What information do people use, trust, and find useful during a disaster? Evidence from five large wildfires

Toddi A. Steelman · Sarah M. McCaffrey · Anne-Lise Knox Velez · Jason Alexander Briefel

Abstract The communication system through which information flows during a disaster can be conceived of as a set of relationships among sources and recipients who are concerned about key information characteristics. The recipient perspective is often neglected within this system. In this article, we explore recipient perspectives related to what information was used, useful, and trustworthy in a wildfire context. Using a survey ($n = 873$) on five large wildfires in 2009 and 2010, we found significant gaps between the sources that were used by the most respondents and those that that they rated as useful or trustworthy. The sources that were used most before the fires were highly correlated with the sources that were used most during the fire.

1 Introduction

Information is an essential resource during a disaster. Without information, responders cannot effectively manage a disaster, and those affected by the disaster cannot best adapt to

T. A. Steelman (✉)
School of Environment and Sustainability, University of Saskatchewan, 329 Kirk Hall,
117 Science Place, Saskatoon, SK S7H 2J5, Canada
e-mail: Toddi.Steelman@usask.ca

S. M. McCaffrey
Northern Research Station USDA Forest Service, 1033 University Place, #360, Evanston,
IL 60626, USA
e-mail: smccaffrey@fs.fed.us

A.-L. K. Velez
Department of Public Administration, School of Public and International Affairs,
North Carolina State University, Campus Box 8102, Raleigh, NC 27695, USA
e-mail: aknox2@ncsu.edu

J. A. Briefel
Washington, DC, USA
e-mail: Jason.Briefel@gmail.com

the threats they face (Auf der Heide 1989; Kapucu 2006). The communication system through which information flows during a disaster can be conceived of as a set of relationships among senders, messages, and receivers (Fessenden-Raden et al. 1987; Renn 1991). This conceptual framework is helpful to understand how information is conveyed during a disaster, or any situation in which risk-based information is communicated, and dates back to communication studies in the 1940s (Lasswell 1948). Gauging public information preferences is a key aspect in fostering learning within the risk communication system; however, this aspect is often underexplored (McCallum et al. 1991; Wray et al. 2004; Palttala et al. 2012). While much literature exists on message construction for effective risk and crisis communication before and during disasters (Reynolds and Seeger 2005; Steelman and McCaffrey 2013; Witte and Allen 2000) and about factors that make members of the public most likely to respond to a warning during a disaster (Mileti et al. 2006), until recently, much less attention has been paid to the information sources recipients actually turn to during an event and which ones they see as useful and trustworthy. This is important because if a source is found to be effective in motivating proactive public response but is little used by the public, its effectiveness is in reality limited. In this article, we seek to understand what kinds of information sources people who were affected by a wildfire used, trusted, and found useful to better inform more effective communication during a disaster. In doing so, we provide a snapshot of behaviors and perspectives prevalent in the surveyed areas of the American West at the time of our research in 2009 and 2010.

This article proceeds in the following sections. First, we cover the literature related to understanding communication systems and the salience of exploring receiver experience. Second, we investigate the literature to understand what we already know about receiver perspectives related to what is used, trusted, and useful in crisis situations, and derive from this literature several hypotheses to test. Third, we address methods and the research context, which in this case is five large wildfires. We then turn to findings, implications, and conclusions in the fourth and fifth sections.

2 Communication systems: senders, receivers, transmitters, feedback loops

Early risk analysis research and practice stressed the linear, unidirectional model of communication (Kasperson and Stallen 1991; Fischhoff 1995). This technocratic model was challenged in the late 1980s to more fully encompass the social and political contexts in which risk communication was embedded (Plough and Krimsky 1987). Lasswell (1948) initially conceived of a "system" of communication to understand information transfer, and this model was later extended to understand environmental crisis situations (Fessenden-Raden et al. 1987; Renn 1991). Fessenden-Raden et al. (1987) initially characterized risk communication as an interactive process between sender, receiver, and message. The social amplification of risk model encouraged thinking about risk communication processes as a more extensive system of relationships (Kasperson et al. 1988; Renn 1991). In this model, information sources were conceived of as official agents who deliver information to the transmitters, primarily the media, who then directed that information to the receivers, including the general and affected publics. Feedback loops from the receivers to the sources can provide insight into the usefulness, timeliness, and value of the information agencies provide during the disaster. Such feedback is critical because what may be meaningful information to those delivering information may not necessarily be meaningful to those who are in danger or looking to receive information about the disaster (Quarantelli

1988). This concept of a feedback loop from the senders to the receivers has been a key theoretical contribution to the reciprocal and ideally interactive nature of risk communication and management (Renn 1991). However, in practice, the ideal of connecting this loop has fallen short (McCallum et al. 1991; Wray et al. 2004). While conceiving of the relationship as a more interactive and dynamic process was important conceptually, research has tended to focus on the perspectives of the sender, including their view of receiver information source preferences (Palttala et al. 2012), while only a handful of studies have actually examined preferences from the receiver perspective. More recently, as the rise of peer-to-peer communications and use of social media (American Red Cross 2011) has further reinforced the interactive nature of information dissemination (Palen and Liu 2007; Sutton et al. 2008; Crowe 2011; Adam et al. 2012), there has been increased attention paid to the receiver's perspective due to interest in the importance of social media as an information source during a disaster (Burger et al. 2013; Sutton et al. 2008).

A key element that may shape receiver response to an information source is how useful or trustworthy that source is seen to be. Risk communication, as an essential part of risk management, is believed to hinge on the importance of trust (Renn and Levine 1991; Kasperson and Stallen 1991). Slovic (1987, 1993) was one of the first researchers to explore the relationship of trust and risk perception, and the work of Slovic and others pointed the way to understanding that trust of managers was related to public concern over how situations involving risk were managed. Consequently, trust has a key role in risk communication and risk management. The receiver must have confidence not only in the content of the message itself, but also in the source. The credibility of the source can have a valence effect on how users of information view and respond to messages about environmental risks. Key characteristics related to information delivered during a crisis event include crafting honest, trustworthy messages, and leveraging credible sources (Reynolds and Seeger 2005; Seeger 2006; Sellnow et al. 2009).

