

2-8-2019

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# Leading After-Action Reviews among Emergency Responder Teams: how Perceptions of Leader Behaviors Relate to Proximal and Distal Outcomes

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## Abstract

Safety concerns are a critical issue for individuals and teams in high reliability organizations (HROs). As HROs with positive safety climates often have fewer accidents and injuries, understanding which approaches can improve safety climate is paramount. The purpose of the current study was to investigate how leaders' behavior in after-action reviews (AARs) relates to AAR quality, perceptions of team safety climate, and perceptions of organizational safety climate. We used a sample (N = 89) of firefighters to test the mediation model. Results indicated that AAR leader behaviors focusing on consideration and learning promote positive perceptions of team and organizational safety climate through AAR meeting quality.

## Keywords

After-action reviews. Leader behavior. Firefighting. Emergency responders. Safety norms

Improving the safety of workers is a growing concern for organizations and teams alike. According to the United States Bureau of Labor Statistics in 2016, there were more than 2.9 million non-fatal employee injuries and 5190 worker fatalities in the United States alone (Bureau of Labor Statistics, 2017). Organizational safety concerns

also affect the individuals and teams who respond to these numerous non-fatal and fatal work-related incidents. For example, the National Fire Protection Association reported 62,085 non-fatal firefighter injuries in 2016 and 60 firefighter fatalities in the line of duty in 2017 in the United States (Haynes & Molis, 2016; Fahy, LeBlanc, & Molis, 2018). Perhaps as no surprise, emergency responders (e.g., medical, fire, and law enforcement services) are among the occupations most at risk for injury and death in the line of duty (Reichard & Jackson, 2010). Thus, leaders of emergency responder teams and organizations continue to seek ways to reduce costs associated with accidents of all types and improve safety and well-being of employees and clients/patients (Allen, Baran, & Scott, 2010). One way to improve safety in organizations is the development and maintenance of a climate for safety (Dunn, Scott, Allen, & Bonilla, 2016; Zohar, 2000).

Organizations with a strong climate of safety often have fewer accidents and injuries (Zohar, 2000), and hospitals with a strong, positive safety climate have lower incidence of patient safety events (Singer, Lin, Falwell, Gaba, & Baker, 2009). Safety climate is a type of organizational climate in which employees believe that management supports, rewards, and expects safe behavior and safe work practices (Hofmann, & Stetzer, 1996; Hofmann, & Stetzer, 1998). Zohar introduced the construct to the organizational science literature nearly 20 years ago, and a recent meta-analysis demonstrated that safety climate is linked to both increased safety behavior and decreased occupational accidents (Clarke, 2006, 2010).

Practitioners and researchers, therefore, continue to pursue ways to increase occupational safety climate; one such avenue is the use of after-action reviews (Tannenbaum & Cerasoli, 2013). After-Action Reviews (AARs) are a specific type of work meeting in which individuals discuss, interpret, and attempt to make sense of a recent event during which they collaborated (Scott, Allen, Bonilla, Baran, & Murphy, 2013). In most cases, AARs seek to answer four overarching questions about recent actions by the team or organization: What went right?, what went wrong?, what almost went terribly wrong?, and how can we do better under similar circumstances in the future? (Allen, Reiter-Palmon, Crowe, & Scott, 2018). Sometimes labeled as post-incident critiques, post mortems, hot washes, or debriefs, AARs have been a common feature of military and paramilitary organizations for decades (Allen et al., 2018). Effectively managed AAR meetings help teams that operate in hazardous or high-risk contexts maintain reliability and resiliency by learning from past events, promoting changes in perceptions, and allowing individuals to recall what they learned from the AAR during future events (Busby, 1999; Eddy, Tannenbaum & Mathieu, 2013).

Before proceeding, as noted by Allen and colleagues (Allen et al. 2018), the structure and formality of AARs tend to vary across contexts and between organizations within the same context. Some AARs are quite formal. For example, the post-fall huddle is a formal AAR or debrief that occurs after a patient falls in a healthcare setting (Reiter-Palmon, Kennel, Allen, Jones, & Skinner, 2015). The post-fall huddle uses a formal

reporting document that includes a series of key questions targeted toward identifying the root cause of a patient fall in a hospital care setting. Similarly, fire departments hold formal debriefs after major incidents, especially those involving significant loss of life or property. These formal debriefs can lead to blaming and potentially less constructive conversations and learning (Crowe, Allen, Scott, & Harms, 2017). In contrast, some AARs are much less formal. Firefighters are increasingly encouraged to hold informal AARs that occur after each call, regardless of the nature of the call or severity of outcome (Crowe et al., 2017). Due to the great variety in the nature of the calls responded to in the fire service, formality in reporting and documentation is considerably more challenging. Although there are certainly merits to studying both the formal and informal forms of AARs, the current study focuses on the more informal AAR, called by a leader, with the overt purpose of learning.

Interestingly, while informal AARs are common in military organizations, they are much less common in firefighter organizations. When they are conducted, these informal AARs improve safety climate. For example, Allen et al., (2010) found that AAR frequency was positively associated with individual perceptions of safety climate in a sample of firefighters. Further, the quality of the AARs has been shown to improve team outcomes such as performance and safety (Dunn et al., 2016; Ellis & Davidi, 2005; Ellis, Mendel & Nir, 2006). Because leadership is an important factor shaping meeting processes (Yoerger, Crowe, & Allen, 2015; Lehmann-Willenbrock, Lei, & Kauffeld, 2012; Provost et al., 2015; Ravn, 2013), it follows that perceptions of leader behavior should promote safety through facilitating higher-quality AARs.

The purpose of this study was to focus on participants of AARs and how their perceptions of leader behavior during AARs improves AAR meeting quality, thereby promoting positive individual perceptions of team and organizational safety climate. Based on previous research on workplace meetings and leadership of those meetings (Yoerger et al., 2015), the research presented here considers how leaders can facilitate higher quality AAR meetings. Further, and building upon research concerning meeting quality (Rogelberg, Allen, Shanock, Scott, & Shuffler, 2010), we argue that highquality AAR team meetings promote the establishment of positive individual perceptions of team and organizational safety climate within an organization by creating an atmosphere conducive to productive group reflection and sensemaking. Thus, we contribute to the growing literature on AARs and workplace meetings by testing a mediation model in which perceptions of leader behavior influences individual perceptions of safety climate through high-quality AAR team meetings (see Fig. 1).

