Safety Science 118 (2019) 126–144

Contents lists available at ScienceDirect

Safety Science

journal homepage: www.elsevier.com/locate/safety

Development and validation of the fire service safety climate scale

Jennifer A. Taylor[a,*], Andrea L. Davis[a], Lauren J. Shepler[a], Jin Lee[c], Carolyn Cannuscio[b], Dov Zohar[d], Christian Resick[e]

[a] Department of Environmental & Occupational Health, Dornsife School of Public Health at Drexel University, 3215 Market Street, Philadelphia, PA 19104, USA
[b] University of Pennsylvania, 3620 Hamilton Walk, Philadelphia, PA 19104, USA
[c] Department of Psychological Sciences, Kansas State University, BH467, Manhattan, KS 66506, USA
[d] Faculty of Industrial Engineering and Management, Technion-Israel Institute of Technology, Technion City, Haifa 3200003, Israel
[e] Department of Management, Drexel University LeBow College of Business, 3215 Market Street, Philadelphia, PA 19104, USA

ARTICLE INFO

Keywords:
Safety climate
Firefighter
Injury
Engagement
Job satisfaction
Mixed methods

ABSTRACT

Purpose: Understanding the climate of safety is a core initiative of the US fire service in its quest to reduce injuries, fatalities, and toxic exposures linked to occupational disease. The purpose of this study was to develop a fire service safety climate scale to support this goal.

Method: Survey development followed an exploratory sequential mixed methods design combining qualitative methods (interviews and focus groups with 123 firefighters to generate items), and quantitative methods (exploratory and confirmatory factor analyses; multi-level models) to examine the survey's psychometric properties in a geographically-stratified random sample of 130 fire departments including 615 stations and 8575 firefighters.

Results: Based on the EFA results, a 14-item multi-level measure of fire service safety climate containing two factors—management commitment (fire department-level) and supervisor support (fire station-level)—was developed. Results of multi-level CFAs indicated acceptable fit of the measurement model, supporting construct validity. Multi-level path analyses showed that fire service safety climate scores were significantly related to safety-related outcomes such as injury rates and safety compliance along with well-being focused outcomes such as job satisfaction, burnout, and employee engagement, supporting criterion-related validity.

Discussion: A reliable and valid fire service safety climate scale was developed. The scale's dimensions of management commitment within fire department and supervisor support within stations are embedded in a larger instrument, the Fire service Organizational Culture of Safety survey (FOCUS). This simple tool allows fire departments to assess shared perceptions of safety policies and practices and the impact of such perceptions on safety and organizational outcomes.

1. Introduction

> *The issue that has been identified most consistently as the key factor in reducing firefighter fatalities and injuries is a change in the prevailing fire service culture with regard to safety. The prevailing culture of the fire service glorifies the acceptance of extreme personal risk far ahead of the thoughtful analysis and management of risk factors. Instead of having a commitment to safety incorporated into the fundamental values of the fire service, in too many cases safety is considered as an afterthought and an inconvenience. This cultural orientation allows firefighters to feel justified in violating established safety standards and regulations, if they are perceived as a hindrance to a more important mission.* (National Fallen Firefighters Foundation, Indianapolis Mini Summit)

1.1. The United States fire and rescue service

The fire service is commonly known as a hazardous industry. It has two major work activities: fire suppression and emergency medical services (EMS). The fire suppression side is known for its risks of heat, inhalation and absorption of combustion products, musculoskeletal effort, compromised and dangerous built environments, and exposure to hazardous materials. The EMS side presents infectious disease

* Corresponding author at: Drexel University School of Public Health, Department of Environmental & Occupational Health, 3215 Market Street, Nesbitt Hall Rm 655, Philadelphia, PA 19104, USA.
E-mail addresses: jat65@drexel.edu (J.A. Taylor), aly25@drexel.edu (A.L. Davis), ljs326@drexel.edu (L.J. Shepler), Jinlee@ksu.edu (J. Lee), cannusci@wharton.upenn.edu (C. Cannuscio), dzohar@tx.technion.ac.il (D. Zohar), Cjr63@drexel.edu (C. Resick).

https://doi.org/10.1016/j.ssci.2019.05.007
Received 30 July 2018; Received in revised form 19 April 2019; Accepted 6 May 2019
Available online 15 May 2019
0925-7535/ © 2019 The Authors. Published by Elsevier Ltd. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/BY-NC-ND/4.0/).

exposures, intense musculoskeletal effort, and persistent emotional demands. For both activities, short-term exposures lead to lost work and disability; longer-term effects include inability to return to work, accumulation of mental stress, and death in the line of duty.

There are approximately 1.2 million firefighters in the United States, of whom 345,000 are career and 815,000 are volunteer employees (Haynes & Stein, 2017). In 2015, the fire service responded to 33,635,500 calls for service, 64% of which were for medical aid (NFPA, 2017). The National Fire Protection Association (NFPA) estimated 62,085 line-of-duty injuries in 2016 (Haynes & Molis, 2017). Over the past five years, an average of 70 firefighters died annually in the line-of-duty, with approximately 62% resulting from injuries and 38% from sudden cardiac events (Fahy et al., 2017). While cancer and other occupational disease estimates are often difficult to quantify due to exposure and latency issues, a groundbreaking study found excess risk of cancer due to the hazardous exposures experienced during firefighter work (Daniels et al., 2014). Subsequent research identified decision-making behaviors such as peer pressure, organizational solidarity, and image as relevant to compliance with the respiratory protection needed for cancer risk reduction (Maglio et al., 2016). The Firefighter Life Safety Initiatives (FLSI) contain 16 consensus priorities that reflect fire service safety and health goals. Three of them indicate opportunities for organizational science intervention (National Fallen Firefighters Foundation, Firefighter Life Safety Initiatives):

> #1 "Define and advocate the need for a cultural change within the fire service relating to safety; incorporating leadership, management, supervision, accountability and personal responsibility."
> #2 "Enhance the personal and organizational accountability for health and safety throughout the fire service."
> #4 "All firefighters must be empowered to stop unsafe practices."

1.2. Safety climate

Culture is a term used to describe the work environment providing some cues as to why accepted norms and practices exist within that context (Reichers & Schneider, 1990). Culture is a combination of artifacts (dress codes e.g., turnout gear, equipment e.g., Halligan, stories e.g., "eating smoke"), shared espoused values (leader-driven e.g., always wear your seatbelt), fundamental assumptions (it's a dangerous job, you're going to get hurt eventually, we want to be first in) (Schein, 2004). Work climates are a measurable artifact of organizational cultures (Schein, 2004) that have direct implications for how people do their job (Schneider et al., 2013).

Unit level climate captures shared perceptions about the policies, procedures, practices, and types of behavior that are expected, supported, and rewarded in the workplace (Schneider, 1975; Schneider et al., 2013; Kuenzi & Schminke, 2009). Notably, climate perceptions refer to the logics of action in organizations, targeting the implicit rules that determine the kinds of behavior likely to be rewarded, which may differ from formal policies and explicit procedures (Reichers & Schneider, 1990; Schneider et al., 2013). Climate perceptions reflect organizational policies and procedures not as formally espoused but rather as actually applied or enacted at work units (Zohar, 2011). For example, if members of a fire department have signed the Everyone Goes Home seatbelt pledge (espoused) but engines are leaving the station every day without firefighters belted (enacted) then a discrepancy exists between what is formally supported and what is done in practice. Climate perceptions, by virtue of defining behavioral expectations, have been shown to be among the strongest predictors of role behavior (Zohar, 2011). For example, if during overhaul (the phase of fire suppression with significant but invisible combustion exposures) a rookie firefighter observes coworkers removing their self-contained breathing apparatus without repercussions, then they are likely to remove theirs as well (despite being trained otherwise in the academy).

Zohar's (1980) seminal work introduced the concept of safety climate which he subsequently defined as "shared perceptions with regard to safety policies, procedures and practices" (Zohar 2011, p. 143). The most compelling evidence of safety climate's relationship with safety outcomes emanates from a series of meta-analytic studies across a multitude of countries and industries (e.g., manufacturing, commercial fishing, off-shore drilling, etc.) concluding that safety climate is positively related to safety behaviors and negatively related to key safety outcomes (e.g., fatalities, injuries, near-misses; Christian et al., 2009; Beus et al., 2010; Nahrgang et al., 2011).

1.3. Generic versus industry-specific scales

Using a generic scale, Allen et al. (2010) found positive improvements in fire station safety climate following after-action reviews, which are a post-event debrief discussion targeting what went well, what did not go well, and speculation regarding why. However, their study stopped short of investigating whether the improvement in safety climate was associated with an increase in safety behaviors or a decrease in injuries. In addition, the generic scale may not have fully captured the demands and practices relevant to firefighters. Zohar (2010) argued that context specific safety climate scales provide a more nuanced understanding of safety practices and expectations than generic tools. Huang et al. affirmed this idea in the development of a lone utility worker safety climate scale (Huang et al., 2013a, 2013b), and a trucking industry safety climate scale (Huang et al., 2013a, 2013b) that also demonstrated increased predicative incremental validity of safety behaviors compared to Zohar and Luria's (2005) generic scale.

While Keiser and Payne (2018) recently found no meaningful differences between context-specific and general measures in their assessment of safety climates in research laboratories, their study focused on a context that does not have the same level of risk as the fire service. The unique demands and risks inherent in the fire service work environment, and evidence that context specific safety climate scales have incremental predictive validity over generic safety climate measures in some settings, suggests that a fire service specific safety climate tool is likely to have important implications for both safety climate research and the fire service.

Attempting to address this unique work context, Smith and DeJoy (2014) adapted items from four existing measures to assess safety climate within the fire service. While these authors adapted the items to reference the fire department context, they did not use a robust mixed-method approach combing qualitative interviews and quantitative analyses to develop items that reflect the nuances of the fire service industry. Moreover, their study excluded volunteers (75% of fire service), and were based on 398 professional firefighters from only two fire departments as opposed to a nationally representative sample of firefighters. Finally, the level of theory and level of analysis associated with their tool is unclear as they did not adopt a multi-level framework for the conceptualization of a fire service safety climate. In turn, the criterion-related validity analyses they present were conducted at the individual level of analysis ignoring the non-independence of responses of firefighters clustered within the same department or station.

Because of these limitations, validity and utility of their fire service safety climate scale cannot be generalized. Therefore, the fire service still lacks a safety climate tool rigorously designed from a robust, nationally representative sample of firefighters that demonstrates a strong relationship with safety and organizational outcomes. The purpose of this research is to create an industry-specific firefighter safety climate scale using robust epidemiologic and theoretical designs and examine its criterion-related validity against firefighter injuries, safety compliance, burnout, engagement, and job satisfaction.

1.3.1. Theoretical framework

The framework guiding this research draws on Christian et al.'s (2009) and Nahrgang et al.'s (2011) meta-analytical findings that safety climate is a critical resource that has downstream consequences for

both safety-related performance and outcomes as well as member well-being and morale. Given the evidence regarding the linkages between safety climate and employee motivation, compliance, and accidents, improvements in safety climate are expected to result in subsequent improvements in safety compliance behaviors along with a reduction in near-misses, injuries, and workplace fatalities. Our framework was also informed by Huang et al.'s (2016) expanded theory of the impact of safety climate on organizational outcomes, in that enhancements result in improvements to a broader set of workplace attitudes and behaviors such as well-being, morale, engagement, and turnover (Huang et al., 2016; Taylor et al., 2012; Griffin & Curcuruto, 2016, Nahrgang et al., 2011).

In their comprehensive review of the safety climate theory and research, Griffin and Curcuruto (2016) highlighted the role of sensemaking processes in the development and emergence of safety climates. According to sensemaking theory, "reality is an ongoing accomplishment that emerges from efforts to create order and make retrospective sense of what occurs" (Weick, 1993, p. 635). In other words, sensemaking is an interpretive processes through which individuals decode situational cues and social information to understand their environment and reduce uncertainty regarding norms, priorities, and expectation (Weick, 1995). In turn, sensemaking processes are central to the emergence of shared perceptions of safety norms, practices, and procedures through the collective interpretation of situational cues and social information (Gonzalez-Roma et al., 2002; Griffin & Curcuruto, 2016; Ostroff et al., 2003).

Regarding the outcomes of safety climate, Griffin and Curcuruto's (2016) review discussed the importance of social exchanges and reciprocity to understanding the linkages between safety climate and safety-related behaviors. Social Exchange Theory (SET; Blau, 1964) argues that individuals who receive some valued assistance, benefit, or service tend to develop a felt obligation to reciprocate, and are motivated to give back in exchange for the goodwill they received. safety climate reflects the extent to which the organization and its leaders cares about workers' safety and well-being, and takes steps to create a safe work environment (Griffin & Curcuruto, 2016; Huang et al., 2016). Considering the reciprocity norm underlying SET, the organization's commitment and support for safety motivates employees comply with safety practices and demonstrate positive attitudes (e.g., higher job satisfaction and engagement). In addition, the Job Demand–Resources model (JD-R; Bakker & Demerouti, 2007) provides a theoretical basis supporting the proposed negative relationship between safety climate and burnout. Safety climate is an important organizational resource supporting employee safety, health, and well-being (Nahrgang et al., 2011). A clear safety climate is therefore an important organizational resource that promotes well-being and inhibits burnout, particularly in high-risk environments (Nahrgang et al., 2011)

Drawing on these frameworks and theoretical foundations, we developed FOCUS, a multilevel fire service specific safety climate measure. We further propose that safety climate in the form of management commitment to safety (department-level factor) and supervisor support for safety (station-level factor) are negatively related to injury rates and burnout, and positively related to safety compliance, engagement and job satisfaction at the station-level, and negatively related to burnout and positively related to engagement and satisfaction at the individual firefighter level.

2. Methods

2.1. Item generation

We used a combination of inductive and deductive approaches to generate a set of items that broadly encompass the domain of the safety climate construct within the specific context of the fire service. Beginning with an inductive approach, we conducted in-depth interviews and focus groups with a national sample of firefighters to gain in-depth and culturally grounded comprehension of how firefighters perceive safety climate.

2.1.1. Participants

The eligibility criteria for focus group participants were: (1) career or volunteer firefighter, (2) male or female (3) holding the rank of "firefighter" or "driver/engineer," (4) without supervisory responsibilities (presently or previously), (5) currently active for at least one year of service, and (6) at least 18 years of age. The groups had approximately 7–10 participants each. Focus groups lasted between 90 and 120 min. The eligibility criteria for the interview participants were: (1) career or volunteer firefighter, (2) male or female, (3) holding the rank of company officer or above, (4) with supervisory responsibilities (presently or previously), (5) currently active or retired, and (6) at least 18 years of age. Individual interviews lasted approximately 60 min.

