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Safety Climate and Safety Performance Management for Improved Road Safety Practices in the transport sector

S. Keffane

Department of Psychology, University Setif 2, Setif, Algeria.

keffane1967@yahoo.fr

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Abstract: Road accidents in the World in recent years leave much to be desired. Road accidents have become an international canker eating deep into the core fabric of peoples' lives. Safety climate among organizations could play an important role in increasing road safety. This study tests the proposition that the organizational climate-behavior relationship is based primarily on extrinsic Safety Performance Management induced by climate perceptions. Using safety climate as exemplar, the effect of climate-induced extrinsic Safety Performance was compared with that of engagement-induced intrinsic Safety Performance Management on Improved Road Safety Practices in the transport sector and subsequent injury outcomes. Using a sample of Bus and truck drivers representing 290 employees, (individual-level) safety climate perceptions and employee engagement predicted safety Performance Management, which mediated their effect on subsequently measured road injury outcomes. Consistent with mea-analytic evidence suggesting a non-symmetric compensatory relationship between extrinsic and intrinsic Safety Performance Management on the transport sector. The results of this study would help the concerned transport sector in improving their ability to assess the road safety indicators and to the future development of the safety performance management for road safety practices in transport sector.

1. Introduction

Road accidents in the World in recent years leave much to be desired. Road accidents have become an international canker eating deep into the core fabric of peoples' lives. According to the World Health Organization (2013), injuries resulting from road accidents are significant causes of deaths worldwide.

According to the World Health Organisation (WHO) 1.3 mil-lion people die annually as a result of road traffic accidents, which equates to more than 3000 deaths each day, globally. The economic consequences of motor vehicle crashes have been estimated to fall between 1% and 3% of the respective GNP of the world countries, reaching a total of over $500 billion annually (WHO, 2013). The World Health Organization (2013), chap. 2 also report that work-related road accidents are significant causes of deaths at the workplace. Globally, the risk of dying through road accidents is estimated at 18 per 100,000 populations, 10.3 per 100,000 population in Europe and 24.1 per 100,000 populations in Africa (World Health Organization, 2013).

In Algeria the statistics of road crashes (Algeria Interior Ministry, 2017); revealed a number of 19 559 road crashes, 2827 people that lost their lives, 28 647 were injured.

According to these statistics, what can companies do to maintain the employees' safety, Employees in the transport sector reported that work affects their health negatively more likely than employees from other sectors. Psychological safety climate and time pressure are relevant antecedents of drivers well-being. The psychological safety climate acts as a relevant frame of reference for lone/remote workers, such as drivers (Huang et al., 2013a), because they work alone and without in-person direct supervision or support from others (Huang et al., 2013b). With respect to time pressure, it is a crucial stressor among drivers (e.g., Coeugnet, Naveteur, Antoine, & Anceaux, 2013; Dorn, Stephen, af Wåhlberg, & Gandolfi, 2010; Naveteur, Coeugnet, Charron, Dorn, & Anceaux, 2013; Paillé, 2011); indeed, employees in the transport sector reported higher quantitative job demands related to time pressure (working at very high speed, working to tight deadlines, frequent disruptive interruptions, and not having enough time to do the job) than those pertaining to other sectors (Eurofound, 2016).

Safety climate is generally defined as employees' transport sector shared perceptions of their organization's policies, procedures, and practices in regards to the value and importance placed on safety (Zohar, 1980, 2000). According to Zohar (2008, 2010), safety climate should be measured using a framework that distinguishes between organization-level (employees' transport sector perceptions of top management commitment to and prioritization of safety) and group-level (employees' perceptions of direct supervisor or workgroup commitment to safety) safety climate perceptions (Huang et al., 2013). Considering the social and financial implications of work-related road traffic crashes, there is an urgency to investigate the maturity of risk management in workplace road safety. Although work-related driver safety has been given some attention in the scientific literature, it is uncertain how well this knowledge has been translated to industry. This is due to two reasons. First, workplace road safety has not been well integrated within Occupational Health and Safety (OHS) system (Newman et al., 2002, 2012). The work vehicle is now considered to be part of the workplace; however, there has been significant lag in the acknowledgement of this, particularly in light vehicle fleets (Newman and Watson, 2011). Second, there is a lack of understanding regarding what constitutes 'best practice' in risk management. With the exception of a few case studies (e.g., Wallington et al., 2014) that describe effective fleet safety programs, there is limited research to guide practitioners in the establishment of best practice.