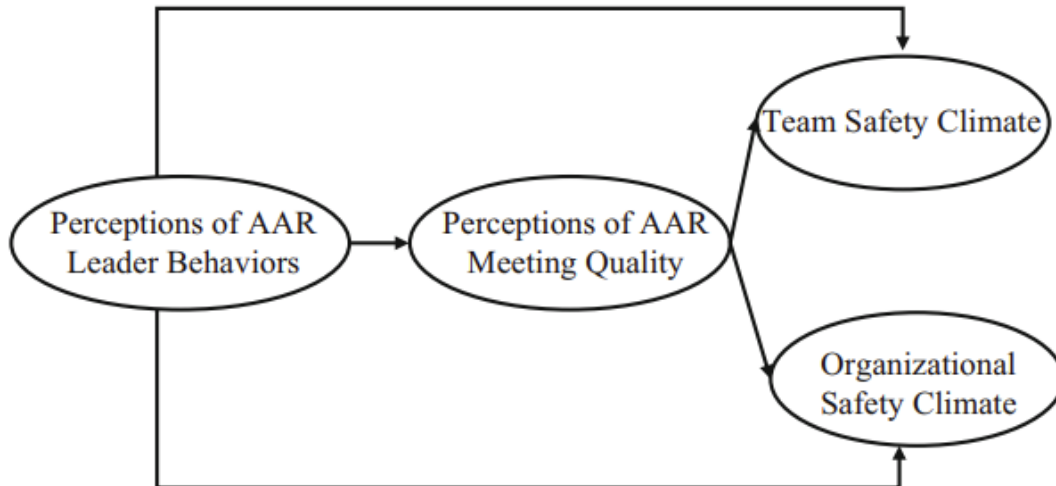


Fig. 1 Proposed theoretical model of AAR leader behaviors and perceptions of safety climate

### Perceptions of Team Leader Behavior and After-Action Review Meetings

In occupations that carry inherent risk, such as emergency responders and firefighters, team leaders play an important role in promoting behaviors that facilitate good performance, including safety behaviors (Dunn et al., 2016). While there are many ways to conceptualize leadership in teams, for the purposes of our study we leverage the functional leadership approach, and focus upon the role of formal, internal leaders (Morgeson, DeRue, & Karam, 2010). We take this perspective as it best describes the structure of leadership in emergency response teams in paramilitary organizations. Teams in these contexts follow a more traditional, hierarchical structure in which there is a single, formally-appointed leader (Zaccaro & DeChurch, 2012). From this perspective, the responsibility of team leaders is to do, or get done, whatever is not adequately handled for the group needs (McGrath, 1962, p. 5). That is, team leadership involves performing whatever necessary functions may be required for reaching team success (Morgeson et al., 2010). This means performing a range of behaviors, both those specific to the task at hand as well as those behaviors aimed at enhancing the social climate of the team (Zaccaro, Heinen, & Shuffler, 2009).

### Leading Team Meetings

As AARs are a type of meeting, understanding the role of leaders in leading team meetings can provide important insight into the AAR process and outcomes. One of the most important leadership tasks in organizations is leading team workplace meetings, and in this context, AARs. Based on the functional leadership perspective, meetings provide leaders with the opportunity to display leadership behaviors in general, and specifically those that relate to conducting effective meetings (Lehmann-Willenbrock et al., 2012). It is important to note that team members' perceptions of their leader's

behavior may be more influential than the leader's intentions or actual behaviors in shaping team outcomes (Foti, Knee, & Backert, 2008; Lord & Dinh, 2014).

From the functional leadership framework, leadership behaviors can be understood in the context of the purpose and goal of the meeting. Given the goal of AARs as a mechanism for learning and improving safety (Allen et al., 2018), leader behaviors that facilitate information sharing, reflection, and learning will be particularly important. Further, AARs have the overt purpose of reflecting on recent events, therefore leaders who facilitate sensemaking and reflection about recent events, ensure full participation, and provide guidance for the AAR are likely to shape both proximal (e.g., AAR quality) and distal (e.g., individual perceptions of safety climate) outcomes.

Within the context of meetings, perceptions of leaders' behavior can have important implications for not only how the meeting itself is perceived, but also its outcomes. Thus, participants' evaluation of AAR quality is an important criterion variable for several reasons. Meeting quality refers to an attendee's global evaluation of meetings concerning both their satisfaction with and their perception of the effectiveness of meetings (Cohen, Rogelberg, Allen, & Luong, 2011). Attendees' evaluation of meetings also influences how current and future meetings are viewed, used, and supported, and can ultimately affect the group's ability to accomplish team goals within meetings. For example, negative meeting perceptions may prompt attendees to have pessimistic attitudes toward meetings, avoid meetings, undermine meeting outcomes, or behave dysfunctionally in meetings (Bennett, 1998; Yoerger, Jones, Allen, & Crowe, 2017). Conversely, providing attendees with positive AAR meeting experiences may have a lasting impact beyond the meeting at hand. For example, focusing on meetings in general, Rogelberg and colleagues (Rogelberg et al., 2010) found that satisfaction with meetings is an important predictor and a specific facet of general job satisfaction. Further, Allen and Rogelberg (2013) found that leader effectiveness in running meetings is related to employees' engagement in their work. Thus, the quality of meetings may have lasting effects on employee attitudes and behavior.

In order to achieve high-quality AARs, leaders must engage in certain leadership behaviors that enhance both the interpersonal dynamics among participants as well as establishing an environment that will encourage learning and development. First, leaders should create a context that is psychologically safe for attendees, which is conducive to openly sharing feedback and providing potential solutions to performance gaps (Rudolph, Simon, Raemer, & Eppich, 2008). Psychological safety can be enhanced by asking open-ended, non-judgmental questions and waiting for input, avoiding engaging in blame, and allowing participants of all levels of experience opportunities to share thoughts and ideas.

Second, AAR meeting leaders should focus on the learning opportunities within the AAR meeting. Ravn (2013) proposed that meeting leaders can engage in activities such as setting direction and focus, monitoring conversation, and encouraging

participation, in an effort to enhance the meaning and value derived from the meeting. This requires providing consideration for multiple viewpoints that facilitates learning. Similarly, Burke, Stagl, Klein, Goodwin, Salas, and Halpin (2006) suggested that leader behaviors that are associated with consideration and respect are associated with team effectiveness and team learning.