Krueger and Casey (2000) recommend that researchers conducting focus groups avoid "mixing people who may feel they have different levels of expertise or power related to the issue" (p. 27). The significance of rank is supported by previous qualitative research with the fire service which has found significant differences in perceptions between firefighters and fire chiefs regarding causes of injury (Conrad et al., 1994). Therefore, rank-and-file firefighters participated in the focus groups and their supervisors were interviewed separately. Even though our focus groups only included rank and file firefighters, we still found that rookie firefighters did not feel comfortable expressing their viewpoints when more senior firefighters were included in the focus group. Therefore, our research team switched from focus groups to mini-interviews (approximately 30 min in duration) with rank and file firefighters. This strategy for data collection ensured that all rank-and-file voices were heard, whether a firefighter had one year or twenty years of experience.

2.1.2. Sampling

Consistent with best practices (Creswell & Plano Clark, 2011), purposeful sampling was used to obtain a sample of participants with diverse experiences with fire service safety climate. Previous research has suggested that cultural norms within the fire service are more similar within broad geographical regions than the traditional four categories used by the U.S. Census (Poston et al., 2011). Therefore, we targeted a total of 12 fire departments—including career, volunteer, and combination—from across the west, central and east geographical regions of the U.S. to participate in the interviews and focus groups. Several departments were selected with certainty in order to maximize existing partnerships and available injury data. After departments were selected, the research team (in collaboration with department and local union leadership) recruited individuals that met the eligibility criteria described above. In total, 10 focus groups (n = 60) and 63 individual interviews were conducted with fire service personnel of various ranks to ensure that we captured diverse experiences and the language used was consistent with that of actual firefighters. Eighty percent (n = 98) of the sample was male and 20% (n = 25) was female. 83% (n = 102) of the sample identified as Caucasian and 34% (n = 42) of the sample completed a 4-year college degree. 64% (n = 79) of participants were rank and file firefighters and 36% (n = 44) held supervisory roles.

2.1.3. Interviews and FOCUS groups

Interviews were approximately 60 min long, on average, and focus groups were approximately 90–120 min long. Focus groups and interviews were co-facilitated by team members (ALD, JAT) who collaborated on asking questions and taking notes to record nonverbal interactions and dynamics. Focus groups and interviews were digitally recorded and then sent to a professional transcription agency. Semi-structured interview guides were used for both the interviews and focus groups. These guides provided structure, while also providing the flexibility to probe further for relevant topics that emerged during the course of the groups and interviews (Patton, 2002). Pursuant to the

Table 1
Qualitative Data and Candidate FOCUS Survey Items.

First-order factors of safety climate (Table 1-Christian et al., 2009)	Exemplary qualitative data	Candidate FOCUS survey items
Management Commitment: The extent to which people perceive that management values safety and engages in communication and actions that support safety	"You have to show that from the top down. If you want the firefighter to be safe and operate as safe as possible, you have to provide the equipment, you have to provide the training, and you have to provide the money to do all that. You can't just dictate, 'we want you to be safe.' That's great. How about training, how about proper equipment, and that type of thing."	*In my opinion, when the budget is tight, our department cuts corners on safety.*
	"What makes our Chief different from the chiefs we've had in the past is - we kind of have a saying in the department, after you go beyond two bugles you kind of forget what it's like to be a boot being on the street - and you forget what the struggle's about, being firemen, and what we have to go through day in and day out and I just think sometimes you forget what it means to be that guy that's riding a tailboard on the back of the truck and you forget about what they have to go through and what they have to put up with day in and day out and I think they have unreal expectations on it sometimes. So I think this Chief's different. I think he really cares about us and he understands what we go through and he's sympathetic to that. And at the same time, he keeps us in check and makes sure we're doing the right thing and we're not getting out of hand or something but that's – I think that's the big difference between him and other chiefs."	*The decision-makers in this department are out of touch with what we need to do our job safely.*
Huan resource management practices: The extent to which people perceive that selection, training, and reward systems contribute to safety	"…it's unacceptable to have an injury or a death in the training environment because all of those are going to be viewed as preventable because it's not an emergency to train. You're not on alarm…We have to do a risk benefit analysis and evaluate the training that we are doing. We might do some higher risk evolutions but we need to make it as safe as possible and make sure it's not a dangerous act that's going to put our personnel in jeopardy just to train them to be in that bad environment. We just have to do our best to simulate that and train them effectively to make sure they use all their personal equipment at all times… So we can try to expose them to that higher risk in the controlled environment so that when they meet that in the uncontrolled environment, they have that muscle memory and they have that cognitive skill of here's my checklist if I'm going into that hazardous environment. I have to do this, this and this."	*My direct supervisor puts a high emphasis on safety training.*
	"…the only thing that membership doesn't like is when we do discipline. That's the only message that really gets them to conform, is discipline, as crazy as that sounds. Sometimes they think we're too hard on them for enforcing a seat belt. We have a Deputy Fire Commissioner out there…he probably gets one to two guys a month on a seatbelt violation. That's eight hours suspension…and they don't like him…however he does get them to conform."	*Leadership's policies emphasize punishment rather than safety.*
Safety systems: Perceived quality of policies, procedures, or interventions implemented by an organization with the intention of improving safety outcomes	"Well, see I have a problem with those, too…the safety-wise policies, we can start from leaving the station…This morning I got a call for his knuckles hurt from arthritis…there's no reason to put a fire truck in the street on a Bravo response because his knuckles hurt. So, I just turned on red lights, ran red lights, stopped traffic, for somebody's knuckles hurting."	*Policies, procedures, and practices keep firefighters alive.*
	"We had a firefighter who rescued someone. In the process of rescuing someone, he actually took his mask of air and gave it to the victim. Well, the fire department deemed that he was no longer covered full PPE, and they tried to bring charges up against him because he took off his protective gear. And it was just punitive. Whether it's a cut on the hand, anything, it's all punitive."	*Safety policies constrain my ability to make decisions on scene.*
Supervisor Support: The extent to which people believe their supervisor values safety as reflected in communication, encouragement, and consequences	"I certainly know, being responsible for a battalion, there was a fire that I was extremely unpopular in, because it was just property, and we weren't making headway, and I just said, we're backing out, and oh my gosh…It's like, 'we're not going?' It's like, 'you let this building burn down?' You're right. Because the insurance company will be able to rebuild it. I can't rebuild you."	*I have confidence in my command/ my company level officers to keep me safe.*
	"…you need strong leaders to make sure that they get the message and say, 'hey, look, no matter what's going on right there, these are the policies. They work.' If you follow them, directives keep you out of trouble. Operational procedures keep you safe. We need those types of advocates so we have men and women that's pushing that. You look, you see people who are working hard, strong, using the policies that's been developed, explaining why they're there and we're going to have a safe fire ground and this is what it's about and we're able to talk about that stuff at the kitchen table."	*Our house does a good job of carrying out its safety policies.*
Internal group processes: Perceptions of communication and support for safety within work groups or the extent to which employees perceive that their coworkers provide them with safety-related cooperation and encouragement	"We go on the scene, look at a scene with what your brother or your sister's wearing, and make sure you're following suit with that. I mean especially going on the fire scene, we want to make sure we have our PPE on, if we got to look at our buddy here or our brother, make sure that he's properly donned, got all his stuff on because any exposure could mean his life so those are simple basic things that we learned when we were in rookie school – you still got to have those fundamental building blocks and building that throughout your career but communication and paying attention is very – a very paramount."	*I usually ask another firefighter to check my personal protective equipment (PPE) prior to entering the hazard area.*
	"People are very cognizant and will catch when something's wrong very easily. The analogy I make is when I'm checking out the fire engine. I can't tell you if everything's there, but if I open a compartment and something's missing I can tell you that something's missing, because it just doesn't look right. And when you see a guy in all his gear and everything looks right you don't even think about it. But if you look and you go something's not right, you say something…when you see something that's out of the ordinary it catches your eye and you immediately stop somebody and you say hey, you need to zip up that jacket."	*On our crew, people expect one another to wear their PPE.*

(*continued on next page*)

Table 1 (*continued*)

First-order factors of safety climate (Table 1-Christian et al., 2009)	Exemplary qualitative data	Candidate FOCUS survey items
Risk: The extent to which workers perceive the work itself as dangerous	"I believe that we'll never make this job completely safe. We might make it safer but I've always believed, as my Dad said, that if you're afraid of being hurt why don't you go be a clerk because this is a full contact sport. And we will never completely eliminate the element of risk. Getting in the fire apparatus and going on a medical run somewhere requires a certain amount of risk."	*It's a dangerous job, the chances of getting hurt are highly likely.*
	"One of the things recently has been cancer. I guess that's an issue that is so entangled and so difficult because of the great number of types of cancers and [determining] which are job related. But I think there's no doubt that some of them have to do with exposure. There's just absolutely no doubt in my mind…I think, as someone who started off in the department when I think we had, you know, like, probably four or six SCBA in the entire department. That was part of it, was going in and smoke eating and how stupid that is. So I think those issues are really coming in now, and recognizing exposure to the products we deal with on a regular basis that we may not recognize as carcinogens, but they are."	*The exposures I face on this job can affect my long term health.*
Work pressure: The extent to which the workload overwhelms one's ability to perform safely	"I have a myriad of concerns for the emergency medical services workers, which is our firefighters and our paramedics. Those men and women that go into the community, they're doing a big job. It's a challenge for them. They're always short…they're running all the time. They're taking care of our citizens all over the place. My concern has always been having enough unit in place, personnel to actually take care of the citizens, making sure that we have the right resources… and when you're running as we are, in a dynamic mode all of the time, especially in the peak hours, it's a little tough…"	*Our department has enough staff to do our job safely.*
	"EMS is more mentally taxing because you see stuff that you can't sometimes - and I mean, we're really good at wiping the slate as far as our memory, of what we see, you know, we're very good at that, because you have to be…But there are times when you come across something…and exposed to something that will jar your inner soul. I mean, you see people living in conditions that are just deplorable."	*I believe what I see on this job can affect my mental health.*

overarching goal of evaluating safety climate, interview questions covered topics such as reflections on supervisor support, firefighter risk-taking, use of personal protective equipment, safety behaviors, and policies, procedures, and practices in the department. The language that participants used in the focus groups and interviews were studied to ensure that the survey items developed reflected the language that firefighters use to describe their daily work experience and perceptions. The research team conducted qualitative data collection and analysis simultaneously. Adapted from Grounded Theory (Charmaz, 1990), the simultaneous data collection and analysis strategy capitalizes on the inherent flexibility of the qualitative approach, by allowing the research team to modify the focus group or interview guide to reflect any new or unexpected insights that participants may provide in the initial set of focus groups and interviews.

All focus group and interview participants completed a brief confidential demographic questionnaire so that we could accurately describe the sample and investigate similarities and differences between departments and subgroups. All participants received and signed informed consent documents about the study's risks and benefits. This study was approved by the principal investigator's IRB and received research compliance review from the Department of Homeland Security.

2.1.4. Data coding

All digital recordings and notes were professionally transcribed and edited for clarity and anonymity. The research team first read a subset of transcripts multiple times to familiarize themselves with the data and record key concepts. Those concepts informed development of a codebook, which included definitions for each code. Next, transcripts were imported into NVivo 10.0, a qualitative data management software package, to code and organize the data. After multiple rounds of topic coding, the team conducted a final review of the study's transcripts to ensure that all relevant text has been coded into any newly created codes. Coding independently, five transcripts were coded. As each team member read the transcripts they recorded observed themes, assigning labels to text. After multiple rounds of coding in this manner, they refined the codes into parent and child codes. After multiple rounds of topic coding, the team conducted a final review of the study's transcripts to ensure that all relevant text has been coded into any newly created codes. Once all members of the analytic team agreed on the coding structure established, the codebook was finalized which listed each code and the definition of what text would be grouped within it. Thereafter, graduate research assistants used the finalized codebook to code all remaining transcripts, bringing questions to the team. Quality checks of this coding were conducted (ALD). It took two graduate research assistants 108 h total to code all transcripts within NVivo. The researchers used NVivo's coding comparison query function to assess inter-coder reliability between the graduate research assistant's codes. The percent agreement between both coders was 96.6%.

2.1.5. Candidate items

From the qualitative data, culturally relevant survey items were developed. Data from focus groups and interviews produced a variety of information about firefighters' views regarding the training and use of personal protective equipment, regard for the safety of coworkers, and the relationship of rules and regulations to personal autonomy. This information allowed for the development of items that stem directly from the language used by firefighters.

From the detailed reading of each individual qualitative transcript, coupled with the qualitative analysis performed within NVivo, team members generated potential survey items to be included. In total, 205 unique preliminary items were generated from the qualitative analysis. We also used a deductive approach in the generation of items drawing on prior research (Christian et al., 2009; Neal & Griffin, 2004) which suggests that the domain of the unit-level safety climate construct encompasses six sub-domains including management commitment, human resource management practices, safety systems, supervisor support, perceived risk, and work pressure. Specifically, we developed items to ensure that we captured all themes identified in our analysis of the interviews and focus groups, and ensured that these items covered each of the six sub-domains. To showcase the depth and breadth of data from the field, Table 1 contains quotes exemplary of participants' responses to our semi-structured interviews and focus groups. We provide examples of candidate survey items mapped to each first-order factor of

safety climate identified by Christian et al. (2009) that were then beta-tested in the field. Items within the 'Management Commitment' and 'Supervisor Support' factors were ultimately retained as indictors of safety climate for the FOCUS survey based on the exploratory factor analyses.

The team refined, de-duplicated, and eliminated items, yielding 107 novel items. These were cognitively tested with 16 firefighters from a career and volunteer fire department to ensure representation of both perspectives. In the cognitive testing, we asked participants to provide comments on item clarity to determine whether the respondent understood the question as written, and to identify any potential bias-inducing language. Based upon feedback provided by firefighters, survey items were edited accordingly or dropped from inclusion resulting in a final sample of 54 novel items reflective of fire service safety climate.

The final survey included the safety climate items along with measures of safety compliance behaviors, employee engagement, job satisfaction, and burnout. The survey contained a total of 138 items and took approximately 15 min to administer.

2.2. Survey administration

2.2.1. Sample and procedures

We recruited fire departments to participate in this study using a geographically-stratified random sample in which we selected departments to contact from each of the 10 FEMA regions using the United States Fire Administration's National Fire Department Census to construct the sample. The National Fire Department Census is a national fire department registry including approximately 26,500 fire departments. Participation in the Census is voluntary; as such, the Census does not include a comprehensive list of all U.S. fire departments. However, for the purposes of constructing a representative sample of fire departments across the U.S., it is the best available public data source. Within each FEMA region, and within career and volunteer subsets, fire departments were assigned a random number. Our recruitment goal was approximately 13 fire departments (7 career and 6 volunteer) per FEMA region. Of the approximately 26,500 fire departments in the Census, 1,022 fire departments were randomly selected for inclusion in our recruitment sample and contacted by our research team. Research team members contacted each fire department in the ascending order of their randomly assigned number. On average, departments were contacted every two days with a total of three points of contact for recruitment. If after three points of contact a department was unresponsive, they were replaced with the next randomly assigned department. 76 of these fire departments (7% of the recruitment sample) declined to participate. 747 fire departments were dropped due to an inability to contact anyone from the fire department or unresponsiveness after an initial point of contact. In total, 199 fire departments were recruited to participate in the beta-test of FOCUS and 132 fire departments successfully completed FOCUS survey administration.

