



After-action reviews: A venue for the promotion of safety climate

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ABSTRACT

This study investigated the role of after-action reviews on perceptions of safety climate at the group and organizational levels. Moderated and mediated regression analyses of data from 67 firefighting crews suggest that after-action review frequency positively influenced both levels of safety climate. Safety-oriented group norms fully mediated the relationship between after-action review frequency and group-level safety climate. Fire-station busyness moderated the relationship between after-action review frequency and organizational-level safety climate, such that the relationship was non-existent for highly busy stations. These findings suggest that after-action reviews constitute a specific venue through which managers can promote safety climate in high-risk environments.

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1. Introduction

Practitioners and researchers continue to pursue ways to increase occupational safety such as safety training (Leiter et al., 2009) and reward systems (Collinson, 1999), but the efficacy of these interventions may depend upon the organizations' climate for safety (Zohar, 1980, 2000). Safety climate refers to a type of organizational climate in which employees perceive that management rewards, supports, and expects safe practices (Hofmann and Stetzer, 1996, 1998). Organizations with a positive safety climate tend to have fewer accidents and injuries than those with a negative safety climate (Zohar, 2000). This study sought to examine the potential influence of formal and informal post-incident discussions, or after-action reviews, on both organizational- and group-level safety climates. Furthermore, we investigated the role of busyness and safety-oriented norms in the formation of safety climate at the group level.

Formal methods that facilitate structured feedback after major incidents, such as post-incident critiques and stress debriefings, have long existed. This study concerns a feedback procedure often used in military contexts: the after-action review. After-action reviews typically occur soon after an incident or training exercise has concluded (Busby, 1999; Ellis et al., 2006), regardless of whether an accident or some other negative event occurred. As a specific type of workplace meeting, after-action reviews are a crucial part

of how employees make sense of hazards or impediments encountered and decide which actions taken were correct or incorrect. Ultimately, they set the stage for what, if anything, can be learned from the incident (Ellis et al., 2006). Based on an extensive literature search and review, this study appears to be the first of its kind to investigate after-action reviews directly as a specific way to promote a strong safety climate in organizations. As such, this study is unique in that it examines a non-attitudinal antecedent to safety climate.

1.1. High-reliability organizations and after-action reviews

Within some specific types of organizations, organizational members have learned how to manage error and risk in a way that has made them remarkably accident-free despite the inherent dangers of their respective industries. These organizations, known as high-reliability organizations, develop organizational practices that promote a higher attention to detail and "mindfulness," allowing them to collectively recognize and respond to error signals in their environments during the earliest stages of crisis development (Weick and Roberts, 1993; Weick and Sutcliffe, 2007). One aspect of high-reliability organizations that is most relevant to this study is the manner in which they engender organizational learning from mistakes and successes. After-action reviews and other such developmental procedures help high-reliability organizations become more mindful of the ever-changing environment, helping to develop the safety climate necessary to avoid occupational accidents and injuries (Weick and Roberts, 1993). After-action reviews are a setting where organizational members can maintain their pre-occupation with failures, stay attuned to normal operations, and learn from misses or near misses that occur routinely in the work environment.

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1.2. Safety climate: organization and group levels

The way in which employees perceive organizational leaders' efforts to address safety concerns plays a large role in how safety climates are enacted in the workplace (Hofmann and Stetzer, 1998). Essentially, people who observe their supervisors communicating about safety in an earnest, committed manner while receiving consistent messages about safety-related issues are more likely to engage in safe behavior (Hofmann and Morgeson, 1999).

Another crucial aspect regarding the development of safety climate is the mitigation of organizational errors through error reporting. Employees may perceive reporting errors (or unsafe conditions, for example) as risky, which may increase their reluctance to report (Zhao and Olivera, 2006). Probst et al. (2008) found that organizations with a more positive safety climate appear to have less underreporting of errors. It is proposed that after-action reviews are a setting where error reporting can occur or be encouraged or discouraged.

Recent work by Zohar (2000, 2002, 2008) suggests that employees perceive safety climate at multiple levels within organizations. Employees face a multitude of contradictory policies, procedures, and work practices concerning what the organization values in terms of safety at the workplace (Collinson, 1999; Zohar and Luria, 2005). Although supervisors provide a starting point for understanding what is valued in terms of safety, employees may be left to reconcile two divergent safety climates: one at the organizational level (defined by senior-level management) and one at the group level (defined by their direct supervisor).

