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Best practices in risk and crisis communication: Implications for natural hazards management

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Abstract As societies evolve, often the most appropriate response to the hazard must also evolve. However, such shifts in appropriate response to a hazard, whether at the individual or at the societal level, are rarely straightforward: Closing the gap between desired practice and current practice requires effective communication. Although there is a significant literature on how to encourage adaptation before an event and how to communicate during an event, there is less work tying the two together or on how to communicate shifts in larger scale societal response to a natural hazard. In this article, we bring together the best practices and theoretical literature from risk communication and crisis communication and empirical literature on wildfire communication to derive the key characteristics associated with best communication practices. We then use this framework on three case studies of wildfires in California, Montana, and Wyoming, each of which used a different strategy for managing the fire, to understand whether approaching communication more holistically can lead to more desired natural hazard management outcomes. Our working hypothesis was as follows: effective communication before and during a fire would be associated with acceptance of more flexible fire management strategies. The findings indicate how a type of desired management change (more flexible fire management) is associated with more effective communication practices before and during the event.

Keywords Crisis communication · Risk communication · Wildfire · Disaster · Emergency management · Wildfire policy

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1 Introduction

One of the primary foci within the natural hazards field has been to understand the disjuncture between practices that are adopted to mitigate perceived risks and those that are not (Whyte 1986; Mileti 1994). Much of the focus of this effort has been on helping individuals and communities be better prepared for a specific hazard. Effective communication is often identified as a key practice to move toward the desired goal—more disaster resilient communities.

In the case of wildfire, the last decade has seen a great deal of communication work directed to fostering firewise actions by homeowners on their property and creation of Community Wildfire Protection Plans (CWPP) (Daniel et al. 2007; Jakes et al. 2011; McCaffrey et al. 2012). Both in the larger natural hazards field and wildfire specifically, less attention has been paid to the need for shifts in larger scale response during an event. For wildfire, suppression has been the dominant policy for over 100 years (Dombeck et al. 2004). However, similar to how building flood levees only served to raise the flood threshold, suppression has contributed to increased fire severity as it led to fuel build up and less fire-resistant ecosystems. Over the last decade, recognition of this dynamic has led to a desire to shift away from a sole focus on suppression to include a less aggressive set of strategies to manage a fire such as modified suppression (partial perimeter control) or monitoring a fire allowed to burn for resource benefits (NIFC 2009; QFR 2009). This potential use of a wider range of firefighting strategies (more flexible fire management) is thought to lead to better long-term outcomes by promoting more ecologically sound resource management, thereby fostering lower future fire hazard levels, as well as to reduced losses and more efficient use of resources during a wildfire (QFR 2009). A key challenge to making these changes is that fire management expectations, like all natural hazards management expectations, are situated in a broader social context. The ability to implement different natural hazard management strategies could be hindered by a public that may have come to expect a more suppression oriented–only response. Hence, there is a need to understand both public response to these alternatives and how to effectively communicate the need for more flexible fire management strategies to the people in communities at risk.

While communication has often been seen at the heart of improved response throughout the disaster cycle, to date, the two fields that best inform communication thinking for a hazard, risk communication and crisis communication have tended to focus on separate points in the disaster management cycle. However, we believe that understanding communication requires a more holistic view, an event-based approach that provides a temporal view of the significant decisions made before, during, and after an event (Reynolds and Seeger 2005; McCool et al. 2006). Our rationale is that large-scale shifts in management response likely need to be communicated before as well as during an event, as effective outcomes may be dependent on how the communication in one period influences another.

Although the conceptual work on risk and crisis communication is strong, it is somewhat weak on actual empirical case studies. We supplemented this understanding with literature from wildfire communication research to develop an integrated natural hazard communication framework. We then used this framework in an empirical study of communication during wildfires in California, Montana, and Wyoming to understand whether approaching communication more holistically can lead to more desired natural hazard management outcomes. Our working hypothesis was as follows: Effective communication

both before and during the fire will be associated with acceptance of more flexible fire strategies during the fire.

1.1 Risk and crisis communication

Risk communication emerged out of the study of risk management, which was based predominantly on quantitative models of risk analysis and assessment (Plough and Krimsky 1987; Sellnow et al. 2009). Traditionally associated with environmental management, public health, and emergency management traditions, risk communication seeks to inform people about a potential future harm and the associated dangers so that they might take action to mitigate the risk (Seeger et al. 2003; Seeger 2006). Initially, a primary assumption was that the main issue was poor recognition of a risk and that official provision of information would resolve the issue (Kasperson and Stallen 1991: Fischhoff 1995). However, beginning in the late 1980s, this expert driven, technocratic model of risk communication was challenged when it was found that such a linear, unidirectional approach focus on providing official information to increase recipient awareness did not necessarily lead to action (Neil 1989; Tierney 1993; Fischhoff 1995).

