

## It Takes a Team: Supportive Team Climate as a Catalyst of Safety Behavior in the Railway Sector

Luise Ross

*German Centre for Rail Traffic Research, Dresden, Germany. E-mail: RossL@dzsf.bund.de*

Kristin Mühl

*German Centre for Rail Traffic Research, Dresden, Germany. E-mail: MuehlK@dzsf.bund.de*

Railway incidents are frequently attributed to human error, yet the social environment shaping individual behavior is often overlooked. Building on a safety culture framework, this study investigates how psychological safety and cohesion influence safety behavior among train drivers. Train driving represents a distinct work context within the railway sector, characterized by highly autonomous work, as train drivers operate for extended periods without direct interaction with coworkers or supervisors. Focusing on psychological safety and team cohesion as key social mechanisms of safety culture, the study examines how these factors enable or constrain safe behavior despite physical separation within teams. Empirical research on social influencing mechanisms in this distinct work environment is scarce.

To address this gap, a cross-sectional online study was conducted among German train drivers. Vignettes describing safety-relevant situations from train drivers' day-to-day work were developed to assess safety behavior. Due to significant empirical overlap, psychological safety and cohesion were integrated into the single latent factor supportive team climate. Structural equation modeling revealed that supportive team climate is positively associated with train drivers' safety behavior and their perception of supervisors' safety behavior. These findings highlight that safety culture in railway operations is socially constructed. The study concludes that fostering cohesion and psychological safety within teams can enhance safety culture and behavior even in solitary work environments.

*Keywords:* Safety culture, rail transport, safety behavior, train driver, cohesion, psychological safety, supportive team climate, survey, vignettes

### 1. Introduction

In the investigation of railway incidents, human behavior is often cited as the primary cause (Naweed et al., 2022), overlooking the necessity of understanding the social environment in which employees operate, that shapes individual behavior (Hogg and Terry, 2000). Safety behavior is not an isolated act, it rather represents the enactment of an organization's safety culture, which emerges through ongoing social interactions within teams and between leaders and followers (Bisbey et al., 2021). Within their safety culture framework, Bisbey et al. (2021) identify psychological safety and team cohesion as central enabling mechanisms at the team level for the development of safety culture and safety behavior.

Both are closely linked to team leadership (Appelbaum et al., 2020). In addition to the influence of leaders on their team, emerging research sug-

gests that team dynamics and follower behavior may also affect leader behavior (Uhl-Bien et al., 2014). Leaders' interpretations, responses, and reinforcement of safety-relevant behavior may therefore be influenced by the social cues, norms, and behavioral patterns within their teams (Smallfield et al., 2020).

The railway sector and train driving in particular presents a unique context for these dynamics. Train drivers often work isolated from their supervisors and peers for long stretches of time, yet are still embedded in operational teams that provide the opportunity to exchange experiences, develop norms and share safety-relevant information (Sharma et al., 2025; Basińska and Reczek, 2016). How team dynamics such as psychological safety and team cohesion operate in this distinct, socially distributed work environment and how they shape safety behavior has received little em-

pirical attention so far.

Addressing this gap, the present study investigates how psychological safety and cohesion relate to train drivers' safety behavior and examines the interplay between these factors and perceived supervisors' safety behavior. Rather than assuming a unidirectional flow of influence, this approach considers the reciprocal nature of team and leader dynamics and provides insights into the social mechanisms that guide safety behavior in the railway sector.

### **1.1. Safety culture**

Safety culture describes a subcomponent of the organizational culture and entails shared safety-related values and attitudes within a company that manifest themselves in behavioral norms and safety behavior (Bisbey et al., 2021; Guldenmund, 2000). Safety culture is socially constructed over time and positively influences organizational safety outcomes through employee safety behavior (Denison, 1996; Singer and Vogus, 2013).

In their framework, Bisbey et al. (2021) describe individual, group and organizational aspects that shape an organization's safety culture and performance. They emphasize that these enabling factors foster and reinforce shared safety behavior norms that in turn guide individual safety behavior. They suggest that safety culture may be developed through a bottom-up process in which employees adopt shared norms and values that are enacted in behavior. Within companies, teams can act as microenvironments that shape safety behavior norms through social influences (Bisbey et al., 2021; Fugas et al., 2011). Specifically, psychological safety and team cohesion may cultivate an environment that supports the development of safety behavior norms and a strong safety culture.