Previous traffic safety climate studies have examined the link between traffic safety climate and traffic safety outcomes, which can provide some inspiration. For example, Wills et al. (2006) performed hierarchical regression analyses and discovered that safety climate factors accounted for significant amounts of variance in work-related driving (i.e., traffic violations, driver error, driving while distracted, and pre trip vehicle maintenance), even after controlling for the influence of age, sex, and work-related driving exposure. Similarly, Amponsah-Tawiah and Mensah (2016) identified a negative relationship between the safety climate and risk work-related driving behaviors (i.e., speeding, rule violation, inattention and driving while tired). The results of a standard multiple regression analysis revealed that when drivers perceive their traffic environment to be positive, they tend to reduce their speed, adhere to traffic regulations, pay attention to the road and avoid driving when tired. Some studies have demonstrated that the traffic safety climate may serve as a mediating factor. Naveh and Katznavon (2015) found that the road safety climate mediated the relationship between road safety intervention and the number of traffic violation tickets. However, few studies have investigated the relationship between the traffic safety climate and pedestrian behavior. Despite the wealth of research regarding climate-outcome relationships (Kuenzi & Schminke, 2009), there is limited work testing mechanisms capable of explaining this relationship and the above arguments have remained little studied, if at all.

The purpose of the present study was to test extrinsic safety performance management in the transport sector as an explanatory mechanism for the well-validated climate-outcome relationship. Doing likewise, using safety climate as exemplar, is expected to expand organizational climate theory at large. Our first contribution to the literature is to extend prior literature concerning the distinct and interactive roles of safety climate and safety management performance outcomes. Extensive research, summarized in several meta-analytic reviews, demonstrates the importance of safety climate in predicting safety outcomes (Beus et al.,2010; Christian et al., 2009; Clarke, 2006a, 2010; Griffin and Neal, 2000; Nahrgang et al., 2011). Our second contribution concerns the nature of our sample. We focus on drivers who have received relatively little attention in safety climate literature despite the importance of safety for these workers. Transportation-related incidents are the number one cause of workplace fatalities in the United States, and truckers have a disproportionate share of those incidents (Bureau of Labor Statistics, 2014). From a theoretical perspective, an example of lone workers for whom safety climate-related processes may operate differently than for workers aggregated into larger units (e.g.,Huang et al., 2013; Olson et al., 2009) and for whom communication with their supervisor may be especially important, as the supervisor often is their only link to the broader organization. Our study extends prior research (employees' transport sector driving safety by investigating the effects of both safety performance management and safety climate. We link these antecedents to two outcomes relevant to employees' transport sector: (1) self-reports of safe driving performance and (2) an objective measure of days lost to injuries.

This study extends previous research in several ways. First, research on the antecedents of employees' transport sector well-being is less developed as compared to research on driving performance both in the field of safety climate research (Amponsah-Tawiah & Mensah, 2016; Huang et al., 2017; Naveh & Katz-Navon, 2015; Öz & Lajunen, 2014; Zohar, Huang, Lee, & Robertson, 2015; Zohar & Lee, 2016) and in the stress field (Coeugnet et al., 2013; Ge et al., 2014; Qu, Zhang, Zhao, Zhang, & Ge, 2016; Rendon-Velez et al., 2016; Rowden, Matthews, Watson, & Biggs, 2011).Second, the mechanisms underlying the linkage between psychological safety climate and individuals' well-being remain unexplored. Third, previous research has focused on the effect of composite measures of job demands on well-being (e.g., Alarcon, 2011; Consiglio, Borgogni, Alessandri, & Schaufeli, 2013), neglecting the single effect of specific demands, such as time pressure, which are critical among professional drivers. Finally, research conducted in remote working environments is scarce and should be encouraged (Huang et al., 2014).