Partially in response to this critique, two approaches developed to understand reasons why there were differences in risk perception: mental models and social constructivism. The first focuses on understanding how the mental model of the recipient differs from that of the expert in the belief that effective risk communication needed to better understand different ways people viewed risk (Morgan et al. 2002). Empirical evidence from this work suggests that risk communication messages that take into account differences in mental models are more effective in achieving general education goals, as well as encouraging action (Maharik and Fishhoff 1992; Bostrom et al. 1994). From this perspective, interaction and dialogue with those who face the risks may shed light on their mental models, including how these people view the risk and how these perceptions then relate to message targeting.

Social constructivists went a step beyond the mental model approach to assess the cultural and social context in which the risk was understood and communicated (Beck 1992; Heath et al. 2009). Message appropriateness for the given social setting and credibility of and similarity with those delivering the message was argued to potentially effect acceptance. Consequently, developing a plan that closely adhered to community conditions could contribute to effective risk communication. As such, social constructivist's focused on creating a process of risk communication and management with a greater emphasis placed on the importance of interaction among individuals, groups, and institutions (Slovic 1986; Witte 1995; NRC 1996; Chess 2001; Heath et al. 2002). Studies indicated that trust in the messenger was essential to receivers' trust in the message and that leveraging personal relationships that were credible with the public, including appropriate officials or authority figures, engendered greater trust in the information provided to recipients (Fessenden-Raden et al. 1987; Earle et al. 2007).

Thus, the goals of risk communication can include building trust in the communicator, raising awareness, educating, reaching agreement, and motivating action (Rowan 1991). Given these different goals, it is important for organizations to be clear about their purposes with respect to their risk communication effort. Thus, planning is seen as being at the heart of sound risk communication. Writing in 2000, Bier summarized the state of the art on risk communication and offered the following general guidelines for planning a risk communication message: (1) determine the purpose of the effort; (2) select a strategy that is appropriate for the given goal; and (3) take into account the characteristics of the

audience. More recently, Sellnow et al. (2009) identified the following nine best risk communication practices: involve the public in a dialogue about risk, present risk messages with honesty, remain open and accessible to the public, include risk communication in policy decisions, treat risk communication as a process, account for the inherent uncertainty in risk, design messages to be culturally sensitive, acknowledge diverse levels of risk tolerance, and collaborate and coordinate with credible information sources.

While risk communication focuses on preventing harm, crisis communication, which has its roots in crisis management and public relations (Williams and Olaniran 1998), focuses on communication during an event. Event centered and incident specific, it traditionally has focused on the message and how it is delivered during the event with an emphasis on the need to distribute accurate, timely, and useful information during an event (Seeger 2006). Recommended messaging often focuses on the current state of affairs or conditions, what is known or not known, and the status of the message deliverer, who is often an authority figure or emergency manager (Seeger et al. 2003). Recently, some authors have begun to broaden the scope of how to conceive of a crisis beyond the actual event to include pre- and post-crisis phases (Reynolds and Seeger 2005; Heath et al. 2009). In this manner, crisis communication scholarship has begun to overlap with the risk communication literature. Started as separate efforts, increasingly scholars have argued that effective disaster communication needs to be considered across all stages as part of an ongoing and integrated risk and crisis communication process (Seeger 2006; Reynolds and Seeger 2005).

Like risk communication, crisis communication also has identified its best practices. A panel of crisis communication experts helped categorize several best practices for crisis communication that highlighted the importance of the following: pre-event planning, treating the public as a legitimate partner, understanding and taking into account public concerns; working with credible sources, using honest communication that acknowledges uncertainties, working pro-actively with the media, and providing concrete actions people can take (Seeger 2006). Finally, Heath et al. (2009) identified partnerships with the community as key to effective crisis communication. These partnerships "…arise or are created to discuss, challenge, and make decisions relevant to prevailing risk and crisis tolerance, mitigation ability and communication practices" (Heath et al. 2009, p 125). In spite of the knowledge gained, putting these lessons into practice has continued to be a challenge (Palttala et al. 2012).