### **1.2. Cohesion and psychological safety**

Cohesion describes the shared bond that motivates members to stay united in pursuing task-related goals and satisfying members affective needs (Carron et al., 1998; Casey et al., 2017). These reciprocal positive feelings toward the group and its members have been linked to increased con-

formity to group norms and improved individual and group performance (Castaño et al., 2013; Prapavessis and Carron, 1997). Cohesion is characterized by trust between coworkers and promotes collaborative and altruistic behavior (Van Gerwen et al., 2018). Additionally, members of cohesive groups value the group membership and internalize group goals as their own (Beal et al., 2003). Within cohesive groups, informal social interactions can foster sharing of task-related tacit knowledge (Kakar, 2018).

While cohesion emphasizes unity, psychological safety describes the shared belief held by members that the team is safe for interpersonal risk taking (Edmondson, 1999). Psychological safety has been linked to knowledge sharing, feedback giving and seeking as well as reporting of errors within teams and employee work engagement (Newman et al., 2017). Psychologically safe teams value learning from mistakes and foster employee citizenship behavior (Frazier et al., 2017).

Although cohesion typically fosters agreement and psychological safety encourages speaking up (Kakar, 2018), these two constructs also share a strong conceptual and empirical connection. Both constructs are fundamentally rooted in interpersonal trust (Edmondson, 1999; Kakar, 2018) and psychological safety has shown a positive association with cohesion (Appelbaum et al., 2020). Specifically, high-quality relationships and supportive interactions that may be found in cohesive teams can foster the development of psychological safety (Edmondson and Lei, 2014; Thompson and Choi, 2006). Furthermore, strong familiarity and social support between team members have been linked to an increased sense of psychological safety (Newman et al., 2017).

### **1.3. Effects of cohesion and psychological safety on safety behavior**

Safety behavior serves to identify, reduce or eliminate safety hazards (Singer and Vogus, 2013). While often operationalized as safety compliance, safety behavior also entails safety participation which goes beyond formal role requirements (Neal et al., 2000). In their framework, Bisbey et al. (2021) identify behavior patterns such as

communication and information exchange, incident reporting, teamwork and collaboration as well as fair rewarding and punishing as enactments of an organization's safety culture.

Preliminary evidence suggests that psychological safety and cohesion might promote safety behavior and in turn help to decrease safety incidents (Mitropoulos and Memarian, 2012). Cohesion and the resulting strong social bonds foster a sense of responsibility for other team members, so that team members will aim to reduce the risk exposure of others (Fruhen and Keith, 2014). In addition, shared goals that are regarded as important might affect group norms regarding dealing with errors, fostering sharing of and learning from mistakes.

In the healthcare sector, psychological safety has been linked to increased reporting of treatment errors and speaking-up behavior among nurses (Lee and Dahinten, 2021; Leroy et al., 2012). Within software teams, psychological safety fostered knowledge sharing behavior (Kakar, 2018).

Information sharing and effective communication can increase risk awareness and in turn enable timely identification and mitigation of hazards (Pandit et al., 2018). The authors also reported that psychological safety and cohesion interacted in predicting knowledge sharing, showing that only under conditions of high psychological safety were higher levels of cohesion more strongly associated with more knowledge-sharing behavior than moderate cohesion, whereas low cohesion was consistently detrimental, regardless of psychological safety (Kakar, 2018). In the construction sector, Pandit et al. (2018) showed, that high crew cohesion was positively related to sharing safety-relevant information.

These insights point to an important role of psychological safety and cohesion for safety behavior, however evidence from the railway sector is currently lacking. The largely solitary nature of train driving might suggest that social team processes are less relevant; however, preliminary evidence suggests that interactions with colleagues remain important social contacts (Basińska and Reczek, 2016; Sharma et al., 2025). Therefore, investigating cohesion and psychological safety

within the railway sector can offer valuable insights into the social mechanisms that shape safety behavior in work settings where employees spend much of their time working alone.