Adapting the traditional source–receiver model and working in the field of knowledge transfer in international business management, Perez-Nordtvedt et al. (2008) conceptualized important aspects of the knowledge transfer relationship as including source, recipient, and information characteristics. This modified typology is helpful for understanding the key attributes associated with communication during a disaster. The basic structure of the communication process is that sources pass information to recipients who want specific types of information that ideally satisfies specific desirable characteristics. Our project was structured around providing a greater understanding from the recipients' perspective of what sources of information satisfied desirable characteristics, specifically which sources were reported as most used, and rated by respondents as useful, and as trustworthy.

3 What information does the public use, and find useful and trustworthy?

A substantial body of work has developed around public response to warnings (see Mileti et al. 2006). While this work tends to focus on a more narrow aspect of communication during a disaster—generally related to characteristics of effective evacuation warnings—there are nevertheless insights to be gained from this research. In terms of more general recipient perspectives of communication during a disaster, there is a much smaller body of work. The types of information recipients used, found useful, and trusted are typically not explored comprehensively in one study, but rather, findings must be pieced together from portions of various studies that span an array of threats including terrorist threats (Wray et al. 2004, 2006), health crises (Lowrey et al. 2007; Holmes et al. 2009), various natural

hazards (Perez-Lugo 2004; Burnside et al. 2007; Cretikos et al. 2008; Burns et al. 2010; Burger et al. 2013; Ryan 2013), water quality crises (Fessenden-Raden et al. 1987; Rundblad et al. 2010), and chemical facility risks (McCallum et al. 1991; Peters et al. 1997; Jungermann et al. 1996). The findings for what information sources are most used, useful, and trustworthy across these literatures are quite varied given the diverse contexts, thus making general inferences difficult. In the literature review below, we consolidate what is known to try to better understand how our research triangulates with this existing work. Several tentative hypotheses about information use during a disaster are offered to advance our collective knowledge in this field.

3.1 Mass media

Mass media is often found to be a highly used information source in hypothetical and actual disaster situations (e.g., Becker 2004; Burger et al. 2013; Lindell et al. 2005; Cretikos et al. 2008; Heath et al. 2009; Holmes et al. 2009). In an assessment of where people obtained safety information in the lead up to Superstorm Sandy, television and radio were the two sources that were most frequently mentioned by interviewees. However, once the storm hit and electricity was lost, often for extended periods, information choices became more limited and individuals relied most on portable and car radios and friends (Burger et al. 2013). In a summary of theories and findings related to environmental risk communication, Wray et al. (2004) found that 1990s polling data indicated that radio and television were the primary information sources for people in crisis. The same polls indicated that people leveraged a variety of sources to confirm information they were hearing (Wray et al. 2004). Specific to fire, Cohen et al.'s (2007) study after a bushfire found that participants saw mass media as part of a larger overall information searching effort; how useful it was depended on the timeliness of the information, and how well local concerns were taken into account.

While mass media use is high relative to other sources, various studies related to disaster contexts and the media reveal differential use and trust among the primary sources—television, newspapers, and radio. Several studies have found that the perceived tendency of television media to sensationalize stories rather than providing specific local emergency information reduced its usefulness and trustworthiness as an information source. Radio was found to be both useful and trustworthy as an information source when local stations remained operational during hazard events (e.g., Becker 2004; Taylor et al. 2007; Cretikos et al. 2008). Rundblad et al. (2010) investigated compliance with public health advice during a flooding disaster that affected drinking water and found the public preferred the use of the local radio throughout the incident. Perez-Lugo (2004) found that during a hurricane in Puerto Rico, radio was the only mass media form available and that it served multiple purposes: it provided emotional support and was seen as both an important source of information and interactive as individuals would call in with their local conditions.

As the disaster wears on, newspapers may become more dominant due to their ability to provide more in-depth analytic coverage, sometimes adding special open pages and special issues related to effects in the community (Quarantelli 2002).[1] Quarantelli (2002) found

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[1] While newspapers are increasingly less popular as a source of information among the mass public, at the time the research was carried out, newspapers were still in circulation and used as information sources during our wildfire events. Consequently, we continue to use newspapers as an important source of information in this work.

that newspapers play a more complex gatekeeper role during disasters than radio or television due to a less pronounced need for immediacy in coverage. During disasters, both radio and television increased the amount of live coverage, and so, there was less filtering than usual. Because of the more in-depth coverage and more complex gatekeeper role, newspapers may be seen as more trustworthy than other media sources.

These collective findings about trends in mass media provide us with two tentative hypotheses for testing:

H1 Television and radio will be used more than newspapers.
H2 Newspapers and radio are more trusted during a disaster than television.

3.2 Family, friends, and neighbors

Family, friends, and neighbors are frequently cited information sources in both real and potential disasters, but their usefulness as an information source varies (Burnside et al. 2007; Cretikos et al. 2008; Sutton et al. 2008; Burns et al. 2010). Rundblad et al. (2010) found that family, friends, and neighbors were used early during a flood, but not as often later in the incident. While not specifically referencing family and friends, Ryan (2013) found that word of mouth was a key information source in flood disasters, particularly as a source of locally relevant information. Sutton et al.'s (2008) study of communication during a 2007 wildfire found peer-to-peer or informal information sources were used among community members to gather and share information that official sources and mass media were at times unable to provide. Burkhart (1991) found that social network membership and official information sources played a more important confirmatory role than mass media. Numerous other studies in the warning literature have found that social network membership is associated with the recipient being more likely to respond to the warning (see Mileti et al. 2006). These findings suggest that such informal information channels are important information sources during a disaster, particularly in terms of confirmation. However, there is limited empirical evidence related to their relative importance compared to other sources or how useful or trusted they are. Burger et al. (2013) found that while friends were the third most commonly mentioned information source for Superstorm Sandy (roughly one-third of interviewees mentioned friends as an information source on safety concerns), less than five percent indicated they were a trusted source. Lindell et al. (2005) found that although peers were relied on less for hurricane information than local and national news and local authorities, information from peers and local authorities had higher correlation with evacuation than information from news sources.

