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Differences in Information Needs for Wildfire Evacuees and Non-Evacuees

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This paper examines whether evacuees from two wildfires displayed different information seeking behavior than non-evacuees. Findings are the results of a mail survey sent to residents affected by wildfires outside Flagstaff, Arizona and Boulder, Colorado in 2010. We found evacuees sought information more actively than non-evacuees and placed a greater emphasis on use of interactive information sources, which they also tended to see as more useful and trustworthy. Evacuees also expressed lower satisfaction levels for receipt of information items that were more important to them including evacuation and road closure information. Finally, evacuees differed significantly in their assessments of pre-fire information suggesting that experiences during a fire may retroactively influence views of pre-fire information needs. Overall, findings support that of previous work and highlight the importance of disseminating information in as timely a manner as possible and through sources that allow as much interaction as possible with information providers.

Keywords: evacuation, disaster communication, risk communication, wildfire, sensemaking.

Introduction

Recent years have seen large numbers of individuals affected by wildfires. Providing information to such populations during an event is an important, but challenging, part of

minimizing negative outcomes and ensuring public safety. While fire managers have actively worked to provide information to the public for years, little empirical work has been conducted to understand whether managers are providing the affected public with the type of information they most want and through the channels they typically access and trust. The limited qualitative work conducted to date on wildfires suggests that evacuees have different information demands than other populations and that information needs change over the course of a fire (Cohn, Carroll, and Kumagai 2006; Taylor et al. 2007). To provide more in-depth understanding of the specific information needs of those more directly affected, this study assesses the differences in information needs and seeking behavior between evacuees and non-evacuees in two communities directly affected by fires in 2010.

Literature Review

Literature from the fields of natural hazards, emergency management, public health, and risk communication provide insight into the potential information dynamics to consider for individuals and communities affected by natural or man-made disasters. In a brief assessment of the state of risk communication, Alaszewski (2005) challenges the traditional assumption that individuals would automatically use any risk information they received to reduce their exposure. Instead risk communication is best characterized as a two-way process that needs to take into account how people seek and interpret risk information. In emergencies, events are often chaotic and unpredictable: to reduce the uncertainty associated with such situations individuals actively search for information in an attempt to make sense of the situation (Hodgson 2007; Weick, Sutcliffe and Obstfeld 2005). How individuals search for and respond to risk information will be shaped by their particular context and viewpoints (Alaszewski 2005; Dash and Gladwin 2007; Hodgson 2007).

During a disaster, individuals turn to a large diversity of information sources as they try to decrease their uncertainty and determine which actions to take (Hodgson 2007). Public information sources in particular can have a significant impact on decision making (Baker 1991; Burnside, Miller and Rivera 2007; Fitzpatrick and Mileti 1994; Gladwin and Peacock 1997; Kumagai et al. 2004; Lindell, Lu and Prater 2005; Stein, Duenas-Osorio and Subramanian 2010). Family, friends and neighbors can also be important information sources during natural hazards events (Burnside, Miller and Rivera 2007; Fitzpatrick and Mileti 1994; Cretikos et al. 2008; Heath, Lee and Ni 2009). Media outlets such as television are another common source of emergency information but may not always be an effective information source. Several studies found radios to be among the most-used information sources in emergency situations, and that they were particularly useful in situations involving loss of electricity (Cretikos et al. 2008; Heath, Lee and Ni 2009; Rundblad, Knapton and Hunter 2010). Other studies found mass media to be

subject to concerns of sensationalism (Becker 2004; Taylor et al. 2007) and general resident distrust (Wakefield and Elliott 2003). One study found that as radio stations continue to conglomerate and become centrally located in and around cities, their ability to provide community level coverage and information, especially in rural locations, is being diminished (Lowrey et al. 2007). Taylor et al. (2007) found the same to be true for television, and suggested that “when the public service function is subjugated to focus on the primary media market, television and newspapers can lose the function of informing a crisis situation” (p. 208). While gathering information is a key part of how individuals make sense of an uncertain situation, communication is another key aspect of sensemaking as individuals engage in iterative discourse to develop a plausible explanation for their situation (Hodgson 2007; Weick, Sutcliffe and Obstfeld 2005).

Several studies have found indications that those who feel more at risk seek information more actively than those at less risk. Hodgson (2007) describes the situation created by evacuations as “strip[ping] residents of almost all sense of control over the outcome of the situation” (p. 238). In response to such conditions, evacuated members of the public more actively and aggressively search for information and can at times be more critical of the information they find. Lindell et al. (2005) found that members of the public who lived in areas of the highest hurricane risk more actively searched for information and relied more heavily on local news media, the internet, and local authorities than those facing lower levels of risk. In a survey of Hurricane Katrina evacuees, Spence et al. (2007) found differences in the information desired and information seeking behavior of the disabled and non-disabled.

While only a few studies have examined risk information needs during wildfires, their findings support those of the larger field of work confirming the active information seeking behavior of individuals to reduce uncertainty and maintain a sense of normalcy (Cohn et al. 2006; Kumagai et al. 2004; Taylor et al. 2007). The same three studies also found that a high value was placed on receipt of real-time, place-specific information and that evacuees placed particular emphasis on timely provision of information about the status of their homes. When this need for information was not satisfactorily fulfilled by fire management agencies, members of the public turned to less official information sources such as television and friends and neighbors (Cohn et al. 2006; Taylor et al. 2007). Evacuees had an especially difficult time obtaining information that was up-to-date and locally accurate once their community had been dispersed by large scale evacuations (Cohn et al. 2006; Taylor et al. 2007). For this group in particular, lack of specificity or timeliness of information could lead to dissatisfaction and more critical assessments of fire authorities (Cohn et al. 2006; Kumagai et al. 2004). Cohn et al. (2006) found that a major issue for individuals was how to interpret information coming from multiple sources and how to determine the possibility of evacuation. In addition, Taylor et al. (2007) found that the information sought by both the public and evacuees changed over the course of the fire, shifting from wanting to know about the fire’s location, size

and direction at the onset, to whether evacuations would be necessary, to questions about the status of homes, road closures, and when re-entry would be allowed.

