to deliver loads safely
Fixes truck/equipment problems in a timely manner

Driver Safety Priority.

Will overlook log discrepancies if I deliver on time
Makes it clear that, regardless of safety, I must pick up/deliver on time
*Expects me to sometimes bend safety rules for important customers
*Turns a blind eye when we use hand-held cell phones while driving

Supervisory Care Promotion.

*Assigns too many drivers to each supervisor, making it hard for us to get help
*Hires supervisors who don't care about drivers
*Turns a blind eye when a supervisor bends some safety rules

Supervisor-level Safety Climate Measure and Sub-dimensions

Safety Promotion.

Compliments employees who pay special attention to safety
Provides me with feedback to improve my safety performance
Respects me as a professional driver
Frequently talks about safety issues throughout the work week
Discusses with us how to improve safety
Uses explanations (not just compliance) to get us to act safely
Is supportive if I ask for help with personal problems or issues
Is an effective mediator/trouble-shooter between the customer and me
Is strict about working safely even when we are tired or stressed

Gives higher priority to my safety than on-time delivery
Would like me to take care of serious equipment problems first before delivering
Gives me the freedom to change my schedule when I see safety problems
*Makes me feel like I'm bothering him/her when I call

Delivery Limits.

*Encourages us to go faster when deadheading (going for a new load)
*Expects me to sometimes bend driving safety rules for important customers
*Sometimes turns a blind eye with rules when deliveries fall behind schedule
*Pushes me to keep driving even when I call in to say I feel too sick or tired

Cell Phone Disapproval.

*Expects me to answer the cell phone even while I'm driving
Stops talking to me on the phone if he/she hears that I am driving
*Turns a blind eye when we use hand-held cell phones while driving

* Denotes a reverse-scored item.

Appendix B

Measure of Co-Worker Support for Safety

Instructions: If you are currently a team driver, please answer the following questions about your [Company] teammate. If you are NOT a team driver, please choose “not applicable”.

Strongly disagree / disagree / neutral/ agree / Strongly agree / Not applicable

My teammate is ready to talk to me when I fail to use safety equipment/procedures.

My teammate is prepared to stop me from working dangerously.

My teammate encourages me to work safely.

Appendix C

Measure of Safety Behavior

I always comply with the posted speed limits

*I occasionally jump to get out of my truck quickly

*I occasionally drive without getting enough sleep

*I sometimes find myself in a difficult situation without having a way out

I always use my log book legally

*When I'm tired or rushed, I some- times skip the daily vehicle inspection

* Denotes a reverse-scored item.

TABLES

Table 1

Means, standard deviations, and correlations for Team Truck Drivers

Variable	<i>M</i>	<i>SD</i>	1	2	3	4	5
1. OSC	4.24	0.78	(.94)				
2. GSC	4.10	0.75	0.79**	(.96)			
3. PCSS	4.66	0.76	0.30**	0.35**	(0.96)		
4. Safety Behavior	4.47	0.58	0.54**	0.51**	0.44**	(.69)	
5. Crash	0.22	0.42	0.08	0.03	0.13*	0.11*	-
6. Miles Driven per Year	22,954	9,912	-0.10	-0.10	-0.11	-0.06	0.01

Note. * $p < .05$, ** $p < .01$. Values on the diagonal are Cronbach's alpha values for each scale. Sample sizes ranged from 326 to 364. Crash is a dichotomous variable where 1 indicates a "yes" response and 0 indicates a "no" response. OSC = organization-level safety climate. GSC = supervisor-level safety climate. PCSS = co-worker support for safety

Table 2

Means, standard deviations, and correlations for Solo Truck Drivers

Variable	<i>M</i>	<i>SD</i>	1	2	3	4	5
1. OSC	4.08	0.69	(.92)				
2. GSC	4.22	0.72	.77**	(.94)			
3. Safety Behavior	4.44	0.65	.51**	.54**	(.76)		
4. Crash	0.25	0.44	0.03	0.02	.04*	-	
5. Miles Driven per Year	19,983.28	10,594.52	0.01	0.03	-0.0002	.05**	-

Note. * $p < .05$, ** $p < .01$. Values on the diagonal are Cronbach's alpha values for each scale. Sample sizes ranged from 3,038 to 3,717. Crash is a dichotomous variable where 1 indicates a "yes" response and 0 indicates a "no" response. OSC = organization-level safety climate. GSC = supervisor-level safety climate.

Table 3

Model summary and parameter estimates interaction between supervisor-level safety climate and co-worker support predicting safety behavior.