Working from these findings, we derived two hypotheses for testing:

H3$_a$ Family and friends are used less than mass media.
H3$_b$ Family and friends are an important information source.
H4 Family and friends are a more trusted information source than mass media.

3.3 Official sources

Both official and unofficial sources have been found to be important in disaster communication (Fitzpatrick and Mileti 1994). Official information sources are generally characterized as governmental. McCallum et al. (1991) assert that the public typically do not analyze risk information themselves and therefore rely on others to process the information for them. Hence, credibility of sources becomes an important filtering criterion for the public when evaluating risk-based information. A frequent finding from research on

warnings (see Mileti et al. 2006) is that people are more likely to believe or respond to warning messages that come from official sources, suggesting that these are seen as a credible, useful, or trustworthy information source. Within the context of wildfire, Taylor et al.'s (2007) study on communication and information sources used and deemed useful by California residents before and during two 2003 wildfires found that members of the public used multiple sources of information, both official and unofficial. However, they also found that because information provided by mass media was generally seen to be inaccurate and sensational, many residents expected government agencies to fill the need for accurate information. In a more recent study by Burns et al. (2010), the Queensland Police Service in Australia effectively utilized social media to disseminate crisis information to the public during a severe flooding event.

In a study of survey data on environmental risks, Peters et al. (1997: 53) found that the "determinants of trust and credibility were not monolithically invariant across organizations and institutions." Different groups of people have different expectations for what contributes to greater trust and credibility from those giving information. Concrete experiences with individual government agencies tend to be viewed positively by citizens (Goodsell 1994). Consequently, it may be that increased opportunity for practical interaction with local government officials translates into greater trust for government personnel during a disaster. Conversely, the general public tends to know very little about most federal government agencies and responses about trust in these agencies may be affected by a valence of distrust in government in general (Citrin 1993). The trust people have in local political institutions and officials is associated with the level of trust they place in the information delivered by those individuals (Fessenden-Raden et al. 1987). In situations where individuals harbored dislike toward federal officials and institutions, this halo extended toward distrust of information by those federal entities. These dynamics have also been reflected in survey work conducted by Jungermann et al. (1996). Investigating members of the German public who lived near a chemical manufacturing facility about technical risks, Jungermann et al. (1996) found that honesty and competence of the sources were the major factors related to trustworthiness of information. National political and administrative sources were not seen as honest or competent. Institutions like local law enforcement, local fire protection, and local emergency management had higher competency and trust scores compared to national political and administrative sources (Jungermann et al. 1996). Wray et al. (2006) found similar results in a study of focus groups on terrorist threats. Local officials and first responders, such as local fire departments, law enforcement, and health services instilled greater trust than some federal officials when it came to preparedness activities (Wray et al. 2006).

Collectively, the literature suggests the following hypotheses:

H5$_a$ Official and unofficial sources of information are used equally during a disaster.
H5$_b$ Greater value is placed on information from official sources.
H6   Local government sources are more trusted than federal government sources.

Finally, while little is written in the literature specific to which sources are seen as most useful and trustworthy, there is some indication that those sources that are most useful are not used in proportion to their perceived usefulness. For example, in their six community study of environmental health risks, McCallum et al. (1991) found that the federal government was seen by 36 % of respondents as being very knowledgeable about the risks, but only 4 % of those surveyed used it as a source of information. This same pattern held for state and local government. Nearly 30 % of those surveyed found state government very

knowledgeable, and 22 % found local government very knowledgeable, but only 6 % used state government and 5 % used local government (McCallum et al. 1991: 358). More recently, Lindell et al. (2005) found that the use of a source was not the same as its impact, while local news was relied on most as an information source during hurricanes, information from local authorities and peers was more influential in determining evacuation decisions, and the closer to the risk someone was the more likely they were to rely on local authorities for information. Understanding the degree to which sources are used and perceived useful can help direct future efforts to inform the public. If those sources that are perceived as most useful are used disproportionately less, then that suggests that those managing disasters might want to identify additional ways to increase the use of those information sources.

These findings suggest two additional hypotheses to test:

H7 The most useful sources are not used in proportion to their usefulness.
H8 The most trusted sources are not used in proportion to their trustworthiness.

4 Methods and study context

This analysis focused on the findings from a mail survey sent to populations affected by five large wildfire events (Hat Creek Fire in northern California, Tecolote Fire in New Mexico, Schultz Fire in Arizona, Bull Fire in southern California, and Fourmile Canyon Fire in Colorado) as part of a larger project examining agency–community interactions during wildfire events. The initial survey was piloted in summer 2009 and revised based on feedback from participants. The Hat Creek survey was then conducted in fall 2009. The survey was slightly revised after the implementation in 2009. The remaining surveys were conducted in fall 2010. The fires were chosen based on several criteria: response by a type I or type II Federal Incident Management Team, proximity and threat to a local community, and presence of evacuations or road closures.

Surveys were mailed in fall of 2009 and fall 2010 using a three wave process based on Dillman's methods (2008). Surveys were mailed to a random sample of residents inside the fire perimeters and within ten miles of the Hat Creek Fire perimeter (1,000 sample size) and of the Tecolote Fire perimeter (1,130 sample size), five miles of the Schultz Fire perimeter (1,000 sample size) and of the Fourmile Canyon Fire perimeter (1,000 sample size), and fifteen miles of the Bull Fire perimeter (1,000 sample size). Perimeter distance varied to account for difference in local geography and population density patterns. An additional 496 residents who were within the evacuation zone of the Schultz Fire were also surveyed, due to the high evacuation rates on this fire. The survey was designed to assess communication needs and dynamics before and during the fires. The response rates for all the fires varied between 13 and 26 %.