A number of authors have argued that pre-event collaboration and communication could contribute to effective communication during confusing situations (Cohn et al. 2006; Martin, Bender and Raish 2007; Queensland Police Service 2011; Taylor et al. 2007). In this respect, several studies have examined how people access wildfire management information in general. This work has shown that although interactive information formats are used less often, they tend to be seen as more useful (McCaffrey and Olsen 2012; Shindler, Toman and McCaffrey 2009; Taylor et al. 2007; Toman, Shindler and Brunson 2005). McCaffrey (2004) found that coupling educational materials with more individualized contact was the most effective method for providing information to residents on wildfire management and mitigation. Given the argument made by Weick, Sutcliffe and Obstfeld (2005) and Hodgson (2007) that communication and iterative discourse is an important aspect of how individuals make sense of uncertain situations, it is likely that interactive information sources will be equally valuable information sources during a wildfire.

In the remainder of the paper we use data from 2010 surveys to examine more closely information needs and dynamics during and prior to wildfires. The paper is organized into the following sections: methods and site characteristics, description of the two wildfire events, specific results, discussion of what these results may mean, and a conclusion.

Methods

This paper reports on findings from a subsection of a larger study examining agency-community interaction before and during wildfires. The larger study used a combined method research approach with key informant interviews during the course of three 2010 wildfire events (Tecolote Fire in New Mexico, Schultz Fire in Arizona, and Bull Fire in California) followed by mail surveys of the affected local populations to assess their information needs both during and before the fire. For the survey, one additional fire was added that matched the basic criteria (Fourmile Canyon Fire in Colorado). This analysis focuses on the findings from the mail survey for two of the fire sites, Schultz and Fourmile Canyon, which had a significant number of respondents who evacuated. This enables a comparison of differences in information needs and information seeking behavior between evacuees and non-evacuees. The survey consisted of 22 pages divided into four sections focusing on respondent satisfaction with and views on the usefulness and trustworthiness of information sources and communication processes during and before the fire, opinions and knowledge about fire management, and demographic information. Terms, such as credible and trustworthy, were not defined in the survey and are reported here as they were used in the survey.

To generate the sample frame, geographic information system (GIS) maps highlighting a 5-mile area around the perimeter of each fire were created. These were used by the local assessors' offices to generate a list with the name and contact information for tax parcels within the specified perimeter. Public, corporate, and trust lands were then excluded from the list, as were duplicate ownership and those parcels with a mailing address outside the perimeter. In the fall of 2010, surveys were mailed to a random sample of the remaining names (1000 in each site) using Dillman's (2007) three-wave methodology. To ensure that sufficient evacuation responses were received for at least one fire, an additional 496 residents who were within the evacuation zone of the Schultz Fire were included in the survey mailing. Mail survey response rates were 18% for the Schultz Fire, 26% for the subset of Schultz Fire evacuees, and 16% for the Fourmile Canyon Fire. Due to the relatively low response rates, a follow-up telephone survey was conducted to test for non-response bias. Ten percent of non-respondents from the mail survey were contacted via telephone using an abbreviated version of the survey. Demographically, no differences were found for education or employment, but non-respondents were more likely to be younger, female, live in an urban area, and have lived in the community for less time. The primary information specific difference found was in relation to overall satisfaction with communication which respondents were asked to rate on a four-point scale from very dissatisfied to very satisfied. Non-respondents were more satisfied with information both before and during the fire, suggesting that our results may paint a more negative picture of communication response than may be the case. This is notable given that a common assumption is that non-respondents are the dissatisfied or uninterested group and consequently, survey results may underreport key negative views.

Although surveys were sent to a specific sub-population in the area affected by the Schultz fire, evacuee status was determined by respondents' self-reporting of their evacuation status. For both fires, a total of 274 respondents indicated that they did not evacuate (183 for Schultz, and 91 for Fourmile Canyon), and 158 reported that they did evacuate (109 from Schultz, and 49 for Fourmile Canyon). Quantitative statistical analysis comparing responses of evacuees and non-evacuees is reported below and reinforced with qualitative comments made by respondents in a write-in section of the survey. When not specified, the significance level we report in the results section is 0.05. Because ANOVA assumes an interval-level dependent variable and our Likert-type scales are ordinal but not truly interval, a nonparametric test is technically preferred. Because the comparisons are pairwise between evacuees and non-evacuees, the Mann-Whitney U Test is appropriate. However the vast majority of the results do not differ from ANOVA results, so ANOVAs are reported as they are the more prevalently reported test in the social sciences. ANOVAs were run using IBM SPSS Statistics 19 to make pairwise comparisons of whether evacuated and non-evacuated populations overall reported differing responses. To determine whether the experiences of respondents before

or during the fire influenced assessments of satisfaction with information received we used ANCOVAs.

Wildland Fire Events

The Schultz Fire started on the Coconino National Forest outside Flagstaff, Arizona on June 18, 2010, and resulted in no structural losses, although two thousand structures were threatened. During the peak of the event, Highway 89, a major thoroughfare, was closed and over 1,000 residences were placed under an evacuation order. 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). After the Schultz Fire, seasonal rains caused severe flooding as a result of damage done by the fire and caused further property damage to many of the residents that were evacuated during the fire. 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 168 residences and five additional structures. Values at risk included residences and public utilities infrastructure (Steelman et al. 2011a).

