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Measuring wildland fire leadership: the crewmember perceived leadership scale

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Abstract. The aims of this research were to develop and test a scale used to measure leadership in wildland firefighting using two samples of USA wildland firefighters. The first collection of data occurred in the spring and early summer and consisted of an online survey. The second set of data was collected towards late summer and early fall (autumn). The second set of data was collected via hard-copy surveys that were mailed in by respondents who were recruited via email and in person at large wildland fires. Through confirmatory factor analyses, a three-factor, higher-order, multidimensional structure of leadership in wildland fire was supported. The Crewmember Perceived Leadership Scale consists of perceptions of competent decision-making, personal genuineness and integrity of supervisors as seen by their subordinates. Initial evidence of reliability and validity was supported during the first study of this research. Results from Study 1 indicate that higher rankings of fire leaders by their crewmembers was related to higher worker engagement and job satisfaction. The second study included an additional five items to rate fire leaders; the structure of the three leadership components was again supported. Implications for leadership development in wildland fire, future research and practice are discussed.

Additional keywords: group dynamics, human factors, industrial psychology, organisational psychology, questionnaire, workforce development.

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Introduction

Wildland firefighting occurs in an environment where crew supervisors, managers and other national-level fire personnel must consistently make decisions regarding how fire incident personnel and the general public respond to and interact with a constantly changing environment. Much of the focus for development in the 20th century was on increasing fire personnel's capacity to deal with environmental hazards. Far less time was dedicated to the intra- and interpersonal development aspects of fire personnel. The loss of elite-level firefighters in the South Canyon Fire of 1994 served as a catalyst to propel human factors, leadership research and development into essential aspects of safety, employee growth and a basis for a leadership curriculum in wildland fire (Useem *et al.* 2005). Since South Canyon, many fire personnel and academics alike have searched for understanding, answers and remedies to leading, managing and operating more safely in a dangerously complex environment.

Empirical research since the South Canyon Fire has come from a variety of sources with different emphases, including an initial overall assessment of wildland firefighter human factors issues (Tri-Data Corporation 1996, 1997, 1998); forest social science research in understanding employee voice in the wildland firefighting culture (Lewis *et al.* 2011); understanding mindfulness and self-compassion in wildland firefighting (Lewis and Ebbeck 2014; Waldron and Ebbeck 2015); organisational communication in understanding the implications of the language used in wildland firefighting (Thackaberry 2004; Ziegler and DeGrosky 2008); using high-reliability organisations (Weick and Putnam 2006; Weick and Sutcliffe 2008); and safety climate theory to understand crew communicative interactions (Jahn 2012). Advances in training and strategies have been made that focus on human factors in wildland fire with the inception of the 'L-Courses' or leadership courses officially adopted in 2004 with the publication of the internal agency document *Leading in the Wildland Fire Service* (National Wildland Coordinating Group (NWCG) 2007). Although this document has served as a foundational piece for moving leadership and human development forward in wildland fire in the United States, it is largely a comprehensive review of military literature with little empirical research from the wildland firefighting environment to confirm its usefulness and transferability. Thus, empirical approaches to understanding leadership in wildland firefighting are still in their infancy.

Table 1. Leadership definitions (Lewis 2008)

Leadership quality	Definition
Quality experience	Depth and variety of experience
Self-aware or humble	Knowing one's limitations
Critical thinker	Consistently and actively analysing the details, while keeping the bigger picture in mind
Competent	The ability of leaders to interpret information in the fire environment accurately and make timely decisions based on those abilities
Decisive	Inclusive of the ability to make decisions, but further emphasises the making of a plan, sticking to the plan as much as possible while recognising when to stop and listen and when to decide
Open to input	Open to others' opinions, especially when those opinions are different from one's own, or the individual is lower-ranking
Safety-oriented	Having a specific focus on the safety of subordinates as a key aim when considering plans and strategies
Compassionate or caring	Having a genuine interest in the growth and overall wellbeing of crewmembers
Trustworthy	The faith subordinates have in their leaders' abilities

In an effort to study leadership from the ground level up in wildland fire, Lewis (2008) used a qualitative, grounded theory approach to understand how fire personnel describe good, safe and effective leadership in wildland fire. As seen in Table 1, Lewis (2008) reported nine qualities and behaviours of a wildland fire leader. Although nine distinct qualities (i.e. competent, decisive, open to input, trustworthy, safety-oriented, compassionate, critical thinker, quality experience and self-aware or humble) were identified, their intertwining nature suggest that they support each other like a frame of a house, a sound structure supported by individual parts. As such, some qualities may be interpreted as one factor rather than separate entities and others may be missing. A more complete understanding of the qualities and behaviours is needed, especially with regards to how they form into factors of leadership in wildland firefighting.