Due to the low-response and concerns about non-response bias, we conducted a telephone survey of the 2010 fires of 10 % of non-respondents for the 2010 fires using a shortened version of the mail survey. One-way ANOVA tests revealed those who responded to the mail survey to be significantly different in some respects to those surveyed as part of the telephone non-response survey. Telephone respondents were significantly more satisfied overall with information they received on fire management both prior to the fire and during the course of the fire than were the mail survey respondents. Telephone respondents were also more satisfied with specific types of information they received prior to the fire than were mail respondents. Overall, those responding to the

telephone survey were more likely to be female than male responders. They were also older, had lived in the area longer, and were more likely to reside in urban rather than rural areas. Consequently, the findings from the mail survey should be interpreted with this in mind. However, given that a common assumption that non-respondents in mail surveys are dissatisfied or uninterested and therefore survey results may underreport key negative views, the higher levels of satisfaction reported among telephone respondents may suggest that our survey results actually reflect lower levels of satisfaction than exist in the population. Analysis consisted of aggregating the databases from each fire into excel spreadsheets and using IBM SPSS statistics software to run descriptive and inferential statistics.

4.1 Wildland fire events

The Hat Creek Fire started on the Lassen National Forest in northern California on August 1, 2009, and did not result in structural losses or evacuations, although electric supplies were affected and parts of the Pacific Crest Trail were closed. The Tecolote Fire started on the Santa Fe National Forest in New Mexico on June 6, 2010, and resulted in no structural losses and voluntary evacuations, although National Forest roads were closed for several days. Values at risk included the watershed for the city of Las Vegas, cultural/historical sites, recreational sites, and structures (Steelman et al. 2011a). The Schultz Fire started on the Coconino National Forest in Arizona on June 18, 2010, and resulted in no structural losses, although 2,000 structures were threatened. Evacuation of over 1,000 residents was necessary during the peak of the event, as was the closure of a major highway. Values at risk included residences, recreational sites, roads, power lines, threatened and endangered species, cultural resources, communication sites, the Flagstaff municipal watershed, and gas and water lines (Steelman et al. 2011b). The Bull Fire started on the Sequoia National Forest in California on July 26, 2010, and threatened 1,200 residences and led to the eventual loss of eight residences and six outbuildings, as well as in the closure of a major highway. Values at risk included structures in Riverkern and Kernville, historic sites, and campgrounds (Nowell et al. 2011).The Fourmile Canyon Fire started in Boulder County, Colorado on September 6, 2010, and required evacuation of more than 500 residences. The fire resulted in the destruction of 167 residences and five additional structures. Values at risk included residences and public utilities infrastructure (Burke et al. 2011). All five of the fires relied on direct suppression as fire management strategies. Findings reported below are the aggregate across all fires.

5 Findings: most used, useful, and trustworthy information sources

5.1 Most used sources: during the event

The five information sources most commonly cited by respondents as an information source they used during the fire were family/friends/neighbors, newspapers, television, radio, and maps. More than 60 % of all respondents indicated they used all these sources. Aggregated data across all five fires indicated that family/friends/neighbors were the single most used source. As shown in Fig. 1, more than 80 % indicated this was an information source, followed by newspapers (78 %), television (75 %), radio (68 %), and maps (62 %). The results also indicated a significant drop off after the top five most used sources to sources that were used by 40 % or fewer of the respondents. This suggests that the top five are distinctive in their grouping relative to the other sources surveyed.
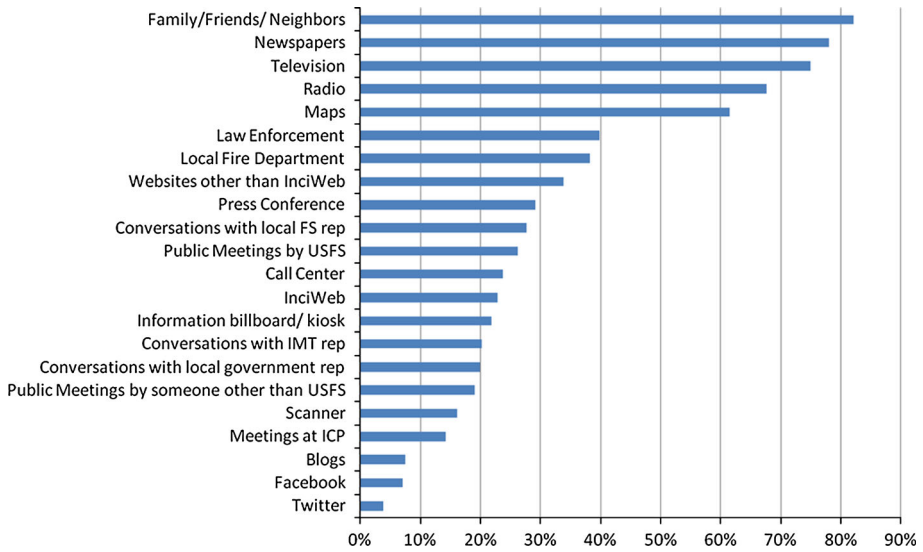
Fig. 1 Information used on five large wildfires

Also of interest were the sources used by fewer than 10 % of respondents. These included Twitter (4 %), Facebook (7 %), and blogs (8 %). The relative lack of use of these social media tools may derive from how new they were in 2009 and 2010. Alternatively, this may reflect the rural nature of the fires—three were in predominantly rural areas (Burney, CA; Las Vegas, NM; Lake Isabella, CA), while two were in more urbanized settings (Flagstaff, AZ and Boulder, CO). We ran a t test to see if there were statistically significant differences between the uses of these sources in the rural versus urban areas and found that those living in urban areas were more likely to use blogs and Facebook. There was not a significant difference found in the number of Twitter users between urban and rural areas, but this was likely because of the low number of Twitter users overall (only 28 of 873 respondents reported using Twitter).