2. Safety Climate In Transport Sector

The safety climate of an organization is the set of perceptions and expectations employees' transport sector have about how safe their organization is (Griffin & Neal, 2000). Safety climate has also been conceptualized as being a component of organizational climate, indicating that it exemplifies a sub-climate that reflects how employees perceive an organizations safety practices and culture (Hayes, Bartle, & Major, 2002; Neal, Griffin, & Hart,2000), Psychological safety climate refers to individual perceptions (James & James, 1989) of policies, practices, and procedures focused on safety (Christian, Bradley, Wallace, & Burke, 2009; Zohar, 2010) and their interrelationship with those related to other competing goals (e.g., productivity or efficiency) that establish the relative priority of safety (Zohar, 2003).

This study focuses on employees' transport sector rather than group safety climate—shared perceptions among employees' transport sector in a particular work environment—in accordance with other studies based on remote/lone workers (Amponsah-Tawiah & Mensah, 2016; Huang et al., 2013a, 2017; Zohar et al., 2015). Remote/lone workers, due to their limited interaction with coworkers and supervisors, do not have many opportunities to reconcile their individual perceptions with their coworker's perceptions, which makes the emergence of shared safety climate perceptions difficult (Huang et al.,2017; Zohar et al., 2015). Employees' transport sector perceptions of the prevailing safety climate in their organization tend to influence their behaviors at work, particularly driving safety behaviors. Safety climate predicts safety behavior and safety outcomes (such as accidents and injuries) at the workplace. (Beus, Payne, Bergman, & Arthur, 2010; Christian et al., 2009).

The original paper on safety climate defined it as "shared employees' transport sector perceptions about the relative importance of safe con-duct in their occupational behavior" (Zohar, 1980; p. 96). This definition identifies safety climate as consensual or shared social cognition regarding the relative importance or priority of driving safely. A positive safety climate will increase the frequency of safe driving among employees' transport sector even when it means failing to meet competing demands such as falling behind schedule. Recent meta-analytic results, covering some two hundred published studies, support the safety climate-behaviour relationship, suggesting it is one of the strongest predictors of organizational safety performance (Beus et al., 2010; Christian et al.,2009; Clarke, 2010; Nahrgang et al., 2011).

Safety climate assumes that; first, employees' transport sectors are constantly faced with irreconcilable and ambiguous demands from management and immediate supervisors. Second, policies and regulations are developed by management; however the implementations and interpretations of these policies and regulations are executed by supervisors. Most often, in the interpretation of management's mandate, supervisors exercise a great deal of flexibility leading to incongruence among supervisory groups (Zohar & Luria, 2005). The implications thereof from these assumptions are that, in the face of competing demands, employees and supervisors will select highly prioritized behaviors in the organization. Thus, employees are likely to choose safe behaviors if safety is highly prioritized in the organization or select speed when faced with competing demands if productivity is highly prioritized over safety. Thus, the decision for drivers to engage in safe driving behaviors when faced with competing and conflicting demands is based on the extent to which organizations prioritize safety. Even though these theoretical arguments support the linkage between psychological safety climate and time pressure, this relationship remains unexplored. Additionally, research on the influence of other facet-specific aspects of organizational climate on different job-specific demands is inconclusive (e.g., Idris, Dollard, Coward, & Dormann, 2012). Several authors (Dollard et al., 2012) have provided longitudinal evidence on the cross-level positive effect of climate for psychological well-being on workload (Dollard et al., 2012), work pressure (Dollard & Bakker, 2010), and emotional demands (Dollard & Bakker, 2010; Idris, Dollard, & Yulita, 2014). However, (Idris et al., 2012) showed partial support for the influence of team climate for psychological well-being on workload, psychological (e. g., work pace), and emotional demands. Moreover, unexpectedly, none of the other climate measures included in this study (team psychological climate and climate for physical safety) were associated with job demands.