The resulting qualities and characteristics that emerged in Lewis (2008) are the impetus for creating a leadership scale to measure wildland fire leadership. There are three primary aims for the present research:

(1) To discuss the fit and ability of other leadership theories to describe and explain the most valued behaviours and qualities in wildland fire;
(2) To create and substantiate the reliability and validity of an assessment tool that captures essential leadership qualities and behaviours that are specific to the wildland fire environment;
(3) To investigate relationships of optimum organisational outcomes with essential wildland fire leadership qualities outlined in this research.

The Institutional Review Board of the first and third authors' university approved the series of studies described in this paper.

Application of leadership theory in wildland firefighting

No one leadership theory captures all nine of the qualities identified by Lewis (2008). However, some theories capture fundamental aspects of what wildland fire personnel had described as good leadership in wildland firefighting. The most fitting theories were those with a modern, benevolent focus, specifically: transformational leadership, servant leadership and authentic leadership.

In select interpretations of transformational leadership, leaders with a base of experience and competence can envision what is needed in an organisation and act on that vision (Bass 1985; Bennis and Nanus 1985; Bass and Avolio 1994; Kouzes and Posner 2002). This helps shape leaders who listen to their subordinates' needs (Bass 1985; Bass and Avolio 1994), encourage trust and portray credibility, (Kouzes and Posner 2002), and focus on self-development (Bennis and Nanus 1985). These qualities are similar to seven of Lewis' (2008) fire leadership qualities (i.e. decisiveness, trust, self-awareness, competence, openness to input, critical thinking and compassion). These qualities encourage the growth and accomplishments of followers that support the overall goals of an organisation (Northouse 2013).

Servant leadership complements and extends transformational leadership by emphasising serving, empowering and developing others through qualities such as authenticity, listening, empathy, awareness and conceptualising an organisation's operational needs (Greenleaf 1970, 1996; Spears 2010; van Dierendonck 2011; Northouse 2013). Servant leaders put others' development above their own self-interests. The components of servant leadership embody firefighter leadership components that stress the qualities related to the leaders' social perceptiveness of the growth and development of their subordinates.

Authentic leadership (Luthans and Avolio 2003) includes many of the same underlying components as transformational and servant leadership, but it discusses them with one additional factor, balanced processing. This refers to the ability of leaders to remain decisive while also taking in the necessary information (Luthans and Avolio 2003; Walumbwa *et al.* 2008). As such, it is inclusive of two often-competing elements that fire personnel have described as being essential in the field. That is, being simultaneously decisive and yet remaining open to input.

These three leadership theories include only seven of the nine essential leadership qualities in wildland firefighting. There are two others that were not adequately addressed: quality experience and safety-orientated. Quality experience is described by wildland fire personnel as having not only many experiences but also a variety of experiences in different places (e.g. fuel types, crews, techniques), and safety-oriented is described as having a clear focus on general safety when making specific decisions and assigning tasks for subordinates (Lewis 2008). Although

quality experience is partially implied in the three theories and in the fire literature (NWCG 2007), no one quality or concept captured the essence of what fire personnel described in terms of the variety and depth needed for quality leadership performance. It also proved to be difficult when looking to the leadership literature for concepts that describe safety-oriented as a key component of leadership. Mullen and Kelloway (2006) did discuss the juxtaposition of transformational leadership and safety-specific transformational leadership as distinct concepts, although later noting that transformational leadership is relevant to improving safety at work (Mullen and Kelloway 2009). So although safety has been shown to be related, its relevance was explored more as a key component of wildland fire leadership due to the particularly dangerous operating environment and the amount of emphasis that is put on safety in the culture; appropriate literature was reviewed for the development and validation of the safety-oriented construct of the wildland fire leadership scale created in Study 1.

It is evident that modern leadership theories build off previous theories, overlap while still maintaining uniqueness, and contribute to the further development and understanding of high-performance leadership. Previous work on leadership in fire has shown that it builds from, overlaps with and yet is still unique relative to other leadership theories and cultures. Thus, the aims of the following studies are to come to a better understanding of how leadership is best understood in the context of wildland fire.