5.2 Very useful sources: during the event

The five information sources identified by the highest percentage of respondents as "very" useful were the local fire department (64 %), maps (58 %), conversations with local Forest Service representatives (53 %), family/friends/neighbors (53 %), and conversations with the Incident Management Team representative (51 %), as indicated in Fig. 2. Among the top five sources identified as very useful, four were interactive. The local fire department, conversations with the local Forest Service, family/friends/neighbors, and conversations with the Incident Management Team all provide opportunities for active information exchange, which may be one of the reasons respondents more readily identified these sources as useful to them. In addition, four sources (maps are generally issued by the IMT) can be seen as more official or governmental sources. The sources the lowest percentage of respondents indicated were "very" useful were social media tools—Facebook (10 %), blogs (11 %), and Twitter (13 %).
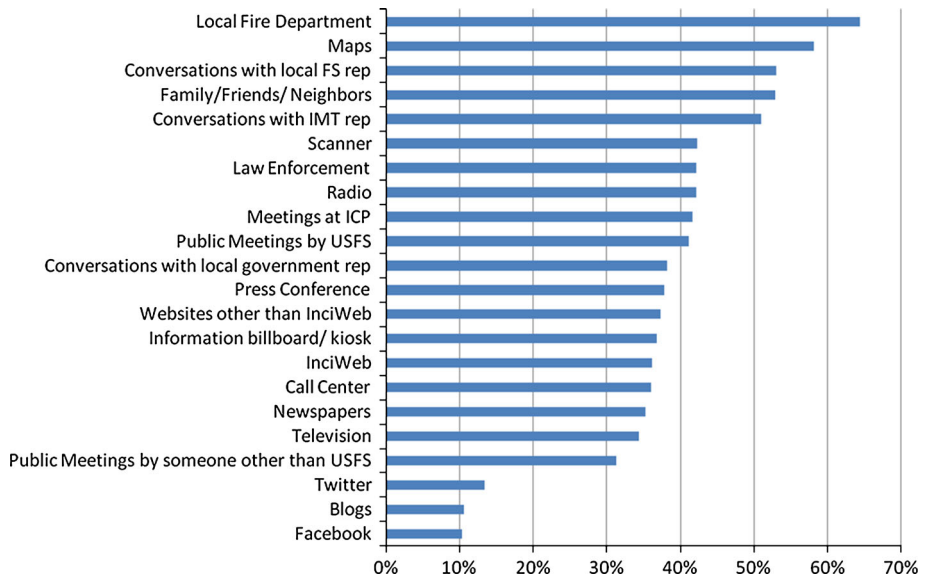
Fig. 2 Sources identified as "very" useful on five large wildfires

5.3 Very trustworthy sources: during the event

The sources identified by the highest percentage of respondents as "very" trustworthy were the local fire department (75 %), maps (64 %), conversations with local Forest Service representatives (60 %), conversations with Incident Management Team representatives (59 %), and law enforcement (57 %) (see Fig. 3). Among the top five sources identified as very trustworthy, all were "official" sources. The local fire department, maps, conversations with the local Forest Service, conversations with the Incident Management Team, and local law enforcement are all either local or federal sources with an official capacity in disaster response. This may be one of the reasons respondents more readily identified these sources as trustworthy.

Our survey findings support that both official and unofficial sources are used by respondents, but official sources appear to be considered more trustworthy than unofficial sources based on respondent ratings of trustworthiness. In addition, four of the top five trustworthy sources can be seen as interactive. The sources identified by the lowest percentage of respondents as "very" trustworthy were blogs and Twitter (11 % each), and Facebook (15 %).

The existing literature on the topic of trustworthiness of sources suggests that local sources would be more trustworthy than federal sources (Fessenden-Raden et al. 1987; Jungermann et al. 1996; Wray et al. 2006). This does not seem to be the case with our data. Both local and federal sources were among those identified by higher percentages of people as very trustworthy. While the local fire department was the source the largest percentage of people rated as very trustworthy, significant numbers also identified conversations with local Forest Service representatives (a federal agency) and conversations with the Incident Management Team (the federal teams that come into manage the fires) as very trustworthy. Local law enforcement rounded out the top five.
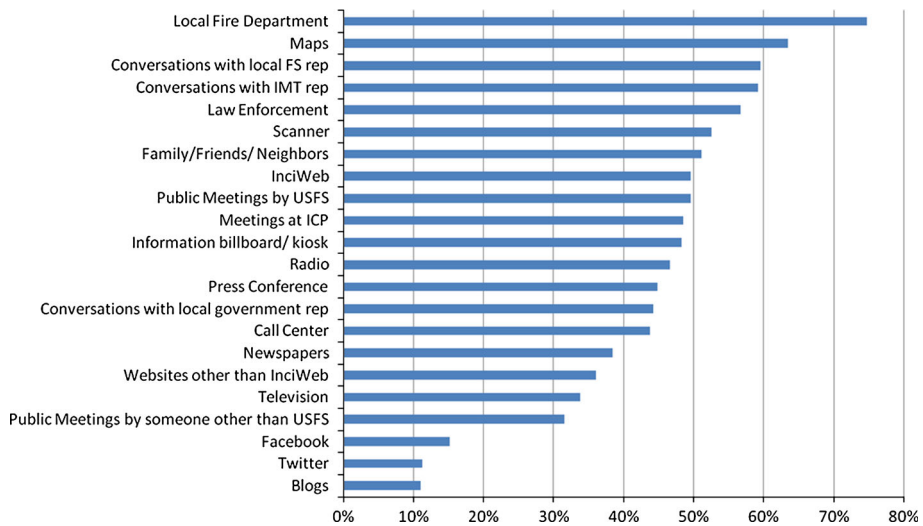
Fig. 3 Sources identified as "very" trustworthy on fire large wildfires

Family/friends/neighbors were found to be trusted more than other sources in McCallum et al.'s (1991) study. While a little more than 50 % of our survey respondents identified family/friends/neighbors as very trustworthy, other sources had a higher percentage of responses indicating they were very trustworthy.

Finally, newspapers have been found to be more trustworthy than television and radio in disaster contexts (Quarantelli 2002). Out of the three different types of mass media, radio rated the highest percentage of respondents indicating very trustworthy (47 %). This was followed by newspapers (38 %) and television at 34 %. These results may point to local sources (radio and newspapers) being more trustworthy than television, which increasingly tend to serve regional rather than local markets (Quarantelli 2002). Our findings are consistent with radio and newspapers being identified by a higher percentage of respondents as trustworthy relative to television.