Model	<i>R</i>	<i>R</i> ²	Adj. <i>R</i> ²	Std. Error
1	0.58	0.33	0.33	0.48

Parameter estimates for the interaction between supervisor-level safety climate and co-worker support for safety predicting safety behavior.

Model	Parameter	<i>B</i>	Std. Error	β	<i>t</i> -value	<i>p</i> -value
1	Intercept	4.47	0.03	-	162.06	<.001
	GSC	0.31	0.04	0.40	8.44	<.001
	PCSS	0.23	0.04	0.30	5.47	<.001
	GSC*PCSS	0.001	0.04	0.001	0.02	0.984

Note. All predictors mean centered. GSC = supervisor-level safety behavior. PCSS = perceived co-worker support for safety. DV = safety behavior.

Table 4

Model summary and parameter estimates interaction between organization-level safety climate and co-worker support predicting safety behavior.

Model	R	R ²	Adj. R ²	Std. Error
1	0.61	0.37	0.36	0.47

Parameter estimates for the interaction between organization-level safety climate and co-worker support for safety predicting safety behavior.

Model	Parameter	B	Std. Error	β	t-value	p-value
1	Intercept	4.48	0.03	-	168.70	<.001
	OSC	0.34	0.04	0.44	9.60	<.001
	PCSS	0.22	0.04	0.28	5.54	<.001
	OSC*PCSS	-0.05	0.04	-0.06	-1.17	0.244

Note. All predictors mean centered. OSC = organization-level safety behavior. PCSS = perceived co-worker support for safety. DV = safety behavior.

Table 5

Parameter estimates of the interaction between organization-level safety climate and co-worker support for safety predicting crashes in a logistic regression

Predictor	B	SE	$\Delta\chi^2_{removal}$	Odds Ratio	95% CI for Odds Ratio	
					Lower	Upper
Constant	-1.58	0.37	--	--	--	--
Miles	5.36E-06	7.10E-06	0.58	1.00	1.00	1.00
OSC	0.30	0.21	2.15	1.36	0.90	2.05
PCSS	0.50	0.28	4.24*	1.65	0.96	2.85
OSC*PCSS	-0.55	0.4	2.03	0.58	0.27	1.26

Note. * $p < .05$, Model $\chi^2 = 325.40$, $df = 4$, $n = 326$, $R^2_L = 0.03$. Initial -2 Log Likelihood (-2LL) = 336.53, Model -2 LL with predictors = 11.12. OSC = organization-level safety climate. PCSS = perceived co-worker support for safety. Miles driven = miles driven per year and is included as a control variable. DV = crashes.

Table 6

Parameter estimates of the interaction between supervisor-level safety climate and co-worker support for safety predicting crashes in a logistic regression

Predictor	B	SE	$\Delta\chi^2_{removal}$	Odds Ratio	95% CI for Odds Ratio	
					Lower	Upper
Constant	-1.52	0.37	--	--	--	--
Miles	4.69E-06	7.14E-06	0.44	1.00	1.00	1.00
GSC	0.07	0.21	0.13	1.08	0.72	1.61
PCSS	0.51	0.28	4.13*	1.66	0.96	2.87
GSC*PCSS	-0.66	0.4	3.05	0.52	0.24	1.14

Note. * $p < .05$, Model $\chi^2 = 325.43$, $df = 4$, $n = 326$, $R^2_L = 0.03$. Initial -2 Log Likelihood (-2LL) = 336.53, Model -2 LL with predictors = 11.09. GSC = organization-level safety climate. PCSS = perceived co-worker support for safety. Miles driven = miles driven per year and is included as a control variable. DV = crashes.

Table 7

Indirect effects and effect sizes for hypothesized path models

Hypothesis	Path	Indirect Effect	Boot St. Error	CI	Effect Size
1b	GSC → PCSS → Safety Behavior	0.0783	0.0241	.0399 - .1336	0.2037
2b	OSC → PCSS → Safety Behavior	0.0707	0.0227	.0352 - .1248	0.1724
3b	OSC → PCSS → Crash	0.1720	0.1038	.0433 - .4379	0.5552
4b	GSC → PCSS → Crash	0.2280	0.1237	.0657 - .5300	-
5a	OSC → GSC → PCSS	0.2368	0.0933	.0663 - .4302	0.7911
5b	OSC → GSC → Safety Behavior	0.1373	0.0529	.0344 - .2418	0.3304
-	OSC → GSC → PCSS → Safety Behavior	0.0526	0.0238	.0141 - .1067	0.1283
-	OSC → GSC → PCSS → Safety Behavior → Crash	0.0266	0.0222	.0001 - .0905	0.0859

Note. The indirect effects, standard errors, and confidence intervals presented were obtained through 5,000 bootstrapped samples. The effect size is the proportion of the total effect accounted for by the indirect effect. CI = confidence interval. OSC = organization-level safety climate. GSC = supervisor-level safety climate. PCSS = co-worker support for safety.