Once a department agreed to participate, we recorded the most up-to-date roster size and the primary point of contact for the project was entered in a database. Additionally, we collected demographic information on the department via a Department Demographic Form sent via email or post mail.

The survey was offered in both an online format and paper format. Participants responded to each item using a 5-point Likert-type response scale (1 = *strongly disagree* to 5 = *strongly agree*). If a department did not utilize an online training platform such as TargetSolutions, the department was only offered the survey in the paper format due to the difficulty in tracking firefighter completion. Paper surveys were delivered by a mail service. For departments that administered the survey online, an email was sent to our point of contact that contained a unique weblink that all personnel needed to follow to take the survey. We also sent an instruction sheet, tailored to the administration method, to each department. Once a department received their surveys, a team member contacted the department to ensure the surveys were actually received and address any questions the department may have. At this time, a team member would also discuss the anticipated completion date with our point of contact which was within two weeks of receiving the survey package. Departments were subsequently dropped from study inclusion if one of the following conditions applied either during recruitment or after a department had agreed to participate: (a) inability to contact the department due to faulty contact information, (b) lack of response to contact attempts, or (c) a department stated they would not like to participate.

2.2.2. Preparation of data for psychometric evaluation

In total, 10,073 firefighters in 757 fire stations from 132 departments completed the survey. As we designed the FOCUS survey to capture unit-level safety climate, our unit of theory and analysis is the fire station. Next, we removed individual cases that: (a) had 25% or more missing data, (b) used a single response for all items, (c) indicated that the item was not applicable for 10% or more items, and (d) that not include a station identification number. Individuals responses were then aggregated to the station level. We then removed those stations that had fewer than 5 respondents to ensure we had a stable, reliable, and representative sample from within the station. The final sample for psychometric analysis included 615 fire stations nested within 130 fire department and encompassing 8,575 individual firefighters. Demographic information on the final sample is summarized in Table 2. The sample was predominantly male and Caucasian. Slightly more than half of the sample were career departments and the remaining were either volunteer or volunteer/combination departments. 64% of all calls were for EMS services. Reflective of the geographically-stratified random sample, each FEMA region had roughly equivalent representation (range 7–12%). We randomly split the sample into two groups: sample A (308 fire stations) and sample B (307 fire stations). We used sample A to conduct item reduction analyses, sample B to conduct multi-level confirmatory factor analyses (MCFAs), and the full sample for criterion-related validity analyses.

2.3. Item reduction

By definition, organizational climate is a unit-level construct encompassing shared perceptions of the policies, practices, and procedures that are observed, expected, rewarded and supported within that unit (Schneider & Reichers, 1983; Schneider et al., 2013). Yet, most studies of organizational climate have focused on climates that emerge within organizational subunits as opposed to the overall organization (Schneider et al., 2013). At the same time, Zohar and Luria (2005) argued that operational priorities and demands differ, and sometimes even compete, across organizational levels which has implications for both the formation of safety climate perceptions and the effects of safety climate. To address this shortcoming in climate research, they developed a multi-level model and measure of safety climate capturing the commitment of top management to safety (organization-level) and the support for safety provided by direct supervisors (group-level). Their model guided our thinking about safety climate within the fire service where fire stations are nested within fire departments. Specifically, strategic priorities and decisions are set at the fire departments level (similar to the organization level) and tactical operations are conducted at the fire station level (similar to groups or units).

Within our study, positioned the fire station as the primary level of theory and analysis for several reasons. First, within the same fire station, firefighters share physical (e.g., sleeping, eating, working quarters), managerial (e.g., quality of leadership and communication), and psychological (e.g., stress and engagement) work environments. Being exposed to equal or similar working environments and performing their jobs in a collaborative manner informs sensemaking (Weick, 1995) and social cognitive processes (Bandura, 1989) resulting in a shared

Table 2
Resultant sample for psychometric analyses (n = 8575; nested within 615 stations in 130 departments).

Respondent Characteristics		
Age (mean/SD)	40.2 (SD = 10.05), range = 18–99	
Years of experience (average, range)	16.06 (SD = 9.68), range = 0–76	
Sex	Male	90.2% (7733)
	Female	5.5% (474)
	No response	4.3% (368)
Race/ethnicity*	Caucasian	75% (6435)
	African American	5.7% (491)
	Asian/native Hawaiian/ Pacific Islander	3.7% (321)
	Hispanic	11% (944)
	Other	4% (346)
	No response	6.1% (521)
Education	Less than high school	0.3% (25)
	High school or equivalent	31.7% (2715)
	Undergraduate degree	40.5% (3469)
	Graduate degree	8.3% (713)
	No response	19.3% (1653)
Rank*	Firefighter	66.2% (5679)
	Paramedic	26.1% (2239)
	Emergency Medical Technician (EMT)	25.4% (2176)
	Lieutenant	13% (1112)
	Captain	14.6% (1254)
	Battalion Chief	4.2% (360)
	Chief/ Commissioner	1.0% (85)
Injury in the last year	yes	16.5% (1411)
	no	77.8% (6675)
	No response	5.7% (489)
Fire Department Characteristics		
Organization Type	Career	51.5% (67)
	Volunteer	20.8% (27)
	Combination	27.7% (36)
EMS & FIRE %	EMS (%)	64.01 (SD = 22.92)
	FIRE (%)	31.01 (SD = 27.08)
Roster size	0–24	21.5% (28)
	25–49	28.5% (37)
	50–99	25.4% (33)
	100+	24.6% (32)
FEMA Region	1	10% (13)
	2	9.2% (12)
	3	11.5% (15)
	4	10% (13)
	5	10.8% (14)
	6	8.5% (11)
	7	6.9% (9)
	8	9.2% (12)
	9	12.3% (16)
	10	11.5% (15)
Population served	0–4999	13.1% (17)
	5000–9999	11.5% (15)
	10,000–24,999	22.3% (29)
	25,000–49,999	16.2% (21)
	50,000–99,999	14.6% (19)
	100,000+	19.2% (25)
	No info	3.1% (4)
Annual number of calls	0–499	17.7% (23)
	500–999	10% (13)
	1000–4999	30.8% (40)
	5000–9999	14.6% (19)
	10,000+	21.5% (28)
	No info	5.4% (7)

*Totals greater than 100% due to multiple selections.

understanding of desired and acceptable work and safety practices emerging from firefighters within a station. Second, firefighters within the same station interact on a regular basis both during fire runs and in period of down time and transition between runs. Moreover, station members share responsibility for the upkeep of the station and equipment and must rely on one another to successfully respond to both fire and EMS calls. Individuals who interact regularly and have some form of interdependence among them tend to form similar perceptions of their work environments (Klein et al., 2001). For these reasons, we conducted exploratory factor analyses (EFA) with items aggregated to the station-level. Recognizing that fire stations are also nested with fire departments, we then conducted multi-level confirmatory factor analyses (MCFA) to examine the factor structure at both the station and department level.

We conducted an exploratory factor analysis (EFA) on the initial set of 54 items using principal axis extraction with direct oblimin rotation. Specifically, the open source R package "nFactors" (Raiche, 2010) was utilized to examine the Eigenvalues and another R package "psych" (Revelle, 2016) was used to conduct the EFA. We did not specify the number of factors to extract letting the data guide the determination of factors. A Scree test based on Eigenvalues suggested a two- or three-factor solution as an optimal representation of the factor structure underlying the data. However, only two items loaded on the third-factor. Therefore, we selected a two-factor solution which explained 35% of the cumulative variance (i.e., 20% and 15% respectively by the first and second factors). A total of 14 items loading most strongly on Factor 1 clearly represented FOCUS Management Commitment, while 11 items loading most strongly on Factor 2 clearly represented FOCUS Supervisor Support for safety.

Next, we employed the following criteria to select initial items for retention for each factor: (a) item factor loading greater than or equal to 0.50 (McCoach et al., 2013), and (b) item cross loadings less than 0.30 (Comrey & Lee, 1992). In addition, we also considered: (a) item clarity, (b) item representativeness of the factor, (c) item contribution to the internal consistency reliability of the factor, and (d) inter-item correlations. We selected a final set of seven items to represent Factor 1 (FOCUS Management Commitment). The primary factors loadings for these items were 0.75 or higher and the cross loadings were below 0.20. Likewise, we also selected seven items to represent Factor 2 (FOCUS Supervisor Support). The primary factors loadings for these items were 0.64 or higher and the cross loadings were below 0.20. An acceptable level of internal consistency reliability was found for Factor 1 (FOCUS Management Commitment; $\alpha = 0.92$), Factor 2 (FOCUS Supervisor Support; $\alpha = 0.91$), and across the overall set of 14 FOCUS items ($\alpha = 0.90$). The final items and factor loadings from the EFA are summarized in Table 3.

The items composing F1 (FOCUS Management Commitment) address perceptions of department level resource allocation decisions and the strategic prioritization of safety among department decision makers. In contrast, the items composing F2 (FOCUS Supervisor Support) capture perceptions of practices within the station and the support provided by station leadership. Therefore, the items and factor structure that surfaced through the EFA provide a basis for measuring fire service specific safety climate from a multi-level perspective with FOCUS Management Commitment at the department level and FOCUS Supervisor Support at the station level. Next, we conduct a series of multi-level analyses to confirm the measure's factor structure at both the department and station levels, and examine its criterion-related validity.

2.3.1. Multi-level CFA

Using the 307 fire stations included in Sample B, we conducted MCFAs (Dyer et al., 2005; Muthén, 1994) to confirm the factor structure of the 14 item FOCUS survey and compare the fit of a correlated 2-factor to a merged 1-factor model using Mplus 8.2 (Muthén & Muthén, 1998-2017). Using the individual-level data, we first clustered the

Table 3
Item factor loadings based on exploratory and confirmatory factor analyses.

FOCUS scale Items	EFA		MCFA – Department		MCFA – Station	
	F1	F2	F1	F2	F1	F2
1. Leadership's policies emphasize punishment rather than safety.*	0.83	0.00	0.82 (0.04)	–	0.78 (0.04)	–
2. Decision-makers in this department consider members the most important asset in our department.	0.82	0.05	0.99 (0.13)	–	0.75 (0.04)	–
3. People who make policy decisions (SOPs, SOGs) in this department see eye-to-eye with rank and file on safety.	0.79	0.13	0.99 (0.01)	–	0.71 (0.06)	–
4. The decision-makers in this department are out of touch with what we need to do our job safely.*	0.79	−0.07	0.97 (0.02)	–	0.54 (0.05)	–
5. Our apparatus is fixed and returned to service in a timely manner.	0.79	−0.17	0.67 (0.08)	–	0.46 (0.07)	–
6. In my department, it's after an injury occurs that safety becomes prioritized.*	0.78	0.02	0.88 (0.07)	–	0.61 (0.06)	–
7. In my opinion, when the budget is tight, our department cuts corners on safety.*	0.75	0.07	0.83 (0.05)	–	0.70 (0.06)	–
8. My direct supervisor puts a high emphasis on safety training.	−0.01	0.83	–	0.95 (0.05)	–	0.77 (0.04)
9. Our house does a good job of carrying out its safety policies.	0.05	0.81	–	0.95 (0.06)	–	0.76 (0.07)
10. My direct supervisor takes my safety concerns seriously.	−0.08	0.80	–	0.98 (0.06)	–	0.74 (0.06)
11. In our firehouse, we talk about safety on a consistent basis.	−0.01	0.78	–	0.92 (0.05)	–	0.68 (0.04)
12. I have confidence in my command/my company level officers to keep me safe.	0.02	0.73	–	0.81 (0.08)	–	0.80 (0.05)
13. Our direct supervisor prioritizes rest and rehabilitation on scene.	−0.10	0.73	–	0.89 (0.10)	–	0.71 (0.07)
14. On our crew, people expect one another to wear their PPE.	0.11	0.64	–	0.75 (0.19)	–	0.67 (0.07)

Notes. FOCUS Management Commitment (F1); FOCUS Supervisor Support (F2); EFA = exploratory factor analysis. MCFA = confirmatory factor analysis. EFA is based on Sample A ($n_{department}$ = 96, $n_{station}$ = 308); MCFA is based on Sample B ($n_{department}$ = 97, $n_{station}$ = 307); Values in () in MCFA section are standard errors; All of the factor loadings from the MCFA are statistically significant ($p < .01$); *indicates reverse-scored item.

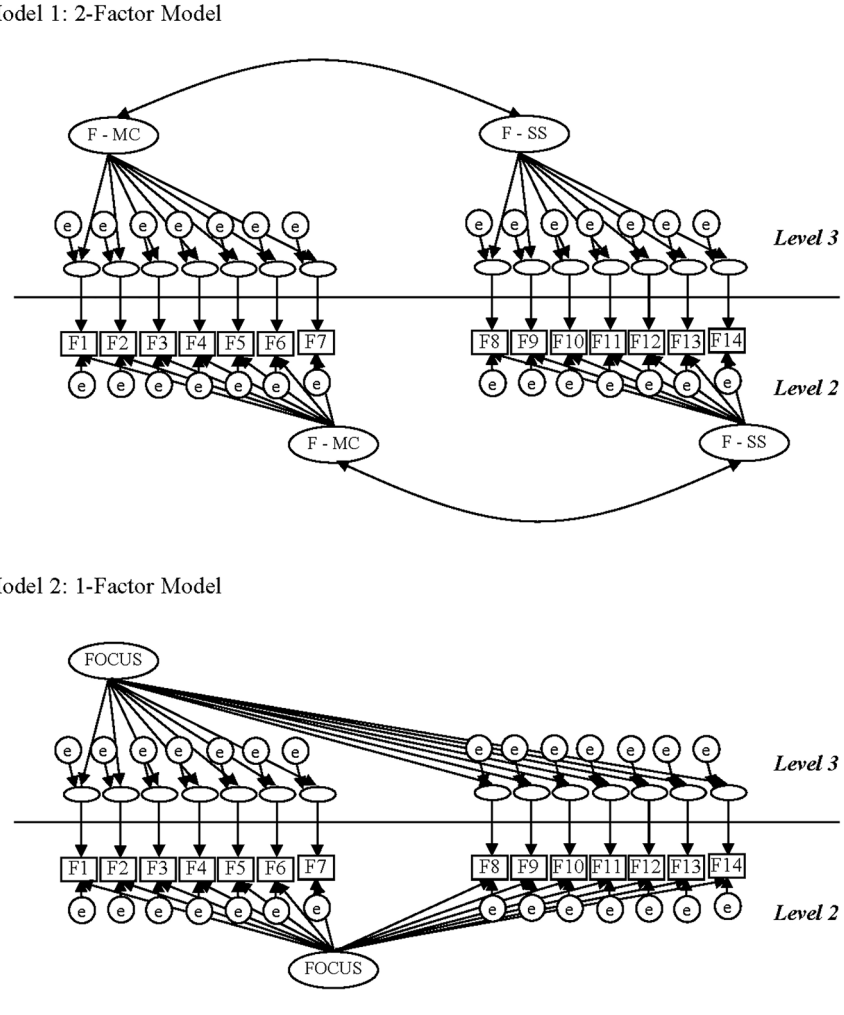

Fig. 1. Model specification of the confirmatory factor analysis (CFA). *Notes.* F – MC = FOCUS – F1, Management commitment; F – SS = FOCUS – F2, Supervisor support, Level 1: individual-level ($n_{individual}$ = 4239); Level 2: station-level ($n_{station}$ = 307); Level 3: department-level ($n_{department}$ = 97).

individual responses to each item to the station level and then specified a 2-factor model (i.e., FOCUS Management Commitment and FOCUS Supervisor Support) at both the station- and department-level. Each item was set to load only on its intended latent construct and all error terms were independent as shown in Model 1 (Fig. 1). We compared the fit of this 2-factor model to a 1-factor model where all items were set to load on a single latent climate factor at both the station and department levels. To evaluate model fit, we applied recommendations for the use of multiple indices (Hu & Bentler, 1999; MacCallum et al., 1996; Mathieu & Taylor, 2006) and considered CFI values above 0.95 and RMSEA or SRMR values below 0.05 as indicators of excellent fit, CFI values from 0.90 to 0.95 and RMSEA or SRMR values from above 0.05 to < 0.08 as indicators of good fit, CFI values from 0.90 to 0.95 and RMSEA or SRMR values above 0.08 to < 0.10 as indicators of acceptable fit, and CFI values below 0.90 and RMSEA or SRMR values above 0.10 as indicators of deficiency.