5.4 Most used, very useful, and very trustworthy: gap analysis

A comparison of the sources that respondents indicated were very useful relative to their use revealed gaps between how many indicated they used the source and how many indicated it was either very useful or very trustworthy (Fig. 4). There was a 31 % point differential between the perceived usefulness of conversations with IMT representatives and their actual use. This may be due in part to the limited availability of IMT members during the event. They may not be as available as other entities due to the primacy of the function they serve during the wildfire. There was a 25 % point differential between the perceived usefulness of conversations between local Forest Service representatives and their use during the fire. There was a 26 % point differential between the local fire department's perceived usefulness and use during the fire. Law enforcement and maps were used roughly in proportion to their perceived usefulness, while family/friends/neighbors were used more than their perceived usefulness.
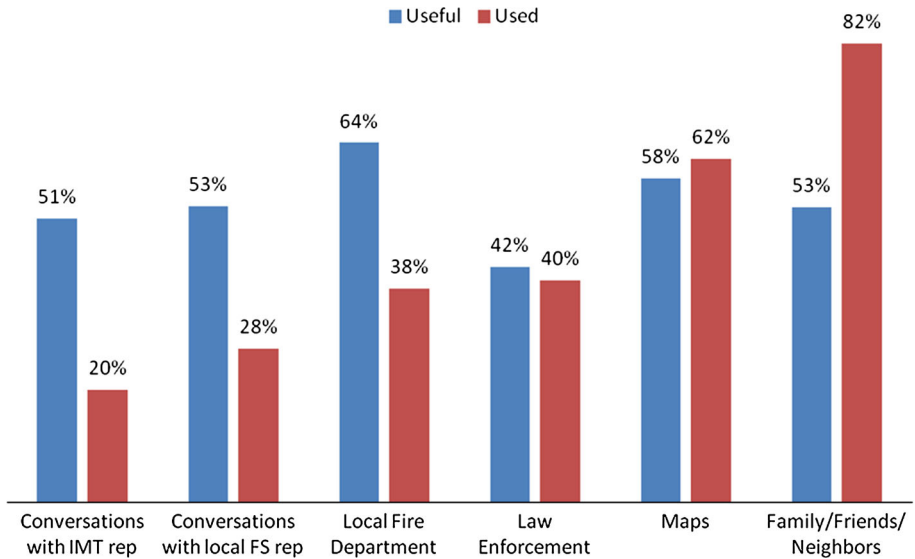
Fig. 4 Comparison of most used and very useful sources

Likewise, a comparison of the sources identified by respondents as very trustworthy relative to their use (Fig. 5) revealed gaps between conversations with IMT representatives, conversations with local Forest Service representatives, the local fire departments, and local law enforcement. There was a 39 % point differential between the perceived trustworthiness in conversations with IMT representatives and their actual use. There was a 37 % point differential between use and perceived trustworthiness in conversations with local law enforcement, a 32 % point differential for conversations between local Forest Service representatives, and a 27 % point differential for the local fire department. Maps were used roughly in proportion to their perceived use while a higher percentage of respondents used family/friends/neighbors than found them trustworthy information sources.

5.5 Information sources used before the fire

To better understand why respondents were using sources that were disproportionate with their usefulness and trustworthiness, we wanted to explore the information sources that were used before the fires. Before the fire, the information sources about fire issues that were used by more than 70 % of respondents were newspapers and family/friends/ neighbors. Television was used by 65 % of respondents, and radio was used by more than 55 %. Rounding out the top five was the local fire department at a little over 40 %. The sources used before the fire (Fig. 6) very closely mirrored those used during the fire, which caused us to examine whether there was a statistical relationship between these sources. We found relatively high, positive correlations among the various sources used before and during the fire (Table 1) suggesting that respondents were going to the same sources during the fire that they were using before the fire.
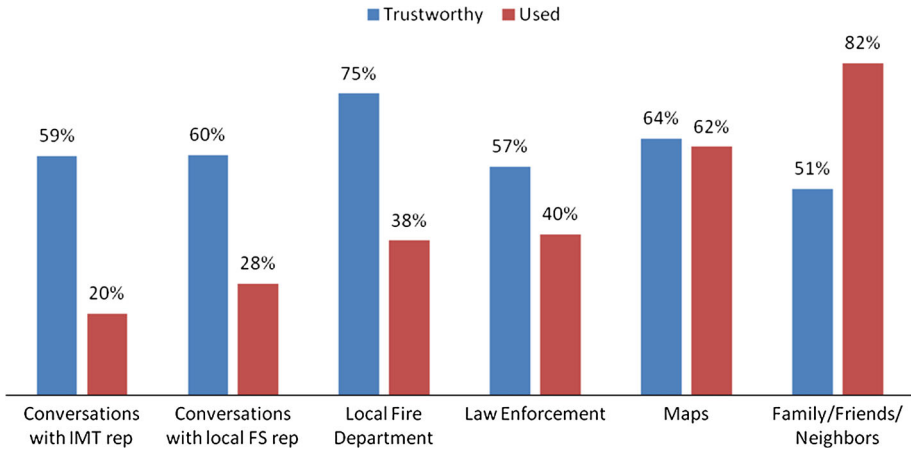
Fig. 5 Comparison of most used and very trustworthy sources
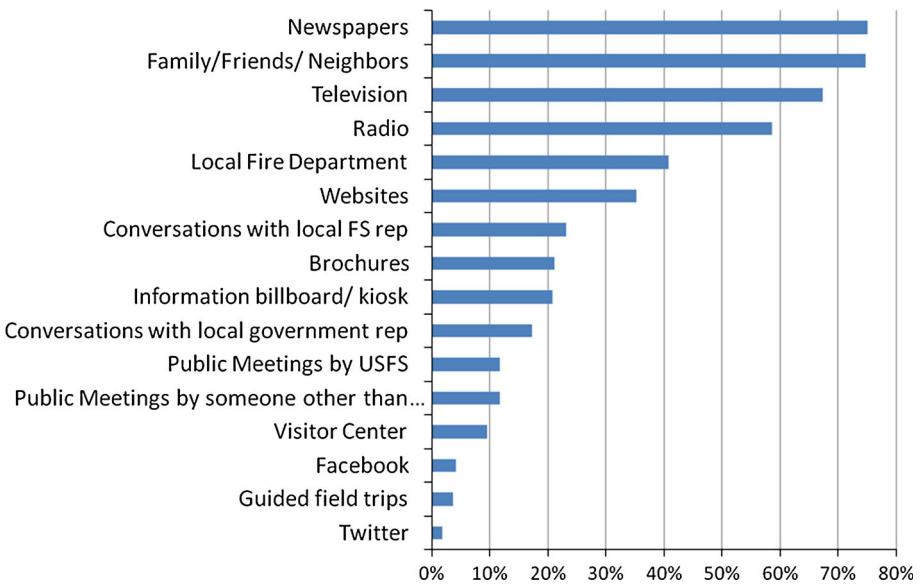
Fig. 6 Information sources used before the fire