1.2 Lessons from wildfire communication studies: before and during an event

The specific context for the empirical study carried out in this article is wildfire. Therefore, we examined the wildfire literature for findings specific to effective communication before and during wildfire events. Many of the early studies related to wildfire call for improved public education about wildfire risks and greater levels of stakeholder involvement in risk management decisions (Cortner et al. 1984, 1990; Gardner and Cortner 1988; Beebe and Omi 1993). However, subsequent work on wildfires and other natural hazards has shown that simply receiving risk information does not necessarily lead to preparedness for wildfire as other factors besides risk perceptions come into play (Kumagai et al. 2004; McCaffrey 2007).

Using a mental models approach, Zaksek and Arvai (2004) examined how experts and non-expert stakeholders characterized risks and benefits of wildfire. Their research identified several areas where the two groups characterized risks and benefits similarly, but found other areas where significant gaps in understanding existed. More effective

communication, they argued, would be facilitated by creating opportunities to meaning-fully engage all stakeholders in risk management decisions such that the goal was less to educate stakeholders but to develop a more comprehensive understanding of stakeholder values and concerns as they related to fire management. These findings are supported in other studies (Gregory 2000; Arvai et al. 2001; Winter et al. 2002; Vaske et al. 2007).

Paveglio et al. (2009) leveraged a social constructivist approach in examining wildfire communication efforts. Their research revealed significant gaps between what the agency was trying to communicate and what the citizens living near wildfire threats heard and understood. Focus group participants emphasized a desire for more active participation with agency representatives, including pro-active, two-way communication and hands-on education opportunities. The authors also suggested that factors like frequency, reliability, and predictability of contact are desirable characteristics for facilitating better communication.

The role of local environmental knowledge in risk communication has also been the focus of research (Martin et al. 2009; Eriksen and Prior 2011). Eriksen and Prior (2011) contend that traditional risk communication processes do not lead to better wildfire pre-paredness because the varying ranges of natural hazards knowledge have not been taken into account. They suggest that we need to better understand the learning processes of individuals as well as how the community perceives its key risk characteristics and that interactive, two-way communication is essential in this context. Martin et al. (2009) provide additional support for how the effect of knowledge mediates risk perception. Their study of WUI homeowners found that higher subjective wildfire knowledge increased risk perception which in turn led to undertaking more risk reduction actions.

Toman et al. (2006) used the adult learning literature to investigate what kinds of communication strategies best facilitated measures to reduce hazardous fuels and improve forest health prior to a wildfire. They identified four broad theoretical principles about adult learning that frame expectations about what constitutes effective communication. First, adults tend to approach learning from a practical, problem-based perspective (Knowles et al. 1998; Merriam et al. 2007). As a result, communication programs that relate information to issues people are familiar with and that are relevant to their lives are expected to be more effective. Second, prior experience and knowledge shape how adults respond to information. Consequently, the degree to which participant experiences are taken into account will facilitate more effective learning. Third, adults tend to want to play an active role in information exchange. They want to learn from a variety of sources, peer, and expert, while sharing their own knowledge and experience. Consequently, outreach efforts where adults actively participate in information exchange are more likely to effectively engage individuals. Finally, trust in the process and the credibility of the information provider are important in effective information sharing and communication. Each of these theoretical principles are more likely to be appropriately addressed through interactive exchange, a notion supported by the study's finding that interactive commu-nication strategies were found to be significantly more helpful than unidirectional methods for learning about wildfire risk and management (Toman et al. 2006).

In recent years, studies have shown that a variety of factors can influence the acceptance of fire management approaches, including trust, consideration of local values, knowledge of conditions and practices, and understanding of management objectives and potential outcomes (Winter et al. 2006; Blanchard and Ryan 2007; Vaske et al. 2007; Martin et al. 2009; Toman et al. 2011; LaChapelle and McCool 2012; McCaffrey et al. 2012). Overall, interactive outreach efforts seem to be most robustly associated with acceptance and change in wildfire prevention and risk mitigation programs. Such interactive methods

encourage two-way exchange that can better promote understanding of the purpose and effectiveness of mitigation measures as well as trust in those implementing a practice, both items associated with greater acceptance of mitigation measures (McCaffrey et al. 2012). In a review of well over a dozen research studies that assessed wildfire information sources, McCaffrey and Olsen (2012) found that interactive exchange was the most consistently meaningful outreach method, with clear preferences across studies for one-on-one interactions, and that interactions with government personnel in particular appeared to positively influence assessments of information and risk mitigation activities. The review also found a clear preference for information that addressed local context and from local sources. Olsen and Shindler (2010) further emphasized that communication between citizens and the agencies responsible for fire management should occur before the fire, during the fire, and after the fire to facilitate building meaningful relationships. A synthesis of the wildfire literature highlighted the importance of open and transparent decision-making processes and found that good agency interactions with the public were important in acceptance of fire management activities throughout the management cycle (McCaffrey et al. 2012). A recent study of Community Wildfire Preparedness Plans also identified agency transparency in communication during preparedness work as a key factor associated with trust (Lachapelle and McCool 2012).