Findings

Information Seeking and Information Sources

Survey respondents were provided a list of 22 information sources, equally divided between unidirectional (e.g. radio, web sites) and interactive sources (e.g. meetings, conversations). During the fires, evacuees sought information more actively than did non-evacuees, matching findings from previous studies (Cohn et al. 2006; Kumagai et al. 2004; Taylor et al. 2007; Weick et al. 2005). Evacuees reported seeking information from an average of 9.7 sources, while non-evacuees reported seeking information from only 6.6 sources. Evacuees were also more likely to agree that they “used multiple sources of information to learn about the fire” and to indicate that it was important to them to access multiple sources of information. Along with using more information sources overall, evacuees were more likely to use interactive information sources. Survey respondents who evacuated reported obtaining information from an average of 5.3 of the 11 interactive information sources while non-evacuees obtained information from an average of 2.7 of these sources. There was a smaller difference, albeit still statistically significant, between the two groups for use of unidirectional information sources, with evacuees obtaining information from an average of 4.4 of the 11 unidirectional sources while non-evacuees used an average of 4.0 of these sources.

Respondents were also asked to rate how useful and trustworthy they found each information source during the fire (Table 1). There were few differences between the two groups for individual unidirectional sources, with the only significant difference being that evacuees were less likely to rate radio as useful and trustworthy.

Table 1. Usefulness and Trustworthiness of Information Sources During the Fire: Unidirectional vs. Interactive Sources (Means)

Unidirectional Information Sources	Usefulness		Trustworthiness	
	Evacuees (n = 17-132)	Non-Evacuees (n = 44-222)	Evacuees (n = 18-125)	Non-Evacuees (n = 42-213)
Maps	2.46	2.53	2.56	2.61
Inciweb	2.32*	2.07	2.52	2.34
Websites other than Inciweb	2.24	2.21	2.31	2.25
Newspapers	2.16	2.23	2.18**	2.38
Information billboard/kiosk	2.12	1.84	2.32	2.02
Radio	2.08***	2.34	2.25***	2.45
Scanners	2.08	1.93	2.39	2.16
Television	2.07	2.14	2.11	2.21
Twitter	1.63	1.57	1.60	1.55
Facebook	1.62	1.57	1.77	1.64
Blogs	1.41	1.57	1.39	1.60
Interactive Information Sources				
Local fire department	2.77***	2.34	2.86**	2.53
Family/friends/neighbors	2.58***	2.39	2.51	2.41
Conversations with IMT representative	2.45**	2.13	2.58	2.40
Public meetings not led by USFS	2.29***	1.77	2.36***	1.84
Conversations with National Forest representative	2.29	2.03	2.43	2.27
Law enforcement	2.23	2.16	2.52	2.38
Public meetings by USFS	2.21**	1.90	2.41**	2.14
Call center	2.21	2.00	2.41	2.16*
Meetings at ICP	2.20	1.92	2.38	2.18
Conversations with local government representative	2.11	2.03	2.29	2.14
Press conference	2.09**	2.34	2.22**	2.46

1= Not Very Useful (Trustworthy), 2= Somewhat Useful (Trustworthy), 3= Very Useful (Trustworthy); Asterisks indicate significant difference at .01 (***), .05 (**) and .10 (*) levels.

The difference between groups is rather striking as, for evacuees radio was near the bottom quartile of sources in terms of useful and trustworthy ratings while it was in the top quartile of non-evacuee ratings for both categories. Evacuees also rated newspapers as less trustworthy, although there was no significant difference between groups in their perceived usefulness. More differences between the two groups were found for interactive information sources. Evacuees were more likely to report that they found the

local fire department and public meetings by the US Forest Service and others to be both more useful and more trustworthy than did non-evacuees. Conversely, evacuees were less likely than non-evacuees to find one interactive source, press conferences, as either useful or trustworthy. This lower rating may reflect the fact that press conferences may not have been providing evacuees with information that was sufficiently specific to their needs. Interestingly, conversations with Incident Management Team representatives and family/friends/neighbors were seen as more useful by evacuees but not as more trustworthy.

The higher value placed on interactive information sources by evacuees is further demonstrated by the higher importance they placed on being able to interact with information providers and feeling that their concerns were being acknowledged. Although evacuees were no more likely than non-evacuees to report having been provided information by those they trusted or were familiar with, they were significantly more likely to report that it was important for them to have access to trustworthy and familiar sources during the fires (Table 2).

The survey also asked respondents about information sources they used prior to the fire. Interestingly, there were more differences found between the two groups for use of unidirectional sources before a fire (data not shown) than there were during the fire. Evacuees were significantly less likely to report using newspapers, television, Twitter, Facebook, and visitors' centers prior to the fire. Conversely, they were significantly more likely to report using several interactive sources before the fire, including conversations with local government representatives, the local fire department, and public meetings either by the US Forest Service or by other entities to get information about fire management prior to the fires. These findings are noteworthy given that there is no clear reason why the two groups would have used different information sources before a fire and begin to suggest that experiences during a fire may retroactively influence views of pre-fire information needs—a possibility supported in subsequent findings and discussed more fully in the discussion section. Evacuees also were more likely than non-evacuees to indicate that prior to the fire it was important to them to be provided information by people they trusted or were familiar with, have their concerns acknowledged, and to have opportunities to ask questions and to interact with information providers prior to the fire (Table 2). However, unlike during fires, evacuees were no more likely than non-evacuees to indicate accessing information from multiple sources was important to them.