Table 8

Model summary and parameter estimates for 4-path mediation analysis

Model	R	R ²	MSE	F	df1	df2	Sig.
1	0.79	0.63	0.22	560.4	1	336	<.001
2	0.35	0.12	0.51	23.27	2	335	<.001
3	0.61	0.37	0.22	66.23	3	334	<.001
Model	-2LL	Model LL	n				
4	334.44	13.05	338				

Model	Parameter	B	Std. Error	t-value	Sig.
DV = GSC					
1	Intercept	0.003	0.03	0.14	0.888
	OSC	0.81	0.03	23.67	<.001
DV = PCSS					
2	Intercept	0.02	0.04	0.42	0.675
	GSC	0.29	0.08	3.56	<.001
	OSC	0.06	0.08	0.74	0.457
DV = Safety Behavior					
3	Intercept	-0.01	0.03	-0.28	0.782
	PCSS	0.22	0.04	6.23	0.005
	GSC	0.11	0.06	2.05	0.041
	OSC	0.25	0.05	4.6	<.001
DV = Crashes					
	B		Std. Error	Z-value	Sig.

4	Intercept	-1.42	0.15	-9.63	<.001
	Safety Behavior	0.51	0.34	1.51	0.131
	PCSS	0.51	0.29	1.73	0.084
	GSC	-0.53	0.31	-1.68	0.092
	OSC	0.44	0.33	1.33	0.183

Note. Model 4 included a dichotomous outcome and logistic regression was used. OSC = organization-level safety climate. GSC = supervisor-level safety climate. PCSS = perceived co-worker support for safety. Miles = miles driven per year.

Table 9

Model summary and parameter estimates predicting safety behavior

Model	<i>R</i>	<i>R</i> ²	Adj. <i>R</i> ²	Std. Error	Change Statistics				
					ΔR^2	ΔF	df1	df2	$\Delta \text{Sig. } F$
1	0.06	0.004	0.001	0.59	0.004	1.33	1	348	0.25
2	0.53	0.28	0.28	0.50	0.28	130.41	1	336	<.001
3	0.55	0.30	0.30	0.50	0.02	9.81	1	335	0.002
4	0.61	0.37	0.37	0.47	0.07	38.83	1	334	<.001

Note. Predictors model 1 = miles driven per year. Removed from subsequent models. Predictors model 2 = organization-level safety climate. Predictors model 3 = organization-level safety climate, supervisor-level safety climate. Predictors model 4 = organization-level safety climate, supervisor-level safety climate, perceived co-worker support for safety. DV = safety behavior.

Table 9 continued

Parameter estimates for organization-level safety climate, supervisor-level safety climate, and perceived co-worker support for safety predicting safety behavior

Model	Parameter	<i>B</i>	Std. Error	β	<i>t</i> -value	<i>p</i> -value
1	Intercept	4.55	0.08	-	57.47	<.001
	Miles	-0.000002	1E-10	-0.60	-1.15	0.25
2	Intercept	4.47	0.03	-	165.40	<.001
	OSC	0.41	0.04	0.53	11.42	<.001
3	Intercept	4.47	0.03	-	167.53	<.001
	OSC	0.27	0.06	0.34	4.61	<.001
	GSC	0.18	0.06	0.23	3.13	0.002
4	Intercept	4.47	0.03	-	176.55	<.001
	OSC	0.25	0.06	0.33	4.60	<.001
	GSC	0.11	0.06	0.15	2.05	0.041
	PCSS	0.22	0.04	0.29	6.23	<.001

Note. Miles = miles driven per year. OSC = organization-level safety climate. GSC = supervisor-level safety climate. PCSS = perceived co-worker support for safety. DV = safety behavior.