3. Safety performance management In Transport Sector

The Safety performance management in Transport Sector is used as a rather efficient strategy to approach the wide audience in terms of promoting road safety, improving driving behavior and contributing to less road accidents, injuries and fatalities (Zohar, D., 2008, Zohar, D., 2010). Research in the area of road safety became prominent during the past three decades. Its primary objective is to predict safety related outcomes such as accidents and injuries in order to provide valuable guidance for improving safety in Algerian Transport Sector. This requires extensive knowledge, not only about the various aspects that influence safety, but also as to how this influence occurs. The fact that organizational and social factors do influence safety performance led to extensive research in the field of safety culture and safety climate (Huang, Y. H et al., 2013, Newnam, S et al., 2002, Beus, J.M et al., 2010).

(Christian, M.S et al., 2009) took safety climate as a single factor containing management values, communication, training, and safety systems and studied the mediating role of safety knowledge and motivation on the relationship between safety climate and safety behavior. (Clarke, S., 2006a) Operationalized perceived safety climate as management commitment, supervisor support, co-worker support employee participation, and competence level in the study looking for mediators in safety climate safety performance relationship. (Clarke, S., 2010) included management commitment To safety, return to work practices, post-injury administration and safety training as the constituents of safety climate while analyzing the mediating role of safety control of the relationship between safety climate and safety performance. (Neal, A et al., 2000) took safety attitudes and communication as the factors in safety climate while assessing the mediating role of psychological strain in the safety climate safety performance relationship. In another study, (Nahrgang, J. D et al., 2011) opined that safety climate constitutes of CEO's safety commitment, managers' safety committee, employees' safety commitment, emergency response and perceived risk. In the study of (U.S. Bureau of Labor Statistics, 2008a), the mediating role of attitudinal ambivalence of employees towards personal protective equipment on the relationship between safety climate and unsafe behavior was investigated.

This study considered Algerian Transport Sector safety concern, senior managers' safety concern, work pressure and supervisors' attitude towards safety as the dimensions of safety climate. It is evident from these studies that the choice of safety climate dimensions can partially be determined by practical interest (Clarke, S., 2010). In light of the research presented above, it is argued here that construction workers who feel more comfortable to raise and discuss safety issues with their supervisors, should be more likely to initiate and engage in such performance management, and thus become more competent in safety procedures and policies, as well as more aware of the consequences of unsafe behaviors and of potential workplace hazards (Huang, Y. H et al., 2013, Olson, R et al., 2009).

As (Olson, R et al., 2009) state, "one way in which good quality communications allow employees to behave safely is to provide them with the information they need to work safely. Summary, the perceptions of managers and employees at the level of the selected safety performance management in road safety practices implemented in their organizations are considered as organizational factors which can influence their safety performance. Hence, the above safety performance management on road safety practices is considered as antecedents of safety performance in this study. Even though traditional measures of safety performance rely primarily on some form of accident or injury data, safety related behaviors such as safety compliance and safety participation can also be considered as components of safety performance. Safety compliance represents the behavior of the employees in ways that increase their personal safety and health. Safety participation represents the behavior of employees in ways that increase the safety and health of co-workers and that support an organization's stated goals and objectives (Amponsah-Tawiah, K., & Mensah, J. 2016). The model proposed by (Huang, Y.-H., 2017) based on the theories of job performance (Naveh, E., & Katz-Navon, T. (2015), Öz, B., & Lajunen, T. (2014) distinguishes between the antecedents of performance, determinants of performance and components of performance. (Christian, 2009) Considered safety climate as antecedent of safety performance, safety knowledge and safety motivation as determinants of safety performance and safety compliance and safety participation as components of safety performance.

In another study, (Öz, B., & Lajunen, T. (2014) measured safety motivation and safety knowledge as two individual attitudes to safety. Self-rated safety behavior was measured by three safety behavior measures. They were named as structural safety behavior (concerning participation in organized safety activities), instructional safety behavior (concerning safety activities in the daily work in interaction with co-workers and management) and personal safety behavior (measuring behavior promoting personal protection). Considering the above studies, the authors included the perceptions of the employees in the six identified safety management practices as the antecedents of safety performance in the current study. The determinants of safety performance were measured by safety motivation and safety knowledge and components of safety performance were measured by safety compliance and safety participation in this study.