Table 2. Information Seeking Characteristics During and Prior to the Fire: Evacuees and Non-Evacuees (Means)

	Level of Agreement		Importance	
	Evacuees (n = 138- 155)	Non- Evacuees (n = 157- 255)	Evacuees (n = 129- 145)	Non- Evacuees (n = 168- 234)
During the Fire				
I used <i>multiple sources</i> of information to learn about the fire.	3.57**	3.42	2.86**	2.72
I was provided information by people whom I <i>trusted</i> .	3.22	3.17	2.77**	2.63
I was provided information by people who were <i>familiar</i> to me.	3.01	2.92	2.47**	2.30
When providing information to me people <i>acknowledged my concerns</i> .	3.01***	2.66	2.56***	2.07
I had opportunities to <i>interact</i> with the people who were providing information.	2.70***	2.40	2.36***	1.96
Prior to the Fire				
I used <i>multiple sources</i> of information to learn about wildfire risks.	2.82	2.92	2.57	2.50
I was provided information by people whom I <i>trusted</i> .	2.95	2.90	2.63**	2.44
I was provided information by people who were <i>familiar</i> to me.	2.56	2.56	2.29**	2.06
When providing information to me people <i>acknowledged my concerns</i> about wildfire risks.	2.48	2.43	2.32***	2.04
I had opportunities to <i>interact</i> with the people who were providing information.	2.51	2.34	2.27***	1.94
I had opportunities to <i>ask questions</i> about what I needed to do in response to wildfire risks.	2.46	2.35	2.43***	2.07

Agreement scale: 1= Strongly Disagree, 2= Disagree, 3= Agree, 4= Strongly Agree
Importance scale: 1= Not Very Important, 2= Somewhat Important, 3= Very Important
Asterisks indicate significant difference at .01 (***), .05 (**) and .10 (*) levels.

Information Content and Quality

Along with more active information seeking behavior and greater emphasis placed on interactive information sources, evacuees also wanted certain types of general fire information more than non-evacuees during the fire. For both groups the information most wanted was on the status of the fire and the least wanted information was on ecological conditions of the local forest. Those who evacuated were significantly more likely to report wanting information about evacuation, protecting home or property, road closures, and wildfire recovery (Table 3). Evacuees also gave significantly lower

adequacy ratings for information about fire hazards, fire status, evacuation, and road closures.

Table 3. General Fire Information During and Prior to the Fire: Want and Adequacy (Means)

	How much did you want this type of info?		Was this info Adequate?	
	Evacuees <i>n</i> = 148-156	Non- Evacuees <i>n</i> = 248-259	Evacuees <i>n</i> = 117-143	Non- Evacuees <i>n</i> = 203-235
During the Fire				
Status of the fire	2.96*	2.91	2.43***	2.61
Evacuation	2.87***	2.54	2.48**	2.65
Where the fire is	2.85	2.78	2.51	2.56
Road closures	2.76***	2.46	2.49**	2.63
Fire hazards/ concerns	2.74	2.77	2.38***	2.65
Protecting home or property	2.55***	2.34	2.44	2.59
Likely fire management strategies	2.53*	2.41	2.33	2.40
Wildfire recovery	2.43***	2.21	2.15	2.14
Hazardous fuels reduction on the local national forest (mechanical thinning or prescribed burning)	2.14	2.07	1.96	2.05
Ecological conditions of local national forest	1.89	2.03*	2.10	2.19
	How much did you want this type of info?		Was this info Adequate?	
	Evacuees <i>n</i> = 137-142	Non- Evacuees <i>n</i> = 244-254	Evacuees <i>n</i> = 126-135	Non- Evacuees <i>n</i> = 215-225
Prior to the Fire				
Fire hazards/ concerns	2.68*	2.59	2.21	2.34
Hazardous fuels reduction on the local national forest (mechanical thinning or prescribed burning)	2.47***	2.26	2.02**	2.21
Defensible space/ FIREWISE	2.47***	2.23	2.31	2.35
Evacuation planning	2.42***	2.21	1.93	1.98
Likely fire management strategies	2.31**	2.15	1.85*	2.02
Ecological conditions of local national forest	2.18	2.20	1.96**	2.19

Want scale: 1= Did Not Want, 2= Wanted Somewhat, 3= Wanted Very Much

Adequacy scale: 1= Did Not Receive, 2= Not Adequate, 3= Adequate

Asterisks indicate significant difference at .01 (***), .05 (**) and .10 (*) levels.

Although evacuees had higher interest in topics that were directly related to their safety, we found few differences between the two groups in terms of ratings for receipt, importance, and timeliness of nine pieces of information specific to each fires' management. For both groups the most important information was about where the fire affecting them was going or likely to go and the least important was how much the fire cost (Table 4). The only significant differences between the two groups was that evacuees

were more likely than non-evacuees to rate as important information about what fire management choices were being made, why these choices were being made, and why these were the best choices.

Table 4. Specific Fire Information: “During the Fire, How Important Was it for You to Receive Information on...” (Means)

	Evacuees n = 152-155	Non-Evacuees n = 252-260
Where is the fire going?	2.95	2.90
Where is the fire likely to go?	2.92	2.92
What fire management choices are being made? ***	2.61	2.31
What should I be doing?	2.59	2.63
Why are the fire management choices being made? ***	2.50	2.21
Why are these fire management options the best ones? ***	2.46	2.15
How is the ecology of the region affected by the fire?	2.28	2.27
Who is responsible for the fire?	2.28	2.16
How much does the fire cost?	1.73	1.69

1= Not Very Important, 2= Somewhat Important, 3= Very Important

Asterisks indicate significant difference at .01 (***), .05 (**) and .10 (*) levels.

The fact that evacuees placed greater value on information related to fire management decisions may reflect Taylor’s (2007) findings that evacuees are at a different temporal point in information needs and have become interested in fire management choices that could influence how soon they can return to their property. In terms of timeliness and receipt of the information there were few differences between the groups (data not shown), with the only significant difference that evacuees were less likely to indicate they got information about where the fire was going in a timely manner than non-evacuees and to have received information on where the fire was likely to go, but more likely to have received information on how much the fire cost and who was responsible for management of the fire. Finally, although there were no significant differences (data not shown) between the two groups in feeling they had received credible, accurate, or up-to-date information during the fire, evacuees were significantly more likely to indicate that it was important to them to receive credible and up-to-date information.