Study 1

When approaching the development of the current wildland fire leadership scale, it was important to consider what the qualities would look like when enacted in the firefighting community – specifically during fire operations. As such, the descriptions of wildland fire-specific leadership qualities that were depicted in Lewis (2008) were used as the basis of this leadership scale (Table 1). The scale is taken from crewmembers' perspectives, as it is they who experience the leadership of supervisors.

Quality experience was seen in Lewis (2008) to be a critical element for enhancing and developing many of the other following leadership components. The depth of leader experience noted earlier refers to the years and time spent on the fireline. Depth, in combination with the variety of experience of a leader – includes having had experience fighting fire in different fuel types, different geographic areas, on different crews or modules, and other factors that speak of the ability to understand fire activity and resources from different perspectives – conveys the complete aspect of experience described in Lewis (2008). Although this was seen as an important quality, the ability of others to know and assess a leader's entire experience may not have been known; as such, it was omitted from the current scale. That said, clearly a leader's experience is indirectly captured through the multidimensional measure that was created. Namely, from experience, a *self-aware* or *humble* leader is one who knows her or his limitations and is not overconfident. Knowing oneself is connected to being a *critical thinker*, or a leader who is consistently, actively, analysing and looking at the details of the self, others and the environment while keeping the bigger picture in mind. The ability of leaders to interpret information in the fire environment accurately and make timely decisions based on that information was referred to by fire personnel as *competent*, relatedly, *decisive* is inclusive of the ability to make decisions, but further emphasises the making of a plan, sticking with the plan as much as possible, while also recognising when to stop and listen and when to decide. The ability of a leader to stop and listen is the quality known as *open to input*, which is created through a leader's ability to craft an environment where subordinates feel comfortable voicing their concerns to the leader. The creation of this environment is heavily influenced by two additional factors: *safety-oriented* – which was described earlier as having a specific focus on safety of subordinates; this quality appeared to emerge from the other quality supporting open to input – *compassionate* or *caring* – which describes fire leaders who have a genuine interest in the growth and overall wellbeing of crewmembers. Finally, firefighters described the last component, *trustworthy*, as a leader whose abilities crewmembers have faith in and will follow. Firefighters would often describe trustworthy as being an outcome of many of the previously listed qualities. It was from these items that the Crewmember Perceived Leadership Scale (CPLS) was developed.

Item development and validation

The original measurement was constructed by identifying keywords and phrases from Lewis (2008) that were used to describe the essential qualities of wildland fire leadership. Seven essential qualities of leadership are each represented by five to six items – 42 items total. In the development of one subscale, *safety-oriented*, very little usable description was offered by fire personnel; thus, a safety survey from the National Institutes of Health was identified and used for this subscale. Once a list of five to six items was made for each subscale, the individual subscales were made available to a 10-person panel composed of graduate students and faculty members at a university in the north-west region of the United States. The panel also reviewed definitions of what constructs or essential leadership qualities the items were meant to depict in each subscale. Based on the panel's responses, the measure was further refined.

Prior to the measurement's delivery, face validity was first demonstrated by using language that fire personnel had offered in Lewis (2008). Next, face validity was assessed through the first author's experience as a wildland firefighter of 8 years and knowledge of the language and nuances of firefighting. Finally, two subject matter experts who had been involved in firefighting with various government agencies for over 20 years were given the measurement to assess its accuracy and overall depiction of leadership in wildland firefighting. Beyond the theme saturation (Creswell 2003) that was captured in Lewis (2008), the chance to further assess content validity was done by giving participants two empty slots to describe missing leadership qualities that were not listed in the original measurement.

In order to assess the criterion validity, two established, validated scales were used to reference outcomes that would be hoped for in wildland firefighting, especially while working under a high-performing leader (i.e. job satisfaction and work engagement). Wildland firefighting often takes place in two

extremes of an environment. The first is in rugged, steep, hot terrain surrounded by smoke for consecutive hours and days. The second is after a fire is almost out (e.g. during a mop-up phase of a fire) when fire personnel are asked to complete very monotonous tasks for consecutive hours and days. Considering the challenging environments to operate in, leaders who are able to contribute and mould a setting where employees are both engaged and are satisfied with their jobs are helping to fulfil critical functions of a safe and effective crew.