*H1: Psychological safety (a) and cohesion (b) positively influence train drivers' safety behavior.*

Leadership is increasingly recognized as a reciprocal process, rather than a purely unidirectional function. Followers are not merely passive recipients but rather active agents who can affect leader motivation, trust in followers and behavior (Goody et al., 2010; Uhl-Bien et al., 2014). Leaders are often confronted with pre-existing patterns of follower behavior and relationships within teams, which they cannot fully control, positioning them also as recipients of follower behaviors. They rely on cues from their social environment, such as team member interactions to interpret situations and guide their own actions.

Building on this insight, Toader and Martin (2023) reported that team processes and the organization of knowledge within the team might affect leader actions and cognition as part of a reciprocal influence process. Accordingly, cohesion and psychological safety may not only facilitate safety behavior among employees but might also be associated with how leaders are perceived to interpret, respond to and reinforce safety-relevant behavior within their teams. Additionally, when employees consistently engage in safety-oriented behavior, such as adhering to procedures, reporting hazards, or intervening in unsafe situations, these actions may signal to the leader responsibility, engagement, and provide cues on expectations and safety norms within the team. In turn leaders may be inclined to model safety-oriented behavior themselves, share safety relevant information or provide fair rewards.

*H2: Psychological safety (a) and cohesion (b) are positively related to perceived supervisor safety behavior.*

*H3: Train drivers' safety behavior is positively related to perceived supervisor safety behavior.*

In summary, a positive relation of psychological safety and cohesion on train drivers' safety behavior and their assessment of supervisors' safety behavior is expected. Additionally a positive asso-

ciation of train drivers’ and perceived supervisor safety behavior is expected (see Figure 1).

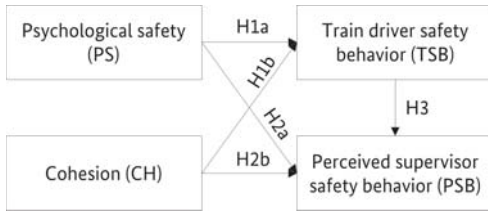


Fig. 1. Theoretical model

**2. Methods**

Cross-sectional quantitative data was collected from July 30th 2025 to December 19th 2025 through an online questionnaire that was developed using the software LimeSurvey. The survey was distributed over personal contacts and LinkedIn. Twelve 40€ giftcards were raffled off among participants as rewards for their invested time.

**2.1. Survey**

Ten short scenario descriptions (vignettes) from train drivers’ day-to-day work were developed by a train driver and were used to assess safety behavior (TSB), e.g.: *You are in the rail yard, walking toward the vehicles for your train. On your way, you meet a new colleague. You chat briefly and find him likeable. You notice that the colleague is not wearing his safety vest.* In comparison to conventional survey items, vignettes have been shown to reduce the risk of social desirability bias (Alexander and Becker, 1978).

For each vignette, participants assessed possible courses of action on a 7-point Likert scale ranging from 1 = *highly unlikely* to 7 = *very likely*. For each vignette, a safety-conscious and a more risky course of action were developed in consultation with train drivers and experts from the railway sector. For the example vignette above, the provided courses of action were: (1) *You point it out to them, emphasizing that safety comes first* and (2) *You say nothing*. An average score was then calculated for each scenario.

For all items that assessed perceived supervisor safety behavior (PSB, 6 items, Hughes (2023), e.g.: *My supervisor asks for ideas about safety*) as well as psychological safety (PS, 4 items, Fischer and Hüttermann (2020), e.g.: *It is safe to take a risk on this team*) and team cohesion (CH, 3 items, Kauffeld and Frieling (2001), e.g.: *We feel like a team*) a 5-point Likert scale ranging from 1 = *strongly disagree* to 5 = *strongly agree* was applied, consistent with the original instruments from which the items were adapted. Additionally, age, gender and working experience of participants within their company as well as organization size and years of train driver license ownership were assessed.

**2.2. Participants**

The final sample size included  $N = 113$  German train drivers (82.7% male, 15.3% female). On average, participants were 41.1 years old ( $SD = 10.8$ ) and had held their train driver license for 10.7 years ( $SD = 9.4$ ). The majority of participants (94.9%) worked in passenger transport, in organizations with less than one thousand employees (73.5%), and had been working there for more than five years (69.4%). A valid train driver license was a requirement for the participation in the survey.