Third, leaders can further structure the conditions that support effective and constructive AARs by creating an environment in which appropriate behavior in meetings is expected. Recent research on counterproductive meeting behaviors identified a variety of common meeting behaviors (e.g., side conversations, texting/emailing, long monologues) that distract from the meeting purpose, thereby hampering meeting effectiveness and outcomes (Yoerger et al., 2017). To mitigate such behaviors, leaders must visibly model appropriate and desired behaviors, such as open reflection, sharing information, and respectful interaction (Provost et al., 2015).

As these three general domains of desirable leader behaviors have been shown to be relevant to meetings and leader behavior in meetings, we anticipated that AAR attendees would perceive the meeting to be more effective when leaders display these behaviors. In other words, the more attendees perceive their leaders as engaging in these leader behaviors, the higher their perceived quality of the meetings. Thus, the following is hypothesized.

Hypothesis 1: Perceptions of effective AAR leader behavior are positively related to perceptions of AAR team meeting quality.

### **The High Reliability Organization, After-Action Reviews, and Safety Climate**

High reliability organizations (HROs) are organizations that are able to sustain nearly error-free operations, despite the fact that hazardous conditions and possible failures may lead to dramatic consequences (Roberts, 1990; Weick, & Roberts, 1993). HROs (e.g., firefighting crews, nuclear reactors, military organizations, first responders) rely on collaborators to monitor and respond efficiently in risky, turbulent environments as a primary organizational objective. Because HROs typically feature highly interdependent, complex, and uncertain relationships with their environments (Barton & Sutcliffe, 2009), it is particularly important for HROs to have positive team and organizational safety climates. As previously stated, safety climate is a type of team or organizational climate in which employees believe that their supervisor or management rewards, supports, and expects safe behavior and safe work practices (Zohar & Luria, 2005). Safety climate is usually evaluated as an aggregation at the team or organizational level and as a predictor or outcome of various team or organizational properties, characteristics, or dimensions (Clarke, 2010). Others, seeking to understand individual differences in their experiences in workplace environments, study individual level perceptions of safety climate (e.g., Allen et al., 2010). Although some refer to the analysis of safety climate at the individual level as safety norms, others follow the

convention used in the present study and refer to them as individual perceptions of safety climate (Clarke, 2006, 2010).

Individuals' perceptions of safety climate are fostered through both formal and informal communication processes within organizations, become part of team and organizational culture, and help individuals quickly detect a dangerous situation as well as guide decisions about how to respond (Christian, Bradley, Wallace, & Burke, 2009). One way that team leaders attempt to foster these positive perceptions of safety climate is by implementing strategic team communication processes, such as after-action reviews. From this perspective, AARs serve to facilitate and continuously improve awareness of emergent problem situations that may affect the safety of the team, as well as contribute to team decision making about contingent responses (Weick, & Roberts, 1993; Zohar, 2000). From a safety climate perspective, this means that AARs serve to both establish new positive safety climate perceptions as new or different issues arise, as well as reinforce the importance of existing safety climate perceptions if they are violated during an incident. Therefore, one major purpose of AARs is to enhance the reliability of team processes through post-incident discussion, primarily through facilitating collective sensemaking about a prior incident (Maitlis & Sonenshein, 1988; Rudolph et al., 2007).

Effective, high-quality AARs are assumed to enhance performance by continuously producing discussions that reflect, reinforce, and enhance desired safety attitudes as well as shared frameworks for interpreting incidents as they unfold (Weick, Sutcliffe, & Obstfeld, 2008). In contrast, ineffective AARs increase the likelihood that individuals will walk away with a mistaken or partial understanding of why the incident unfolded the way it did—specifically how individual and collective action contributed to its outcome and how to improve for future incidents. Thus, individuals' perceptions of the quality of their AARs should be positively related to their perceptions of both team and organizational safety climate. Therefore, the following hypotheses are proposed:

Hypothesis 2a: Perceptions of AAR quality are positively related to perceptions of team safety climate.

Hypothesis 2b: Perceptions of AAR quality are positively related to perceptions of organizational safety climate.

### **Mediated Model of Leader Behaviors, AAR Quality, and Safety Climate**

Our arguments and hypotheses to this point suggest that AAR meeting leader behaviors relate to AAR meeting quality as rated by meeting attendees, and that attendees' perceptions of AAR meeting quality are related to their perceptions of both their team and their organizational safety climate. In other words, consistent with leadership research and theories (Bass and Bass 2009; Schein, 2010), leaders have a significant influence on cultural expectations, team climate, as well as organizational climate, and this influence may impact meeting outcomes first and then permeate the team and organization in the form of changes in perceptions climate and norms



(Alvesson, 2011). Specifically, Schein (2010) argues that leaders develop and transmit organizational and team culture, climate, and associated norms. AARs are the perfect location for leaders to respond to crisis, model appropriate reactions to such crisis events, and directly teach how things should be done in their team and in their organization regarding safety. AAR attendees will likely reciprocate the efforts of their leader to effectively lead meetings by both feeling that their AAR meetings are of high quality and that the safety climate is more positive. Therefore, we expect to find the following mediated model as hypothesized:

Hypothesis 3: Perceptions of AAR quality mediate the relationship a) between perceptions of AAR leader behavior and team safety climate perceptions and b) between perceptions of AAR leader behavior and organizational safety climate perceptions.

## **Methods**

### **Sample and Procedure**

Career, full-time firefighters were recruited for this study from a moderate-sized fire department in the Midwest, through a reciprocal grant opportunity between a university and a local firefighter battalion. The Battalion Chief of the local fire department agreed to have all stations participate in the study. In addition to responding to fire emergencies, the public fire department also responds to medical emergencies in the community (about 25,000/year). Therefore, it is common for firefighters in this department to also be certified Emergency Medical Technicians and/or Paramedics in order to serve in staffed Medic Units. A couple of firefighters who participated in the study indicated that they were certified hazardous materials specialists.

This study was conducted in a time-lag design, in which the predictor and mediator variables were collected via survey at one time point, and the criterion variables were collected 3 months later. This method provides a more rigorous test of our hypotheses and also mitigates concerns related to common method bias (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). Both surveys were delivered to 1191 firefighters' email addresses. Each survey remained open for 3 weeks, and biweekly email reminders were sent by the authors. Three months after the pre-survey, the post-survey was delivered to the firefighter email addresses. The response rate was higher than expected to both surveys, given previous research on firefighters (e.g., Allen et al., 2010). First, 265 firefighters responded to the first survey, which resulted in a 22.3% response rate. To the second survey, 215 responded, resulting in a response rate of 18.1%. Only 96 firefighters completed the survey at both times, which resulted in a completion rate of 8.1%. A total of seven participants did not complete enough of the measures to be included in the analyses, thus the final, usable sample included responses from 89 firefighters.