1.2.1. Safety climate and after-action reviews

Scholars have traditionally defined safety as the minimization of risk or error (Slovic, 1999). This definition is problematic because the culture, environment, and the individual dispositions of the people that engage in safe or unsafe behavior influence how they define safety (Slovic, 1999). Safety, therefore, is socially constructed (Rochlin, 1999). Workers define what is safe through intersubjective process within groups, where talk and non-verbal communication play central roles in how group members determine what is valued, expected, supported, and rewarded in terms of safety (Collinson, 1999; Eisenberg, 2007; Scott and Trethewey, 2008; Weick, 2001). Thus, climate is defined conceptually and methodologically in terms of group- or organizational-level consensus (Schneider, 1990).

This study examines a previously unstudied approach to improving safety climate, namely, the use of after-action reviews. The work environment in many organizations is fraught with ambiguity, "leaving wide latitude for inference and interpretation" (Simpson, 1996, p. 550). Ideally, after-action reviews should function as forums through which groups can discuss candidly perceptions about regular work operations. Through this communication forum, employees in high-risk environments have the opportunity to learn from recent incidents and retain these lessons for future incidents. Accurately detecting and analyzing occupational errors through proper communication reduces future errors (Van Dyck et al., 2005).

After-action reviews are different than other more elaborate feedback session for unusual events (e.g., post-incident critiques, post-incident stress debriefings) because those more formal sessions typically describe organization-wide (versus subunit) events, cannot be held regularly due to their formality and size, and involve considerable political maneuvering and blaming instead of learning. After-action reviews, which occur within subunits, are formal or informal discussions about what went right and what went wrong. These forums usually include less blaming than often occurs in post-incident critiques and debriefings because after-action reviews deal with errors of a lesser magnitude than those

associated with post-incident debriefings (e.g., death or severe injuries). Moreover, most or all review participants were present at the event under discussion, which minimizes the potential for blaming and scapegoating.

After-action reviews have the potential to prevent oversimplified interpretations of the hazard environment, encourage discussion of errors and "near misses," enhance operational sensitivity and resilience, and provide opportunities to acknowledge individual expertise—all hallmarks of high-reliability organizations (Weick and Sutcliffe, 2007). As a summary of perceptions shared by employees about the work environment that guide adaptive hazard behavior (Schneider, 1972; Zohar, 1980), safety climates may change over time as a result of the intentional and unintentional feedback members receive. Therefore, after-action reviews hold considerable promise as interventions that shape safety climates and, ultimately, incident-management behaviors. It is believed that the more frequently a group holds after-action review discussions, the more salient the safety-related behaviors expected by the supervisor and upper management become. Therefore, it is hypothesized that the frequency with which groups hold after-action reviews positively relates to both group- and organizational-level safety climates (Hypothesis 1).

1.2.2. Safety-oriented group norms, group-level safety climate and after-action reviews

Research suggests that a supervisor's orientation toward safety, provision of incentives for safe behavior, actual safe behavior, and discussion of safe behaviors leads to the development of group norms concerning safety (Haines et al., 2001; Zohar, 2000). Given that after-action reviews are opportunities to discuss both what went right and what went wrong in terms of safe behavior, after-action reviews may also be an important antecedent to group-safety norms. Therefore, the frequency with which groups hold after-action reviews should positively relate to safety-oriented group norms (Hypothesis 2).

Safety-oriented group norms should contribute to group-level safety climate. One reason for this relationship is that norms are a shared way of understanding as well as a shared way of routinely behaving (Ehrhart and Naumann, 2004). Therefore, after-action reviews may serve as a venue for the development of specific safety-oriented group norms which may in turn bolster group-level safety climate (see Fig. 2). As such, safety-oriented group norms may act as the mechanism through which after-action review frequency influences group-level safety climate, functioning as a mediator (Hypothesis 3) (Fig. 1).

1.2.3. The role of busyness

Although decisions influencing organizational- and group-level safety climate occur at each respective level (Zohar and Luria, 2005), climate perceptions are potentially constrained by factors operating at both the organizational and group levels. Specifically, busyness is a type of situational constraint, or environmental factor, which interferes with the translation of abilities and motivation into effective performance (Kanfer and Ackerman, 1989; Peters and O'Connor, 1980). Although organizational busyness may vary predictably over time (e.g., increases in sales volumes near certain holidays), specific sites within an organization may consistently be busier than others due to a host of reasons, including location and client density.



Fig. 1. Theoretical model of Hypothesis 3.