Table 10

Parameter estimates for driver type predicting safety behavior

Predictor	<i>B</i>	<i>St. Error</i>	Sig.
Constant	4.401	0.04	<.001
Driver Type	0.037	0.035	0.298

Parameter estimates for co-worker support for safety predicting safety behavior

Predictor	<i>B</i>	St. Error	Sig.
Constant	2.899	0.179	<.001
PCSS	0.337	0.038	<.001

Predicted values for co-worker support predicting safety behavior

Level of Support (x)	Outcome (y)	df	<i>t</i> -value
1	3.236	336	-39.27*
2	3.573	336	-28.26*
3	3.91	336	-17.25*
4	4.247	336	-6.24*
5	4.584	336	4.77*

Table 11

Parameter estimates for driver type predicting crash outcome

Variable	B	St. Error	Sig.
Constant	-1.079	0.04	<.001
Driver Type	-0.148	0.13	0.185

Predicted values of crash outcomes by driver type

Predicted Crash Outcome by Driver Type			
	Logit	Odds	Probability
Solo	-1.08	0.34	0.25
Team	-1.25	0.29	0.22

Parameter estimates and predicted values for co-worker support predicting crashes

Variable	B	St. Error	Sig.
Constant	-4.37	1.36	0.001
PCSS	0.64	0.28	0.022

Predicted values for co-worker support predicting crash outcomes

Predicted Crash Outcome by Levels of Support for Team Drivers			
Levels of Support (X)	Logit	Odds	Probability
1	-3.73	0.02	0.02
2	-3.09	0.05	0.04
3	-2.45	0.09	0.08
4	-1.81	0.16	0.14
5	-1.17	0.31	0.24

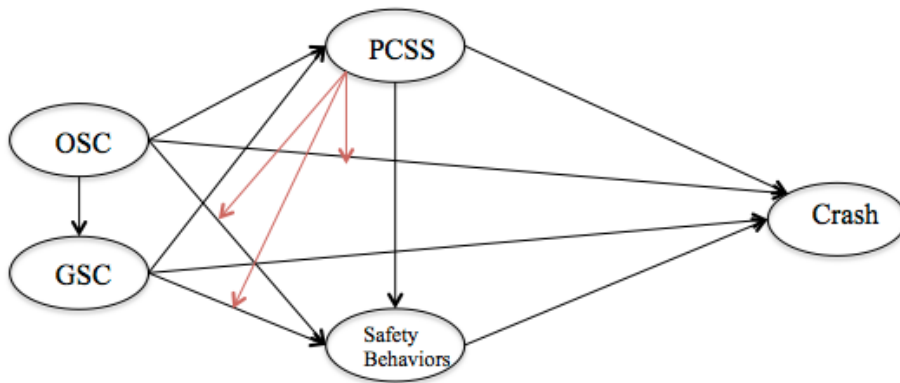
FIGURES

Figure 1. Base model.



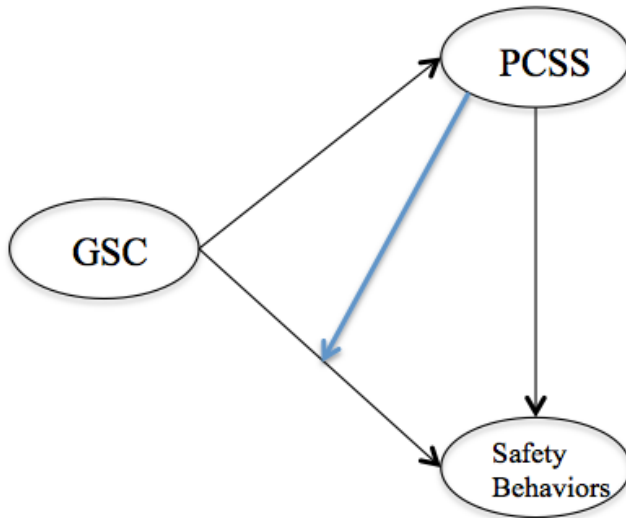
Note. OSC = organization-level safety climate. GSC = supervisor-level safety climate.

Figure 2. Conceptual model.



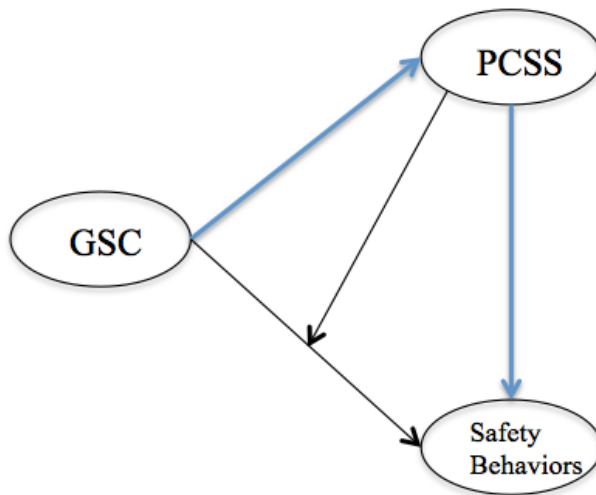
Note. OSC = organization-level safety climate; GSC = supervisor-level safety climate; PCSS = perceived co-worker support for safety.