I needed more up to date info posted on computers. I needed more info from City, police and fire because I was running a shelter and people there were concerned. – Fourmile Canyon non-evacuee

Very frustrated by lack of focused real-time, focused info re: exact details of fire (i.e. did my house burn down) I desperately searched many resources - most were useless (local news) or very accurate but too global

(Inciweb). (2) no info/notice re: evacuation, or when to go back to house, and no advance notice. (3) Road closure info not updated on ADOT (Arizona Department of Transportation). – Schultz Fire evacuee

When asked about what kind of general fire information they wanted before the fire, evacuees were significantly more likely to indicate that they wanted information about likely fire management strategies, evacuation planning, defensible space, and hazardous fuels reduction activities on the local national forest like mechanical thinning or prescribed burning (Table 3). Information about fire hazards and concerns was the information most wanted by both groups prior to the fire, while information about ecological conditions of the local national forest was least wanted. Similar to assessments of during-fire information quality, there were no differences between groups in whether they felt they received credible, accurate, and up-to-date information prior to the fires (data not shown). However, evacuees were more likely to indicate these three qualities were important to them.

Overall Information Satisfaction

As indicated in Table 5, we found no significant differences in overall communication satisfaction ratings during the fires. However, for specific topics, evacuees were less satisfied providing lower ratings for information on evacuation and road closures, how they received information, and how easy it was to get information. Surprisingly, more differences were found between the two groups for communication satisfaction before the fire. Evacuees were significantly less satisfied than non-evacuees with overall communication prior to the fire. They were also more likely to be less satisfied with how they were given information and how easy it was to get information prior to the fire, and with information they received prior to the fire about evacuation and forest conditions related to wildfire risk. The one item where no difference was found between the two groups in satisfaction prior to the fire was for information on how to protect their homes, which has been the primary focus of most fire outreach materials in recent years.

Finally, respondents were asked whether they agreed that communication from local government and the Forest Service before and during the fire helped them understand fire management and whether seeing how the fire was managed increased their trust in the relevant entity (data not shown). There was no difference between the two groups in views of communication from and trust in their local governments, both before and during the fires, with both groups holding essentially neutral views. However, while non-evacuees had response levels for the Forest Service similar to those they had for local government, evacuees were less likely to agree that communication from the Forest

Service helped them understand fire management before or during fires, and that seeing how the fire was managed increased their trust in the institution.

The Forest Service does not communicate with residents about fire prevention strategies and seems impervious to public comment. – Shultz
Fire respondent (evacuee)

Table 5. Information Satisfaction During and Prior to the Fire: Evacuees and Non-Evacuees (Means)

During the fire, how satisfied were you with ...	Evacuees n=136-155	Non-Evacuees n=203-255
Overall communication?	2.97	3.09
Who gave you information?*	2.95	3.14
<i>How you were given</i> information? **	2.71	2.92
<i>How easy it was to get</i> information? ***	2.55	2.84
Information you received about <i>evacuation</i> ? ***	2.78	3.08
Information you received about <i>road closures</i> ? ***	2.82	3.10
Information you received about <i>how the fire was fought</i> ?	3.01	3.14
Information you received about why certain fire <i>management choices</i> were being made?	2.77	2.91
Prior to the fire, how satisfied were you with....	Evacuees n=126-145	Non-Evacuees n=179-226
Overall communication? **	2.67	2.90
Who gave you information?*	2.82	3.01
<i>How you were given</i> information? ***	2.57	2.85
<i>How easy it was to get</i> information? **	2.51	2.78
Information you received about <i>evacuation</i> ? **	2.51	2.82
Information you received about how to <i>protect your house/ property</i> ?	3.11	3.19
Information you received about <i>forest conditions</i> related to wildfire risk? **	2.57	2.82
Information you received about the <i>upcoming fire season</i> ? *	2.57	2.79

1= Very Dissatisfied, 2= Somewhat Dissatisfied, 3= Somewhat Satisfied, 4= Very Satisfied
Asterisks indicate significant difference at .01 (***), .05 (**) and .10 (*) levels.

Local Context

Although our primary focus was on assessing differences in information needs between evacuees and non-evacuees, we also assessed whether these differences varied for evacuees by fire. In general we found few differences between evacuees on the two

fires. However, the few significant differences that are found highlight the role that local context likely plays in shaping information needs and use.

Table 6 shows that during the fire Schultz evacuees were significantly more likely than Fourmile Canyon evacuees to desire information about ecological conditions and hazardous fuels reduction on the forest and wildfire recovery. Shultz evacuees also were more likely to have provided higher adequacy ratings for information about the fire status, where the fire was, and local ecological conditions.

Table 6. Evacuee General Fire Information Needs During the Fire: Differences Between Fires. (Means)

	How much did you want this type of information?		Was this information adequate?	
	Schultz Evacuees n=102-107	Fourmile Evacuees n=42-49	Schultz Evacuees n=83-97	Fourmile Evacuees n=34-46
Status of the fire	2.97	2.94	2.51**	2.26
Evacuation	2.91*	2.80	2.44	2.57
Where the fire is	2.81*	2.94	2.60**	2.33
Fire hazards/ concerns	2.78	2.76	2.37	2.42
Road closures	2.76	2.76	2.43	2.63*
Protecting home or property	2.60	2.43	2.49	2.35
Wildfire recovery	2.58***	2.05	2.12	2.24
Likely fire management strategies	2.56	2.48	2.39	2.21
Hazardous fuels reduction on the local national forest	2.28***	1.80	1.97	1.95
Ecological conditions of local national forest	2.09***	1.43	2.28***	1.68

Want scale: 1= Did Not Want, 2= Wanted Somewhat, 3= Wanted Very Much

Adequacy scale: 1= Did Not Receive, 2= Not Adequate, 3= Adequate

Asterisks indicate significant difference at .01 (***), .05 (**) and .10 (*) levels.