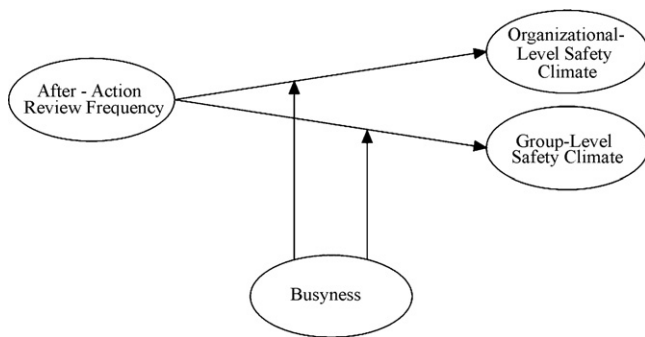


Fig. 2. Theoretical model of Hypothesis 4a and 4b.

Group busyness may be a type of situational constraint that interacts with after-action-review frequency as an explanation of organization- and group-level safety climate. Site- and group-level busyness represents a physical context and time-availability constraint (Peters and O'Connor, 1980), meaning groups at busier locations likely have less time to participate in activities thought to contribute positively to safety climate (e.g., discretionary training activities, after-action reviews, etc.). This is particularly the case when examining “extra effort” or voluntary behaviors such as after-action reviews (Ellis et al., 2006). Under high workload conditions, people focus on the basic performance goals to conserve resources at the expense of extra behaviors.

A second and related busyness issue concerns the repetitive nature of work at busier locations. As ethnographic studies of firefighting crews (Myers, 2005; Scott and Myers, 2005; Scott and Trethewey, 2008; Tracy and Scott, 2006) have shown, busier fire stations tend to be dispatched on a greater number of calls that are either minor or not true medical or fire emergencies (e.g., when merchants falsely report medical emergencies as a means of removing homeless people from their premises). These “nuisance” calls are a common source of frustration for firefighters, one that they often attribute to supervisors and upper-level managers, the party perceived as having some level of control over policies that influence the volume and quality of calls received. Retrospective sensemaking theory (Weick, 1979) suggests that backward-looking discussion (e.g., after-action reviews) functions as a product of ambiguity and the presence of multiple, plausible interpretations regarding what just happened. Conversely, retrospective communication is more necessary in circumstances of greater ambiguity. In the context of post-incident discussion among emergency-response personnel, minor or illegitimate calls are less likely to necessitate after-action reviews because they generate little or no ambiguity regarding what just transpired (Jablin and Kramer, 1998). Therefore, it is hypothesized that the relationship between after-action review frequency and organizational-level safety climate is moderated by group busyness, such that the relationship is stronger for less-busy groups than for busier groups (Hypothesis 4a). Additionally, it is hypothesized that the relationship between after-action review frequency and group-level safety climate is moderated by group busyness, such that the relationship is stronger for less-busy groups than for busier groups (Hypothesis 4b) (Fig. 2).

2. Materials and methods

2.1. Sample and procedure

To test the hypotheses, data was collected from active career (non-volunteer) firefighters within a large municipal fire department in the eastern United States. Given that work within the fire service involves frequent encounters with numerous occupational

hazards—including, for example, extreme temperatures, collapsing structures, toxic smoke and fumes, high-voltage electricity, and negotiating traffic while traveling at high speeds en route to an incident—many fire departments try to minimize the high frequency of occupational accidents that they endure. As such, the fire service functioned as an ideal setting in which to study after-action reviews and perceptions of safety climate. In collaboration with departmental officials, an electronic survey was distributed to departmental personnel; 352 (33.88%) responded to the survey. Most of the respondents were male (93.2%), Caucasian (91.2%), middle-aged ($M = 38.95$ years, $SD = 8.26$), and experienced in terms of years as a firefighter ($M = 13.41$ years, $SD = 7.45$). All respondents indicated that they had at the minimum completed high school, with a sizable portion reporting that they attended some college (50.2%) or completed a bachelor's degree (34.8%).

The fact that all of the variables of interest were group-level phenomena required us to focus exclusively on responses from firefighters who served on the same crew. Within this particular fire department, firefighting crews typically include four or five firefighters. Therefore, the survey data was matched with departmental records to determine which respondents served on the same crew at the same fire station. In this matching process, only data from at least two of the members on a crew was considered usable for further hypothesis testing. This resulted in usable responses from 169 firefighters serving on 67 crews.