Figure 3. Co-worker support for safety as a moderator of the relationship between supervisor-level safety climate and safety behavior.



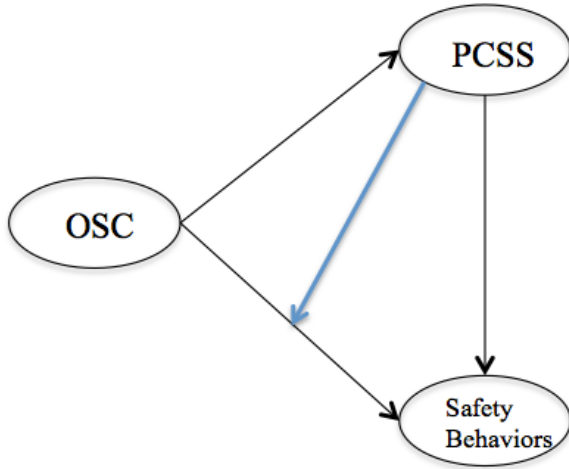
Note. GSC = supervisor-level safety climate; PCSS = perceived co-worker support for safety.

Figure 4. Co-worker support for safety as a partial mediator of the relationship between supervisor-level safety climate and safety behavior.



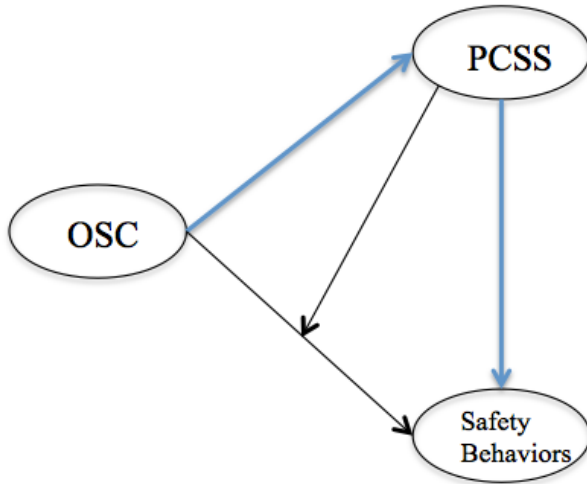
Note. GSC = supervisor-level safety climate; PCSS = perceived co-worker support for safety.

Figure 5. Co-worker support for safety as a moderator of the relationship between organization-level safety climate and safety behavior.



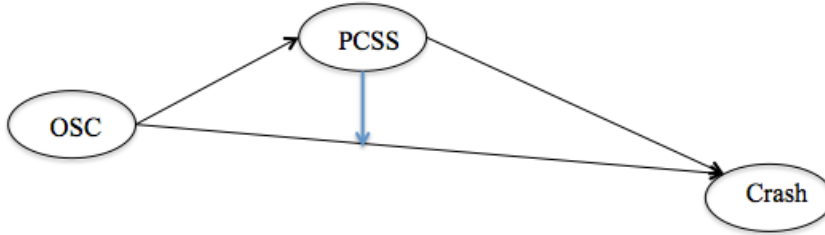
Note. OSC = organization-level safety climate; PCSS = perceived co-worker support for safety.

Figure 6. Co-worker support for safety as a partial mediator of the relationship between organization-level safety climate and safety behavior.



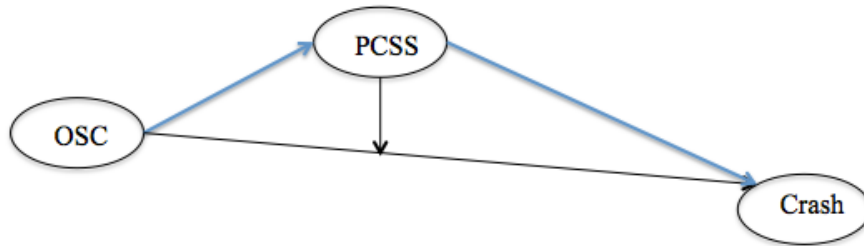
Note. OSC = organization-level safety climate; PCSS = perceived co-worker support for safety.

Figure 7. Co-worker support for safety as a moderator of the relationship between organization-level safety climate and crashes.