The specific aims of Study 1 were to:

(1) assess the reliability and validity of the CPLS;
(2) assess the relationships among the CPLS, job satisfaction and work engagement.

Although it is not expected or desired that work engagement and job satisfaction align perfectly, it is hypothesised that a positive relationship will exist among the CPLS and both work engagement and job satisfaction.

Methods

Participants and procedures

Participants were invited to complete an online questionnaire that took ~10 min; of those who started the survey (305), 81% completed it (248). Participants included current and former wildland firefighters (215 men, 33 women) in a criterion sample (Patton 2002). Participants were recruited through fire-related classes at two large north-west universities and through government agency listservs (electronic mailing list applications). Participants were free to skip questions that they felt uncomfortable answering.

Measures

Crewmember Perceived Leadership Scale items (*CPLS*). Participants were presented with the 42 wildland fire leadership items that had been previously created. *Safety-oriented* and *trust* each included six items, with the other components (i.e. decisive, self-aware or humble, critical thinker, competent, open to input, compassionate or caring) including five items each. Participants were asked to rate items of wildland fire leadership with their best fire leader in mind in terms of how often they exhibited the qualities listed on a five-point Likert scale (1 = never to 5 = always).

Utrecht Workplace Engagement Scale (UWES; Schaufeli and Bakker 2003). This is a 17-item scale used to measure three components of work engagement: vigour, dedication and absorption. Answers are reported on a seven-point Likert scale (0 = never to 6 = always, every day) to prompt how often an individual feels this way at work in response to each item. Internal consistencies have ranged from 0.81 to 0.95 in previous studies (Schaufeli and Bakker 2003).

Abridged Job Index General Scale (AJIG; Russell *et al.* 2004). The AJIG measures job satisfaction. The AJIG is an eight-item general scale with responses recorded as 'Y' for yes, 'N' for no, or '?' for unsure in response to a prompt to think about one's job in general and how it is most of the time. Russell *et al.* (2004) reported good internal consistencies of 0.87 and a high correlation to the full job in general scale (i.e. $r = 0.97$).

Statistical analysis

The data were determined to not be normally distributed on the basis of the Shapiro–Wilk test of normality; thus, adjustments were made to the statistical analyses. Parallel analysis (Horn 1965) was then used to determine the optimal number of factors for the CPLS. The authors chose parallel analysis because of its ability to give accurate results with non-normally distributed data (Dinno 2009). Responses to the CPLS were analysed using exploratory factor analysis (EFA) using maximum likelihood estimation with a varimax rotation. Items with loadings lower than 0.40 were omitted from the final version. The final version was then analysed using confirmatory factor analysis (CFA) to assess the goodness of fit of the model to the data. The statistical tests used were the comparative fit index (CFI), the Tucker–Lewis index (TLI), the root mean square error of approximation (RMSEA) and the standardised root mean square residual (SRMR). The CFA utilised maximum likelihood estimation with robust standard errors and a Satorra–Bentler scaled test statistic to correct for the non-normally distributed data (Curran *et al.* 1996).

In addition, the CPLS factors were tested for adequate reliability and validity. Internal consistency was tested using Cronbach's α. Construct validity was tested using Spearman's rank correlations between the CPLS factors, the AJIG and the UWES.

Results

For the CPLS, 19 of the original 42 items met the loading criteria (see Table 2). The CFA confirmed the three-factor structure; the model fitted the data adequately well (CFI = 0.96; TLI = 0.95; RMSEA = 0.05; SRMR = 0.04). The three factors were labelled and defined by the items found in each one. The first, *competent decision-making*, is defined as being able to use knowledge gained in meaningful ways to form effective strategies in a timely fashion. The next factor, *personally genuine*, characterises a leader who is down-to-earth, open to suggestions, really cares about crewmembers and has an unassuming confidence. The third factor, *integrity*, is defined as the quality of a leader who is consistently reliable in relaying information to the crew, and is found trustworthy by doing what he or she says he or she will do.

Each factor had high internal consistency values (i.e. Competent decision-making: $\alpha = 0.93$; Personally genuine: $\alpha = 0.94$; Integrity: $\alpha = 0.92$). As shown in Table 3, both the AJIG and UWES showed moderately strong positive correlations with all three CPLS factors (AJIG: $\rho = 0.44$–0.50, UWES: $\rho = 0.57$–0.60).