4. Methodology

4.1. Participants

The participants for this study were drivers of haulage companies in Setif, Algeria. Haulage company drivers are individuals who earn a living as drivers or individuals employed by organizations to provide the services of transporting goods and humans (mainly employees of the organization) from one destination to the other. To participate in this study, a participant needed to be a driver of a haulage company who drives almost every week transporting goods and humans. Systematic sampling was used to select studied organizations from a list of haulage companies in Setif, Algeria. Organizations from which participants were drawn from every 2nd organization on the list of haulage companies in Setif, Algeria. In all data was collected from participants of 10 haulage companies in Setif, Algeria. The convenience sampling technique was adopted in the sampling of participants from the randomized organizations. Thus studied participants were employees that were readily available and accessible. In all 350 questionnaires were distributed and 290 duly completed and returned. Thus a response rate of 82.86% was attained. Table 1 Below presents the demographic details of the studied sample.

Table 1. Profiles of respondents (N = 290)

Characteristics		%
Age	(20-25) years	5,7
	(25-30) years	18,6
	(30-35) years	30
	(35-40) years	15,7
	(40-45) years	18,6
	(45-50) years	8,6
	(50-55) years	2,9
Job experience	(1-5) years	8,6
	(5-10) years	44,3
	10-15) years	18,6
	15-20) years	24,3
	(20-25) years	4,3
Gender	Male	62,9
	Female	37,1

Experience driver's license	(1-5) years	10
	(5-10) years	17,1
	(10-15) years	31,4
	15-20) years	20
	(20-25) years	15,7
	(25-30) years	5,7
Job category	Manager	34,78
	Employee	65,22

4.2. Measures

4.2.1. Transport sector safety climate (TSSC)

Transport sector safety climate was measured with a recently developed and validated 40-item scale referring to perceived company policies and procedures and dispatcher practices (Huang et al., 2013). Scale items are accompanied by a 5-point scale ranging from Strongly Disagree (1) to Strongly Agree (5). As noted above, testing of hypotheses are based on a brief 20-item version whose items refer specifically to expected outcomes of safe performance. Sample items include: Company makes it clear that, regardless of safety, I must pick up/deliver on time; Company expects me to sometimes bend safety rules for important customers; and Dispatcher compliments employees who pay special attention to safety. Alpha reliability coefficient for all scale items was □ = 0.78

4.2.2. Employee engagement

Employee engagement was measured with six items taken from a short version of the Utrecht Work Engagement Scale (UWES) developed by Schaufeli et al. (2006). This scale is among the most widely used scales for measuring this construct (Simpson, 2009). Sample items include: When I get up in the morning, I feel like going to work; When I am driving, I feel strong and full of energy; and I find the work that I do full of meaning and purpose. Scale items were accompanied by a 5-point scale ranging from Strongly Disagree (1) to Strongly Agree (5). Alpha reliability among items was □ = 0.88.

4.2.3. Driving safety

Driving safety was measured using six items adapted from Huang, Roetting, McDevitt, Melton, and Smith (2005) and interview responses collected for the original development of the TSC scale. Items of the driving safety scale refer to frequent safety shortcuts identified by bus or truck drivers. Item wording was designed to minimize social desirability bias. The sample items include: I always use the log book legally; I sometimes find myself in a difficult situation without having a way out; and when I am tired or rushed, I sometimes skip the daily vehicle inspection. Items were rated using a 5-point agreement scale (1 = strongly disagree to 5 = strongly agree). The reliability estimate (i.e., Cranach’s alpha) among scale items was □ = 0.75.

4.2.4. Road injury

Road injury was measured with the severity rate criterion, counting the number of lost workdays per 100 workers following a road-related injury (i.e. 106 employee hours) after excluding several statistical outliers associated with extensively long sick leaves. This criterion was chosen over injury frequency due to reporting inaccuracies associated with the latter (Kjellen, 2000). Road injury was defined as bodily harm resulting from self-inflicted collision between bus or truck and another (mobile or stationary) object. Data were collected from searchable electronic files maintained by the participating companies. Measurement of injury data started six months after the survey completion and covered a period of the following six months (i.e. ending 12 months after survey delivery). Such a delayed measurement of safety outcomes offers a more stringent test of predictive validity of variables in our conceptual model.