2.2. Aggregation

With the final data set comprising only responses from firefighters who worked together on the same crews, recommendations from previous researchers concerning minimum requirements to determine appropriateness of aggregation were followed (e.g., Bliese, 2000; Homan et al., 2008). That is the unit of analysis must occur naturally in the sample, and both within-group homogeneity and between-groups heterogeneity must be sufficient (Bliese, 2000; Wallace et al., 2006). All three steps were successfully accomplished in this sample.

Within-group homogeneity was assessed using James et al.'s (1984) $r_{wg(j)}$ statistic. All $r_{wg(j)}$ values for each of the focal variables were greater than .70, suggesting sufficient within-group agreement. For each of the variables of interest (after-action review frequency, safety-oriented group norms, group-level safety climate, and organizational-level safety climate), the average $r_{wg(j)}$ (using a uniform null distribution) values were .80, .82, .91, and .86, respectively. Homogeneity was further assessed using intraclass-correlation coefficients (ICC(1) and ICC(2)). Statistically significant ICC(1) values are traditionally interpreted as the proportion of variance explained by group membership and ICC(2) values indicate the reliability of the means (Bryk and Raudenbush, 1992). ICC(2) values greater than .70 suggest the group means are reliably different (Bliese, 2000). All values of ICC(1) and ICC(2) were within acceptable levels to support the aggregation of data.

2.3. Measures

Responses were collected regarding group-level safety climate, organizational-level safety climate, after-action review frequency, and safety-oriented group norms via the survey described above; departmental data was used to assess station busyness. With the exception of after-action review frequency, all measures used scales with 5-point response options ranging from 1 (*strongly disagree*) to 5 (*strongly agree*).

2.3.1. Busyness

Departmental records provided an indication of the number of calls that each fire station and crew completed during the four

months during which the survey took place. These data were matched to survey responses allowing the analysis of busyness as it related to aggregated crew responses. Thus, busyness was the number of calls responded to by a given crew over a set time period.

2.3.2. After-action review frequency

After-action review frequency was assessed using the following item: “After a call, how often do you talk (formally or informally) with members of your crew about how things went?” with 5-point response options ranging from 1 (*never*) to 5 (*always*). Using the same procedures just outlined regarding the other measures, responses to this item were aggregated with those of other firefighters who served on the same crew, thereby providing a multisource indication of each crew’s after-action review frequency.

2.3.3. Safety-oriented group norms

Haines et al.’s (2001) four-item measure was used to assess group norms related to safety. Scale items were preceded with the following statement: “Think about the firefighters you work with on a regular basis. Please indicate your agreement with the following statements.” Sample items include “My team cares about safety procedures” and “In my team, we inform new members of the importance of health and safety.” The scale demonstrated a high level of internal consistency (Cronbach’s alpha = .90).

2.3.4. Group-level safety climate

To assess safety climate at the group level, an adapted version of Zohar and Luria’s (2005) group-level safety climate scale was used. The 12-item scale was preceded by the following instructional statement: “Respond to the following statements concerning your direct supervisor (e.g., ‘my direct supervisor.’).” Sample items include “My direct supervisor says ‘a good word’ to workers who pay special attention to safety,” “My direct supervisor frequently checks to see if we are all obeying the safety rules,” and “My direct supervisor discusses how to improve safety with us.” The scale demonstrated a high level of internal consistency (Cronbach’s alpha = .96).

2.3.5. Organizational-level safety climate

To assess safety climate at the organizational level, an adapted version of Zohar and Luria’s (2005) organizational-level safety climate scale was used. The 12-item scale was preceded with the following instructional statement: “Think about the top management in your fire department.” Sample items include “Top management in this organization reacts quickly to solve the problem when told about safety hazards,” “Top management in this organization listens carefully to workers’ ideas about improving safety,” and “Top management in this organization uses any available information to improve existing safety rules.” The scale demonstrated a high level of internal consistency (Cronbach’s alpha = .93).

Table 1

Means, standard deviations, and zero-order correlations for study variables^a.

	Mean	SD	1	2	3	4	5
1. After-action review frequency	4.11	.51	–				
2. Safety-oriented group norms	4.08	.45	.45***	–			
3. Group-level safety climate	3.84	.49	.38**	.64***	–		
4. Organizational-level safety climate	3.78	.45	.30*	.45***	.42***	–	
5. Number of calls (busyness)	216.15	75.84	–.24*	–.05	–.15	–.34**	–

^a $n = 67$ crews.

* $p < .05$.

** $p < .01$.

*** $p < .001$.

Table 2

Regression summary for the mediation analysis with group-level safety climate^a as the dependent variable.