The 2-factor CFA model showed generally acceptable model fit in general ($\chi^2 = 259.97$, $df = 152$, CFI = 0.931, $SRMR_{station} = 0.067$, $SRMR_{department} = 0.110$, RMSEA = 0.013). We then compared this model to a 1-factor model in which all FOCUS items loaded on a single latent climate construct both at station- and department-level ($\chi^2 = 480.59$, $df = 154$, CFI = 0.792, $SRMR_{station} = 0.171$, $SRMR_{department} = 0.395$, RMSEA = 0.022). The expected 2-factor model fit better than the 1-factor model ($\Delta\chi^2 = 221.02$, $\Delta df = 2$, $p < .001$). Additionally, all items in the 2-factor model loaded on their intended latent construct to a statistically significant degree. Although $SRMR_{department}$ was slightly greater than 0.10, it can be attributed to relatively small sample size at the department-level (n = 97). In fact, Cangur and Ercan (2015) noted that SRMR is sensitive to sample size in multi-level models such that it increases as sample size declines. Similarly, Cheung et al. (2006) also noted deterioration of SRMR in their MCFA at the between-unit level (e.g., SRMR within [n = 7590] for two factors = 0.042: SRMR between [n = 40] for two factors = 0.152). We therefore concluded that the 2-level, 2-factor model provided a reasonably good fit for the data.

Next, using procedures originally developed by Fornell and Larcker (1981) and used in recent scale development research (e.g., Hannah et al., 2014; Ashill & Jobber, 2010) we conducted an average variance extracted (AVE) analysis. We used the standardized factor loadings from the 2-factor CFA in the analysis. When conducting AVE analyses, convergent validity is demonstrated when the average variance extracted from the factor loadings is 0.50 or higher (meaning that at least 50% of the variance in the construct can be attributed to the measure; Fornell & Larcker, 1981). AVEs for FOCUS Management Commitment were.78 (department-level) and 0.43 (station-level). AVEs for supervisor support were 0.80 (department-level) and 0.54 (station-level). In addition, the zero-order correlations between FOCUS Management Commitment and FOCUS Supervisor Support are 0.66 ($p < .01$) at the department-level and 0.50 ($p < .01$) at the station-level. Three of the four AVE values exceeded the 0.50 benchmark providing evidence of convergent construct validity. Interestingly, the AVE value for FOCUS Management Commitment at the station level fell short of the 0.50 benchmark. As noted earlier, the contents of the FOCUS Management Commitment dimension capture perceptions of the strategic prioritization of safety among department decision-makers. The lower than desired AVE value for FOCUS Management Commitment at the station level further suggests that the FOCUS Management Commitment factor may be more appropriately modeled as a department-level factor as opposed to a station-level factor. We therefore conceptualized FOCUS Management Commitment as a department-level safety climate dimension and FOCUS Supervisor Support as a station-level safety climate dimension.

2.4. Data aggregation

To justify the aggregation of the individual-level responses to the department level for the FOCUS Management Commitment dimension and to the station-level for the FOCUS Supervisor Support dimension, we examined interrater agreement using index $r_{wg(j)}$. We also examined interrater reliability using intraclass correlation coefficients ICC(1) which represents the extent to which scores from any one members of a unit (here department or station) represent the overall unit, and ICC(2) which represent the reliability of the unit-level means within the sample. To be comprehensive, we examined interrater agreement and interrater reliability for each fire service safety climate dimension management commitment and supervisor support at both the department and station levels, first across the entire sample ($n_{station} = 615$, $n_{department} = 130$) and then for each subsample. Across the entire sample for FOCUS Management Commitment, the median $r_{wg(j)}$ with a uniform null distribution = 0.99, the median $r_{wg(j)}$ with a slightly skewed null distribution = 0.99, ICC(1) = 0.75, ICC(2) = 0.93, and the F-value from the ANOVA used to calculate the ICC values was statistically significant ($F = 14.96$, $p < .01$) at the department level; the median $r_{wg(j)}$ with a uniform null distribution = 0.87, the median $r_{wg(j)}$ with a slightly skewed null distribution = 0.70, ICC(1) = 0.34, ICC(2) = 0.88, and the F-value from the ANOVA used to calculate the ICC values was statistically significant ($F = 8.21$, $p < .01$) at the station level. For FOCUS Supervisor Support, the median $r_{wg(j)}$ with a uniform null distribution = 1.00, the median $r_{wg(j)}$ with a slightly skewed null distribution = 0.99, ICC(1) = 0.36, ICC(2) = 0.73, and the F-value from the ANOVA used to calculate the ICC values was statistically significant ($F = 3.67$, $p < .01$) at the department level; the median $r_{wg(j)}$ with a uniform null distribution = 0.96, the median $r_{wg(j)}$ with a slightly skewed null distribution = 0.92, ICC(1) = 0.12, ICC(2) = 0.66, and the F-value from the ANOVA used to calculate the ICC values was statistically significant ($F = 2.92$, $p < .01$) at the station level.

We also conducted these same analyses on sample A and sample B. Within sample A for FOCUS Management Commitment , the median $r_{wg(j)}$ with a uniform null distribution = 0.99, the median $r_{wg(j)}$ with a slightly skewed null distribution = 0.99, ICC (1) = 0.74, ICC(2) = 0.90, and the F-value from the ANOVA used to calculate the ICC values was statistically significant ($F = 10.13$, $p < .01$) at the department-level, the median $r_{wg(j)}$ with a uniform null distribution = 0.87, the median $r_{wg(j)}$ with a slightly skewed null distribution = 0.70, ICC (1) = 0.34, ICC(2) = 0.88, and the F-value from the ANOVA used to calculate the ICC values was statistically significant ($F = 8.15$, $p < .01$) at the station-level. For FOCUS Supervisor Support, the median $r_{wg(j)}$ with a uniform null distribution = 1.00, the median $r_{wg(j)}$ with a slightly skewed null distribution = 0.99, ICC(1) = 0.36, ICC(2) = 0.65, and the F-value from the ANOVA used to calculate the ICC values was statistically significant ($F = 2.83$, $p < .01$) at the department-level; the median $r_{wg(j)}$ with a uniform null distribution = 0.96, the median $r_{wg(j)}$ with a slightly skewed null distribution = 0.92, ICC(1) = 0.12, ICC(2) = 0.66, and the F-value from the ANOVA used to calculate the ICC values was statistically significant ($F = 2.98$, $p < .01$) at the station-level.

Within sample B for FOCUS Management Commitment, the median $r_{wg(j)}$ with a uniform null distribution = 0.99, the median $r_{wg(j)}$ with a slightly skewed null distribution = 0.99, ICC(1) = 0.73, ICC(2) = 0.90, and the F-value from the ANOVA used to calculate the ICC values was statistically significant ($F = 9.65$, $p < .01$) at the department-level; the median $r_{wg(j)}$ with a uniform null distribution = 0.87, the median $r_{wg(j)}$ with a slightly skewed null distribution = 0.70, ICC(1) = 0.35, ICC(2) = 0.88, and the F-value from the ANOVA used to calculate the

Table 4
Inter-rater reliability and agreement.

	ANOVA (FOCUS by Stations)	ICC1	ICC2	median R_{wgj} (Uniform)	median R_{wgj} (Slightly Skewed)
Entire sample ($N_{station}$ = 615)					
FOCUS – F1	$F(614, 7960) = 8.21$	0.34	0.88	0.87	0.70
FOCUS – F2	$F(614, 7960) = 2.92$	0.12	0.66	0.96	0.92
Sample A for EFA ($N_{station}$ = 308)					
FOCUS – F1	$F(307, 4028) = 8.15$	0.34	0.88	0.87	0.70
FOCUS – F2	$F(307, 4028) = 2.98$	0.12	0.66	0.96	0.92
Sample B for CFA ($N_{station}$ = 307)					
FOCUS – F1	$F(306, 3932) = 8.30$	0.35	0.88	0.87	0.70
FOCUS – F2	$F(306, 3932) = 2.84$	0.12	0.65	0.96	0.92
	ANOVA (FOCUS by Departments)	ICC1	ICC2	median R_{wgj} (Uniform)	median R_{wgj} (Slightly Skewed)
Entire sample ($N_{department}$ = 130)					
FOCUS – F1	$F(129, 485) = 14.96$	0.75	0.93	0.99	0.99
FOCUS – F2	$F(129, 485) = 3.67$	0.36	0.73	1.00	0.99
Sample A for EFA ($N_{department}$ = 96)					
FOCUS – F1	$F(95, 212) = 10.13$	0.74	0.90	0.99	0.99
FOCUS – F2	$F(95, 212) = 2.83$	0.36	0.65	1.00	0.99
Sample B for CFA ($N_{department}$ = 97)					
FOCUS – F1	$F(96, 210) = 9.65$	0.73	0.90	0.99	0.99
FOCUS – F2	$F(96, 210) = 2.67$	0.34	0.62	1.00	0.99

Notes. All *F* statistics were statistically significant ($p < .01$), FOCUS-F1 = Management Commitment, FOCUS-F2 = Supervisor Support.

ICC values was statistically significant ($F = 8.30$, $p < .01$) at the station-level. For FOCUS Supervisor Support, the median $r_{wg(j)}$ with a uniform null distribution = 1.00, the median $r_{wg(j)}$ with a slightly skewed null distribution = 0.99, ICC (1) = 0.34, ICC(2) = 0.62, and the F-value from the ANOVA was statistically significant ($F = 2.67$, $p < .01$) at the department level; the median $r_{wg(j)}$ with a uniform null distribution = 0.96, the median $r_{wg(j)}$ with a slightly skewed null distribution = 0.92, ICC (1) = 0.12, ICC(2) = 0.65, and the F-value from the ANOVA was statistically significant ($F = 2.84$, $p < .01$) at the station-level. The results are summarized in Table 4.

2.5. Criterion-related validity

We conducted two sets of analyses to examine the criterion-related validity of the FOCUS survey with management commitment modeled as a department-level factor and supervisor support modeled as a station-level factor. In the first set of analyses, we modeled all outcomes at the station-level as depicted in Fig. 2A. Next, we modeled all of the outcomes at the individual-level (except for injury rates) as depicted in Fig. 2B.

2.5.1. Measures

Safety Compliance Behavior. We assessed firefighter safety compliance with four items adapted from the Vulnerability Assessment Project (VAP; National Fallen Firefighters Foundation). The VAP is a tool used by fire department leadership to assess their risks relating to exposures, injuries, and line of duty deaths. The measure exhibited an acceptable internal consistency ($\alpha_{(station)} = 0.81$; $\alpha_{(individual)} = 0.88$). A sample item is "I wear my self-contained breathing apparatus at all times while engaged in a firefight, including during overhaul, until the environment is declared safe by an officer". The full set of items in included in Appendix A.

Job Satisfaction. We assessed job satisfaction adapting four items from the Safety Attitudes Questionnaire's subscale on job satisfaction (Sexton et al., 2006). A sample item is "Working here is like being part of a family", and the full set of items in included in Appendix A. The measure exhibited an acceptable internal consistency ($\alpha_{(station)} = 0.72$; $\alpha_{(individual)} = 0.77$).

Burnout. To measure burnout among firefighters, we used 7 items adapted from Maslach's Burnout Inventory (Maslach & Jackson, 1981) such as, "I become more detached from the people I help". The measured exhibited an acceptable internal consistency ($\alpha_{(station)} = 0.72$; $\alpha_{(individual)} = 0.71$). The full set of items in included in Appendix A.

Engagement. We assessed employee engagement using (Schaufeli et al., 2002) 6-item measure. An acceptable internal consistency reliability was again found ($\alpha_{(station)} = 0.86$; $\alpha_{(individual)} = 0.84$). The full set of items in included in Appendix A.

Injury Rates. We asked respondents the following question, "During the past 12 months were you injured while performing your job?" Using the self-report injury variable, 123 stations reported no injuries while 492 stations (80.0%) reported at least one injury in the past 12 months. Among the total 615 stations, mean station injury rate was 17.8%. Among the 492 stations in which there was at least on injury in the past 12 months, mean station injury rate was 22.2%.

Generic safety climate. Zohar and Luria's (2005) generic, multi-level safety climate scale served as an internal control for the evaluation of our industry-specific construct. In consultation with Zohar, the organizational-level measure was constructed of items 1,3,10,12, plus one item from an unpublished 10-item scale developed by Zohar for consulting ("The decision-makers in this department try to reduce risk levels as much as possible") (Dov Zohar, personal communication). The group-level measure contained items 3,5,8,9,12. We used shortened scales because of the overall length of the survey and concerns about inducing mental fatigue or respondent disengagement.