Relatively little research has taken place to document effective communication practices during a fire. The small number of studies that have been conducted suggests that communication dynamics are different during an event as the need to create some sense of control in a highly uncertain situation leads to greater emphasis on timely and locally specific information (Cohn et al. 2006; Taylor et al. 2007; Sutton et al. 2008). In an Australian community affected by bushfires, Sharp et al. (2009) identified several important during fire communication needs including the provision of accurate, timely, and reliable information; the ability for community members to ask questions of fire personnel; and the use of an interactive approach to information transfer. Taylor et al.'s (2007) research on the Old and Grand Prix Fires indicated that unidirectional methods of communication were most prevalent at the early stages of these wildfire events. They also found that official communication did not tend to focus on what was important to community residents but on what was salient to fire managers and that a consistent critique was the lack of site specific and up-to-date information. Kumagai et al. (2004) found that those who did not receive up-to-date information during the fire or had limited agency interactions either before or during the fire were more critical of how the fire was managed.

2 Common characteristics of effective communication

In triangulating between the risk, crisis, and wildfire literature, we identified five common communication characteristics (Table 1). First, interactive processes are consistently seen as a key communication characteristic as it allows for dialogue and risk clarification and can lead to better support for wildfire prevention interventions. Second, the literature cumulatively emphasizes the importance of taking into account local context. Considering contextual conditions from the perspectives of the participants, and relating explanations of action to why they are needed and how they will make a difference given local conditions, can facilitate understanding and action. Third, providing timely, accurate, and useful information, particularly during an event, in a reliable and honest manner was prevalent across the literature. Fourth, research suggests that the person delivering the information is important to consider. Credibility of the messenger can affect the acceptance of the

Table 1 Common characteristics of effective communication in risk, crisis, and wildfire literature

	Risk communication—pre-event, anticipatory	Crisis communication—during event, incident specific	Wildfire communication—before wildfire events	Wildfire communication—during wildfire events
Engage in interactive processes or dialogue	Interactive processes and dialogue among individuals, groups, and institutions help facilitate understanding of risk perceptions (Witte 1995; NRC 1996; Chess 2001; Heath et al. 2002; Palenchar and Heath 2002; Sellnow et al. 2009)	Plan and coordinate with community partners and first responders (Seeger 2006; Heath et al. 2009)	Interactive communication strategies can lead to better support for desired outcomes (Parkinson et al. 2003; Toman et al. 2006; Shindler et al. 2009; Eriksen and Prior 2011; McCaffrey and Olsen 2012)	Provide opportunities for community members to ask questions of fire personnel (Sharp et al. 2009)
Strive to understand the social context in which the threat is situated	Understand the social context of risk (Beck 1992; Heath et al. 2009); can help design culturally sensitive messages (Sellnow et al. 2009), which can then help effectively frame, present, and discuss risk content for audience (Bier 2000; Palenchar and Heath 2002)	Listen to the public's concerns to understand the audience (Seeger 2006)	Create opportunities to meaningfully engage in risk management decisions (Winter et al. 2002; Zaksek and Arvai 2004) to develop a more comprehensive understanding of values and concerns (Gregory 2000; Arvai et al. 2001; Vaske et al. 2007) and the broader social context in which residents are situated (Martin et al. 2009; Paveglio et al. 2009; Eriksen and Prior 2011; Lachapelle and McCool 2012; McCaffrey and Olsen 2012)	High levels of uncertainty during a fire create greater demand for information tailored to recipient's specific needs (house loss, need to evacuate, etc.) (Cohn et al. 2006; Taylor et al. 2007; Sutton et al. 2008)