4.3. Statistical analysis strategy

Given that the road injury variable was a non-normally distributed count variable, we used zero-inflated Poisson regression with maximum likelihood estimation (Long, 1997). Numerical integration of the estimation was achieved with Monte Carlo simulation, using 500 integration points. Given that testing of the path from driving safety to road injury could not have used a log-linear regression coefficient or model fit indexes such as v2, TLI, or RMSEA, mediation effect was tested based on the 20,000 bootstrapped confidence interval of the estimated indirect effect (Pituch, Stapleton, & Kang, 2006), in addition to Sorel's tests. The bootstrapping method does not rely on the normality assumption unlike the Sorel's method. R open source program was used for the confidence interval estimation, while moderation and mediation effects were tested with Mplus 6.0 (Muthén & Muthén, 1998-2010).

5. Results

The first step in data analysis was testing the strength of the relationship between the full-length and brief versions of the TSSC scale. With a correlation coefficient of 0.96 ($p < 0.001$), our testing of hypotheses will proceed with the brief TSSC version. For the sake of comparison, results using the full TSSC scale are presented in Table 1.
Previous studies found that safety climate scales are often captured by single higher-order factor inducing lower-order ones (e.g. Griffin & Neal, 2000; James et al., 2008; Johnson, 2007; Zohar & Luria, 2005). Given the parsimony in theoretical modeling of such a factorial structure, confirmatory factor analyses (CFA) were conducted, comparing a single- vs. two-factor solution. Model fit indexes for a single-factor model were as follow:
X^2 (df) = 27415.33 (739), CFI = .97, and RMSEA = .070 (90% confidence interval = .069 ─.070), supporting this model's goodness of fit (Browne & Cudeck, 1993; Hair, Anderson, Tatham, & Black, 1998; Hu & Bentler, 1999).

Table2. Descriptive statistics, Cranach's and inter-correlations among variables. (Full TSSC scale)

	Mean	S.D.	1	2	3	4
1. Transport sector safety climate	4.22	.69	.98			
2. Engagement	4.55	.68	.59**	(.65)		
3. Driving safety	4.42	.58	.47**	.45**	(.64)	
4. Road injury	0.35	8.05	_.03	_.03	_.05**	(–)

Note:
Values within parentheses are Cranach's □ .
Road Injury is a non-normal count variable requiring caution in correlation interpretation.
** p < .01.

_ p < .10.

Given such results, the remainder of our analysis used a single TSSC score. Additionally, due to the fact that drivers were associated with different dispatchers in each company, we decided to proceed with subsequent analyses after controlling for possible group variance by using group-mean centering of the TSSC score (Bliese & Hanges, 2004). An omnibus CFA model including the TSSC, engagement, and driving safety variables was tested after parceling of the TSSC sub-factor items in order to verify the optimal parameter- to-sample-size ratio. Results indicated an acceptable fit with X^2 (df) = 3546.95 (98), CFI = .91, and RMSEA = .069 (90% confidence interval = .067 −.071). Employee engagement and driving safety scales similarly showed acceptable single-factor model fits. Specifically, the engagement scale's model fits were: X^2 (df) = 118.16 (2), CFI = .97, and RMSEA = .088 (90% confidence interval = .075 −.102), and the driving safety scale's model fits were: v2 (df) = 184.38 (9), CFI = .96, and RMSEA = .051 (90% confidence interval = .045 −.058). For the same reasons listed above, we estimated the effects of engagement and driving safety by using group-centered variables. Table 1 presents descriptive statistics and bi-variate correlations between variables in the statistical path model, using an individual level of analysis (n = 290).