.A few differences also were found in what information sources evacuees used in each location during the fire (data not shown). As compared to Fourmile Canyon evacuees, Shultz evacuees were more likely to report use of radio, the call center, USFS public meetings, and conversations with local government representatives during the fire and lower use of television, blogs, Facebook, press conferences, scanners, and websites other than Inciweb. However, except for television and the call center there were no significant differences in assessments of usefulness and trustworthiness of these sources suggesting the different usage reflected local availability issues and not perceived quality of these items. The call center was used more by Shultz evacuees, who were also more likely than Fourmile Canyon evacuees to indicate it was a useful and trustworthy information source. Conversely they were less likely to use television and to judge it as useful and trustworthy information source. This suggests that differences for these two sources do reflect a judgment of information quality. Satisfaction of several types of pre-

fire information (data not shown) varied for evacuees between the two sites as well, with Fourmile Canyon respondents reporting higher satisfaction with information regarding likely fire management strategies, fire hazards and concerns, evacuation planning, and defensible space information

These differences are likely attributable to differences in the threats posed by the two fires, as well as the local social context. The Schultz Fire took place mostly on Forest Service land, and endangered the city of Flagstaff's watershed. Therefore, concerns over the forest ecology and watershed (manifested in wanting information about wildfire recovery) make sense in that context. Because of previous natural disasters, residents in the area of the Schultz Fire were aware of the problems with fire and consequent flooding; in fact, some respondents expressed the opinion that the survey should have focused on the flooding after the fire as the main event rather than the fire. In contrast, the Fourmile Canyon Fire took place on mostly private property and the fire posed a less clear environmental impact to the area as it did not endanger a municipal watershed. Differences in use and usefulness of information sources likely reflect differences in local communication structure during the fire and highlight the importance of recognizing that structure when disseminating information. For example, given that the Schultz fire area no longer had a locally based television station and television news was Phoenix based, the lower evacuee assessment of television as an information source during the fire is not surprising and congruent with findings of other studies that found media conglomeration resulted in limited local coverage.

Discussion

Overall, the findings from this research support the expectation that those who are more directly affected by a disturbance have a greater need for information (Hodgson 2007; Weick et al. 2005). This is reflected in our findings that evacuees used more sources of information and placed greater value on information more directly related to their needs. In our study evacuees accessed more information sources than non-evacuees and had a higher desire for information on evacuation, road closures, protecting homes, and wildfire recovery. The higher value placed on information about protecting homes and property matches the finding from previous wildfire studies (Cohn et al. 2006; Kumagai et al. 2004; Taylor et al. 2007) that evacuees placed more emphasis on receiving information about the status of their property while evacuated. Our study also provides quantitative support for previous qualitative fire studies that have identified that people affected by wildfires desire information that is credible, accurate, timely and place sensitive (Cohn et al. 2006; Taylor et al. 2007). While we found no difference between respondents in their belief that they had received credible and up-to date information, we did find that evacuees were more likely to think these attributes were important. Comments made by evacuated survey respondents highlight these findings:

You will never understand how extremely hard it was not to know what was going on. People desperately wanted to know if their home made it or not and the agencies involved FAILED to provide this critical information. So many rumors we were told that our house was gone (untrue) with all the satellites available, why didn't you give us pictures? Why were we kept in the dark? People had to sneak up to see if their home made it. Information should have been provided. – Fourmile Canyon Fire evacuee

In addition, the greater use and value evacuees placed on interactive information sources supports the notion (Hodgson 2007; Weick et al. 2005) that reducing uncertainty involves not just seeking information but engaging in discourse. Our results provide a rich quantitative demonstration of the importance of interaction to evacuees who: 1) used a greater number of interactive sources, 2) were more likely to see a number of interactive sources as useful and trustworthy, and 3) were more likely to indicate that characteristics associated with interactive communication (such as information coming from people they trusted and were familiar with) were important to them. As evacuees engage in the information seeking process the ability to access multiple information sources, particularly those that can provide feedback and allow them to discuss the situation, is an important part of the process that helps them make sense of the situation. The findings also indicate that the preference for interactive information sources found in other research on that examined pre- fire information holds for information during wildfires.

Our findings suggest that while mass media sources are appealing because they can reach large segments of the population, their accuracy and usefulness, particularly for those most directly affected during an event, are questionable. Part of the challenge with mass media sources is their ability to provide locally specific information, which will likely vary based on the structure of the local and regional media markets. For instance, our findings regarding the usefulness of radio as an information source differed from findings by Taylor et al. (2007). Although Taylor's study found a radio station that was local to be a highly useful information source for evacuated members of the public, evacuees from our study found radio to be markedly less useful and less trustworthy than non-evacuees. This suggests that views of radio as a useful information source during a disaster may reflect variations in coverage area in different communities and resulting specificity of information provided.

The results also provide support for the findings of other work that suggests that those most affected by a disturbance are more likely to be critical of information, particularly for those information elements that most impact them. Although we found no difference between the two groups on overall during fire communication satisfaction, evacuees expressed lower levels of satisfaction for those information items that were more important to them—ease of information access and evacuation and road closure

information. Although not necessarily easy to accomplish, this highlights the value of working to find ways to ensure that evacuees can easily access up-to-date and accurate information about the evacuation and about roadblocks. As the following comment from a Shultz Fire evacuee indicates, poor information can lead to negative outcomes:

Evacuation info was not delivered in timely manner. No info regarding time allowed, close proximity of fire, or road closures which caused panic. The fire appeared to be closer than it was. My husband was injured during the evacuation due to what we now know was unnecessary haste. We did not know about road closures until they were closed, leaving many including ourselves w/o necessary medical equipment.