Table 1 continued

	Risk communication—pre-event, anticipatory	Crisis communication—during event, incident specific	Wildfire communication—before wildfire events	Wildfire communication—during wildfire events
Provide honest, timely, accurate, and reliable information	Present risk messages with honesty; account for inherent uncertainties (Sellnow et al. 2009)	Distribute accurate, timely, and useful information (Seeger 2006) about the current state of affairs and what is known and not known (Seeger et al. 2003). Communicate with compassion, concern, and empathy, accepting uncertainty and ambiguity (Seeger 2006). Emphasize honesty, candor, and openness in message delivery (Seeger 2006)	Agency transparency in decision making provides trust in ongoing preparedness processes (Paveglio et al. 2009; Shindler et al. 2009; Lachapelle and McCool 2012; McCaffrey and Olsen 2012)	Accurate, timely, and reliable information are of particular concern during a fire (Kumagai et al. 2004; Taylor et al. 2007; Sharp et al. 2009)
Work with credible sources, including authority figures when appropriate	Credibility, similarity, and appropriateness of the message and deliverer can affect acceptance of message (Palenchar and Heath 2002); collaborate and coordinate with credible information sources (Sellnow et al. 2009). Leveraging personal relationships that are credible with the public including officials or authority figures if appropriate may engender greater trust among the recipients of the information (Fessenden-Raden et al. 1987). Trust is driven by shared values and confidence based on performance (Earle et al. 2007)	Status of the message deliverer is important. Collaborate and coordinate with credible sources (Seeger 2006); Authority figures or emergency managers deliver message (Seeger et al. 2003)	Active participation with agency representatives, including pro-active, two-way communication and hands-on education opportunities are important (Paveglio et al. 2009; McCaffrey and Olsen 2012). Frequency, reliability, and predictability of contact help build trust and credibility (Paveglio et al. 2009; Olsen and Shindler 2010)	Those with limited agency interactions before and during a fire were more likely to be critical of how the fire was managed (Kumagai et al. 2004)
Communicate before and during crisis	Integrate across pre- and during crisis stages, treat risk communication as a process (Seeger 2006; Heath et al. 2009; Sellnow et al. 2009)		Communication between citizens and agencies during each phase of the fire cycle can effect outcomes during another phase (Kumagai et al. 2004; Olsen and Shindler 2010; McCaffrey et al. 2012)	

message. Finally, working across the temporal gradient before and during the event so that relationships are leveraged over time was the last common characteristic associated with effective communication.

3 Study context and methods

In 2008, our research team traveled to three wildfires to better understand communication practices and how they related to wildfire management. The fires were selected based on the management strategies they used. The Gap Fire on the Los Padres National Forest used a full suppression (e.g., full perimeter control) strategy and burned nearly 9,500 acres in Santa Barbara County near the town of Goleta, California. This fire took place primarily on Forest Service land adjacent to a dense urban interface and had a complex interface that involved a large population base (180,000) and numerous government agencies and municipalities. Although the fire initially was fast moving leading to nearly 3,000 homes being threatened, in the end no homes were lost. More than $2 billion in real estate values were at risk and the fire cost more than $16 million dollars to suppress.

The Cascade Fire on the Custer National Forest used a modified suppression strategy (where perimeter control was applied on one side of the fire, while the other was simply monitored) and burned more than 10,000 acres near Red Lodge, Montana in Carbon County. Although it took place entirely on Forest Service land, the fire was jointly managed with the town of Red Lodge. The fire threatened a number of in-holdings, a local ski area, and several small subdivisions on the edge of the forest. The fire affected approximately 3,500 people, threatened 200 homes, and cost $6.5 million dollars. Five homes were lost.

The Gunbarrel Fire on the Shoshone National Forest used a wildfire use strategy that was eventually transitioned to a monitor, confine, and contain strategy. It burned more than 68,000 acres between Cody, Wyoming and the east entrance to Yellowstone National Park. This fire threatened 245 residences, several guest lodges, and closure of the main eastern entrance to Yellowstone National Park. More than 9,000 people in Cody, WY were affected by smoke. The fire cost more than $9 million dollars to suppress. Seven outbuildings were lost.

A purposive sample was used for this study. At each site, we interviewed key federal agency and local officials working on the fire as well as members of the affected public within the community. Individuals interviewed were selected to get a sample of the key agency actors involved in fire communication both before and during fire and of local residents. Prior to a fire, the main contact with a community about fire management is often the local Forest Service or the county or municipal entity in charge of fighting wildfire. In most cases, this would be staff, such as District Ranger or Fire Management Officer, from the Forest Service district office. In some cases, it will be a county official who works with homeowners to mitigate the wildfire risk on their property. When local resources are insufficient to manage a fire, a federal Incident Management Team (IMT) is invited in by the local Forest Service. The IMT is designed and trained to have the skill set and managerial capacity to manage large wildfires, but ultimately reports to the local Forest Service. The IMT and local Forest Service will work with local cooperators—such as the Sheriff, emergency managers, and local, county, or municipal fire managers—to deal with the fire. Interviewees are identified below as members of the IMT, local federal forest, local agency, or local community.