Controls. At the department-level, we controlled for community population (department-reported size of population served) and the annual call volume (department-reported number of calls for service). Both of these variables reflect the general workload within the department. The probability of incidents that require the attention and action from firefighters intensifies as the community population and

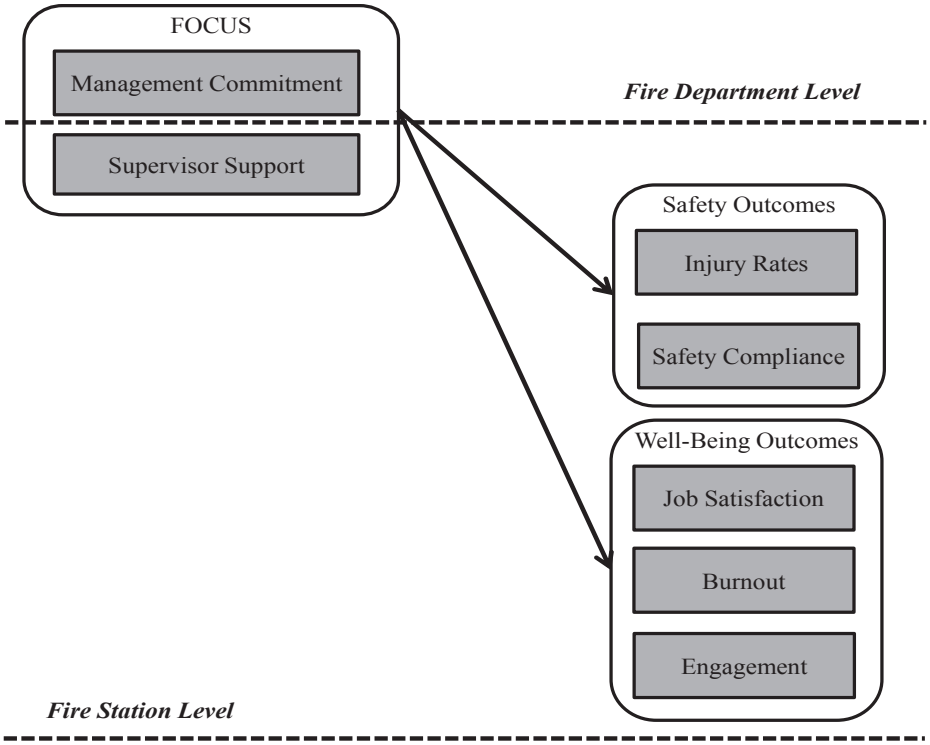

Fig. 2A. Criterion-related Validity Testing with Level 2 Outcomes (Model 1).

annual call volume increase. Also, safety performance can systematically vary depending on the increased workload and more frequent duties/operations as they lead to greater exposure to risks/hazards (e.g., Flin et al., 2000; Katz-Navon et al., 2005). In the station-level analyses, we controlled for mean experience and mean age at the station-level. In the cross-level analyses, we controlled for individual's experience and age. These factors were considered as they can systematically influence safety performance at the individual- or station-

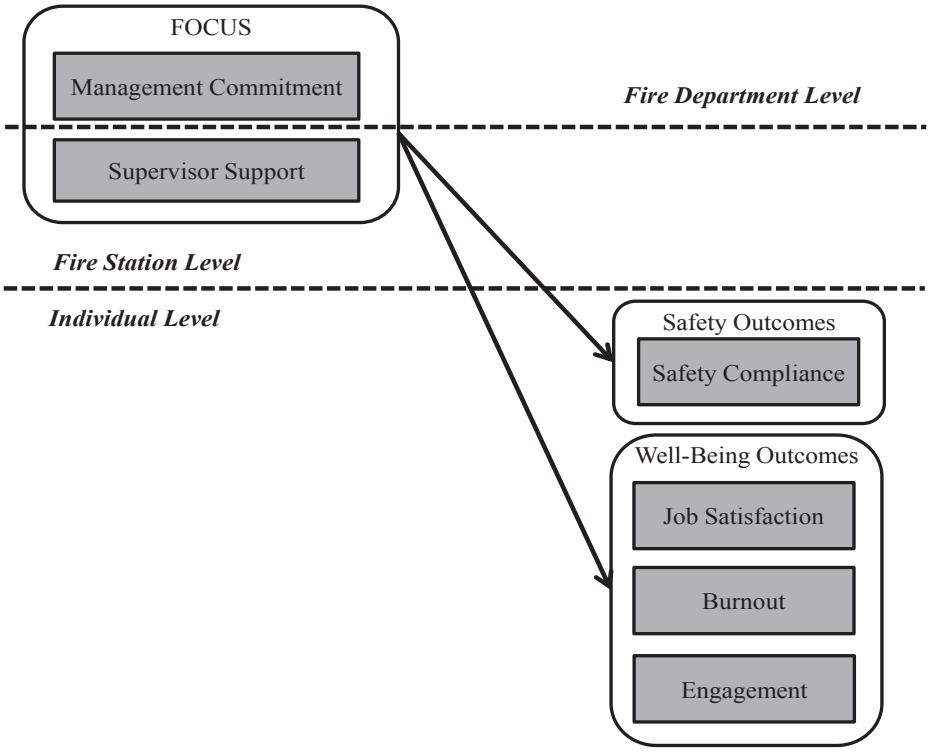

Fig. 2B. Criterion-related Validity Testing with Level 1 Outcomes (Model 2).

Table 5A
Descriptive statistics and zero-order correlations among the individual-level study variables; N = 8575.

Individual-level	Mean (SD)	1	2	3	4	5	6	7	8	9	10	11
1. FOCUS – F1	3.27 (0.79)	(0.82)										
2. FOCUS – F2	4.11 (0.57)	0.37**	(0.86)									
3. Zohar's OSC	4.62 (0.91)	0.74**	0.45**	(0.91)								
4. Zohar's GSC	4.96 (0.79)	0.26**	0.77**	0.34**	(0.89)							
5. Injury (yes/no)	0.17 (0.38)	−0.14**	−0.05**	−0.12**	−0.04**	–						
6. Engagement	4.92 (0.81)	0.13**	0.28**	0.17**	0.23**	−0.02	(0.84)					
7. Safety Compliance	4.92 (0.90)	0.27**	0.28**	0.27**	0.23**	−0.01	0.29**	(0.81)				
8. Job Satisfaction	4.89 (0.75)	0.47**	0.45**	0.46**	0.32**	−0.08**	0.40**	0.27**	(0.72)			
9. Burnout	3.03 (0.63)	−0.24**	−0.24**	−0.19**	−0.15**	0.05**	−0.05**	−0.08**	−0.25**	(0.72)		
10. Age	39.91 (10.34)	−0.04**	−0.11**	−0.09**	−0.11**	0.05**	−0.10**	−0.04**	−0.10**	0.08**	–	
11. Experience	15.93 (9.59)	−0.05**	−0.16**	−0.11**	−0.15**	0.04**	−0.14**	−0.06**	−0.14**	0.13**	0.77**	–

Table 5B
Descriptive statistics and zero-order correlations among the station-level study variables; N = 615.

Station-level	Mean (SD)	1	2	3	4	5	6	7	8	9	10	11
1. FOCUS – F1	3.25 (0.53)	(0.92)										
2. FOCUS – F2	4.11 (0.26)	0.38**	(0.90)									
3. Zohar's OSC	4.60 (0.56)	0.88**	0.51**	(0.96)								
4. Zohar's GSC	4.95 (0.33)	0.26**	0.86**	0.37**	(0.93)							
5. Injury rates (%)	18.45 (14.80)	−0.26**	−0.19**	−0.23**	−0.21**	–						
6. Engagement	4.00 (0.26)	0.16**	0.48**	0.24**	0.43**	−0.12**	(0.84)					
7. Safety Compliance	4.91 (0.49)	0.51**	0.29**	0.54**	0.17**	0.05	0.08	(0.88)				
8. Job Satisfaction	4.87 (0.38)	0.56**	0.59**	0.61**	0.44**	−0.08*	0.50**	0.38**	(0.77)			
9. Burnout	3.03 (0.22)	−0.27**	−0.30**	−0.25**	−0.22**	0.16**	−0.49**	−0.04	−0.32**	(0.71)		
10. Age	40.23 (5.38)	−0.21**	−0.22**	−0.22**	−0.22**	0.19**	−0.26**	−0.05	−0.19**	0.16**	–	
11. Experience	16.33 (4.84)	−0.09*	−0.30**	−0.14**	−0.32**	0.16**	−0.33**	−0.02	−0.22**	0.21**	0.77**	–

level such that more experienced workers could deal with the occupational risks/hazards more efficiently than inexperienced firefighters. Additionally, age affects how firefighters cope with and recover from the cognitive, emotional, physical demands of the work.

Square-root of AVE for FOCUS Management Commitment (department-level) was 0.89 and none of our dependent variables (safety compliance, job satisfaction, burnout, engagement, and injury) showed correlation greater than 0.89 with FOCUS Management Commitment either at individual- and station-level, as shown in Table 5A. Also, square-root of AVE for FOCUS Supervisor Support (station-level) was 0.73 and none of our dependent variables (safety compliance, job satisfaction, burnout, engagement, and injury) showed correlation greater than 0.73 with FOCUS Supervisor Support either at individual- and station-level, as shown in Table 5B. The results showed that our dependent (criterion) variables were adequately discerned from FOCUS factors.

2.5.2. Analyses for criterion-related validity testing

We conducted the criterion-related validity analyses using multilevel path analyses conducted in Mplus 8.2 (Muthén & Muthén, 1998–2017). The data for this study encompasses three levels of analysis, including individuals nested within stations which are subsequently nested within departments. As the fire station is our focal level of theory and analysis, we first tested the model of relationships

Table 5C
Descriptive statistics and zero-order correlations among the department-level study variables, N = 130.

Department-level	Mean (SD)	1	2	3	4	5	6	7	8	9	10	11
1. FOCUS – F1	3.51 (0.53)	(0.94)										
2. FOCUS – F2	4.06 (0.27)	0.62**	(0.93)									
3. Zohar's OSC	4.74 (0.55)	0.93**	0.74**	(0.98)								
4. Zohar's GSC	4.89 (0.34)	0.52**	0.87**	0.63**	(0.94)							
5. Injury rates (%)	15.06 (9.19)	−0.40**	−0.07	−0.36**	−0.16	–						
6. Engagement	3.97 (0.18)	0.35**	0.57**	0.41**	0.54**	−0.23*	(0.88)					
7. Safety Compliance	4.91 (0.35)	0.24**	0.38**	0.25**	0.34**	0.01	0.13	(0.80)				
8. Job Satisfaction	4.88 (0.36)	0.76**	0.77**	0.78**	0.62**	−0.08	0.56**	0.32**	(0.77)			
9. Burnout	3.02 (0.21)	−0.40**	−0.36**	−0.36**	−0.33**	0.21	−0.55**	−0.16	−0.37**	(0.77)		
10. Comm. Popul.	13.99 (32.64)	−0.17	0.18	−0.02	0.14	0.27*	0.09	0.04	0.14	−0.02	–	
11. Ann. Call Vol.	21.92 (15.34)	−0.20	0.18	−0.06	0.22	0.13	0.10	−0.34**	0.10	−0.05	0.38**	–

Notes. Values on diagonal within () indicate Cronbach's α statistics; FOCUS – F1 = Management Commitment; FOCUS – F2 = Supervisor Support; Zohar's OSC = Zohar's generic organization-level safety climate; Zohar's GSC = Zohar's generic group-level safety climate; For raw means and standard deviations, multiply by 10,000 with Comm. Popul. (community population) and 100 with Ann. Call Vol. (annual call volume), $^{*}p < .05$, $^{**}p < .01$.

Table 6A
Criterion-related Validity Testing with Station-Level Outcomes (Model 2).

Independent Variables	Station-Level Outcomes				
	Injury rates	Safety Comp.	Job Sat.	Burnout	Engagement
Department-Level (Level 3, n = 130)					
FOCUS – F1	−10.07 (2.45)**	0.34 (0.11)**	0.45 (0.09)**	−0.15 (0.05)**	0.05 (0.07)
(Control)					
Annual Call Volume	1.13 (0.39)	0.03 (0.01)	0.04 (0.01)**	−0.01 (0.01)	0.02 (0.01)†
Community Population	−2.02 (7.39)	−0.43 (0.31)	0.11 (0.24)	−0.03 (0.13)	−0.09 (0.30)
Station-Level (Level 2, n = 615)					
FOCUS – F2	−4.63 (4.30)	0.20 (0.05)**	0.29 (0.06)**	−0.06 (0.04)	0.25 (0.05)**
(Control)					
Experience (year)	−0.35 (0.43)	0.00 (0.01)	0.00 (0.01)	0.01 (0.01)*	−0.01 (0.01)*
Age (year)	0.61 (0.41)	−0.00 (0.01)	−0.02 (0.01)*	−0.00 (0.00)	−0.00 (0.01)

depicted in Model 1 of Fig. 2A. We specified FOCUS Management Commitment as a department-level exogenous safety climate factor and FOCUS Supervisor Support as an exogenous station-level safety climate factor. Injury rates, safety compliance, job satisfaction, engagement and burnout were modeled as station-level endogenous variables. We controlled for mean experience and age at the station level, and community population and annual call volume at the department level. We then tested Model 2 of Fig. 2B where we modeled safety compliance, job satisfaction, engagement and burnout as individual-level endogenous variables. We controlled for experience and age at the individual level, and community population and annual call volume at the department level. After testing each of the two models, we then added a generic measure of organization-level safety climate (Zohar & Luria, 2005) at department-level and a generic measure of group-level safety climate (Zohar & Luria, 2005) at the station-level to examine the incremental validity of FOCUS over the generic safety climate measure. All criterion-related validity analyses were conducted using the 8575 firefighters from the full sample of 615 stations nested within 130 departments.

3. Results for criterion-related validity testing

The descriptive statistics and zero-order correlations among the study variables at the department, station, and individual levels of analysis are listed in Table 5C.

Beginning with the outcomes modeled at the station level (Fig. 2A) the overall path model fit the data well ($\chi^2 = 11.55$, $df = 0$, CFI = 0.969, $SRMR_{station} = 0.023$, $SRMR_{department} = 0.020$, RMSEA = 0.000) which is not surprising given that the model was just identified (i.e., zero degrees of freedom). The results indicate that FOCUS Management Commitment (department-level factor) was negatively related to injury rates (B = −10.07, SE = 2.45, $p < .01$) and burnout among station firefighters (B = −0.15, SE = 0.05, $p < .01$), and positively related to safety compliance (B = 0.34, SE = 0.11, $p < .01$) and job satisfaction (B = 0.45, SE = 0.09, $p < .01$) among station firefighters. However, FOCUS Management Commitment was unrelated to engagement levels among firefighters (B = 0.05, SE = 0.07, $p = .46$). These results indicate that stations experienced approximately a 10.01% decrease in injury rates and a 0.15-point decrease in burnout levels for every one-point increase in their department's FOCUS Management Commitment score. In addition, stations experienced approximately a 0.34-point increase in safety compliance levels and a 0.45 increase in job satisfaction scores for every one-point increase in their department's FOCUS Management Commitment score. Turning now to FOCUS Supervisor Support (station-level factor), the results indicate that supervisor support is positively related to station safety compliance (B = 0.20, SE = 0.05, $p < .01$), job satisfaction (B = 0.29, SE = 0.06, $p < .01$), and engagement levels (B = 0.25, SE = 0.05, $p < .01$), but unrelated to injury rate (B = −4.63, SE = 4.30, $p = .28$) or burnout (B = −0.06, SE = 0.04, $p = .16$). levels. Fire stations experience approximately a 0.20-point increase in safety compliance levels, a 0.29-point increase in job satisfaction levels,

Table 6B
Incremental Validity Testing with Station-Level Outcomes (Model 2 + Generic Safety Climate Scores as Additional Independent Variables).