We expected the low completion rate for a few reasons. First, computer equipment at the fire stations was outdated, meaning that participants had limited

resources for completing the surveys. Second, the nature of firefighters' work is demanding and unpredictable, increasing the likelihood that they may have been interrupted by calls and unable to complete the surveys. Third, the fire department would not allow an incentive to be offered for participation due to concerns about time constraints and undue pressure upon the firefighters. The low sample size presented us with some limitations for this study in terms statistical power for analysis, and issues about generalizability will be discussed below.

Of the 89 firefighters that participated, 83 were male (87.4%), four were female (4.2%), and eight (8.4%) did not indicate gender. The majority of respondents were white (88.5%), one respondent identified as African American (1%), and three identified as BOther^ (3.1%). Participants in this study were between the age of 23 and 57 years old ( $M = 41.62$ ,  $SD = 6.94$ ). Although there were more male employees in this study compared to female employees, the gender ratio does provide a representative sample of United States firefighters, as the National Firefighter Protection Association indicates that only 3.7% of all U.S. firefighters are female (Haynes & Stein, 2017). Forty participants held the position of captain (41.7%). The tenure of employment was also indicated by the participants and ranged from 2 years to 22 years ( $M = 12.76$ ,  $SD = 5.11$ ) with the firefighter's respective company.

To ensure that respondents correctly understood our definition of AARs, and that these were informal, we provided them with a definition within both the Time 1 and Time 2 survey.

“After Action Review is a relatively brief, **informal**, semi-structured discussion held by a crew/company of first responders soon after calls. An After Action Review is **NOT** a formal, post-incident analysis; it is a discussion that happens after normal operations. For example, an After Action Review might be a scheduled meeting within a single crew to discuss a recent technical rescue, or it might be an informal group conversation that happens on the way back from a fairly typical house fire. Crew members usually talk about what went well, what went poorly, and what almost went completely wrong. Also, After Action Reviews, as defined here, are **NOT** critical stress debriefings. Remember - they are simply informal discussions your crew has about a specific call.”

Then, respondents were prompted to think about their AARs in general before viewing the following measures. All measures were rated and analyzed at the individual level. Although AARs are a team interaction setting, most individuals in the sample were likely from different teams. Firefighter crews in this sample work in teams of four. Although it is possible some from the same team participated, the department was reticent to providing roster information and informed us that crews change relatively frequently. Thus, aggregating or combining into team-level indicators or analyzing in a nested manner was not possible. Additionally, we do not believe much nesting is occurring in the data. Specifically, standard errors for all of the focal measures were

quite small ranging from .06 to .08, suggesting small variability and relatively strong confidence in the mean estimates.

## Measures

All items on the surveys in the present study, except demographics, can be viewed in Appendix A. The items were taken from previously-used scales. All items were modified slightly to cater to a firefighter audience. For example, words like “captain” rather than “supervisor” were used. Alpha-reliability estimates for each scale in our sample are provided in Table 1.

### Leader Behavior in AARs

Firefighters’ perceptions of their leader’s behaviors in AARs were measured using Crowe, Allen, Scott, and Harms’ (2016) measure of leader behaviors in AARs. The measure here was developed using the same process as the measure presented in Crowe and colleagues (Crowe et al. 2017), except the focus of their measure was attendee behavior rather than leader behavior. The behaviors in this scale focused on leader behaviors that show leader consideration, respect, and facilitation of learning (Burke et al., 2006). Sample items include, “My captain gives praise where it is deserved” and “My captain talks about what can be learned from the call.” Twelve items were rated on a 5-point scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). The measure of leader behavior was collected on the Time 1 survey. In this sample, both captains and crew members rated leader behavior and this introduces some ambiguity in what exactly the captains were rating (e.g., themselves or their direct supervisor). To mitigate this concern, we supplement the hypothesis testing by testing captains separately to check for differences, and we return to this concern in more detail in the discussion section.

### AAR Quality

AAR quality was measured as a combination of AAR effectiveness and AAR satisfaction. To report AAR effectiveness, or the extent to which firefighters felt that their AARs are useful and productive (Cohen et al., 2011), respondents indicated to what extent their AARs in general have ten characteristics (e.g., efficient, useless) on a scale of 1 (strongly disagree) to 5 (strongly agree). Six items (e.g., wasteful) were negatively worded items and were recoded before analyses were performed. To report AAR satisfaction, or the extent to which firefighters have positive feelings toward their AARs (Briggs, Reinig, & de Vreede, 2006), respondents indicated how strongly they disagreed or agreed with ten statements regarding their positive feelings about their AARs on a scale from 1 (strongly disagree) to 5 (strongly agree). Based on previous research (Cohen et al., 2011) and noting that the AAR effectiveness and AAR satisfaction scales were highly correlated ( $r = .70$ ;  $p < .05$ ), the two scales were combined to create a measure of AAR quality (see results section for more details). The measure of AAR Quality was collected on the Time 1 survey.

**Table 1** Means, standard deviations, intercorrelations, and alpha reliability estimates

	<i>M</i>	<i>SD</i>	1.	2.	3.	4.	5.	6.	7.
1. Leader Behavior (Time 1)	3.94	0.61	(.95)						
2. AAR Quality (Time 2)	3.87	0.80	.58**	(.85)					
3. Team Safety Climate (Time 2)	3.98	0.65	.42**	.37**	(.97)				
4. Organizational Safety Climate (Time 2)	3.48	0.73	.32**	.36**	.59**	(.95)			
5. Organizational Tenure	12.76	5.11	.01	-.08	-.11	.01			
6. Education	NA	NA	.00	-.20	-.05	-.10	-.22*		
7. Age	41.62	6.94	-.03	-.09	-.17	-.03	.67**	-.18	
8. Captain vs. Crew Member	NA	NA	-.16	-.03	-.06	-.05	-.57**	-.06	-.26*

*N* = 89. Internal consistency estimates, Cronbach's Alpha, for each scale shown on diagonal in parentheses, where applicable. Captain vs. Crew Member variable is coded as follows: 0 = Captain, 1 = Crew Member

\*  $p < .05$  (2-tailed)

\*\*  $p < .01$  (2-tailed)

### Team Safety Climate

Individual perceptions of team safety climate were measured by modifying the 16-items of Zohar and Luria's (2005) Group-Level Safety Climate measure to relate specifically to firefighters and the fire service. Items were measured on a 1 (strongly disagree) to 5 (strongly agree) Likert scale. Higher scores indicate stronger individual perceptions of team (i.e., crew) safety climate. The measure of Team Safety Climate was collected on the Time 2 survey.