Criterion	b^b	s.e.	R^2	ΔR^2
Safety-oriented group norms			.20	.00
Intercept	2.44	.41		
After-action review frequency	.40***	.10		
Group-level safety climate			.15	.00
Step 1				
Intercept	2.34	.45		
After-action review frequency	.37**	.11		
Step 2			.42	.28***
Intercept	.77	.47		
After-action review frequency	.11	.10		
Safety-oriented group norms	.64***	.12		

^a $n = 67$ crews.

^b Unstandardized beta weight.

* $p < .05$.

** $p < .01$.

*** $p < .001$.

3. Results

3.1. Variable correlations

All measures correlated as expected. Table 1 lists descriptive statistics and zero-order correlations among variable measures. The frequency with which groups hold after-action reviews positively related to both group- and organizational-level safety climate ($r = .38$ and $.30$, respectively, $p < .05$) supporting Hypothesis 1. After-action review frequency also positively correlated with safety-oriented group norms ($r = .45$, $p < .05$), supporting Hypothesis 2.

3.2. Mediating role of safety-oriented group norms

To test the role of safety-oriented group norms as a potential mediator of the relationship between after-action review frequency and group-level safety climate, the approach outlined by Kenny et al. (1998) was followed. Kenny et al. stipulate that the first step in demonstrating mediation is to show that the independent variable (after-action review frequency) significantly relates to the mediator (safety-oriented group norms). Using standard regression analyses, after-action review frequency significantly predicted group-level safety climate (see Table 2). The second step involves showing that the mediator significantly relates to the dependent variable (group-level safety climate) while controlling for the independent variable. Thus, a regression analysis of safety-oriented group norms predicting group-level safety climate while controlling for after-action review frequency was conducted. With the direct relationship between after-action review frequency and group-level safety climate controlled, safety-oriented group norms did significantly predict group-level safety climate (see Table 2).

Kenny et al.'s (1998) final condition requires testing the significance of the indirect effects of the independent variable (after-action review frequency) on the outcome variable (group-level safety climate). Sobel tests for indirect effects (MacKinnon et al., 1995) indicated significant indirect effects between after-action review frequency and group-level safety climate ($z = 3.2$; $p < .01$). The findings of a significant indirect relationship between after-action review frequency and group-level safety climate, combined with a lack of a significant direct relationship between after-action review frequency and group-level safety climate, suggest that safety-oriented group norms fully mediated the relationship between after-action review frequency and group-level safety climate. These results support Hypothesis 3.

3.3. Moderating role of busyness

Standard hierarchical regression analyses were used to test for the moderating role of busyness in the relationship between after-action review frequency and group- and organizational-level safety climate (Hypothesis 4a and 4b). Following recommendations by Cohen et al. (2003), the independent variables were centered (after-action review frequency and busyness) to aid in interpretation and to reduce non-essential multicollinearity. Therefore, in step 1, after-action review frequency and busyness were entered, followed by the interaction term created by multiplying after-action review frequency with busyness. In support of Hypothesis 4a, both after-action review frequency and busyness status predicted organizational-level safety climate as displayed in Table 3. Of particular interest to the moderation hypothesis, the interaction term also significantly predicted organizational-level safety climate, suggesting that the relationship between after-action review frequency and organizational-level safety climate depends in part upon fire-station busyness.

In testing Hypothesis 4b, only after-action review frequency predicted group-level safety climate as displayed in Table 4. Busyness was not a significant predictor of group-level safety climate ($p > .05$). The interaction term, therefore, did not significantly predict group-level safety climate. Hypothesis 4b was not supported.

To further aid in interpretation, the lines representing the relationships between after-action review frequency and organizational-level safety climate at different levels of busyness (i.e., at one standard deviation above and below the mean, cf. Cohen et al., 2003) were plotted and are shown in Fig. 3. Simple effects tests were conducted (Aiken and West, 1991), which indicated a significant positive relationship between after-action review frequency and organizational-level safety climate at one standard deviation below the mean number of calls (low busyness), $t(63) = 3.33$, $p < .05$. The effects tests revealed a non-significant relationship between

Table 4

Regression summary for the interaction with group-level safety climate^a as the dependent variable.

Model	<i>b</i> ^b	<i>s.e.</i>	<i>R</i> ²	ΔR^2
Step 1			.15	.00
Intercept	2.47	.54		
After-action review frequency	.35 [*]	.11		
Busyness	.00	.001		
Step 2			.15	.00
Intercept	2.09	1.75		
After-action review frequency	.44	.40		
Busyness	.001	.007		
After-action review frequency-busyness interaction term	.00	.002		

^a $n = 67$ crews.