Independent Variables	Station-Level Outcomes				
	Injury rates	Safety Comp.	Job Sat.	Burnout	Engagement
Department-Level (Level 3, n = 130)					
FOCUS – F1	−4.63 (33.12)	0.47 (0.26)†	0.51 (0.40)	−0.18 (0.20)	0.20 (0.19)
Zohar's OSC	−5.29 (30.50)	−0.13 (0.24)	−0.06 (0.35)	0.03 (0.18)	−0.15 (0.16)
(Control)					
Annual Call Volume	1.30 (1.73)	0.03 (0.01)*	0.04 (0.02)	−0.01 (0.01)	0.02 (0.01)†
Community Population	−0.85 (11.01)	−0.39 (0.31)	0.13 (0.24)	−0.04 (0.14)	−0.05 (0.29)
Station-Level (Level 2, n = 615)					
FOCUS – F2	−1.80 (5.73)	0.30 (0.09)**	0.33 (0.13)**	−0.13 (0.07)*	0.17 (0.12)
Zohar's GSC	−2.90 (4.21)	−0.10 (0.09)	−0.03 (0.10)	0.07 (0.05)	0.09 (0.10)
(Control)					
Experience (year)	−0.35 (0.57)	0.00 (0.01)	0.00 (0.01)	0.01 (0.01)*	−0.01 (0.01)*
Age (year)	0.59 (0.30)	−0.00 (0.01)	−0.02 (0.01)*	−0.00 (0.00)	−0.00 (0.01)

Notes. FOCUS – F1 = Management Commitment; FOCUS – F2 = Supervisor Support; Zohar's OSC = Zohar's generic organization-level safety climate; Zohar's GSC = Zohar's generic group-level safety climate; Safety Comp. = safety compliance; Job Sat. = job satisfaction; †$p < .10$, *$p < .05$, **$p < .01$, For raw coefficients, multiply by 1/100,000 with average annual call volume and 1/10,000 with community population.

and a 0.25-point increase in engagement levels for every one-point increase in their station's FOCUS Supervisor Support score. The results are summarized in Table 6A.

Next, we introduced Zohar and Luria's (2005) generic organizational safety climate scores at the department level and generic group safety climate scores at the fire station level. Once again, the model fit the data well ($\chi^2 = 53.88$, $df = 8$, CFI = 0.950, $SRMR_{station} = 0.057$, $SRMR_{department} = 0.039$, RMSEA = 0.034). Accounting for the effects of the two generic safety climate factors, the effects of FOCUS Management Commitment (department-level factor) on station-level safety compliance (B = 0.47, SE = 0.26, $p < .10$) remained statistically significant. However, the effects of FOCUS Management Commitment (department-level factor) on injury rates (B = −4.63, SE = 33.12, $p = .89$), job satisfaction (B = 0.51, SE = 0.40, $p = .20$), burnout (B = −0.18, SE = 0.20, $p = .36$) and engagement (B = 0.20, SE = 0.19, $p = .30$) were not statistically significant. Likewise, FOCUS Supervisor Support (station-level factor) continued to be related to safety compliance (B = 0.30, SE = 0.09, $p < .01$) and job satisfaction levels (B = 0.33, SE = 0.13, $p < .01$), and unrelated to injury rates (B = −1.80, SE = 5.73, $p = .75$) or engagement level (B = 0.17, SE = 0.12, $p = .15$). Interestingly, the FOCUS Supervisor Support was negatively related to burnout level (B = −0.13, SE = 0.07, $p < .05$) with the addition of the generic safety climate measures. At the same time, generic organization-level safety climate (department-level factor) was unrelated to any of the five station-level outcomes (injury rate: B = −5.29, SE = 30.50, $p = .86$; safety compliance: B = −0.13, SE = 0.24, $p = .59$; job satisfaction: B = −0.06, SE = 0.35, $p = .87$; burnout: B = 0.03, SE = 0.18, $p = .85$; engagement: B = −0.15, SE = 0.16, $p = .37$). Likewise, generic group-level safety climate (station-level factor) was also unrelated to any of the five station-level outcomes (injury rate: B = −2.90, SE = 4.21, $p = .49$; safety compliance: B = −0.10, SE = 0.09, $p = .29$; job satisfaction: B = −0.03, SE = 0.10, $p = .78$; burnout: B = 0.07, SE = 0.05, $p = .13$; engagement: B = 0.09, SE = 0.10, $p = .39$). The results are summarized in Table 6B. This set of analyses provides initial evidence supporting the incremental criterion-related validity of the FOCUS measure for a series of safety and well-being related outcomes that are important within the context of the fire service.

Next, we modeled the safety and well-being outcomes at the individual level (Fig. 2B) and found that the overall path model fit the data well ($\chi^2 = 2.63$, $df = 0$, CFI = 0.996, $SRMR_{individual} = 0.001$, $SRMR_{station} = 0.042$, $SRMR_{department} = 0.009$, RMSEA = 0.000). The strong overall fit is again not surprising as this model was also just identified (i.e., zero degrees of freedom). The results indicate that FOCUS Management Commitment (department-level factor) was positively related to individual safety compliance (B = 0.34, SE = 0.10, $p < .01$) and job satisfaction (B = 0.45, SE = 0.07, $p < .01$), and negatively related to burnout (B = −0.13, SE = 0.04, $p < .01$). Similar to the station-level analyses, FOCUS Management Commitment was not related to firefighter engagement (B = 0.08, SE = 0.07, $p = .28$). The results indicate that firefighters report approximately a 0.34-point increase in safety compliance, a 0.45 increase in job satisfaction, and a 0.13 decrease in burnout for every one-point increase in their department's FOCUS Management Commitment score. Likewise, mirroring the station-level results, FOCUS Supervisor Support (station-level factor) was positively related to safety compliance (B = 0.14, SE = 0.05, $p < .01$), job satisfaction (B = 0.32, SE = 0.04, $p < .01$), and engagement (B = 0.24, SE = 0.05, $p < .01$), but not burnout (B = −0.06, SE = 0.04, $p = .12$). These results indicate that firefighters reported approximately a 0.14-point increase in safety compliance behaviors, a 0.32-point increase in job satisfaction, and a 0.24-point increase in engagement levels for every one-point increase in their station's FOCUS Supervisor Support score. The results are summarized in Table 7A.

When Zohar and Luria's (2005) generic organizational safety climate scores were added at the department level and generic group safety climate scores were added at the fire station level, model fit again fit the data well ($\chi^2 = 17.32$, $df = 4$, CFI = 0.986, $SRMR_{individual} = 0.000$, $SRMR_{station} = 0.034$, $SRMR_{department} = 0.039$, RMSEA = 0.028). Accounting for the effects of the two generic safety climate factors, the effects of FOCUS Management Commitment (department-level factor) on safety compliance behavior (B = 0.44, SE = 0.23, $p < .10$) and job satisfaction (B = 0.51, SE = 0.22, $p < .05$) remained statistically significant. However, the effects of FOCUS Management Commitment (department-level factor) on individual burnout (B = −0.13, SE = 0.10, $p = .19$) and engagement (B = 0.20, SE = 0.18, $p = .27$) were not statistically significant. Likewise, FOCUS Supervisor Support (station-level factor) continued to be positively related to individual safety compliance behaviors (B = 0.28, SE = 0.11, $p < .10$) and job satisfaction (B = 0.42, SE = 0.11, $p < .05$). Similar to the station-level model, with the addition of the generic safety climate measures, FOCUS Supervisor Support (station-level) was negatively related to burnout (B = −0.15, SE = 0.06, $p < .05$). FOCUS Supervisor Support continued to be unrelated to firefighter engagement (B = 0.13, SE = 0.11, $p = .24$). Meanwhile, generic organization-level safety climate (department-level factor) was

Table 7A
Criterion-related Validity Testing with Individual-Level Outcomes (Model 1).

Independent Variables	Individual-Level Outcomes			
	Safety Comp.	Job Sat.	Burnout	Engagement
Department-Level (Level 3, n = 130)				
FOCUS – F1	0.34 (0.10)**	0.45 (0.07)**	−0.13 (0.04)**	0.08 (0.07)
(Control)				
Annual Call Volume	0.03 (0.01)	0.03 (0.01)**	−0.01 (0.00)†	0.01 (0.01)†
Community Population	−0.45 (0.33)	0.20 (0.24)	−0.08 (0.12)	−0.10 (0.30)
Station-Level (Level 2, n = 615)				
FOCUS – F2	0.14 (0.05)**	0.32 (0.04)**	−0.06 (0.04)	0.24 (0.05)**
(Control)				
Experience (year)	–	–	–	–
Age (year)	–	–	–	–
Individual-Level (Level 1, n = 8575)				
(Control)				
Experience (year)	−0.72 (0.29)*	−0.75 (0.22)**	1.03 (0.20)**	−0.94 (0.31)**
Age (year)	0.07 (0.23)	−0.11 (0.25)	−0.18 (0.16)	−0.22 (0.23)

Table 7B
Incremental Validity Testing with Individual-Level Outcomes (Model 2 + Generic Safety Climate Scores as Additional Independent Variables).

Independent Variables	Individual-Level Outcomes			
	Safety Comp.	Job Sat.	Burnout	Engagement
Department-Level (Level 3, n = 130)				
FOCUS – F1	0.44 (0.23)†	0.51 (0.22)*	−0.13 (0.10)	0.20 (0.18)
Zohar's OSC	−0.10 (0.22)	−0.06 (0.19)	−0.01 (0.08)	−0.12 (0.15)
(Control)				
Annual Call Volume	0.03 (0.01)*	0.03 (0.01)**	−0.01 (0.01)	0.02 (0.01)†
Community Population	−0.42 (0.32)	0.22 (0.23)	−0.09 (0.11)	−0.07 (0.28)
Station-Level (Level 2, n = 615)				
FOCUS – F2	0.28 (0.11)**	0.42 (0.11)**	−0.15 (0.06)*	0.13 (0.11)
Zohar's GSC	−0.12 (0.10)	−0.09 (0.09)	0.08 (0.05)†	0.10 (0.10)
(Control)				
Experience (year)	–	–	–	–
Age (year)	–	–	–	–
Individual-Level (Level 1, n = 8575)				
(Control)				
Experience (year)	−0.72 (0.28)*	−0.75 (0.21)**	1.03 (0.20)**	−0.94 (0.31)**
Age (year)	0.08 (0.23)	−0.10 (0.25)	−0.18 (0.16)	−0.23 (0.23)

Notes. FOCUS – F1 = Management Commitment; FOCUS – F2 = Supervisor Support; Zohar's OSC = Zohar's generic organization-level safety climate; Zohar's GSC = Zohar's generic group-level safety climate; Safety Comp. = safety compliance; Job Sat. = job satisfaction; $^{\dagger}p < .10$, $^{*}p < .05$, $^{**}p < .01$, For raw coefficients, multiply by 1/100 with experience and age (Level 1), 1/100,000 with average annual call volume, and 1/10,000 with community population.

unrelated to any of the four individual-level outcomes (safety compliance: B = −0.10, SE = 0.22, $p = .65$; job satisfaction: B = −0.06, SE = 0.19, $p = .74$; burnout: B = -0.01, SE = 0.08, $p = .95$; engagement: B = −0.12, SE = 0.15, $p = .44$). Similarly, generic group-level safety climate (station-level factor) was also unrelated to three of the four individual-level outcomes (safety compliance: B = −0.12, SE = 0.10, $p = .25$; job satisfaction: B = −0.09, SE = 0.09, $p = .30$; engagement: B = 0.10, SE = 0.10, $p = .29$). While generic group safety climate was related to individual burnout (B = 0.08, SE = 0.05, $p < .10$), the effect was positive and opposite of the direction of any of the zero-order correlations between generic group safety climate and burnout (department: $r = -0.33$, $p < .01$; station: $r = 0.22$, $p < .01$; individual: $r = 0.15$, $p < .01$) and contrary to previously shown negative relationships (e.g., Nahrgang et al., 2011). The positive cross-level effect found in the multi-level path model suggests a possible suppression effect. The results are summarized in Table 7B. The overall set of analyses provides further evidence supporting the incremental criterion-related validity of the FOCUS measure for safety and well-being related outcomes important to the fire service.

4. Limitations

There are several limitations of this research that suggest some caution in the interpretation and generalizability of the findings. For the qualitative phase, our research team engaged 12 fire departments. While these participating fire departments were geographically diverse – selected from Eastern, Central, and Western regions of the United States – it is possible that varied perspectives were missed by not selecting from a tighter geographic boundary (like FEMA region, for example). Participants in our focus groups and interviews understood that we were interested in hearing their perceptions on safety at work and as such, could have self-censored their responses to our open-ended questions. However, anecdotally both interview facilitators (JAT and ALD) found our participants to be open, honest, and frank with their assessment of safety within their organization. During our ten focus groups, we were unable to assure confidentially for participants. All focus group participants were instructed to keep the conversation confidential, but our research team could not guarantee anonymity and because of this, participants could have censored their responses.

For the quantitative phase of our work, the first set of limitations focus on potential bias. For example, there could be selection bias from randomly selected fire departments who chose to participate when contacted over those who were randomly selected but chose not to participate. Safety climate may be materially better throughout the sample of stations in departments that chose to participate vs. not participate. In addition, our sample over-represents career departments as opposed to volunteer departments. We divided each FEMA region into an equal number of career and volunteer sites. Yet, volunteer departments outnumber career departments by approximately 3-to-1 in the United States. Our results could be skewed if there are fundamentally different perceptions in safety climate between career and volunteer departments. Volunteer departments were particularly difficult to recruit due to differences in work schedules (e.g., absence of 9 to 5 coverage), and naturally rare opportunities to launch the survey due to less frequent department-wide trainings. Additionally, it needs to be noted that our study participants completed two different forms of survey, online or paper-and-pencil surveys. Although the possibility of systematically different response patterns between the two forms of survey cannot be perfectly ruled out, our supplementary analysis of measurement equivalence based on multi-group CFA showed that psychometric properties of the online and paper-and-pencil surveys were not significantly different.