6 Implications and conclusions

Information is essential in effectively managing a disaster. We sought to better understand the recipient perspective within the broader communication system especially as it related to information characteristics. In particular, we wanted to look at the dynamics associated with what kind of information was used, how useful it was, and how trustworthy it was.

Table 1 Correlations between information sources used before and during the fire

	Hat Creek	Tecolote	Schultz	Bull	Four Mile Canyon
Newspapers	.502**	.688**	.506**	.621**	.450**
Radio	.696**	.828**	.375**	.706**	.393**
Television	.574**	.672**	.548**	.591**	.501**
Family/friends/neighbors	.420**	.656**	.459**	.481**	.639**
Conversations with local Forest Service representative	.557**	.619**	.302**	.512**	.372**
Public meetings by USFS	.486**	.561**	.424**	.617**	.275**
Public meeting by someone other than USFS	.05	.16	.281**	.599**	.467**
Information billboard/kiosk	.520**	.412**	.403**	.487**	.203**
Local fire department	NA	.514**	.381**	.448**	.468**

** .05 significance level

6.1 Information used

We tested several hypotheses that were suggested by the extant literature related to information use during a disaster. The sources that were most used during the fires were family/friends/neighbors, mass media, and maps. These sources are noteworthy in that, except for maps, they are readily available to those affected by the disaster when it is occurring. These same sources were used by respondents before the fires. The high, positive correlations among the sources used before and during the fires suggest that - people turn to the information sources with which they are most familiar. Shifting the patterns of what is used during the disaster may entail shifting the patterns of which sources are used before the disaster.

Hypothesis 1 suggested that television and radio would be used more during the disaster than newspapers. This hypothesis was not supported. Television and radio were both used less than family/friends/neighbors and newspapers. Previous studies suggested that television was most used due to the immediacy of information needs during a crisis context. As expected (H2), newspapers and radio were seen as more trustworthy than television. However, radio was seen as useful and trustworthy by a much larger percentage of respondents than either television or newspapers, the latter of which received only slightly higher response rates than television. Interestingly, radio was used significantly more by respondents in our urban fires than in our rural fires.

Prior studies suggested that family and friends would be used less than media sources but would still be an important information source (H3). This hypothesis was partially supported as family, friends, and neighbors were indeed an important information source and were in fact, the most used information source across the five wildfires. This difference from other studies may reflect differences in crisis context in which the research was carried out or the changing communication environment where individuals can share information more easily through text messages or Internet sites (Shklovski et al. 2008). Wildfires often impact communities quite rapidly, a situation in which mass media may initially be behind the curve in providing information, thereby forcing individuals to turn to those around them to try to find out what is happening. The findings may also reflect a sense that regional consolidation of news media has made media less likely to have the locally relevant information that people feel they need. This dynamic is supported by two studies of wildfires that found that many respondents found news media an undependable

information source, in terms of both frequency and familiarity with local conditions, and instead sought current fire information from individuals they knew who had access to personnel involved in the response (e.g., member of the local fire department or local government; Shklovski et al. 2008; Steelman and McCaffrey 2013). Our findings thus provide clear evidence for the level of importance of family/friends/neighbors relative to other sources of information.

Another reason why family and friends may have been more used than mass media is that they were seen as more useful and more trustworthy than any of the mass media sources, confirming Hypothesis 4. While family and friends were among the top five useful sources and were identified as very trustworthy by over 50 % of respondents, they were not among the five most frequently mentioned trustworthy sources. This mixed response may reflect the dynamic previously mentioned whereby many individuals seek out local contacts who are involved in the response for information: respondents who had access to such individuals likely found them to be useful and trustworthy sources, while those who did not got get information from 'inside' contacts likely recognized their limits as an accurate information source.

6.2 Source usefulness and trustworthiness

The information sources that had the highest percentage of respondents who indicated they found the source useful or trustworthy turned out to be primarily interactive and official sources. The importance of interactivity of an information source was not one of our original hypotheses. The warning literature suggests that confirmation is an important dynamic in warning response (Mileti et al. 2006) and ability to ask questions can be a key part of the confirmation process. In addition, findings in both adult learning (Toman et al. 2006) and pre-fire communication research (McCaffrey and Olsen 2012) suggest that interaction is a key trait of effective pre-fire outreach efforts. Our findings suggest that this dynamic holds during an event, a reasonable conclusion given arguments that in situations of heightened uncertainty, such as during a disaster, interactive information sources will be more valued as a means of reducing uncertainty (Weick et al. 2005; Hodgson 2007). However, this characteristic also makes them a challenge to use widely. Their very usefulness depends on the benefits that come from more personable interaction that requires one-on-one exchange. A relevant question moving forward is whether these sources can be leveraged using platforms that deliver some of the benefits of interaction more broadly. For instance, can public meetings that feature Incident Management Team members, local Forest Service personnel, local fire, and local law enforcement be advertised through social media and broadcast more widely through television, direct streaming, or webinars to allow more people to benefit from the interactive format? Even though they may not be able to participate or interact directly, they may benefit from seeing the interaction of others and the learning that may confer.