^b Unstandardized beta weight.

^{*} $p < .05$.

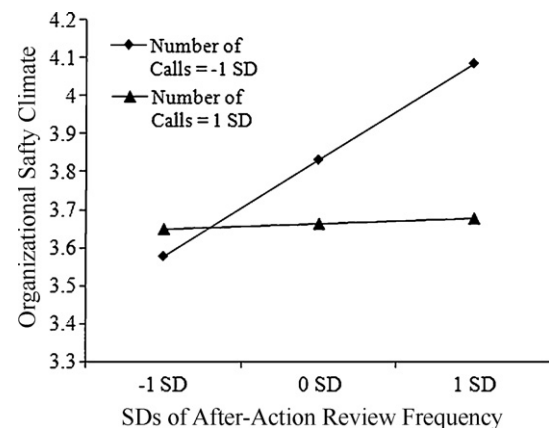


Fig. 3. The relationship between after-action review frequency and organizational-level safety climate as a function of number of calls (busyness).

after-action review frequency and organizational-level safety climate at one standard deviation above the mean number of calls (high busyness), $t(63) = .26$, $p > .05$. Consistent with Hypothesis 4a, the slope of the line representing the relationship between after-action review frequency and organizational-level safety climate when call number was high was significantly different from the slope of the line representing the relationship between after-action review frequency and organizational-level safety climate when call number was low, $t(63) = -3.01$, $p < .05$.

4. Discussion

This study tests the usefulness of a new and previously untested antecedent, frequency of after-action reviews, as a way to develop a positive safety climate at both the organizational and group levels. In addition, this study shows how safety-oriented group norms are a potential mechanism through which after-action reviews influence group-level safety climate. Furthermore, the effects of busyness on the relationship between frequency of after-action reviews and group- and organizational-level safety climate were investigated.

Results indicated that frequency of after-action reviews positively related to both organizational- and group-level safety climates. Although causal inferences cannot be made due to the nature of the data, the findings provide preliminary evidence that after-action reviews, when held routinely and frequently have a positive impact on safety climate. Given that a positive safety climate at all levels is shown to be related with reduced accidents and injuries within a wide range of organizations (e.g., Mearns et al., 2001), this new antecedent provides another way to address the

Table 3

Regression summary for the interaction with organizational-level safety climate^a as the dependent variable.

Model	<i>b</i> ^b	<i>s.e.</i>	<i>R</i> ²	ΔR^2
Step 1			.17	.00
Intercept	3.78	.05		
After-action review frequency	.20	.10		
Busyness	-.002 [*]	.001		
Step 2			.23	.06 [*]
Intercept	3.75	.05		
After-action review frequency	.26 [*]	.10		
Busyness	-.001	.001		
After-action review frequency-busyness interaction term	-.003 [*]	.001		

^a $n = 67$ crews.

^b Unstandardized beta weight.

^{*} $p < .05$.

need for the development of safety-related behaviors in hazardous work environments.

At the group level, it was found that the impact of frequency of after-action reviews on group-level safety climate was fully mediated by safety-oriented group norms. The results suggest that after-action reviews assist groups in developing norms about safe behavior within their groups and the degree to which those norms are shared within the group is what influences group-level safety climate. Group dynamics literature suggests that as these groups engage in talk about safety, the concertive control (Barker, 1993) and legitimation of the safe behaviors results in norms that are enacted by the entire group (Forsyth, 2006; Latane, 1981). Thus, the effectiveness of the after-action reviews in developing and reinforcing these norms is what appears to be the influencing factor on group-level safety climate.

As expected, the relationship between frequency of after-action reviews and organizational-level safety climate was moderated by busyness levels of the crews such that the relationship was stronger for crews that were less busy. This moderation effect suggests that groups attribute the control for busyness levels to higher level management where organizational planning occurs (Scott, 2003). It also suggests that the situational constraint is inhibiting their ability engage in after-action reviews, to a certain extent. Crews with a high call volume do not feel that the organization values their safety and engaging in after-action reviews with their group members does not appear to significantly impact their organizational-level safety climate. Crews with a low call volume feel the organization values their safety and engaging in after-action reviews enhances that perception, presumably reducing accidents and injuries.