5.1. Testing the conceptual model

To test moderation and mediation effects designated in our hypotheses, the path coefficient for each relationship was estimated. The outcomes of this analysis are presented in Table 2. Graphical representation of this analysis is offered with the un-standardized path coefficients. All the hypothesized direct and indirect effects as well as the moderation effect were statistically significant (degree of freedom = 3, Log-likelihood = −72099.82, AIC = 144241.64, BIC = 144372.96). TSSC scores significantly predicted driving safety behavior (coefficient = .29, S.E. = .02, p < .01), supporting. Driving safety behavior negatively and significantly predicted road injury data (coefficient = −.38, S.E. = .15, p < .01). The 95% confidence interval of the indirect effect of the TSSC→ Driving safety→ Road injury path was −.20 ~ −.02, supporting. Employee engagement offered incremental prediction of driving safety after controlling for TSSC (coefficient = .15, S.E. = .02, p < .01). Comparing the R2 statistics for driving safety behavior with and without inclusion of engagement in the path model resulted in R2 coefficients of .22 vs. .18. Thus, engagement resulted in incremental prediction of driving safety behavior over TSSC, supporting. Additionally, the indirect effect of engagement to road injury via driving safety was statistically significant (95% confidence interval = −.11~ −.01).

Table 3 .Direct and indirect effect testing of the hypothesized model relationships.

Path	Un-standardized coefficient (S.E.)	Indirect effect (S.E.)	Sobel's z	Bootstrapped 95% C.I.
Direct effects				
TSSC → Driving safety	.19 (.05)**	–	–	–
Engagement → Driving safety	.25 (.03)**	–	–	–
TSSC ˣ Egmt → Driving safety	−.11 (.04)**	–	–	–
Driving safety →Road injury	−.48 (.17)**	–	–	–
Indirect effects				
TSSC→ Driving safety → Road injury	–	−.12 (.05)	− 2.48*	−20 ~ −.02*

Engagement → Driving safety → Road injury	–		−.08 (.03)
−2.42*	−.11∼−.01*		

Notes.
TSSC: Transport sector safety climate (brief version).
'TSSC ˣ Egmt' is an interaction term of TSSC and Engagement.
For indirect effect testing, 10,000 bootstrap replications were used.
* $p < .05$.
** $p < .01$.

The interaction term created by multiplication of TSSC and engagement variables also predicted driving safety behavior (coefficient = _.11, S.E. = .02, $p < .05$). When the relationship between the interaction term and driving safety was fixed to zero, assuming no-interaction effect, model fit deteriorated by comparison to the original moderation model (D Log-likelihood = 20.64 with degree of freedom change = 1, AIC = 144280.92, and BIC = 144405.99). These results support. Fig. 1 illustrates the moderation effect of engagement on the TSSC-safety behavior relationship. Regardless of the magnitude of engagement, TSC was positively associated with driving safety behavior. However, whereas under high TSC scores engagement had no significant effect on driving safety, the opposite was true for low TSSC scores; increasing engagement resulted in significant improvement in driving safety scores. Considered jointly, our results offer empirical support for the entire conceptual model under examination.

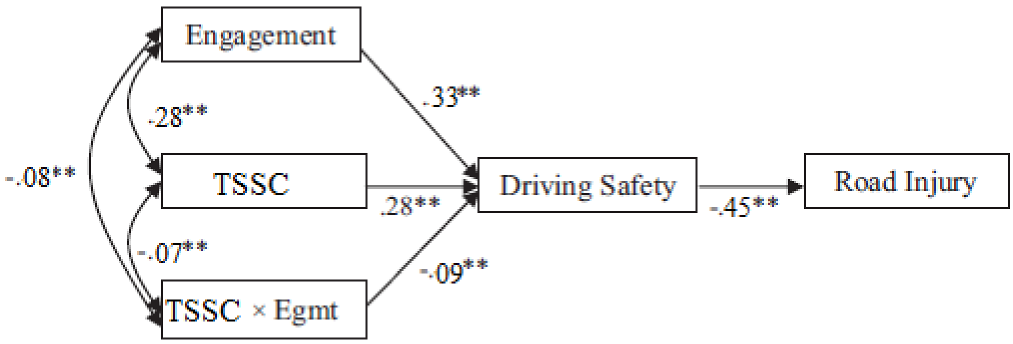

Fig. A.1. Hypothesized model of the transport sector safety climate.

Note: TSSC: transport sector safety climate. TSC ˣ Egmt: indicates an interaction term of TSSC and Engagement variables. Statistics are non-standardized path coefficients. **$p < .01$, *$p < .05$. (Full TSSC scale).