Hypothesis 5 suggested that official sources would be used the same as unofficial sources but that official sources would be more valued. This was partially supported. Out of the five sources used by the most respondents, only one was official—maps. Family/friends/neighbors, newspapers, television, and radio were unofficial sources that were used more than official sources such as maps, law enforcement, local fire department, local Forest Service personnel, or the IMT. However, a larger percentage of respondents rated official sources as more trustworthy and useful than the unofficial sources. Closing the gap between what is most trustworthy and what is used may be a little less daunting than closing the gap between what is useful and what is used. This is due in part to the fact that

the "official" valence of Incident Management Team personnel, local Forest Service personnel, local fire departments, and local law enforcement sources can probably be more heavily leveraged through better transmission venues such as television, newspaper, and radio. Increasingly, social media may also play a role as these sources grow in use over time.

Hypothesis 6 predicted that we should expect greater trust in local government sources as compared to federal government sources (Fessenden-Raden et al. 1987; Jungermann et al. 1996; Wray et al. 2006). This hypothesis was not supported. Local government sources and federal sources were both identified by more respondents as very trustworthy. One reason our findings may differ from the other studies is that some of the federal sources we asked about were locally situated. In other words, local Forest Service representatives, while ostensibly being federal employees, are members of their local communities as well. The logic underlying the expected division between local and federal sources is that the community has more concrete experience and practical interaction with local officials, which thereby confers a valance of trust in the future interaction. If federal representatives are also interacting with locals, then these benefits may also be conveyed to them as well. The issue is less one of the stigmas of being a federal representative than it is of lack of interaction with locals and associated failure in building trust and credibility with them.

There is some indication in existing work that the information sources most often cited as useful are not used in proportion to their usefulness (H7). This hypothesis was partially supported. Similarly, the literature suggested that the sources most often cited as trustworthy are not used in proportion to their trustworthiness (H8). This hypothesis was also partially supported. Conversations with IMT personnel, local Forest Service personnel, and local fire departments were cited as useful and trustworthy by a larger proportion of respondents than indicated they used those information source. However, law enforcement was used roughly in proportion to its usefulness, and maps were used roughly in proportion to their usefulness and trustworthiness. Family/friends/neighbors were used more frequently than they were cited as useful or trustworthy.

Finally, we found a high degree of similarity among sources used before and during the fire indicating that people tend to use information sources that are convenient or familiar regardless of the perceived usefulness or trustworthiness of the source. While this was not something for which we were explicitly looking, we turned to the literature to see if there was anything there that might further explain this finding. The only study we found that hinted at convenience or familiarity had to do with newspaper reporters returning to the same sources during a disaster that they had consulted before the disaster occurred (Quarantelli 2002). Additionally, Cohen et al. (2007) indicated that information needs changed depending on what was easily accessible at different points during the fire. However, the warning literature has previously found that the public is more likely to believe and act on a message if it comes from a familiar source (Lindell and Perry 1987; Mileti and Fitzpatrick 1992; Perry 1983; Simpson and Riehl 1981). The gap between what is used and considered useful and what is used and considered trustworthy may have something to do with the primary useful and trustworthy sources being less familiar or less convenient to respondents. Increasing the presence of local agency representatives, local law enforcement, and local fire departments ahead of the fire so that those affected by the fire are more familiar with them could increase the relative use of these sources. Creating opportunities where these sources are also convenient for recipients may also enhance their use. In short, greater familiarity or convenience with useful and trustworthy sources may facilitate better ease of access and use during the disaster.

6.3 Social media

Social media sources were found to be the least used and have the fewest respondents indicate they were useful or trustworthy within the context of our study. This may be in part due to the relative newness of social media and smartphone technology at the time we conducted our research in 2009 and 2010. Any new technology has its early adopters (Rogers 1995), and it may be that in our study, only early adopters were familiar with social media technology or utilizing it for the purpose of collecting information about the fire. The low usage levels may also reflect the equally low percentage of respondents that saw social media sources as useful or trustworthy. Since the time of our study, the use of social media has grown and has become more used as an information source during disasters (Palen and Liu 2007; Liu et al. 2011; Dabner 2012; Merchant et al. 2011; Bunce et al. 2012; Jung and Moro 2014). How useful or trustworthy these new media sources have become as their use increases has been studied less. Usefulness and trustworthiness may partly depend on who leverages the resource to disseminate information. If Incident Management Teams and local Forest Service leverage the sources, then they may be seen by more individuals as trustworthy than if family, friends, and neighbors leverage them. The valence of "official" identity may confer across social media as it does in the other sources we explored in this study. In the case of the Queensland Police Service, it did and allowed them to engage with and inform the public, including real-time myth-busting (Bunce et al. 2012). In the meantime, we feel we have provided some very solid baseline data against in which future research can be compared.

This study has begun to more directly fill the gap in our knowledge related to recipient information seeking behavior. Although a reasonable understanding has developed on what type of message and which senders are associated with proactive behavior, less attention has been paid to the perspective of the recipient. Until we better understand the broader patterns of information importance to recipients we cannot improve the delivery of information to them during stressful events. In a world of changing climate where wildfires and other disasters are expected to increase, more people will be affected. Understanding that information people use, find useful, and trust is essential to the effective management of disasters that affect these human populations. A better served recipient population can lead to better protection of life and property. This is not to suggest that information delivery in all disaster situations should be treated in exactly the same way. An empirical question for the future investigation is how crisis situations differ in terms of what kinds of sources are most used, useful, and trustworthy to recipients across disaster contexts.

Our research has some limitations that need to be acknowledged. First, we looked only at wildfires. Other disasters may have different characteristics. Understanding these differences would also be illuminating. We suggest that our knowledge about recipient behavior and what they find most useful and trustworthy is lacking. Many other characteristics are also important and very little scholarship exists on information qualities such as accuracy, timeliness, and adequacy of information sources during disasters. Additionally, we did not distinguish between sources and the transmission channels they used. Distinguishing between the source of the message and the channel that carries the message can be challenging (Rogers 1985), but it is reasonable to conclude that newspapers were reporting on information from the Incident Management Team or the local fire department. Since we did not tease apart these modalities, it is possible that they have been conflated here. Future studies or surveys should tease out these relationships.

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