**2.3. Data preparation and analysis**

To test the proposed hypotheses, Structural Equation Modeling (SEM) was utilized. All relevant prerequisites to conduct a SEM analysis were met, except multivariate normality. Therefore, robust standard errors and test statistics were calculated. Statistical analyses were performed using the software R Studio. First, reliability and validity of the proposed measurement model were assessed using confirmatory factor analysis (CFA). Then, a structural model was developed and the path coefficients were assessed. Work experience was included into the model as a control variable, since previous research suggests that longer tenure can lead to the development of increased risk awareness and safety routines (Gyekye, 2006).

### 3. Results

#### 3.1. Measurement validity and reliability

The scales used to assess the study variables showed acceptable scale reliability as the descriptive statistics in Table 1 show. An initial CFA revealed a suboptimal model fit as the CFI value was below .95 ( $X^2 = 324.92$ ,  $df = 224$ ,  $p < .001$ , RMSEA = .06, SRMR = .08, CFI = .88). Subsequently, items with low factor loadings ( $< .50$ ) and  $R^2 < .20$  were excluded from further analyses. These included one item from the psychological safety scale and four items from train driver's safety behavior assessment. Inspection of the latent covariance matrix revealed a very high association between the latent constructs PS and CH ( $r = .94$ ), indicating insufficient discriminant validity. Given their conceptual and empirical overlap, they were combined into the latent factor supportive team climate (STC) by calculating the mean across all items.

Table 1. Descriptive statistics

Variable	<i>M</i>	<i>SD</i>	Cronbach's $\alpha$
CH	3.36	1.09	.84
PS	3.04	1.00	.72
TSB	5.22	1.12	.71
PSB	3.53	0.89	.82

Note: CH = cohesion, PS = psychological safety, TSB = train drivers' safety behavior, PSB = perceived supervisor safety behavior

The final CFA model had satisfactory model fit ( $X^2 = 160.69$ ,  $df = 132$ ,  $p = .045$ , RMSEA = .05, SRMR = .06, CFI = .96, PNFI = .68). Although the latent constructs train drivers' and supervisor safety behavior did not reach the conventional average variance extracted (AVE) threshold of .50, composite reliability (CR) reached the cutoff value of .70 for all latent constructs and heterotrait-monotrait (htmt) values indicated satisfactory discriminant validity (see Table 2). AVE represents the amount of variance in the indicators that is captured by the latent construct relative to measurement error, whereas CR reflects the overall reliability of the construct indicators.

As adequate construct reliability suggests that the latent variable is sufficiently well represented by its indicators, the constructs were retained.

Table 2. Latent construct reliability and validity

Variable	AVE	CR	STC	TSB
STC	.58	.89		
TSB	.30	.70	.24	
PSB	.46	.83	.56	.41

#### 3.2. Effects on safety behavior

Next, the hypothesized paths were entered into the model. The model fit was satisfactory ( $X^2 = 179.39$ ,  $df = 149$ ,  $p = .045$ , RMSEA = .04, SRMR = .07, CFI = .96, PNFI = .68). Results of the path analysis are shown in Table 3. STC was positively related to TSB and PSB, supporting hypothesis 1 and 2. TSB was positively related to PSB, which is in line with hypothesis 3. Additionally, work experience showed a negative relation with TSB.

Table 3. Path analysis results

Path	Estimate	<i>SE</i>	<i>p</i>
STC $\rightarrow$ TSB	0.18	0.09	.04
STC $\rightarrow$ PSB	0.41	0.09	<.001
TSB $\rightarrow$ PSB	0.42	0.18	.02
WE $\rightarrow$ TSB	-0.30	0.11	.008

The model explained 20% of the variance in train driver safety behavior and 44% of the variance in supervisor safety behavior, indicating a moderate explanatory power given the limited number of predictors included. The structural model with beta coefficients and  $R^2$  values is pictured in Figure 2.

### 4. Discussion

Despite extensive research on safety culture, empirical evidence on how team social processes shape safety behavior in railway operations remains limited. The study addresses this gap by

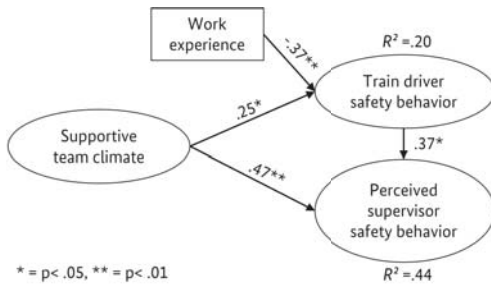


Fig. 2. SEM model

examining the influence of psychological safety and cohesion on safety behavior to understand how safety behavior is socially constructed.