Busyness, however, did not moderate the relationship between after-action reviews and group-level safety climate. Instead, after-action review frequency positively related to group-safety climate across all levels of busyness. This suggests that the time constraints explanation may not fully explain why groups do not engage in after-action reviews. One possible explanation may be that employees perceive busyness as a work constraint placed upon them by upper management rather than their direct supervisors. If workers believe that their busyness is somehow under the control of upper management, they will likely direct any negative sentiments related to busyness back toward the overall organization as opposed to the group. The focus of such an attribution is similar to Lavelle et al.'s (2007) target similarity model. The target similarity model suggests that employees will direct their attitudes and behaviors toward the organizational actor or forces about which they formed a particular impression (Lavelle et al., 2007). In the case of busyness, therefore, employees will likely attribute crew busyness to the organization, making busyness a variable that likely alters the relationship between crew behavior (after-action reviews) and an organizational-level perception.

4.1. Theoretical implications

The findings provide several theoretical implications for researchers in the organizational sciences. First, the findings provide preliminary evidence that retrospective group meetings, as represented by after-action reviews, are a potentially effective method of improving safety climate. Although there is much research on the development of a climate for safety (e.g., Simpson, 1996; Zhao and Olivera, 2006; Zohar, 2000), this is the first paper to illustrate the importance of meetings (formal and informal) in the development of safety climate. This study informs the growing body of research illustrating the myriad of purposes for which the meeting is used in organizations (e.g., Rogelberg et al., 2006; Tracy and Dimock, 2003). Given the broad definition of after-action reviews used in this study, future research should build upon what is known about meetings and meeting structure to look at how

formality of the after-action review influences the relationships found here. Furthermore, research on meetings suggests that formal meetings have numerous design characteristics that influence the quality of the meeting (Nixon and Littlepage, 1992). Future research can look to see how variations in the utilization of these design characteristics and other meeting practices influences safety climate using after-action reviews.

Second, previous research on antecedents to safety climate tend to focus more on attitudinal antecedents, such as perceived organizational support and leader-follower relations (e.g., Mearns and Reader, 2008; Wallace et al., 2006). This study used a more objective antecedent to safety climate that is partly a type of intervention found in high-reliability organizations, after-action reviews. By looking at a potential intervention as opposed to an attitude, this study provides a first look into additional method for developing safety climate in organizations at multiple levels irrespective of certain attitudes. It also highlights the importance of future research that measures both perceptual attitude indicators and intervention-like indicators to understand the interconnectedness of these different antecedents.

Third, the findings illustrate that there may be differences in the experience of organization- and group-level safety climate within an organization. The hypothesized and supported relationships only worked under the conditions specified which indicates that group and organizational-level safety climate are not influenced by the same variables in the same way (Zohar and Luria, 2005). Although others have shown that group and organizational-level safety climate exists, this is the first paper to suggest that groups may develop two different perceptions of safety climate relative to the referent. That is, the firefighter crews in this study appear to have developed impressions of their group- as well as their organizational-level safety climate. The evidence that they are different perceptions is illustrated by showing that the relationships found do not work across both levels (e.g., busyness does not moderate the relationship between frequency of after-action reviews and group-level safety climate). Further research is needed to determine how and why multiple safety climates may exist among employees in organizations.

Fourth, the findings from this study inform the literature and theory concerning sensemaking in organizations and groups (Weick, 2001). According to Morgan et al. (1983), sensemaking increases attention toward the concept that everyday life is an ongoing accomplishment, that takes shape and forms as individuals and groups try to organize and make retrospective sense of the situations they find themselves in. In other words, sensemaking theory describes how groups of individuals collectively attempt to understand events that occur in their environment. After-action reviews provide a venue for establishing the communication patterns described in sensemaking theory. After-action reviews, by their very nature, discuss all events and environmental experiences in the retrospective realm, which is a hallmark of sensemaking (Weick, 1995). It is possible that the patterns of communication developed during these after-action reviews (and potentially sustained by them) provide a cognitive map or repertoire for future behavior during similar events (Scott and Trethewey, 2008; Weick, 1995).

4.2. Practical implications

Given the high costs of workplace accidents for both employees and their organizations, managers should find ways in which they can encourage the development of a climate for safety. This study investigated and found evidence supporting the use of a specific type of meeting, the after-action review, as a way to bolster safety climate. For organizations and their managers, therefore, this study has direct practical implications.

The first implication is that the findings strongly suggest that holding after-action reviews frequently increases safety climate at the group level. It was found that when employees engage after-action reviews—formal or informal post-incident discussions about what went right, what went wrong, and how they can improve future performance—they tend to develop positive group norms about safety. Developing these group norms influences safety climate. As such, a direct implication for managers, particularly those within organizations that have a high number of occupational hazards, is that they should encourage their work groups and teams to engage in post-incident talk. If group members regularly hold candid discussions about what went right and what went wrong after completing assignments, the findings suggest that they will have a stronger safety climate.