In addition to the items measured in the CPLS, there were 173 open-ended comments provided by the participants. These were qualities they felt were not necessarily captured by the 42 items listed. On the basis of a content analysis review, it was found that participants were primarily using different language to convey similar concepts (particularly under personally genuine) to what was already being captured by the CPLS (e.g. honesty was a specific descriptor used by survey respondents that aligned with how integrity was described). As such, five potentially unique items were added to the scale (see Table 4).

Table 2. Items and factor loadings for Crewmember Perceived Leadership Scale (Study 1)

Item	Loading	Mean (s.d.)
Personally genuine (25.3% variance explained)		
Asks for suggestions from subordinates	0.807	3.87 (1.08)
Consults with subordinates	0.790	4.05 (0.99)
Listens receptively to subordinates' ideas and suggestions	0.773	4.12 (0.99)
Tries to understand rather than judge	0.715	4.66 (0.60)
Listens to concerns	0.631	4.19 (0.97)
Is concerned about my overall wellbeing	0.568	4.45 (0.82)
Understand the strengths of each of my crewmembers	0.553	4.43 (0.80)
Competent decision-making (18.2% variance explained)		
Is able to use information about a fire to form effective strategies	0.777	4.43 (0.73)
Takes quick, sound action during fire operations	0.733	4.64 (0.74)
Pays attention to the details, while keeping the big picture in mind	0.726	4.57 (0.75)
Is able to use knowledge gained through experience in meaningful ways	0.704	4.64 (0.57)
Considers facts and alternatives, but makes timely decisions	0.668	4.33 (0.87)
Effectively demonstrates the skills of his or her job	0.647	4.61 (0.77)
Possesses the ability to be decisive	0.609	4.56 (0.82)
Integrity (11.1% variance explained)		
Is reliable in communicating the crew's role in fire strategies	0.734	4.38 (1.01)
Keeps his or her word	0.697	4.58 (0.83)
Does not make his or her crewmembers' jobs more difficult by poor supervising	0.683	4.55 (0.85)
Knows himself or herself well enough to turn down assignments that are beyond his or her abilities to perform	0.602	4.69 (0.54)
Shows visible support for safety through words and actions	0.597	4.49 (0.69)

Table 3. Spearman's rank correlation coefficient (ρ) between Crewmember Perceived Leadership scale and work measures (Study 1)
*, $P < 0.01$

Crewmember Perceived Leadership Scale variable	Abridged Job Descriptive Index	Utrecht Work Engagement scale
Competent decision-making	0.48*	0.57*
Personally genuine	0.44*	0.60*
Integrity	0.50*	0.59*

Table 4. Items added to the Crewmember Perceived Leadership Scale (Study 2)

Item	Construct
Acts in the best interest of the crew rather than being driven by his or her ego	Personally genuine
Is honest in his or her dealings with the crew	Integrity
Cares about crewmembers' growth as people and as firefighters	Personally genuine
Is compassionate when necessary	Personally genuine
Is humble in his or her dealings with others	Personally genuine

Discussion

The results from the present study demonstrate that the nine conceptualised aspects of wildland fire leadership converge into three independent factors of perceived wildland fire leadership. Although nine distinct components were identified through qualitative analysis, the quantitative analysis revealed that these were better expressed as three higher-order constructs. Considering the dangerous environment of wildland fire, it was thought that *safety-oriented* would be its own construct; however, it was not a major factor. From these findings, it could be surmised that safety is an outcome or end goal of good leadership as suggested in Useem *et al.* (2005) rather than a leadership quality.

In addition, five potentially missing items – not necessarily constructs – emerged from the qualitative responses provided by a subsample of participants. To refine the scale further and to provide a potentially more accurate depiction of wildland fire leadership from the crewmembers' perspective, the researchers created five new items that might serve to further establish the scale's ecological validity and general utility (Table 4).

The correlations among crew perceptions of their leaders with the UWES demonstrate moderate support that wildland fire leadership is positively correlated with the three components of work engagement (i.e. vigour, dedication and absorption). Firefighters who had rated their best supervisors highly on the leadership aspects of *competent decision-making*, *personally genuine* and *integrity* reported that they themselves had more vigour and dedication, and were more absorbed in their work as firefighters while working under these supervisors. Regarding the distribution of the data and correlations with other scales, the likely reason for the non-normal distribution of data was the combination of rating positively valanced items with participants' best supervisors.