Members of the affected public were selected by convenience based on their attendance at public meetings, city council meetings, having a business or residence located in close proximity to the fire or along a primary information corridor. We attempted to maintain a parallel strategy for sampling the public in each locale. Nonetheless, contextual features in each study site made it impossible to replicate the processes identically. Consequently, differences in perceptions may be attributed to differences in who was sampled. To give greater validity to the perceptions that were documented, we triangulated based on archival material from the fire including local newspapers, Web sites, and official fire-related documents.

Each interviewee was systematically asked about pre-fire communication activities, during fire communication activities, and their perspectives on how the fire was being managed. We interviewed 11 federal agency representatives (IMT or federal local forest) and 12 community members (local agency or local community) for the Gap Fire; 7 federal agency representatives and 10 community members for the Cascade Fire; and 7 federal agency representatives and 9 community members for the Gunbarrel Fire. Community interviewees were divided into two groups: local agency representatives, those who had formal roles in the fire such as the local sheriff or fire chief, and community residents. Because we wished to use titles when reporting on this research, we could not guarantee confidentiality and our informed consent explicitly stated this. All interviews were digitally recorded and transcribed. Transcribed interviews were verified by interviewees. The qualitative data were subjected to systematic coding and analysis via Atlas.ti, a computer-assisted qualitative analysis software package. For coding, we relied on the methodology developed by Miles and Huberman (1994) for ordering and arraying data. An iterative process of identifying appropriate codes was followed. Data were first coded into three broad categories; (1) communication content and process during the fire; (2) communication content and process before the fire; and (3) adequacy of communication. These systematically identified quotes were then sorted into a matrix according to the five themes we derived from the literature about effective communication characteristics (See Table 1). This allowed us to assess the degree to which different communication characteristics were or were not present at each fire. We present these matrices in the subsequent analysis to illustrate how each fire did or did not meet the pre- and during fire characteristics for effective management.

4 Gap Fire findings

Communication activities on the Gap Fire were primarily unidirectional and included kiosks, radio, television conferences, and newspapers: Interactive processes were limited. The only interactive communication activities we heard referenced were to a local Forest Service call center, which was handling calls for three fires that were going on simultaneously on the Los Padres National Forest, and the actions of the IMT member assigned to work with local cooperators.

Community members described a number of communication problems during the fire including an overwhelmed call center, the main US Forest Service Web site for the incident going down, and power outages. "[T]he Los Padres Forest call center was completely and utterly overwhelmed. Totally ill-prepared to have three major fires established at the same time with one number" (Gap Fire, Local Agency Member F). A Los Padres National Forest employee recognized the limitations on their outreach efforts and how they were compromised by the power outages. "We would lose phones, we would

lose computers, we would lose lights, I mean everything. We're dead in the water, and the public would get a busy signal" (Gap Fire, USFS Member D).

Ineffective communication during televised news conferences was also an issue. "When the Forest Service gets up and says some of the things they say, which is really limited. They don't say very much. They hide behind their handouts" (Gap Fire, Community Resident A). One member of the public felt the communication effort was "insulting" because all the fire fighters and visiting officials thanked each other for 20 min before information about the fire was provided. Residents were frustrated because they wanted information about evacuation, and the information that was given was not specific or timely enough for their purposes. "…[T]he idea of having a two o'clock news conference was a good idea, but it came about a day late….but then how did you use it? You used it to tell people what you wanted them to know and to thank people. That isn't really the way you should work it" (Gap Fire, Community Resident I). A Los Padres National Forest employee in charge of the outreach effort concurred with this description. "I would say getting evacuation information…clear evacuation information out quickly that didn't need to be corrected a few times was the biggest challenge. The public was expecting better" (Gap Fire, USFS Member D). Nor did the information efforts appear to meet expectations for a more interactive communication. "…today's media scene…it's much more partici-patory because of the Internet. And yet there isn't access, you know, to the information nor to the exchange of information" (Gap Fire, Community Resident I). Another resident asked, "Why is the guy from Montana speaking to us?" suggesting that locals wanted to hear from people they knew understood the local context and who had greater legitimacy in their community.

One of the only positive comments we heard about communication during the fire was in relation to the IMT liaison's work with local cooperators. As a local agency repre-sentative recalled, "(she) treated us like we were part of the decision making and I was involved in a lot of the discussions" (Gap Fire, Local Agency Member G).