At the organization level, group busyness influenced the relationship between after-action review frequency and organizational-level safety climate. This finding suggests that employees in busy organizational subunits may be more likely to negatively perceive upper management's regard for their safety and well being than employees in less-busy organizational subunits. Such a perception would likely be highly related to a negative perception of organizational support, which research suggests diminishes desired safety behaviors (Mearns and Reader, 2008). Therefore, it behooves organizational leaders to consider the potential impact of site busyness when planning the location and potential workload of particular subunits.

4.3. Limitations

A few potential limitations of the foregoing research deserve attention. First, the variability of the measures upon aggregation was lower than is typical for scales measured using a 5-point Likert-type scaling format (Cohen et al., 2003). Statistical analysis becomes difficult when variability within the measures is low, especially considering the continued desire to explain variance. This low variability, however, seems to underscore the notability of the results (i.e., significant moderation and full mediation effects). These types of effects are difficult to detect under normal data-analytic conditions and the reduced variability places a conservative barrier on the potential for finding significant results. Thus, the findings may be understated simply because the variability was reduced in this sample.

Second, full participation from each crew member did not occur and those that did participate appear to be of longer tenure with the organization. Naturally those who are older, with higher tenure, and more education are likely to be the leaders of the organization suggesting that the sample may be top-heavy in terms of the distribution of management. Also, because the average crew size is only four members, full participation is truly desirable but extraordinarily difficult. Future research should strive to encourage more full participation across all levels of management and within each crew specifically.

Third, the primary predictor variable, after-action review frequency, was measured using a single item. Previous research indicates that single-item indicators are often unstable, prone to error, and may lead to problematic and contradictory findings (Churchill, 1979; Guion, 1998). Although this issue is highly problematic, two factors associated with this particular measure of after-action review frequency and methodology reduces the level of concern associated with this single-item indicator. First, frequency is not an attitude and is less subjective in nature. Instead of asking about their attitudes toward their after-action reviews, this particular item simply asks about how often they engage in the behavior. This sort of measure is less subject to shifts in mood and feeling relative to the individual differences associated with each crew member (e.g., Brief et al., 1995). Second, because this item was

aggregated to the group level, agreement among crew members concerning the frequency with which they have their after-action reviews was assessed (Bliese, 2000; Wallace et al., 2006). Given that agreement was established among the crew members, the aggregated after-action review frequency variable is actually a multi-source indicator of frequency. This agreement among crew members begins to partially alleviate the concern that individual differences, error, or other problematic factors summarily influenced their initial assessment of after-action review frequency.

Finally, a portion of the results (e.g., mediation results) was susceptible to common-method bias given that the predictor and criterion variables were assessed simultaneously on a common instrument (Podsakoff et al., 2003). The mediation hypothesis was tested using data from a single survey aggregated to the group level. Although the existence of this confounding factor cannot definitively be ruled out, the other findings taken together suggest that if it did exist, the effects were minimal to negligible. The hypothesized moderated relationship, using an objective measure provided by the organization, was indeed significant in the expected direction. Although the presence of an interaction cannot be taken to mean that common-method bias is not present in the mediation hypothesis, it is unlikely that this interaction can be attributed to method variance, which suggests that other analyses are less likely to be attributable to common-method bias (Evans, 1985).

5. Conclusions

In summary, the findings suggest that the frequency with which people actively discuss an event influences their perceptions of hazards and risk, which may influence safety behavior. After-action reviews, it appears, may serve as a venue for constructive sense-making processes to occur that contribute positively to safety climate. Furthermore, after-action reviews may engender communicative processes that allow teams to better comprehend and respond in the face of danger and ambiguity. Future researchers should continue to investigate after-action reviews to determine ways in which they may be the most effective, exploring, for example, optimal group structures and communication patterns for group sensemaking. This study also suggests that the busyness organizational subunits may influence the relationship between holding after-action reviews and perceptions of safety climate at the organizational level, such that the relationship is non-existent in very busy locations. As such, it appears that a subunit's busyness may create negative perceptions among employees regarding the overall organization's regard for safety. Regardless of this finding at the organizational level of safety climate, however, the findings suggest that holding after-action reviews strongly influences group-level safety climate. Thus, managers should consider implementing after-action reviews as a means to bolster safety climate and thereby reduce the high costs that occupational accidents incur upon both human and financial capital.

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