### Organizational Safety Climate

Individual perceptions of organizational safety climate was measured by modifying Zohar and Luria's (2005) 16-item Organizational-Level Safety Climate measure. The measure was modified to relate specifically to firefighters and the fire service, including removing four items. The final 12-item measure is included in the Appendix. Items were measured on a 1 (strongly disagree) to 5 (strongly agree) Likert scale. Higher scores indicate stronger individual perceptions of organizational (i.e., departmental) safety climate. The measure of Organizational Safety Climate was collected on the Time 2 survey.

## Results

### Preliminary Analyses

Means and standard deviations were computed for all primary variables in the study (see Table 1). Bivariate correlations between the primary variables and

demographic variables revealed that none of the primary variables correlated with age, education, or organizational tenure (see Table 1). Therefore, no covariates were included in subsequent hypothesis testing.

Before testing the proposed hypotheses, we sought to verify that the measurement model showed adequate discriminant validity across the various focal measures. A Confirmatory Factor Analysis (CFA) was not conducted because the sample size was too small to allow enough statistical power to reliably detect patterns in the data (MacCallum, Widaman, Zhang, & Hong, 1999). Specifically, in order to do a full test of the measurement model, each item from each measure would serve as an indicator for their respective construct, and each using a degree of freedom in the process. Thus, a CFA for the currently model would require 64 degrees of freedom for the items alone, leaving only a sample of 32 for the path estimates. Instead, Exploratory Factor Analyses (EFAs) were conducted to estimate the factor structure of each scale, rather than the full model. It is important for us to note that conducting an EFA with great confidence requires a sample size of at least 200, preferably 300 (Yong & Pearce, 2013).

In order to begin to demonstrate the unidimensionality of each of the constructs, we first conducted separate EFAs for each measure. The EFAs were run using principal axis factoring, direct oblimin rotation, and eigen values of greater than 1.0 were extracted as factors with scree plots used to verify factor structure. The team safety climate measure loaded onto one factor and all factor loadings were above .48. The organizational safety climate measure loaded onto one factor and all items' factor loadings were above .57. The leader behavior measure also loaded onto one factor and all factor loadings were above .46. These analyses suggest one-factor solutions for these measures, consistent with previous research using these measures as cited in their respective descriptions.

To test the dimensionality and validity of the AAR quality measure, we also conducted an EFA using principal axis factoring, direct oblimin rotation, and eigen values of greater than 1.0 were extracted as factors with scree plots used to verify factor structure. Since the AAR quality measure is comprised of both meeting satisfaction and meeting effectiveness, we were particularly interested in ensuring the construct's dimensionality is appropriately captured before proceeding. Previous research using this same measure of meeting quality treated the scale as unidimensional because the two measures are highly correlated and are associated with similar outcomes (e.g., Cohen et al., 2011). Our analyses showed a two-factor solution, with no cross-loadings, and all factor loadings above .45 within each factor. Upon further investigation, it became clear that the second factor was actually a method factor associated with the negatively worded items that were recorded for the purpose of creating the scale composites (Spector, Van Katwyk, Brannick, & Chen, 1997). Based upon the recommendations by Spector et al. (1997) and given the previous use of the measure, we removed the negatively worded items and proceeded with hypothesis testing with the one-factor

solution of the meeting quality measure. It should be noted that all the negatively worded items were from the effectiveness measure (see Appendix A). Thus, the final meeting quality measure used in the subsequent analyses included a total of 14 items, with 10 items from the satisfaction scale and 4 items from the effectiveness scale.

## Hypothesis Testing

The relatively small sample size prevented the authors from testing hypotheses using Structural Equation Modeling (SEM). Instead, regression techniques and PROCESS macro (Hayes, 2017) were used to test each mediation separately. As predicted in Hypothesis 1, perceptions of leader behavior in AARs were positively related to perceptions of AAR quality,  $r(88) = .58, p < .001$ , which indicates that a perception of leader behaviors that are considerate and focused on learning in AARs by attendees is related to increased ratings of the quality of AARs. Comparisons were made between self-identified captains and crew members, and it seems that the relationships found above are robust in both groups. This means that both leaders ( $r(38) = .36, p = .023$ ) and non-leaders' ( $r(45) = .67, p < .001$ ) perceptions of leader behavior are associated with positive outcomes. The difference in the correlations between the two samples was non-significant ( $z = 1.88; p = .060$ ).

Support was also found for Hypothesis 2a and 2b, as perceptions of AAR quality were positively related to individual perceptions of team safety climate,  $r(90) = .37, p < .001$ , and individual perceptions of organizational safety climate,  $r(90) = .36, p = .001$ , such that higher ratings of AAR quality were related to more positive perceptions of safety climate at the team and organizational level by firefighters. Additionally, we compared these relationships for captains versus crew members, and found the results differed. While the significant, positive correlations persisted in the crew member sample between perceptions of AAR quality and individual perceptions of team ( $r(44) = .40, p = .006$ ) and organizational ( $r(44) = .50, p < .001$ ) safety climate, captains' perceptions of leader behavior were not significantly related to team ( $r(38) = .27, p = .100$ ) or organizational ( $r(38) = .13, p = .433$ ) safety climate, though the correlations were still positive. It is possible that a larger sample size would provide enough power to detect the positive correlation between leader behavior and team safety climate at the critical  $p$  value.

Preliminary support was found for both mediated models – Hypothesis 3a and 3b – by determining that perceptions of leader behavior and meeting quality are related (see Table 1). To test Hypothesis 3a, we used Hayes's (2017) PROCESS macro to determine the direct and indirect effects of leadership behavior on individual perceptions of team safety climate. First, the effect of perceptions of leadership behavior on team safety climate were significant,  $F(1, 88) = 18.99, p < .001, R^2 = .18$ , indicating that perception of leader behavior accounted for 18% of the variance in team safety climate. Thus, perceptions of leader behavior were a significant predictor of team safety climate,  $B = 0.45, \beta = .42, t(88) = 4.36, p < .001, 95\% \text{ CI } [0.24, 0.65]$ , such that as perception of more positive leader behaviors, especially those focused on consideration and learning,

team safety climate is higher (see Table 2). Second, the same relationship was examined when AAR quality was added to the model. The model was significant,  $F(1, 88) = 12.04$ ,  $p < .001$ ,  $R^2 = .22$ , indicating that the combination of perceptions of leadership behavior and AAR quality accounted for 22% of the variance in individual perceptions of team safety climate. When controlling for AAR quality, perceptions of leader behavior were still a significant predictor of team safety climate,  $B = 0.30$ ,  $\beta = .28$ ,  $t(88) = 2.40$ ,  $p = .018$ , 95% CI [0.05, 0.54], providing further support for a direct effect of perception of leader behavior on team safety climate (see Tables 2 and 3) and suggesting partial mediation. To probe the indirect effect of leader behavior on individual perceptions of team safety climate through AAR quality, bootstrapping analysis was conducted. Results from the bootstrapping analysis, 95% CI [0.01, 0.16], did not include zero and therefore lend support to Hypothesis 3a and the partial mediation found here. We repeated the analyses for Hypothesis 3a in the captain sample and found the same pattern of results.