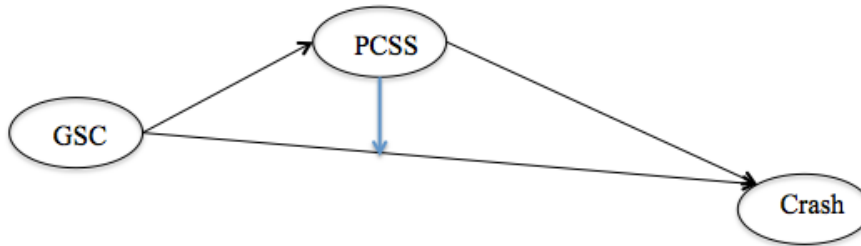
Note. OSC = organization-level safety climate; PCSS = perceived co-worker support for safety.

Figure 8. Co-worker support for safety as a partial mediator of the relationship between organization-level safety climate and crashes.



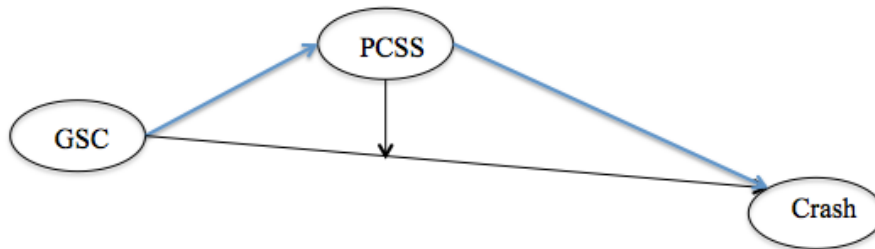
Note. OSC = organization-level safety climate; PCSS = perceived co-worker support for safety.

Figure 9. Co-worker support for safety as a moderator of the relationship between supervisor-level safety climate and crashes.



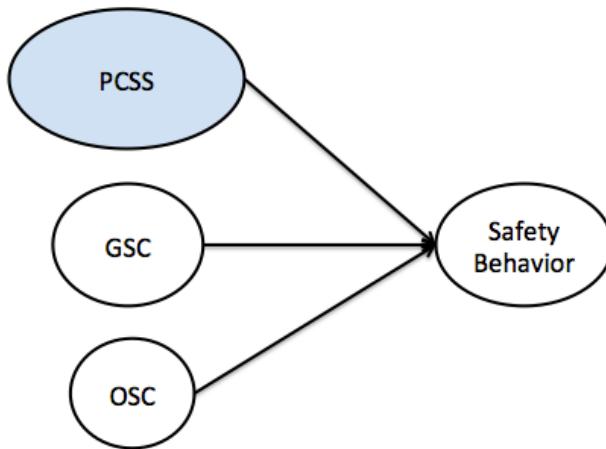
Note. GSC = supervisor-level safety climate; PCSS = perceived co-worker support for safety.

Figure 10. Co-worker support for safety as a partial mediator of the relationship between supervisor-level safety climate and crashes.



Note. GSC = supervisor-level safety climate; PCSS = perceived co-worker support for safety.

Figure 11. The incremental effect of co-worker support for safety beyond organization- and supervisor-level safety climate.



Note. OSC = organization-level safety climate; GSC = supervisor-level safety climate; PCSS = perceived co-worker support for safety.

Figure 12. Model and unstandardized path coefficients for mediation effect of co-worker support for safety on the relationship between supervisor-level safety climate and safety behavior.

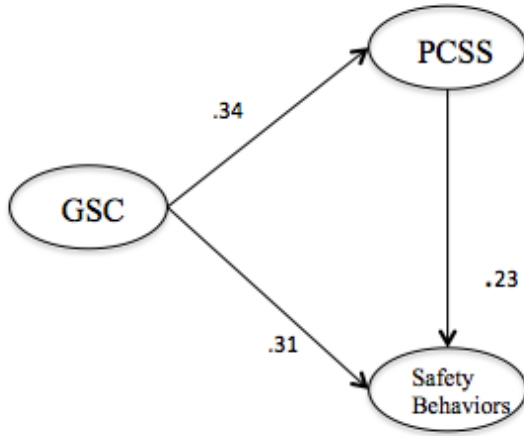


Figure 13. Model and unstandardized path coefficients for mediation effect of co-worker support for safety on the relationship between organization-level safety climate and safety behavior.