Interestingly, there were more differences between the two groups for prior to fire information than during fire information, with evacuees showing lower levels of satisfaction with information prior to the fire including overall communication. Interpreting such differences in responses between evacuees and non-evacuees to before fire information is difficult as there is no clear reason why evacuees should have actually had such different information needs before the fire. Since our surveys were conducted after the fires occurred, it is likely that evacuee experiences during the fire influenced their views of the sources before the fire. The fact that evacuees were more likely to indicate information they received before and during the fire was insufficient for their needs may be a benefit of hindsight and salience. Non-evacuees did not realize that they did not have certain information because they lacked an urgent need for that information. In contrast, evacuees suddenly needed specific information to quell uncertainty about the situation, thereby leading them to realize that they did not have it. As a Schultz Fire evacuee wrote:

I'm thinking back and informed by what I know now. I am also biased by the post fire flooding which has been MUCH WORSE than the fire itself in terms of on-going impacts on homeowners.

This dynamic shows how experiences during and after an event can color not just opinions of the event itself and afterward but may retroactively influence views of what was done before the fire. It also points to one of the challenges of natural hazard information provision: how to get individuals to pay attention to information before it is immediately relevant to them. However, one of the findings also suggests that the lack of attention may be at least somewhat related to how much information is readily available on the topic: the one area where there was no difference between evacuees and non-evacuees in prior to fire information satisfaction was for information about protecting homes and property, the main focus to date of most pre-fire outreach efforts.

Conclusion

These findings support previous work (Cohn et al. 2006; Hodgson 2007; Kumagai et al. 2004; Taylor et al. 2007) highlighting the importance that individuals confronted with a wildfire event place on up-to-date, locally-specific information that helps them make sense out of a complex situation and determine what protective actions, if any, they need to undertake. Those more affected by wildfire events have greater information needs, exhibit more active information seeking behavior, and show a greater reliance on interactive information sources than those less affected by fires. The fact that evacuees were also more likely to judge several interactive sources as more useful and trustworthy further reinforces the need for relevant information to be accessible through meetings and conversations. Collectively these findings, coupled with existing fire research and the literature on sensemaking, suggest that while mass media updates may be useful way of reaching a broad audience during a wildfire, those most directly affected prefer targeted interactive communication that takes local context into account. It therefore appears to be particularly important that evacuees have the chance to interact with individuals who can provide them with the current status of desired information, even when there is no new information to disseminate. Differences between evacuee populations at the two fire sites, with respect to their desire for certain types of information and use of certain information sources, highlights the importance of taking local context into consideration when determining the most effective way to disseminate wildfire information during an event. People want and will search for locally specific information; therefore identifying ways to better fulfill those needs is critical.

At a general level our work confirms that the dynamics of information demands found for other hazards also apply for wildfires. Many of the lessons learned here are parallel to those found on other hazards, particularly in relation to those most directly at risk being more active information seekers who place greater emphasis on receiving timely and accurate information (Hodgson 2007; Lindell et al. 2005; Spence et al. 2007). The importance of interactive information is also a common finding in the risk communication literature (Alaszewski 2005; Sellnow et al. 2009; Toman et al. 2005; Weick et al. 2005) and so likely applicable to other hazards. Our research provides clear demonstration that the more directly impacted a group, the higher and more specific its information needs. Together these findings suggest three ways to potentially improve provision of information to evacuees, irrelevant of the hazard: 1) identifying better ways to ensure evacuees—a hard to reach group—have access to information in as timely a manner as possible, 2) identifying the specific information needs of that group, given the specific situation, and targeting information content to meet those needs, and 3) designing information dissemination processes so that the more directly impacted a group is by a disaster, the greater the emphasis placed on providing that group with access to as many interactive information sources as possible.

Perhaps the most striking of our findings is the indication that experiences during an event may retroactively shape views of information outreach efforts prior to the event. This provides an additional impetus for efforts to minimize information issues during an event given that any missteps could impact perception of information provided before as well as during the event. It also highlights the need for better baseline data for fire prone communities in order to be able to assess how much of such differences in information assessment are due to differences that existed before an event and how much are a result of retroactive assessments. Whether the more critical view we found that evacuees had of pre-fire information would hold for other hazards is more open to question. One of the relatively unique characteristics of wildfire is the fact that the hazard itself is actively managed during the event. Earthquakes and hurricanes can only be prepared for and responded to--little can be done to decrease their impact during the event itself. The fact that most wildfires are actively managed may contribute to greater critique or blaming behavior by those most affected. Understanding how this dynamic plays out with other, less actively, managed natural hazards merits further investigation. A related topic for further investigation is the idea, suggested by the lack of difference we found between the two groups in pre-fire satisfaction with information about protecting homes, that such retroactive criticism could be mitigated in advance by concerted information outreach efforts prior to an event.

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References

- Alaszewski, A. 2005. "Risk Communication: Identifying the Importance of Social Context." *Health, Risk & Society* 7(2):101-105.
- Baker, E.J. 1991. "Hurricane Evacuation Behavior." *International Journal of Mass Emergencies and Disasters* 9:287-310.
- Becker, S.M. 2004. "Emergency Communication and Information Issues in Terrorist Events Involving Radioactive Materials." *Biosecurity and Bioterrorism: Biodefense Strategy, Practice, and Science* 2(3):195-207.
- Burnside, R., D.S. Miller, and J.D. Rivera. 2007. "The Impact of Information and Risk Perception on the Hurricane Evacuation Decision-Making of Greater New Orleans Residents." *Sociological Spectrum* 27 (6): 727-740.