**Table 2** Multiple regression analysis to test perceptions of team safety climate mediation

Model	Variable	<i>b</i>	<i>SE</i>	<i>t</i>	CI	$\beta$	<i>F</i>	$R^2$	$\Delta F$	$\Delta R^2$
1	Intercept	2.23	.41	5.46**	(1.42-3.04)		18.99**	.18		
	Leader Behavior	.45	.10	4.36**	(.24-.65)	.42				
2	Intercept	2.02	.41	4.88**	(1.20-2.84)		12.04**	.22	4.36	.04
	Leader Behavior	.30	.12	2.40*	(.05-.54)	.28				
	AAR Quality	.21	.10	2.09*	(.01-.40)	.24				

*N* = 89. *CI* = confidence interval (95%)

\* $p < .05$

\*\* $p < .01$

Next, to test Hypothesis 3b, we first examined the indirect and direct effects of perception of leadership behavior on individual perceptions of organizational safety climate. The simple regression was significant,  $F(1, 88) = 9.75$ ,  $p = .002$ ,  $R^2 = .10$ , indicating that perception of leadership behavior accounted for 10% of the variance in organizational safety climate. Thus, perceptions of leader behavior are a significant predictor of organizational safety climate,  $B = 0.37$ ,  $\beta = .32$ ,  $t(88) = 3.12$ ,  $p = .002$ , 95% CI [0.14, 0.61] (see Table 3). Next, the same relationship was examined when AAR quality was added to the model. The model was significant,  $F(1, 88) = 9.28$ ,  $p < .001$ ,  $R^2 = .18$ , indicating that the combination of perceptions of leadership behavior and AAR quality accounted for 18% of the variance in individual perceptions of organizational safety climate. When controlling for AAR quality, perceptions of leader behavior were no longer a significant predictor of organizational safety climate,  $B = 0.14$ ,  $\beta = .12$ ,  $t(88) =$

1.00,  $p = .321$ , 95% CI [-0.14, 0.42], providing support for an indirect effect of perceptions of leader behavior on perceptions of organizational safety climate through AAR quality (see Tables 3 and 4) and suggests full mediation. To further probe the indirect effect, bootstrapping analysis was again conducted to investigate this second mediated model. Results from the bootstrapping analyses, 95% CI [0.01, 0.35], indicated an indirect effect. Thus, Hypothesis 3b was fully supported, including support for full mediation. We repeated these analyses in the captain sample and found the same pattern of results.

**Table 3** Multiple regression analysis to test perceptions of organizational safety climate mediation

Model	Variable	<i>b</i>	<i>SE</i>	<i>t</i>	CI	$\beta$	<i>F</i>	<i>R</i> <sup>2</sup>	$\Delta F$	$\Delta R^2$
1	Intercept	2.01	.48	4.21**	(1.06-2.96)		9.75	.10		
	Leader Behavior	.37	.12	3.12**	(.14-.61)	.32				
2	Intercept	1.68	.47	3.56**	(.74-2.62)		9.28	.18	8.03**	.08
	Leader Behavior	.14	.14	1.00	(-.14-.42)	.12				
	AAR Quality	.32	.11	2.83**	(.10-.54)	.34				

*N* = 89. CI = confidence interval (95%)

\*\* $p < .01$

**Table 4** Mediation of the effects of leader behavior on individual perceptions of team and organizational safety climate through after action review (AAR) quality

	Product of Coefficients			Bootstrapping	
	Effect	<i>SE</i>	<i>Z</i>	Percentile 95% CI Lower	Upper
LB – AARQ – TSC	.07	.043	1.53	.005	.157
LB – AARQ – OSC	.12**	.058	2.03*	.112	.385

*N* = 89. TSC = team safety climate; OSC = organizational safety climate; LB = AAR leader behaviors; AARQ = AAR quality; CI = confidence interval; 5000 bootstrap samples

\* $p < .05$

\*\* $p < .01$

## Discussion

Emergency responders engage in work activities that save the lives of many individuals, and the improvement of responders' own safety while on the job should be a



high priority. Building upon previous research showing that AARs improve emergency responder safety climate and safety (Allen et al., 2018), the present study sought to identify a way to enhance the effectiveness of AARs by looking at how AAR leader behaviors relate to perceptions of safety climate. Specifically, the study proposes and confirms that individual perceptions of AAR leader behaviors are significantly related to positive individual perceptions of team and organizational safety climate through perceptions of AAR meeting quality. The mediated model found here contributes to the literature and practice of safety by testing previous postulations and theory concerning how important AARs and leader behavior are to the establishment of a proactive safety climate, essential to the safety of workers and teams who operate in dangerous work environments (Allen et al., 2010; Tannenbaum & Cerasoli, 2013).

More specifically, this study found that when meeting leaders use participative processes, show respect to participants, and encourage learning, AARs are likely to be more effective and attendees more satisfied (Cohen et al., 2011; Odermatt et al., 2016). Additionally, quality meetings appear to relate to both team and organizational safety climate a brief time later. That is, as perceptions of AAR meeting quality increased, so did individual perceptions of team and organizational safety climate after a short time lag, suggesting a lasting impact of good meetings.