When asked about pre-fire communication activities, community interviewees primarily referenced information about defensible space that came from the local county fire department. A local Fire Safe Council was one way various residents interacted with local and federal agencies, including the Forest Service. At the inter-agency level, information officers from local and federal agencies including the US Forest Service had formed a group called EPIC (Emergency Public Information Communicators) that met monthly to talk about relevant communication issues such as media, law enforcement, public health, animal control, and fire. Although this was cited by local information personnel as helping facilitate communication between local agencies and the local forest before the fire, we did not find any evidence that these relationships were leveraged beyond the interagency level during the fire. Members of the local community characterized pre-fire communication efforts as being driven by the community rather than the Forest Service. "It's not that the Forest Service won't work with people. It's just that they don't reach out; you have to reach in" (Gap Fire, Community Resident A). This was confirmed by others, "it's us looking for [the Forest Service], not [the Forest Service] looking for us" (Gap Fire, Community Resident C). A Los Padres National Forest fire manager acknowledged the lack of presence in the community. "I think the Forest Service is not well known for the most part. We're not very visible in the community. We do have our supervisor's office in Goleta, but it's hidden in a warehouse."

As summarized in Table 2, only a few of the characteristics of effective communication were met and then only in a limited manner, as indicated by the plus and minus sign in the matrix. There was some interactive communication before the fire, primarily through the

Table 2 Gap Fire characteristics of effective public communication

	Pre-fire	During fire
Engage in interactive processes or dialogue to understand risk perspectives and how they might be addressed	+/−	+/−
Strive to understand the social context so that message and content can fit the appropriate circumstance	−	−
Provide honest, timely, accurate and reliable information	−	−
Work with credible sources who have local legitimacy, including authority figures where appropriate	−	−
Communicate before and during crisis to leverage established relationships	−	−

+ we found positive evidence of this characteristic; +/− we found evidence of attempts to fulfill this characteristic but not always with a positive outcome; −we found no evidence of this characteristic

Fire Safe Council, EPIC, and the County Fire Department. During the fire, there were two main interactive actions: a phone bank, which due to power outages, was compromised, and an active IMT liaison officer who received high marks. Information before the fire was narrowly focused on defensible space and did little to address local fire management issues. The local Forest Service was not perceived as trying to proactively engage with local agencies or the community before the fire. During the fire, information was not viewed as timely or reliable, and although information came from official sources, they were not seen as credible due to how the information was provided. Both community and local agency members suggested they wanted to hear from locally credible sources instead of people external to their community.

5 Cascade Fire findings

During the Cascade Fire, a number of interactive communication activities were undertaken. The IMT held multiple community meetings. At these meetings, the local forest employees, the IMT, and local agency officials remained after the meeting and answered questions for those who were unwilling to speak up within a broader audience. A call in number was established and staffed by a rotating group of local volunteers who were knowledgeable about the area. An IMT member worked with local government cooperators and organized a community tour of the Incident Command Post that 200–300 people attended. Daily briefings for the local stakeholders were held at the Incident Command Post and others from the public were welcomed to attend. Every morning, a detailed map and summary of the daily fire update were hand delivered to store owners to facilitate discussion and answer questions. Observed one Custer National Forest fire manager, "I think those meetings that [the IMT member] had every day with all the cooperators really helped. Those are members of the community and they are getting asked a lot of questions…" (Cascade Fire, USFS Member B). Traditional, unidirectional communication forms also were used, including the local radio station, which broadcast community meetings live; a local web page, which community residents remarked worked much better than the official US Forest Service web page for the incident; kiosks; and wildfire maps overlaid onto Google Earth, which were very popular.

Not only did the outreach efforts utilize multiple and interactive pathways, but we also heard positive feedback on the level of detail and transparency that was provided. Local

agency officials commented, "I didn't hear any [complaints]…they put out a lot of information that I think satisfied a lot of people" (Cascade Fire, Local Agency Member E). At the public meetings, efforts were made to communicate why specific decisions were being made. IMT members in charge of public information dissemination projected large images with Google earth maps to illustrate where the fire was headed. Cascade Fire Community Resident H emphasized how much he appreciated the forthright explanation of what was happening. "I appreciate blunt communication. I don't like being placated. I don't like being spoken down to. I don't like feeling like somebody's just trying to calm me down and make me go away. If it is serious, tell me it is serious, and they did and it was."

The local fire chief was invited to manage the fire in conjunction with the head of the IMT, even though the fire was entirely on federal lands. This had the dual effect of providing the community meaningful engagement in the incident while also having a local representative who could leverage personal relationships within the community. As recalled by a local official, the IMT and local forest wanted to work in partnership with the community from the very start.