6. Discussion

This study tested and supported the proposition that the (safety) climate-behavior relationship is largely based on Safety Performance Management for Improved Road Safety Practices. Employing the dominant methodology of Safety Performance research, the study operationalized each Safety Performance Management through its proximal antecedents, comparing the effects of Safety Performance Management with engagement-induced intrinsic Safety Performance on safety behavior and subsequent traffic injury outcomes. Using a sample of Bus and truck drivers and a prospective design, (individual-level) safety climate perceptions and employee engagement predicted safety behavior, which mediated their effect on subsequently measured road injury outcomes. Furthermore, the fact that the shape of interaction between the two Safety Performance in our study replicated the shape of such interaction in meta-analytic studies offers additional support regarding the validity of our results. As noted above, the shape of interaction suggests a non-symmetric compensatory effect of climate on safety behavior arising under high levels of (climate-induced) extrinsic Safety Performance Management, compensating for lower (engagement-induced) intrinsic Safety Performance Management effects on safety behavior.

The design of this study was based on a number of considerations. First, it followed the dominant methodology in extrinsic/intrinsic Safety Performance Management by operationalizing each Safety Performance Management type based on its proximal antecedents. (Deci et al., 1999). Given that climate perceptions are targeted at the kinds of role behavior likely to be supported or sanctioned, climate level was used as the proxy measure of extrinsic Safety Performance. Likewise, given that employee engagement ensues from work autonomy and personal interest, engagement level was used as the proxy measure of intrinsic Safety Performance. Such methodological fit increased our measurement validity, allowing comparisons with meta-analytic findings in this field of research. Second, the inclusion of engagement-induced intrinsic Safety Performance Management in our statistical model as an added antecedent for safety behavior offered a more rigorous test of the proposition regarding climate-induced extrinsic Safety Performance Management as the explanatory variable accounting for the climate-behavior relationship. In other words, testing the incremental effect of safety climate on safety behavior and subsequent injuries after controlling for the effect of engagement offers a stronger test than doing likewise by using other control variables that are more distally related to safety Safety Performance such as job satisfaction or organizational commitment (Clarke, 2010), burnout (Nahrgang et al., 2011), or conscientiousness (Christian et al., 2009).

Thirdly, and most importantly, having adopted the standard methodology for Safety Performance Management classification, it was possible to test and replicate the compensatory effect of high extrinsic Safety Performance Management on intrinsic Safety Performance, undermining the latter's effect on safety behavior (Fig. 1). Replication of this well-established interaction (Deci et al., 1999) not only enhances the validity of our data but it also qualifies our investigated proposition, suggesting that, whereas extrinsic Safety Performance Management can explain the (safety) climate-behavior relationship under high climate levels, engagement-driven intrinsic Safety Performance takes over under poor or low climate levels. As such, the underlying mechanism linking climate perceptions and role behavior turns more complex than initially conceived.

This study concerns the role of safety climate in the context of traffic safety. Our search of the traffic safety literature indicated that the few studies investigating the effect of safety climate on professional drivers have used (adjusted) generic safety climate scales designed for in-house employees in conjunction with self-reported accidents over the previous year (e.g. Newman, Griffin, & Mason, 2008; Strahan, Watson, & Lennonb, 2008; Wills, Biggs, & Watson, 2005; Wills, Watson, & Biggs, 2006, 2009). These two attributes may threaten theoretical and methodological strengths, and may also introduce possible reverse causality (Beus et al., 2010). A notable exception is a study that, although using a generic safety climate scale, employed a longitudinal design by measuring post-survey road accidents (Wallace, Popp, & Mondore, 2006). This study used a sample of short-haul truck drivers performing daily deliveries from fixed regional distribution centers. Short-haul driving, unlike transport sector, allows more opportunities for symbolic social interaction among co-workers, increasing the likelihood of emergence of shared (safety) climate perceptions. Consequently, short-haul driving represents an occupational context located in between the poles of in-house and lone working conditions. We hope the present study stimulates further research into the effects of contextual differences along this continuum.

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