It is of note that AAR meeting quality was related to both levels of perceptions of safety climate. It stands to reason that good meetings with one's team will solidify the climate within that team (Dunn et al., 2016). However, this study showed that good meetings within the team were also related to perceptions of climate concerning the organization. This could be because individuals identify the leader as a representative of the larger organization, thereby associating their behavior and meeting outcomes to organization qualities (Eisenberger, Huntington, Hutchison, & Sowa, 1986). These results should be interpreted with caution, as there is a significant and large correlation between the two safety climate measures. As expected, due to nesting, perceptions of team and organizational level safety climate are highly correlated. While the correlation is not so high to indicate the same construct, it does suggest a degree of overlap that must be considered. Alternatively, a recent study suggests that safety climate flows top down within organizations (i.e., from management to supervisors to employees), therefore, the large correlation may be a function of organizational safety climate influencing team safety climate generally (Lee, Huang, Sinclair, & Cheung, in press).

Finally, the last hypothesis suggested the full mediation model, such that perceptions of leader behaviors were related to individual perceptions of safety climate through their association with individual ratings of AAR meeting quality. The results largely support this mediated framework. AAR leader behaviors were related both directly and indirectly to perceptions of team safety climate suggesting partial mediation, whereas it related to organizational safety climate only indirectly when meeting quality was included in the model suggesting full mediation. These results suggest a bit of differentiation occurring by individuals as they perceive team and organizational safety

climate. Specifically, it may be that meetings are the context in which organizational level safety climate is most prominently communicated, whereas team safety climate is communicated by those leader behaviors in other ways outside the AAR meeting. Although these findings generally confirm previous research arguing for the importance of effective leadership in a variety of settings (Bass and Bass 2009), further research is needed to clarify how the levels at which climate manifests are differentially impacted by leaders and perhaps leaders at different levels.

It is important to note that since our sample included captains which would be the leader of the AARs, as well as crew (leaders and team members), we have evaluated the relationships of interests for both. We have found that our results hold across the two different levels, providing further support for the hypotheses.

### **Implications for Research**

The current study provides several implications for research and theory. First, this study further extends the growing body of research on AARs (e.g., Allen et al., 2010) by looking more directly at the behaviors of meeting leaders within the AAR. Previous work tended to focus on frequency patterns (Allen et al., 2010), ambiguity concerns (Scott et al., 2013), other quality concerns (Dunn et al., 2016), and attendee behaviors (Crowe et al., 2017). By looking at leader behaviors during meetings, this study begins to show specific behaviors that organizations will want to promote, train, and develop in leaders. For example, leaders may want to point out good work during the previous call, identify mistakes constructively, encourage voice related behaviors, and so forth. Essentially, the findings provide evidence to suggest that leaders should be more considerate and encourage learning in their AARs, which is consistent with both sensemaking and HRO theories concerning how to maintain a safe climate and to provide for continuous learning. It is important to note that these may not be the only leader behaviors that can facilitate effective AARs, however, these dimensions of leadership behavior were tested in this study, whereas other potential dimensions (for example, task focus) were not.

Second, extending from the previous implication, the finding that perceptions of AAR meeting quality relate to perceptions of team and organizational safety climate continues to build the case that meetings are not mere backdrops in organizations for other more important processes (Allen, Lehmann-Willenbrock, & Rogelberg, 2015; Schwartzman, 1989). Specifically, previous research started showing that meetings matter by connecting their outcomes to organizational attitudes (Allen & Rogelberg, 2013; Rogelberg et al., 2010). In other words, the case is beginning to emerge for meetings serving as tools that can and should be leveraged to promote team and organizational outcomes. This study lends additional support for such ideas and begins to move meeting science forward through connecting leadership, meeting quality, and safety climate.

### **Practical Implications**

Several practical implications flow naturally from the findings presented here. First, leadership in team meetings focused on retrospective learning appears to be helpful for promoting a safe work climate. Specifically, our measure of leader behavior focuses on learning from both positive and negative outcomes, encouraging discussion, and providing praise. Thus, leaders in emergency responder organizations may want to promote such informal meetings in which learning occurs at a greater level. For example, firefighters are required to engage in critical incident stress debriefings after a fellow firefighter is injured or killed in the line of duty. Perhaps promoting more mundane, day-to-day, reflective AARs may serve the purpose of learning from near misses that could help resolve important safety concerns and, in turn, avoid more formal debriefings. It is important to note that finding time for such informal AARs is not always easy, and whether or not these AARs can take place is dependent on a number of factors including the timing, whether an additional call occurs immediately after, stress levels resulting from current call and so on (Allen et al., 2018). Therefore, it should be stressed that while it may not be possible to conduct an AAR after every call, when possible, AARs should be conducted, even after routine calls.

Second, meetings, when done effectively, can have a lasting effect on individuals in the team and across the organization. Thus, improving meetings seems important. Organizational leaders may look to training programs and reward systems to instill good meeting behaviors in leaders. Our findings indicate that good meeting behavior includes praise, open discussion, and learning from both positive and negative outcomes. For example, firefighter captains could be trained on key questions that should be answered during AARs and what behaviors they should personally engage in to improve AAR quality.

### **Limitations and Future Directions**

As with any research study, the current study is not without limitations. There are a number of issues related to the sample size and population. First, we had a low completion rate (8.1%), which potentially limited our ability to generalize our findings. Second, our firefighter sample included a diverse sample including firefighters and EMTs. Due to the small sample size, we were unable to further evaluate whether there are differences across these different sub samples. A more diverse and representative sample of individuals in emergency responder roles would be ideal. Additionally, it is unknown whether the forgoing results will apply in other types of organizations where other norms concerning safety, emergency responding, and meetings likely would alter the model. Gratefully, these two limitations provide opportunities for future research in which both diversity in sampling frame and cultural composition of the sample could be tested.

Another limitation is that the model is based on individual-level perceptions of all the focal constructs, some of which are often modeled at the group or organizational level and have a component of sharedness associated with them (e.g., safety climate, Zohar, 2000). It would have been preferred to model the data at the group level, but the

organization that partnered with the coauthors would not allow for the collection of crew-level affiliation due to concerns with anonymity. As such, we chose to model the data using the individual-level perceptions. Interestingly, this is not the first time that this has been done. Previous work often labeled individual perceptions of group or organizational safety climate as Bpsychological safety climate<sup>^</sup> (e.g., Probst & Estrada, 2010). Others label individual perceptions as Bsafety norms<sup>^</sup> (Crowe et al., 2017). We chose to clearly state that we measured individual perceptions of team and organizational safety climate. We hope that our future work will have the ability to model at either individual or group level relative to the hypotheses.