These results also indicate that the crewmembers' perceptions of their best supervisors' leadership were moderately correlated with job satisfaction. Firefighters who had rated their best leaders high on the three aspects of wildland fire leadership reported that they themselves were more satisfied with their jobs while working under these supervisors.

Overall, the positive correlations among work engagement and job satisfaction with the three aspects of the CPLS – competent decision-making, personal genuineness and integrity – support the hypothesised ideal supervisor in wildland fire. Such outcomes could easily be associated with leadership. Through extensive review of literature, Northouse (2013) defined leadership as 'a process whereby an individual influences a group of individuals to achieve a common goal'. With this definition in mind, the supervisors rated by these fire personnel embody the influence described to achieve goals of the organisation, and therefore further support that the scale developed for this research measures desirable leadership in wildland firefighting. However, this requires verification and potentially clarification, which was the aim of Study 2.

Study 2

With the addition of five items, and a desire to further refine the CPLS, a second study was devised and completed. The aim of Study 2 was to confirm the leadership structure with the additional five items before correlating the CPLS with other scales or constructs that would further confirm the validity and reliability of the slightly revised CPLS. In addition, Study 2 tested the CPLS near the end of the regular wildland fire season in the western region of the United States. This is an optimum time to gauge leadership effectiveness in the wildland firefighting setting because firefighters are most engaged with their supervisors. This timing also allowed participants the available time and space to get to know their supervisors through the majority of a wildland fire season while also keeping a proximal distance to when they worked with supervisors so that they could more accurately rate them on leadership qualities. Thus, the timing allowed the participants to more accurately recall qualities and abilities and further assess the reliability of the CPLS when given at a different time under different circumstances than in Study 1. Furthermore, adding more items and scales to the study may have discouraged respondents from completing the survey owing to its length and the time required to complete the survey during the busiest part of the fire season.

Methods

Participants and procedures

Participants included 281 wildland firefighters (236 men, 45 women) who were working as firefighters at the time of the study. The high percentage of men (i.e. 84%) is similar to what has been observed in other studies of wildland fire personnel (Lewis *et al.* 2011; Jahn 2012), which is also reflective of workforce demographics. In total, 842 surveys were sent to crewmembers; it was suspected that owing to a heavy fire season, not all crewmembers would be able to complete the surveys, which is why such a high number of individuals were surveyed, while still allowing the researchers to fill the necessary quota for conducting a CFA (Brown 2006); the response rate was 33%. Participants were recruited via two methods. The first was through an email sent out through national and regional government listservs asking interested crew supervisors (crews in this context consist of modules, engines, handcrews and other units who consist of two or more individuals working together for fire-related activities) to contact the researchers vie email or phone and provide their mailing address and number of individuals on the crew. The second method was constructed and implemented owing to a heavy fire season. The lead author visited three large wildland fire camps in the north-west region of the United States during the last third of the fire season. The author explained the intent of the research during the morning briefings to an array of fire personnel. Interested crew supervisors provided the researcher with the same information as the crew supervisors in the first method.

When all the necessary information was collected from crew supervisors, a packet was put together for each crew, which included enough surveys for each crewmember as well as a self-returning envelope for each survey. If surveys were not received within 3 weeks, the researcher sent out a reminder email to crew supervisors. The surveys required ~10 min for crewmembers to complete.

Measures

Crewmember Perceived Leadership Scale. Participants were presented with 24 wildland fire leadership items (i.e. the original 19 items from Study 1, plus the 5 new items generated through the content analysis) representing *competent decision-making*, *personally genuine* and *integrity*. The subscales recorded how often crewmembers perceived their current supervisor enacting fire-related qualities on a five-point Likert scale (1 = never to 5 = always).

Statistical analysis

Confirmatory factor analysis was used to analyse the CPLS, which is an appropriate test to measure an *a priori* structure (i.e. the additional five items generated through content analysis; Hurley *et al.* 1997). Similar to Study 1, the data were not normally distributed on the basis of the Shapiro–Wilk test of normality. Therefore, CFA was once again used using maximum likelihood estimation with robust standard errors and a Satorra–Bentler scaled test statistic (Curran *et al.* 1996). Internal consistency was also tested for the three CPLS factors.

Results

Just like Study 1, the CFA model fitted the data sufficiently well (CFI = 0.95; TLI = 0.95; RMSEA = 0.03; SRMR = 0.06). In addition, each factor had an acceptable internal consistency (Competent decision-making: $\alpha = 0.92$; Personally genuine: $\alpha = 0.87$; Integrity: $\alpha = 0.79$).