- Cohn, P. J., M.S. Carroll, and Y. Kumagai. 2006. "Evacuation Behavior During Wildfires: Results of Three Case Studies." *Western Journal of Applied Forestry* 21(1):39-48.
- Cretikos, M., K. Eastwood, C. Dalton, T. Merritt, F. Tuyl, L. Winn, and D. Durrheim. 2008. "Household Disaster Preparedness and Information Sources: Rapid Cluster Survey After a Storm in New South Wales, Australia." *BMC Public Health* 8:195.
- Dash, N., and H. Gladwin. 2007. "Evacuation Decision Making and Behavioral Responses: Individual and Household." *Natural Hazards Review* 8(3):69-77.
- Dillman, D.A. 2007. *Mail and Internet surveys: The Tailored Design Method*. Hoboken, NJ: Wiley.
- Fitzpatrick, C.M., and D.S. Mileti. 1994. "Public Risk Communication." Pp. 71-84 in *Disasters, Collective Behavior, and Social Organization*, edited by R. Dynes and K. Tierney. Newark: University of Delaware Press.
- Gladwin, H., and W.G. Peacock. 1997. "Warning and Evacuation: A Night for Hard Houses." Pp. 52-74 in *Hurricane Andrew: Ethnicity, Gender, and the Sociology of Disasters*, edited by W.G. Peacock and B.H. Morrow. New York: Routledge.
- Heath, R.L., J. Lee and L. Ni. 2009. "Crisis and Risk Approaches to Emergency Management Planning and Communication: The Role of Similarity and Sensitivity." *Journal of Public Relations Research* 21(2):123-141.
- Hodgson, R.W.2007. "Emotions and Sense making in Disturbance: Community Adaptation to Dangerous Environments." *Human Ecology Review* 14(2):233-242.
- Kumagai, Y., S.E. Daniels, M.S. Carroll, J.C. Bliss, and J.A. Edwards. 2004. "Causal Reasoning Processes of People Affected by Wildfire: Implications for Agency-Community Interactions and Communication Strategies." *Western Journal of Applied Forestry* 19(3):184-194.
- Lindell, M.K., J. Lu, and C. Prater. 2005. "Household Decision Making and Evacuation in Response to Hurricane Lili." *Natural Hazards Review* 6(4):171-179.
- Lowrey, W., W. Evans, K.K. Gower, J.A. Robinson, P.M. Ginter, L.C. McCormick, and M. Abdolrasulnia. 2007. "Effective Media Communication of Disasters: Pressing Problems and Recommendations." *BMC Public Health* 7:97.
- Martin, I. M., H. Bender, and C. Raish. 2007. "What Motivates Individuals to Protect Themselves from Risks: The Case of Wildland Fires." *Risk Analysis* 27(4):887-900.
- McCaffrey, Sarah M., and Christine C. Olsen. 2012. *Research Perspectives on the Public and Fire Management: A Synthesis of Current Social Science on Eight Essential Questions*. Gen Tech Rep NRS-104. Newtown Square, PA: US Department of Agriculture, Forest Service, Northern Research Station.
- McCaffrey, S.M. 2004. "Fighting Fire with Education: What is the Best Way to Reach Out to Homeowners?" *Journal of Forestry* 102(5):12-19.

- Queensland Police Service. 2011. "Disaster Management and Social Media – A Case Study." Available at www.police.qld.gov.au/Resources/Internet/services/reportsPublications/documents/QPSSocialMediaCaseStudy.pdf
- Rundblad, G., O. Knapton, and P.R. Hunter. 2010. "Communication, Perception and Behavior During a Natural Disaster Involving a 'Do Not Drink' and a Subsequent 'Boil Water' Notice: A Postal Questionnaire Study." *BMC Public Health* 10:641.
- Sellnow, T.L, R.R. Ulmer, M.W. Seeger, and R. Littlefield. 2009. *Effective Risk Communication: A Message Centered Approach*. New York, NY: Springer Science and Business Media.
- Shindler, B.A., E. Toman, and S.M. McCaffrey. 2009. "Public Perspectives of Fire, Fuels and the Forest Service in the Great Lakes Region: A Survey of Citizen-Agency Communication And Trust." *International Journal of Wildland Fire* 18:157-164.
- Spence, P.R., K. Lachlan, J.M. Burke, and M.W. Seeger. 2007. "Media Use and Information Needs of the Disabled During a Natural Disaster." *Journal of Health Care for the Poor and Underserved* 18(2):394-404.
- Steelman, T., B. Nowell, S. McCaffrey, C. Burke, D. Bayoumi, A.K. Velez, and J. Briefel. 2011a. "Fourmile Canyon Fire Research Findings Summary." Available at atcnr.ncsu.edu/blogs/firechasers/files/2011/10/4-MileCanyon_ResearchSummary_FINAL.pdf
- 2011b. "Schultz Fire Research Findings Summary." Available at <http://cnr.ncsu.edu/blogs/firechasers/files/2011/10/SCHULTZ-FIRE-2010-RESEARCH-SUMMARY-042811-FINAL-VERSION.pdf>
- Stein, R.M., L. Duenas-Osorio, and D. Subramanian. 2010. "Who Evacuates when Hurricanes Approach? The Role of Risk, Information and Location." *Social Science Quarterly* 91(3):816-834.
- Taylor, J.G., S.C. Gillette, R.W. Hodgson, J.L. Downing, M.R. Burns, D.J. Chavez, and J.T. Hogan. 2007. "Informing the Network: Improving Communication with Interface Communities During Wildland Fire." *Human Ecology Review* 14(2):198-211.
- Toman, E., B.A. Shindler, and M. Brunson. 2005. "Fire and Fuel Management Communication Strategies: Citizen Evaluations of Agency Outreach Activities." *Society and Natural Resources* 19:321-336.
- Wakefield, S.E.L., and S.J. Elliott. 2003. "Constructing the News: The Role of Local Newspapers in Environmental Risk Communication." *The Professional Geographer* 55(2):216-226.
- Weick, K. E., K.M. Sutcliffe, and D. Obstfeld. 2005. "Organizing and the Process of Sensemaking." *Organization Science* 16(4):409-421.