Another important limitation is the nature of the leader behaviors in the AARs measure. Specifically, the measure asked participants to indicate if their captain engaged in certain behaviors in their AAR meetings (see Appendix A). However, as previously noted, the sample included both crew members and captains (i.e., leaders). Thus, the ratings upon which the balance of the model was tested include leaders who could have inflated or biased favorably the results in their favor. As shown in the analyses, there was no correlation between crew versus captain status and the study variables. Although the rating process introduced a meaningful limitation, the results appear to be consistent in both subsamples, crew members and captains. Also, since captains may have been rating themselves, the findings do suggest that there is convergence across multiple rating sources, which may actually be a neat strength of the results presented here. Future research should, however, ensure that the raters are the appropriate individuals for rating the phenomenon or behaviors of interest. It remains unknown if the captains were rating themselves, their own line leaders (e.g., battalion chief), or reflecting on previous experiences prior to becoming a captain. .

Another important limitation is the potential for considerable variability in AARs that have been referenced by the participants in the study. This leads to the real possibility that AAR quality perceptions may have been influenced by unmeasured variables such as group composition, overall frequency of AARs, meeting duration, and contextual variables. Further, it is possible that leader behavior in the AAR meeting was evaluated in part based on leader behavior outside of the meeting such as overall leader support. Therefore, future research should aim to understand additional variables that may influence the perception of leader behavior as well the direct and indirect effect that leader behavior in meetings has on perception of meeting quality and safety climate. Further, contextual and other variables may serve as boundary conditions for these relationships.

This study is also susceptible to potential methodological issues related to common method bias because the predictor and criterion variables were both assessed using survey tools. Podsakoff and colleagues (Podsakoff et al. 2003) recommended ways to mitigate common method variance, some of which we were able to follow in the current study. For example, the predictor and criterion were collected on two separate surveys at different times: the temporal distance between the predictor and criterion

measures mitigates common method variance (Podsakoff et al., 2003). The time-lagged nature of the sample also allows for some preliminary indications of the causal nature of the relationships. Additionally, we ensured that the structure of the items on each of the scales varied between one another and reduced the ambiguity of the items by making them more specific to a firefighter context. In the present study, there was a low level of variance in leader behavior, resulting in conservative tests. This may have occurred because most fire captains actually lead quite similarly, which is consistent with the paramilitary structure and strong organizational culture that persists in fire departments.

Although many future research ideas emerge from the study, one particularly intriguing direction is to bring the variability in leadership behavior observed here into the lab and manipulate these behaviors. Specifically, experimental designs could be used to capitalize on the observed difference, control the environment further, and explore the causal effects of leader behavior in these meetings. Doing this would extend the current findings, which are correlational in design, to demonstrate whether the theory and rationale of the direction of the relationship is actually true. Access to an appropriate sample and context for most appropriately testing this in the laboratory may prove challenging. However, our hope is that this research serves as a nice launching point for future work in this area. Compliance with Ethical Standards Conflict of Interest Statement On behalf of all authors, the corresponding author states that there is no conflict of interest.

**Appendix A:**

<b>Leader Behavior</b>
Instruction: Think about your After Action Reviews in regard to your captain and please indicate how much you...
During After Action Reviews, my captain gives praise where it is deserved.
During After Action Reviews, my captain commends us for the good things we did during the call.
During After Action Reviews, my captain points out mistakes to improve on in the future.
During After Action Reviews, my captain talks about what went wrong during the call.
During After Action Reviews, my captain allows everyone involved in the call a chance to speak.
During After Action Reviews, my captain encourages us to speak up about the call.
During After Action Reviews, my captain encourages us to voice our concerns.
During After Action Reviews, my captain discusses everyone's role during the call.
During After Action Reviews, my captain starts the discussion promptly after the call.
During After Action Reviews, my captain points out small things crew members experienced so that others can learn.
During After Action Reviews, my captain talks about what can be learned from

the call.
During After Action Reviews, my captain points out funny things that happened during the call.
<b>Organizational Safety Climate</b>
Instruction: Think about the upper management in your fire department. Respond to the following statements concerning your upper management (e.g., top management in this organization)
Reacts quickly to solve the problem when told about safety hazards
Listens carefully to workers' ideas about improving safety
Uses any available information to improve existing safety rules
Tries to continually improve safety levels in each department
Makes clear that safety is the personal responsibility of each worker
Considers a person's safety behavior when moving/promoting people
Requires each manager to help improve safety in his/her department
Gives safety personnel the power they need to do their job
Invests a lot of time and money in safety training for workers
Provides workers with a lot of information on safety issues
Regularly holds safety/awareness events (e.g., presentations, ceremonies, etc.)
Provides detailed safety reports to workers (e.g., injuries, near accidents, etc.)
<b>Team Safety Climate</b>
Instruction: Please rate the extent to which you agree or disagree with the following statements. My captain...
Makes sure we receive all the equipment needed to do the job safely
Frequently checks to see if we are all obeying the safety rules
Discusses how to improve safety with us
Uses explanations (not just compliance) to get us to act safely
Emphasizes safety procedures when we are working under pressure
Frequently tells us about the hazards in our work
Refuses to ignore safety rules when work falls behind schedule
Is strict about working safely when we are tired or stressed
Reminds workers who need reminders to work safely
Makes sure we follow all the safety rules (not just the most important ones)
Insists that we obey safety rules when fixing equipment or machines
Says a "good word" to workers who pay special attention to safety
Is strict about safety at the end of the shift, when we want to go home
Spends time helping us learn to see problems before they arise
Frequently talks about safety issues throughout the work week
Insists we wear our protective equipment even if it is uncomfortable
<b>AAR Satisfaction</b>
Instruction: Please rate the extent to which you agree or disagree with these statements regarding your crew's informal after action reviews.
I feel satisfied with the way in which my After Action Reviews are conducted.
I feel good about the After Action Review process.
I like the way my After Action Reviews progress.

I feel satisfied with the procedures used in my After Action Reviews.
I feel satisfied about the way we carry out the activities in my After Action Reviews.
I like the outcomes of my After Action Reviews.
I feel satisfied with the things we achieve in my After Action Reviews.
When the After Action Reviews end, I feel satisfied with the results.
Our accomplishments in our After Action Reviews give me a feeling of satisfaction.
I am happy with the results of my After Action Reviews.
<b>AAR Effectiveness</b>
Instructions: Think of After Action Reviews with your crew. Please indicate your level of agreement with the words below as they relate to your informal after action reviews.
Efficient
Waste of time*
Productive use of time
Wasteful*
Inefficient*
Unsuccessful*
Productive
Not beneficial*
Effective
Useless*

\*indicates removed due to negatively worded item creating artificial method factor (see results section)

### **Publisher's Note**

Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

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