The second set of limitations focus on our metric of station level injury rates. We asked respondents to indicate whether they were injured on the job in the past 12-months. This approach allowed us to capture injuries that may not have been reported to the station. However, the response may also suffer from a recall bias given the 12-month time frame we used. In addition, the gauge of injuries is retrospective in nature capturing injuries that preceded the climate assessment rather than contemporaneously with or after. The extent to which climate evolved over the course of the prior twelve months is unknown. Therefore, findings regarding the relationships between the FOCUS Management Commitment factor and station injury rates should be interpreted with caution. Nevertheless, it is noteworthy that the study of Beus et al. (2010) showed that safety climate and injury relationship can be bi-directional.

Third, the criterion-related validity analyses are based on single-source cross-sectional data, which are not ideal for testing the implied causal direction of the relationships between the climate dimensions and the set of safety and well-being outcomes. In addition, because

scores for both climate and the focal outcome were obtained from the same source, the potential for the results to be inflated because of common method bias (CMB) exists. We took steps to ensure that participants clearly understood the instructions, to ensure confidentiality and anonymity of responses, and to assure participants that the results were not intended to be used for punitive purposes which should reduce evaluation apprehension and increase response accuracy, thereby lessening the potential effects of CMB. In addition, Spector (2019) recently argued that time-lagged designs offer few advantages over cross-sectional designs for drawing casual inferences and that cross-sectional designs are "an efficient and invaluable go-to tool for investigating important organizational phenomena" (p. 136). However, the potential for inflated results remains. Future research using pre-post intervention or cross-lagged designs will help to better understand the causal ordering of effects. In addition, future research should obtain ratings of climate and the outcomes from different sources to more fully mitigate the potential impact of CMB. Finally, this study provides no insights into the stability or dynamic nature of climate scores overtime. Future research should use longitudinal designs to explicitly model change in safety climate.

5. Discussion

Our results provide evidence that FOCUS is a useful tool for assessing safety climate specifically within the fire service. Across a nationally-representative, geographically-stratified random sample of over 8,000 firefighters nested in 615 fire stations, from 130 departments, the FOCUS scale demonstrated sound psychometric properties, and convergent, discriminant, and criterion-related evidence of construct validity. Pertaining specifically to safety-related outcomes, departments with higher as opposed to lower FOCUS Management Commitment scores experienced lower injury rates. Firefighters within departments with higher FOCUS Management Commitment and stations with higher FOCUS Supervisor Support scores reported engaging in higher levels of safety compliance behaviors. Further, firefighters within departments with higher as opposed to lower FOCUS Management Commitment scores reported experiencing higher levels of job satisfaction and lower levels of burnout. Also, firefighters within stations with higher as opposed to lower FOCUS Supervisor Support scores reported experiencing higher levels of job satisfaction and engagement.

Findings from this study not only provide evidence supporting the construct validity of a fire service specific measure of safety climate but also directly test several aspects Nahrgang et al.'s (2011) model of demands-resources and workplace safety within the high-hazard context of the fire service. Given the physical, mental, and emotional demands that firefighters face, our findings suggest that safety climate is a critical resource that helps to both mitigate the emotional strain of the job and promote compliance with safety behaviors. Consistent with Nahrgang et al.'s (2011) findings, we expect that fire stations with a positive safety climate are also likely to experience fewer adverse events. It is also encouraging to see that safety climate measured with our fire service specific safety climate scale is associated with both safety related variables and firefighter wellbeing variables. As suggested by Huang et al. (2016), the promotion of safety climate would contribute to the wellbeing of workers and sustainability of the industry. Our study demonstrates that it would be the case in the context of the fire service, underscoring the importance of appropriate management of fire service safety climate.

The FOCUS measure offers several advantages over the Smith and DeJoy (2014) measure. First, items were developed using both inductive (in-depth interviews and focus groups with a national sample of firefighters) and deductive (in-depth review of the literature) strategies to generate a set of items that broadly encompass the domain of the safety climate construct within the specific context of the fire service. Second, we utilized much larger and more representative fire service sample from all regions in the United States, inclusive of volunteers. Third, we have conducted both exploratory factor analysis (EFA) and multilevel confirmatory factor analysis (CFA) using independent samples to empirically derive and confirm the measurement structure of our fire service safety climate. Fourth, we provide evidence supporting the convergent and discriminant validity of the newly developed fire service safety scale. Fifth, we adopted a multi-level analytic framework such that FOCUS Management Commitment was conceptualized and analyzed as a department-level construct and FOCUS Supervisor Support was conceptualized and analyzed as a station-level construct. Also, criterion-related validity analyses were conducted using a multi-level analytic framework after controlling for between-station/department variances (random effects). Sixth, we have demonstrated the incremental validity of our industry-specific fire service safety climate scores over generic safety climate score in their association with various safety and organizational outcomes.

5.1. The relationship between FOCUS and firefighter safety outcomes

For every one-point increase in a department's FOCUS Management Commitment score and for every one-point increase in a station's FOCUS Supervisor Support score, fire stations experienced a 0.34 and 0.20-point increase in safety compliance level, and individual firefighters reported a 0.34 and 0.14-point increase in safety compliance behavior. Additionally, for every one-point increase in FOCUS Management Commitment score within fire departments, stations nested within those departments experienced a roughly 10% reduction in injury rates. However, injuries in the fire service can be rare events. We asked fire department leadership to provide summary statistics of their overall department injuries in the last calendar year. Of the 130 randomly selected fire departments that participated in the development of the FOCUS instrument, 20% reported no injuries in the last year (83% reported 30 or fewer). For this reason, we encourage the fire service to not only look at their injuries, but also include organizational outcomes in their safety assessments as they are upstream of injuries in the causal pathway and more readily measurable.

5.2. The relationship between FOCUS and organizational outcomes

Organizational outcomes also operated as expected based on our theoretical model (Fig. 3). For example, for every one-point increase in FOCUS Management Commitment (F1), there were a 0.13 and 0.15 unit decrease in burnout respectively at individual- and station-level. For every one-point increase in FOCUS Management Commitment and FOCUS Supervisor Support, there were respectively, a 0.45 and 0.32 unit increase in job satisfaction at individual-level, and a 0.45 and 0.29 unit increase in the same variable at the station-level. For every one unit increase in FOCUS Supervisor Support, there was a 0.24 and 0.25 increase in engagement at the individual- and station-level, respectively.

The incorporation of organizational outcomes into the conceptual framework as expressed in Huang et al.'s work (2016) was important for several reasons: (1) it allowed for the shifting of prevention opportunities further upstream in the causal pathway, and (2) it enabled measurement of perceptions known to predict safety outcomes, especially when those safety outcomes were small in number. The inclusion of both safety and organizational outcomes simultaneously in this study is one of the first to show the comprehensive implications of safety climate in the fire service.

5.3. Conclusions

Fig. 3 proposes a framework for understanding the near-term, intermediate and longer-term implications of safety climate as resource for addressing the unique hazards and job demands within the fire service.

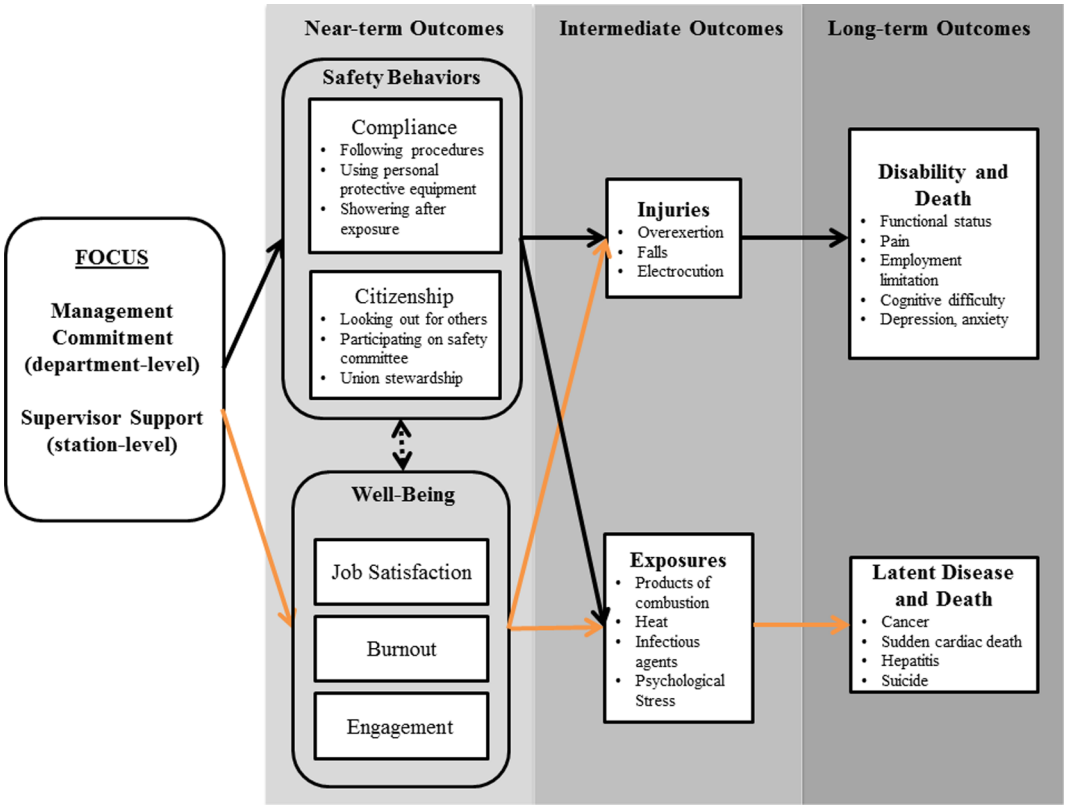

Fig. 3. The relationship between FOCUS, safety outcomes, and organizational outcomes.

In the **near-term**, the results provide initial evidence that FOCUS scores are related to increased engagement in safety *compliance* which involves performing the actual behavior (e.g., wearing PPE during hazardous material handling). In addition, we suggest that firefighters are also likely to engage in safety *citizenship* which involves proactive, voluntary actions aimed at improving safety beyond mere compliance with rules and procedures when they work in a station with commitment and support for safety practices. Likewise, FOCUS scores were associated with higher *job satisfaction* and lower *burnout* which can lower exposures and injuries. These near-term outcomes are readily observable, and therefore relatively easy to capture.

The absence of safe behaviors can lead to injuries and exposures, which are **intermediate outcomes** that are less easy to measure and are highly dependent on self-reporting, gear testing, and field observation. Finally, **long-term outcomes** like disability and death not from injury are fraught with the perils of latency. The relationship between safety climate and exposures has not been studied for impact on long-term health outcomes like cancer or heart disease. It is not easy to say that a firefighter died from lung cancer due to the poor organizational climate that encouraged him not to wear breathing protection. However, since safety climate is a known predictor of safety behaviors, associations like this seem plausible.

Safety climate provides an important organizational resource enabling firefighters to effectively cope with the extreme demands of the environment and has direct implications for safety-related outcomes and firefighter well-being. Prior theory and research have demonstrated the linkages between safety climate, safety behaviors, and near-term accidents and injuries. Therefore, safety climate and safety-related behavior may, hypothetically, have a longer-term importance to minimizing the types of exposure to toxins that firefighters face. Empirical studies testing these connections are now needed. In addition, safety climate also has important implications for engagement levels, satisfaction, and burnout which provide a readily accessible metric of well-being and morale. In turn, these organizational indicators have implications for both retention and engagement in the work environment, which may also reduce the probability of accidents or injuries. Organizational factors such as job satisfaction, engagement, and turnover are critical to assess given the compelling scientific evidence that they are predictive of subsequent injuries and other safety and health outcomes, such as depression, anxiety, and PTSD (Schaufeli et al., 2002; Swaen et al., 2004; Nahrgang et al., 2011; Bal et al., 2011; Schaufeli et al., 2004; Carayon et al., 2006; Cresswell and Eklund, 2005; Halbesleben, 2010). Therefore, a promising potential direction for safety climate research is to examine the longer-term health implications of safety climate on firefighter well-being, morale, and safety behaviors.

5.3.1. Epilogue

The fire service is aware of the need to address aspects of its culture to help reduce firefighter fatalities and injuries. Research has repeatedly indicated that factors related to safety climate are causal factors underlying safety outcomes. Safety climate constitutes the measurable aspect of culture and offers the potential for quantifying and comparing climate across firefighting units. The literature has repeatedly pointed towards the development of industry-specific safety climate assessment tools to conduct targeted safety culture research. Disciplines involved in such research including occupational health psychology, industrial/organizational psychology, and public health are very advanced at safety climate measurement. But, as Peter Drucker is commonly known to say, “one cannot manage what one cannot measure”. After receiving safety climate assessments, industries do not have a menu of evidence-based safety climate interventions from which to choose. For this reason, our disciplines must move from the process of safety climate measurement to the more proactive safety climate promotion efforts, as these efforts have been limited by their scope and quantity (Lee et al., 2019).

Acknowledgements

This research was supported by the Federal Emergency Management Agency (FEMA) FY 2011 Assistance to Firefighters Grant Program, Fire Prevention and Safety Grants EMW-2011-FP-00069 (Research and Development) and EMW-2015-FP-00051 (Fire Prevention and Safety). FEMA had no role in study design; in the collection, analysis and interpretation of data; in the writing of the report; or in the decision to submit the article for publication. The authors express their gratitude to Mr. Victor Stagnaro of the National Fallen Firefighter Foundation for sharing the Vulnerably Assessment Program (VAP) data elements, a subset of which were used to develop the safety behaviors construct in FOCUS. Ms. Heather Schafer of the National Volunteer Fire Council and Assistant Chief Matt Tobia of the Loudoun County Combined Fire Rescue System are thanked for their input on safety behavior assessment. The Center for Firefighter Injury Research and Safety Trends (FIRST) at Drexel University thanks the 132 fire departments for their participation in the development and testing of the FOCUS survey. We dedicate this article to the memory of the late Alan Brunacini, Fire Chief to the world who made the introductory video for the survey's launch and whose service on the FIRST Center Advisory board is greatly missed and never forgotten.

APPENDIX A. FOCUS SCALES AND FINAL ITEMS

Reported Cronbach's alphas are station-level and based on full sample of 615 stations.

"Generic Safety Climate: Organization-level" and "FOCUS Management Commitment" are department level and based on the full sample of 130 departments.

GENERIC SAFETY CLIMATE

Organizational-level; Cronbach's alpha = 0.98

1. The decision-makers in this department react quickly to solve the problem when told about safety hazards.
2. The decision-makers in this department try to continually improve safety levels in this department.
3. The decision-makers in this department invest a lot of time and money in safety training for members.
4. The decision-makers in this department listen carefully to members' ideas about improving safety.
5. The decision-makers in this department try to reduce risk levels as much as possible.

Group-level; Cronbach's alpha = 0.93

1. My direct supervisor discusses how to improve safety with us.
2. My direct supervisor emphasizes safety procedures when we are working under pressure during a response.
3. My direct supervisor is strict about working safely when we are tired or stressed.
4. My direct supervisor says a "good word" to members who pay special attention to safety.
5. My direct supervisor reminds members who aren't working safely to do so.