An online study was developed and distributed among German train drivers. Due to a lack of discriminant validity, psychological safety and cohesion were integrated into a single latent factor, namely supportive team climate.

In line with the safety culture framework by Bisbey et al. (2021) and hypothesis 1 the results showed a positive association between supportive team climate and train drivers’ safety behavior, pointing to the relevance of social mechanisms even in socially isolated work environments. In addition, work experience showed a negative association with train driver safety behavior, contradicting prior research that has suggested a positive relationship between tenure and safety behavior.(Gyekye, 2006).

In line with hypothesis 2, supportive team climate was also positively related to perceived supervisors’ safety behavior, indicating that team dynamics may extend their influence across hierarchical levels. This association was stronger than the relation of supportive team climate with train drivers’ own safety behavior. Possibly, a positive, supportive team climate might function as an evaluative lens, through which train drivers perceive leadership actions more favorably. Additionally, the smaller association with train drivers’ safety behavior may be due to the limited scope of the measurement. The vignettes used to assess train drivers’ safety behavior only captured behavior in specific situations, while the assessment of perceived supervisor safety was more broad. Con-

sequently, these snapshots of train drivers’ safety behavior may not capture all aspects of safety behavior that might be influenced by team dynamics.

Train drivers’ safety behavior also showed a positive association with their perception of supervisor safety behavior, supporting hypothesis 3. This link suggests that employee behavior may shape how leader actions are perceived among their followers. Together, these findings highlight that safety behavior in railway operations emerges in a social context and may be shaped not only by top-down leadership practices but also by team dynamics.

**4.1. Implications**

The present findings contribute to safety culture research by emphasizing the fundamentally relational nature of safety behavior. Rather than being solely driven by individual characteristics or organizational regulations, safety behavior appears to emerge from social dynamics within teams, characterized by interpersonal trust and respect.

The observed influence of train drivers’ safety behavior on perceived supervisor safety behavior supports a dynamic and reciprocal understanding of safety culture, in which behaviors and norms are continuously shaped through influences across hierarchical levels. They indicate that fostering psychologically safe and cohesive teams can promote safety behavior even in work contexts characterized by high levels of individual task execution, such as train driving.

Safety culture interventions should therefore not be limited to individual training but also target team-level processes, for example by creating structured opportunities for reflection, peer exchange, and shared learning from incidents and near misses. Future intervention designs could explicitly leverage bottom-up processes by empowering employees as active contributors to safety culture, for example through peer-led safety dialogues or safety expert roles within teams.

**4.2. Limitations and future research**

The cross-sectional design of the study does not allow causal inferences. In the future, longitudinal studies could help to examine possible reciprocal

influences between team dynamics and safety behavior over time. The reliance on self-report measures introduces the risk of social desirability bias, particularly regarding the sensitive topic of safety behavior. To mitigate this risk, vignettes were used to assess train drivers' safety behavior (Alexander and Becker, 1978). Nevertheless, future research could integrate objective behavior indicators, such as observations or colleague and leader ratings.

The role of work experience could be further investigated in future research, e.g. whether and how psychological safety and cohesion might buffer against negative effects of long tenure on safety behavior. Finally, although psychological safety and cohesion were integrated into one latent factor due to empirical overlap, future studies could explore their interaction in influencing safety behavior, building on preliminary evidence for such an interaction in software development teams (Kakar, 2018).

## 5. Conclusion

This study examined the influence of psychological safety and cohesion on safety behavior within the railway sector by conducting a cross-sectional survey among German train drivers. The findings suggest that even in socially distributed work environments, a supportive team climate, characterized by psychological safety and cohesion, might be associated with increased safety behavior. Furthermore, the results suggest a connection between employee and leader behavior, where both a supportive team climate and train driver behavior are positively related to perceptions of supervisors' safety practices. Future research could employ longitudinal designs to further clarify these reciprocal dynamics and investigate how interventions in the railway sector can leverage psychological safety and cohesion to enhance organizational safety.

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