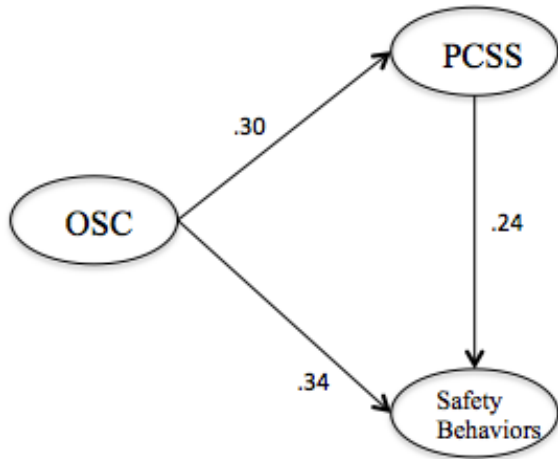


Figure 14. Model and unstandardized path coefficients for mediation effect of co-worker support for safety on the relationship between organization-level safety climate and crash outcomes.

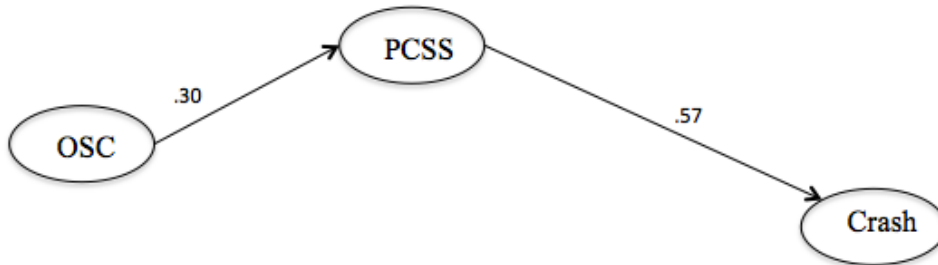


Figure 15. Model and unstandardized path coefficients for mediation effect of co-worker support for safety on the relationship between supervisor-level safety climate and crash outcomes.

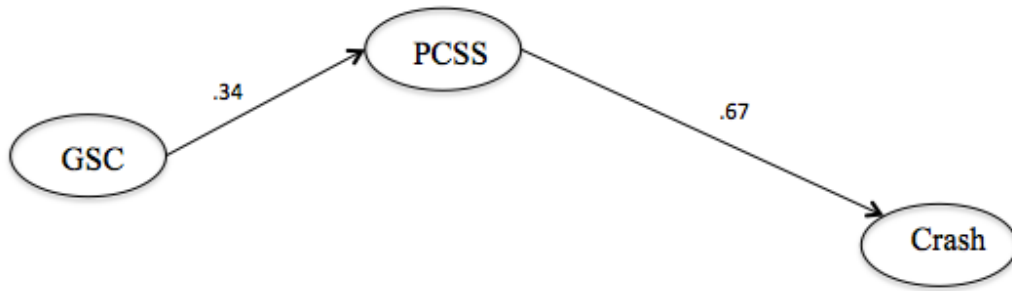


Figure 16. Model and unstandardized path coefficients for mediation effect of supervisor-level safety climate on the relationship between organization-level safety climate and co-worker support for safety.

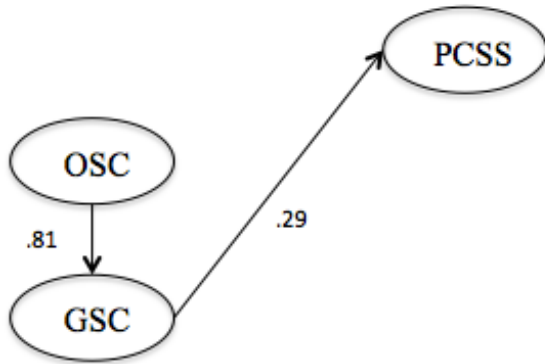


Figure 17. Model and unstandardized path coefficients for mediation effect of supervisor-level safety climate on the relationship between organization-level safety climate and safety behavior.

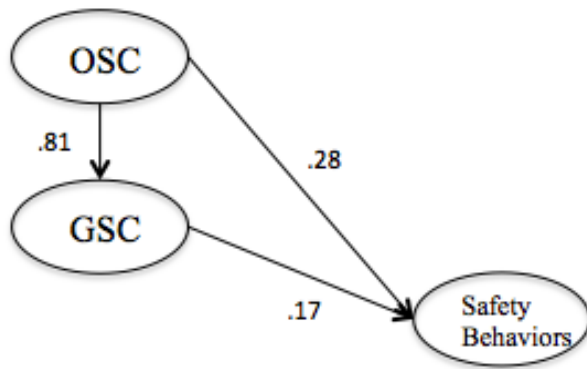


Figure 18. Model and unstandardized path coefficients for 3-path mediation model linking organization-level safety climate to safety behavior.