FOCUS

Management Commitment; Cronbach's alpha = 0.94

1. Leadership's policies emphasize punishment rather than safety. (reverse-worded)
2. Decision-makers in this department consider members the most important asset in our department.
3. People who make policy decisions (SOPs, SOGs) in this department see eye-to-eye with rank and file on safety.
4. The decision-makers in this department are out of touch with what we need to do our job safely. (reverse-worded)
5. Our apparatus is fixed and returned to service in a timely manner.
6. In my department, it's after an injury occurs that safety becomes prioritized. (reverse-worded)
7. In my opinion, when the budget is tight, our department cuts corners on safety. (reverse-worded)

Supervisor Support; Cronbach's α = 0.90

1. Our direct supervisor prioritizes rest and rehabilitation on scene.
2. My direct supervisor puts a high emphasis on safety training.
3. I have confidence in my command/my company level officers to keep me safe.
4. Our house does a good job of carrying out its safety policies.
5. In our firehouse, we talk about safety on a consistent basis.
6. On our crew, people expect one another to wear their PPE.
7. My direct supervisor takes my safety concerns seriously.

ENGAGEMENT (Cronbach's α = 0.84)

1. I feel bursting with energy.
2. I feel strong and vigorous.
3. I am proud of the work that I do.
4. I find the work that I do full of meaning and purpose.
5. Time flies when I do this kind of work.
6. I am immersed in my work.

SAFETY COMPLIANCE BEHAVIOR (Cronbach's α = 0.88)

1. I wear my self contained breathing apparatus at all times while engaged in a firefight, including during overhaul, until the environment is declared safe by an officer.
2. I routinely ensure that my personal protective equipment (gear) is clean, especially after a fire.
3. I routinely wash my protective hood.
4. I shower and change my clothes immediately after returning to quarters from a fire.

JOB SATISFACTION (Cronbach's α = 0.77)

1. I like my job.
2. Morale is high here.
3. Working here is like being part of a family.
4. This department is a good place to work.

BURNOUT (Cronbach's α = 0.71)

1. I become more detached from the people I help.
2. I feel emotionally drained from this kind of work.
3. I feel used up at the end of the run.
4. I feel burned out doing this kind of work.
5. I don't really care what happens to the people I help.

Appendix B. Supplementary material

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ssci.2019.05.007.

References

Allen, J.A., Baran, B.E., et al., 2010. After-action reviews: a venue for the promotion of safety climate. Accid. Anal. Prev. 42 (2), 750–757.
Ashill, N.J., Jobber, D., 2010. Measuring state, effect, and response uncertainty: theoretical construct development and empirical validation. J. Manage. 36 (5), 1278–1308.
Bakker, A.B., Demerouti, E., 2007. The job demands-resources model: state of the art. J. Manage. Psychol. 22 (3), 309–328.
Bal, P.M., Cooman, R., et al., 2011. Dynamics of psychological contracts with work

engagement and turnover intention: the influence of organizational tenure. Eur. J. Work Org. Psychol. 22 (1), 107–122.
Bandura, A., 1989. Human agency in social cognitive theory. Am. Psychol. 44, 1175–1184.
Beus, J.M., Payne, S.C., et al., 2010. Safety climate and injuries: an examination of theoretical and empirical relationships. J. Appl. Psychol. 95 (4), 713–727.
Blau, P.M., 1964. Exchange and Power in Social Life. Wiley, New York.
Cangur, S., Ercan, I., 2015. Comparison of model fit indices used in structural equation modeling under multivariate normality. J. Modern Appl. Stat. Methods 14, 152–167.
Carayon, P., Hundt, A.S., Karsh, B.T., et al., 2006. Work system design for patient safety: the SEIPS model. Qual. Saf. Health Care 15, 150–158.
Charmaz, K., 1990. Discovering chronic illness – using grounded theory. Soc. Sci. Med. 30 (11), 1161–1172.
Cheung, M.W.L., Leung, K., Au, K., 2006. Evaluating multilevel models in cross-cultural research: an illustration with social axioms. J. Cross Cult. Psychol. 37, 522–541.
Christian, M.S., Bradley, J.C., et al., 2009. Workplace safety: a meta-analysis of the roles of person and situation factors. J. Appl. Psychol. 94 (5), 1103–1127.
Conrad, K.M., Balch, G.I., et al., 1994. Musculoskeletal injuries in the fire service: views from a focus group study. AAOHN J. 42 (12), 572–581.
Comrey, A.L., Lee, H.B., 1992. A first course in factor analysis. Erlbaum, Hillsdale, NJ.
Cresswell, S.L., Eklund, R.C., 2005. Motivation and burnout among top amateur rugby players. Med. Sci. Sports Exercise 37 (3), 469–477.
Creswell, J.W., Plano Clark, V.L., 2011. Designing and Conducting Mixed Methods Research. Sage Publications, Thousand Oaks, CA.
Daniels, R.D., Kubale, T.L., et al., 2014. Mortality and cancer incidence in a pooled cohort of US firefighters from San Francisco, Chicago, and Philadelphia (1950–2009). Occup. Environ. Med. 71 (6), 388–397.
Dyer, N.G., Hanges, P.J., Hall, R.J., 2005. Applying multilevel confirmatory factor analysis techniques to the study of leadership. Leadership Quart. 16 (1), 149–167.
Fahy, R.F., LeBlanc, P.R., Molis, J.L., 2017. Firefighter fatalities in the United States. National Fire Protection Association, Quincy, MA.
Flin, R., Mearns, K., O'Connor, P., Bryden, R., 2000. Measuring safety climate: identifying the common features. Saf. Sci. 34 (1–3), 177–192.
Fornell, C., Larcker, D.F., 1981. Structural equation models with unobservable variables and measurement error: algebra and statistics. J. Mark. Res. 18 (3), 382–388.
Gonzalez-Roma, V., Peiro, J.M., Tordera, N., 2002. An examination of the antecedents and moderator influences of climate strength. J. Appl. Psychol. 87, 465–473.
Griffin, M.A., Curcuruto, M., 2016. Safety climate in organizations. Ann. Rev. Org. Psychol. Org. Behavior 3, 191–212.
Halbesleben, J.R., 2010. A meta-analysis of work engagement: relationships with burnout, demands, resources, and consequences. In: Work Engagement: A Handbook of Essential Theory and Research. Psychology Press, pp. 102–117.
Hannah, S.T., Jennings, P.L., et al., 2014. Duty orientation: theoretical development and preliminary construct testing. Organ. Behav. Hum. Decis. Process. 123 (2), 220–238.
Haynes, H.J.G., Molis, J.L., 2017. United States Firefighter Injuries—2016. National Fire Protection Association, Quincy, MA.
Haynes, H.J.G., Stein, G.P., 2017. U.S. Fire Department Profile. National Fire Protection Association. Accessed March 26, 2018. https://www.nfpa.org/News-and-Research/Fire-statistics-and-reports/Fire-statistics/The-fire-service/Administration/US-fire-department-profile.
Hu, L.T., Bentler, P.M., 1999. Cutoff criteria for fit indexes in covariance structure analysis: conventional criteria versus new alternatives. Struct. Eq. Model.: Multidisciplinary J. 6 (1), 1–55.
Huang, Y.H., Lee, J., McFadden, A.C., et al., 2016. Beyond safety outcomes: an investigation of the impact of safety climate on job satisfaction, employee engagement and turnover using social exchange theory as the theoretical framework. Appl. Ergon. 55, 248–257.
Huang, Y.H., Zohar, D., et al., 2013a. Development and validation of safety climate scales for remote workers using utility/electric workers as exemplar. Accid. Anal. Prev. 59, 76–86.
Huang, Y.H., Zohar, D., et al., 2013b. Development and validation of safety climate scales for lone workers using truck drivers as exemplar. Transport. Res. Part F: Traffic Psychol. Behavior 17, 5–19.
Katz-Navon, T.A.L., Naveh, E., Stern, Z., 2005. Safety climate in health care organizations: a multidimensional approach. Acad. Manag. J. 48 (6), 1075–1089.
Keiser, N.L., Payne, S.C., 2018. Safety climate measurement: an empirical test of context-specific vs. general assessments. J. Bus. Psychol. 33, 479–494.
Klein, K.J., Conn, A.B., et al., 2001. Is everyone in agreement? An exploration of within-group agreement in employee perceptions of the work environment. J. Appl. Psychol. 86 (1), 3–16.
Krueger, R., Casey, M.A., 2000. Focus groups: A Practical Guide for Applied Research. Thousand Oaks, CA, Sage.
Kuenzi, M., Schminke, M., 2009. Assembling fragments into a lens: a review, critique, and proposed research agenda for the organizational work climate literature. J. Manage. 35, 634–717.
Lee, J., Huang, Y.H., et al., 2019. A systematic review of the safety climate intervention literature: past trends and future directions. J. Occup. Health Psychol. 24 (1), 66–91.
MacCallum, R.C., Browne, M.W., Sugawara, H.M., 1996. Power analysis and determination of sample size for covariance structure modeling. Psychol. Methods 1 (2), 130–149.
Maglio, M., Scott, C., et al., 2016. Situational pressures that influence Firefighters' decision making about personal protective equipment: a qualitative analysis. Am. J. Health Behavior 40 (5), 555–567.
Maslach, C., Jackson, S., 1981. The measurement of experienced burnout. J. Occup. Behaviour 2, 99–113.
Mathieu, J.E., Taylor, S.R., 2006. Clarifying conditions and decision points for mediational type inferences in organizational behavior. J. Org. Behavior 27 (8), 1031–1056.
McCoach, B., Gable, R.K., Madura, J.P., 2013. Instrument Development in the Affective Domain: School and Corporate Applications, third ed. Springer, New York.
Muthén, B.O., 1994. Multilevel covariance structure analysis. Sociol. Methods Res. 22 (3), 376–398.
Muthén, L.K., Muthén, B.O., Madura, J.P., 1998–2017. Mplus User's Guide. Muthén & Muthén, Los Angeles, CA.
Nahrgang, J.D., Morgeson, F.P., et al., 2011. Safety at work: a meta-analytic investigation of the link between job demands, job resources, burnout, engagement, and safety outcomes. J. Appl. Psychol. 96 (1), 71.
National Fallen Firefighters Foundation. Firefighter Life Safety Initiatives. Accessed April 18, 2018. https://www.everyonegoeshome.com/16-initiatives/.
National Fallen Firefighters Foundation. Indianapolis Mini-Summit. Firefighter Life Safety Initiatives Program. Accessed April 18, 2018. https://www.everyonegoeshome.com/wp-content/uploads/sites/2/2014/08/indy.pdf.
National Fallen Firefighters Foundation. Vulnerability Assessment Program. Accessed March 26, 2018. https://www.firevap.org.
The National Fire Protection Association, 2017. Fire department calls. Accessed March 26, 2018. https://www.nfpa.org/News-and-Research/Fire-statistics-and-reports/Fire-statistics/The-fire-service/Fire-department-calls/Fire-department-calls.
Neal, A., Griffin, M.A., 2004. Safety climate and safety at work. In: Frone, M.R., Barling, J. (Eds.), The Psychology of Workplace Safety. American Psychological Association, Washington, DC, pp. 15–34.
Ostroff, C., Kinicki, A.J., Tamkins, M.M., 2003. Organizational Culture and Climate: Part Three. The Work Environment. Wiley, Hoboken, NJ.
Patton, M.Q., 2002. Qualitative Research and Evaluation Methods. Thousand Oaks, CA, Sage.
Poston, W.S., Haddock, C.K., et al., 2011. A national qualitative study of tobacco use among career firefighters and department health personnel. Nicotine Tobacco Res. 14 (6), 734–741.
Raiche, G., 2010. nFactors: an R package for parallel analysis and non graphical solutions to the Cattell scree test. R package version 2.3.3.
Reichers, A.E., Schneider, B., 1990. Climate and culture: an evolution of constructs. In: Schneider, B. (Ed.), Organizational Climate and Culture. Jossey Bass, San Francisco, pp. 5–39.
Revelle, W., 2016. psych: Procedures for Personality and Psychological Research, Northwestern University, Evanston, Illinois, USA, https://CRAN.R-project.org/package=psych Version = 1.6.12.
Schaufeli, W., Salanova, M., et al., 2002. The measurement of engagement and burnout: a two sample confirmatory factor analysis approach. J. Happiness Stud. 3, 71–92.
Schaufeli, W., Bakker, A., 2004. Job demands, job resources, and their relationship with burnout and engagement: a multi-sample study. J. Org. Behavior 25, 293–315.
Schein, E., 2004. Organizational Culture and Leadership, third ed. Jossey-Bass, San Francisco, CA.
Schneider, B., 1975. Organizational climates: an essay. Pers. Psychol. 28, 447–479.
Schneider, B., Ehrhart, M.G., Macey, W.H., 2013. Organizational climate and culture. Annu. Rev. Psychol. 64, 361–388.
Schneider, B., Reichers, A.E., 1983. On the etiology of climates. Pers. Psychol. 36 (1), 19–39.
Sexton, J.B., Helmreich, R.L., et al., 2006. The safety attitudes questionnaire: psychometric properties, benchmarking data, and emerging research. BMC Health Services Res. 6, 44.
Smith, T.D., DeJoy, D.M., 2014. Safety climate, safety behaviors and line-of-duty injuries in the fire service. Int. J. Emergency Services 3 (1), 49–64.
Spector, P.E., 2019. Do not cross me: optimizing the use of cross-sectional designs. J. Bus. Psychol. 34, 125–137.
Swaen, G., Amelsvoort, L.P., et al., 2004. Psychosocial work characteristics as risk factors for being injured in an occupational accident. J. Occup. Environ. Med. 46 (6), 521–527.
Taylor, J.A., Dominici, F., et al., 2012. Do nurse and patient injuries share common antecedents? An analysis of associations with safety climate and working conditions. BMJ Qual. Safety 21, 101–111.
Weick, K.E., 1993. The collapse of sensemaking in organizations: The Mann Gulch disaster. Adm. Sci. Q. 38 (4), 628–652.
Weick, K.E., 1995. Sensemaking in Organizations. Sage Publications, Thousand Oaks, CA.
Zohar, D., 1980. Safety climate in industrial organizations: theoretical and applied implications. J. Appl. Psychol. 65 (1), 96–102.
Zohar, D., 2011. Safety climate: conceptual and measurement issues. In: Handbook of Occupational Health Psychology. JC Quick & LE Tetrick, second ed. American Psychological Association, Washington DC, pp. 141–164.
Zohar, D., Luria, G., 2005. A multilevel model of safety climate: cross-level relationships between organization and group-level climates. J. Appl. Psychol. 90 (4), 616–628.
Zohar, D., 2010. Thirty years of safety climate research: reflections and future directions. Accid. Anal. Prev. 42, 1517–1522.