Discussion

The results of Study 2 reconfirmed the factor structure of the CPLS with the additional five items (Table 4). The results also indicate that the CPLS has good test–retest reliability as a three-factor structure (from Study 1 to Study 2) even with the added items. The results further demonstrate the flexibility of administering the CPLS in different formats, times and places.

General discussion

This research sought to test the validity and reliability of the CPLS for the benefit of and use in the wildland firefighter

setting. The results from both studies indicate initial evidence to support that the CPLS is a psychometrically sound measure of wildland fire leadership. The results also indicate that scoring a fire supervisor highly on the leadership qualities listed in the CPLS was linked to the crewmembers of those supervisors feeling more engaged in their work and feeling more satisfied with their jobs as firefighters. Considering the paucity of academic research that has been conducted on leadership in the wildland fire setting, it is hoped that the development of the CPLS will encourage more research of this nature, and specifically exploring the relationship of wildland fire leadership with other important processes that result in optimally successful and safe wildland fire environments. Towards this end, many different research directions could be pursued. For instance, many of the nine aspects that make up the three components of the CPLS are similar in many ways to modern leadership theories such as transformational leadership (Bass 1985), authentic leadership (Luthans and Avolio 2003) and servant leadership (Greenleaf 1996). Future research could explore direct ties and relationships to specific leadership theories. The findings of such research could inform future training and development of firefighters.

Next, the prominent maxims of USA wildland firefighting – duty, respect and integrity (NWCG 2007) – are found heavily in the wildland fire literature including *Leading in the wildland Fire Service* (NWCG 2007), various qualification training materials and the *Incident Review Pocket Guide* (NWCG 2006). Understanding that these three maxims are important pieces of wildland fire leadership, the authors investigated and compared these documents and the language and principles used to describe them with this research. Although there were specific items on the scale that were similarly worded to principles described in duty, respect and integrity, there were also several more descriptions and depth of qualities described by fire personnel that exceeded the scope of what has been outlined in duty, respect and integrity. As such, pieces of the three maxims are apparent in the qualities of this research, but they do not encompass the dimensionality that was revealed through this research. Given that, one future recommendation is to refine the meaning of the wildland fire leadership maxims of duty, respect and integrity for clarity and depth to more accurately describe leadership in wildland fire.

Beyond leadership, it is important to consider what processes, education and training could encourage the qualities outlined in the present research. Lewis (2013), Lewis and Ebbeck (2014) and Waldron and Ebbeck (2015) have begun examining mindfulness and self-compassion as processes to increase leadership and performance in the wildland fire setting. Ziegler and DeGrosky (2008) have also examined leadership from the standpoint of how the USA wildland firefighting culture has interpreted the term ‘leader’s intent’. Understanding these processes and having a good understanding of the cultural meaning and implications through education will be critical for maximising the successful use of this newly developed measurement tool.

Although we have presented a sequence of studies in this manuscript, we also remind readers of several study limitations. First, the samples employed were criterion sampling (Patton 2001) of current and former USA firefighters recruited through university classes and federal listservs. Therefore, additional studies with distinct and unique samples from other areas and countries are warranted. Second, the data were fully self-reported. Self-reported data are limited, in part, by item interpretation. On the basis of the multiple qualitative responses shared in Study 1, there may have been some misunderstanding of items. Third, understanding and responding to leadership may also be a function of crewmembers’ experiences and there are most certainly individual preferences. Potential moderators such as these were not considered in this study, but they may be functionally important to consider in future work. Fourth, test–retest reliability and future testing with the workplace measures will further determine the reliability and validity of the CPLS for this population, as the development and slight revision of this scale for Study 2 in this research set a foundation for more research. Finally, the constructs *personally genuine* and *integrity* are conceptually similar, and thus may be interpreted by some as one construct. Future research utilising the CPLS will help reaffirm the uniqueness of the constructs.

Conclusion

It is evident through these two studies and the preceding literature review that the CPLS has sound properties and is relevant to wildland firefighting. It also shares similarities with constructs from leadership theories and is associated with outcomes that would be hoped for from good leadership. This research also fills a gap in research on leadership in wildland firefighting and provides a specific way to measure qualities and behaviours of supervisors within this context.

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