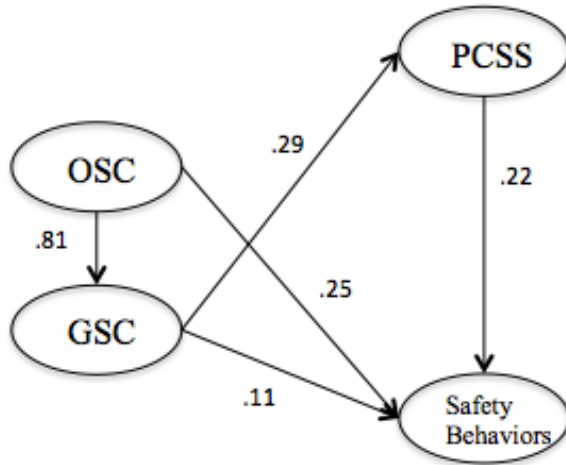


Figure 19. Four-path mediation model tested with PROCESS macro.

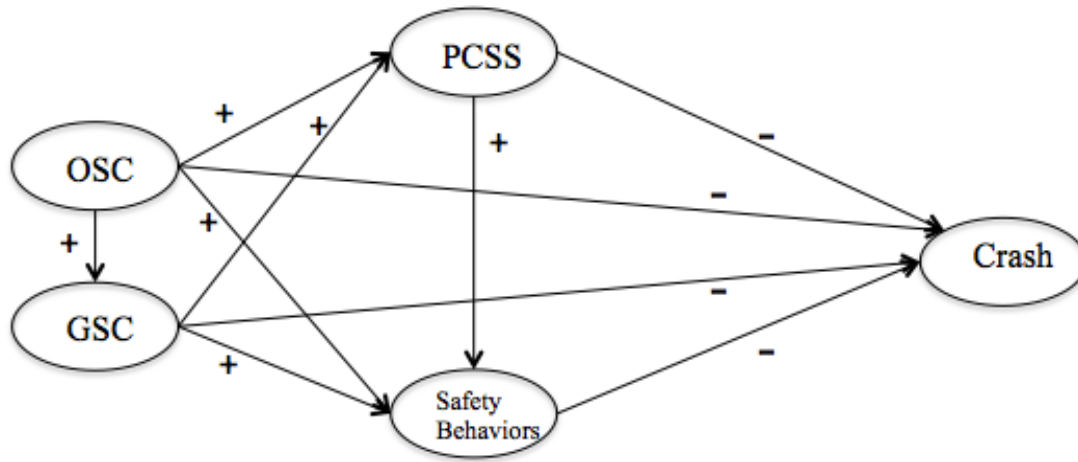
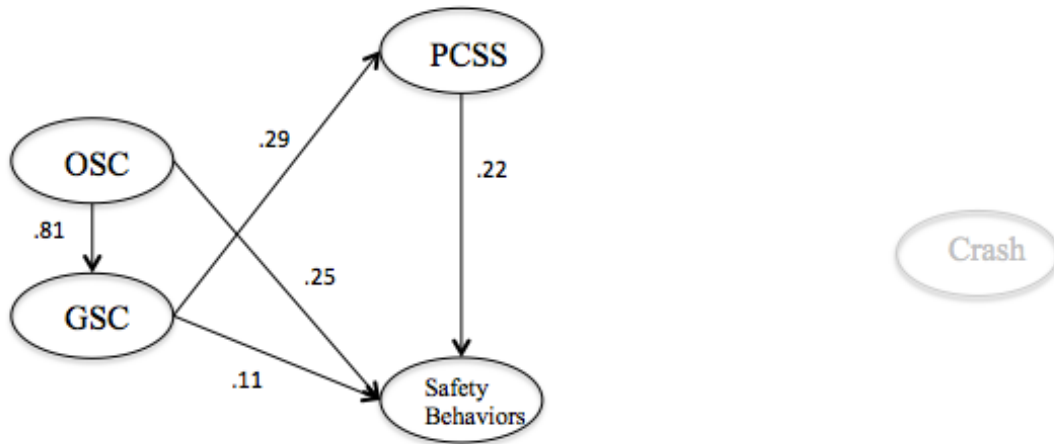


Figure 20. Results of mediation analyses with PROCESS macro. All non-significant paths have been removed from the model. All coefficients are unstandardized.



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