> [IMT member in charge] is very community focused in terms of his team and the way he manages his team. There was recognition early on from him as well as from the [local Forest Service employee in charge] that the community was an important part of this fire. So by having that recognition early on and being in unified command from the second the fire started, it made that transition easier (Cascade Fire, Local Agency Member J).

The Custer National Forest employee in charge of fire management recognized the importance of leveraging the local relationships and capitalizing on the presence of the local fire chief. "[The Fire Chief] is a known person in the community. He owns four restaurants here in town. He's very active and engaged in the community" (Cascade Fire, USFS Member B). Efforts were made to integrate other locals into the response effort as well, including using a local map technician on the IMT and recruiting local volunteers to staff the phones when people called in for information. The Custer National Forest employee in charge of public outreach commented on the benefits of such efforts, "…[the IMT] were bringing volunteers in from the community, so getting them in place so that they know the area and using those folks to help communicate. That's awesome to do that, I think, bringing the locals into do that. So I think there is definitely interaction and collaboration" (Cascade Fire, USFS Member C).

When asked about communication before the fire, interviewees described the work the local forest, in conjunction with the county, had done in terms of working on fuel reduction projects and defensible space practices. The county had also worked on evacuation drills. Local Forest Service employees made efforts to work with the community prior to the fire, "… we've put years of effort, this district and fire management, …fuels projects, evacuation plans, fuels projects with the homeowners and cabin owners …, training exercises with the Rural Fire Department here in town" (Cascade Fire, USFS Member B). In turn, the community recognized the importance of these efforts.

> [The Forest Service] has gotten involved. We have people in our Forest Service who are part of our community as opposed to the revolving door….having had a District Ranger and a Fire Management Officer and resource people who were here for a long time, built that level of trust with the community (Cascade Fire, Local Agency Representative J).

Table 3 Cascade Fire effective communication characteristics

	Pre-fire	During fire
Engage in interactive processes or dialogue to understand risk perspectives and how they might be addressed	+	+
Strive to understand the social context so that message and content can fit the appropriate circumstance	+/−	+
Provide honest, timely, accurate, and reliable information	+/−	+
Work with credible sources who have local legitimacy, including authority figures where appropriate	+	+
Communicate before and during crisis to leverage established relationships	+	+

The Forest Service also made efforts to relate the challenges that would come with a big fire to the contextual conditions that preceded the fire.

> We have very interactive Forest Service. [Our District Ranger] is very visible. They do public speeches at the Service clubs. [He] spoke about the big blow down we had last November. [The District Ranger] was the speaker at all our service clubs last fall…maybe early spring, with a lot of pictures and again the information on how to defend any property (Cascade Fire, Community Resident G).

As summarized in Table 3, two of the characteristics of effective communication were met on the Cascade Fire before the fire, while two other characteristics were partially addressed. Local Forest Service employees worked with local county representatives to prepare for a wildfire. These efforts included evacuation drills with emergency management workers. These employees had legitimacy with local residents. Forest Service officials also have a presence in the community and these pre-fire relationships were leveraged during the fire. The other categories were partially satisfied. Interviewees alluded to how the local Forest Service worked with the local community and agencies, but the interview data did not speak directly to how they strove to understand the local context to improve communication efforts. Additionally, our data suggested that the local US Forest Service was communicating with the local agencies and community before the fire, but interviews did not specifically comment on the honesty, accuracy, timeliness, or reliability of these efforts. During the fire, all of the characteristics of effective communication were met. The IMT engaged in multiple interactive communication processes. They made efforts to engage with people at public meetings and out in the community to understand their perspectives. Interactive modalities of communication were supplemented with unidirectional methods. Efforts were made to explain why decisions were made. Community members felt these messages were honest and transparent. Local volunteers were leveraged who had an intimate understanding of the social context and could relay the message to others with an appropriate style and content. The local fire chief was a key player in managing the fire and played a dual role of providing local contextual information as well as legitimacy as a local authority figure within the community.

6 Gunbarrel Fire findings

During the Gunbarrel Fire, there were a number of interactive communication efforts. Both local forest employees and the IMT member in charge of information communicated actively with local government (sheriff, fire chief, emergency operations), so they could pass information on to local constituents. "…one of the local Forest Service guys-he called me at home a couple times at night telling me when they were going to do back burns and I got on the radio first thing the next morning and told what was going to happen[about their strategy for the next day]. So, they've just been very open and very forthcoming" (Gunbarrel Fire, Local Agency Representative A). Local forest employees also made one-on-one visits to residents who were most affected by the fire.

Three community meetings were held in different locations: one in Cody (20 miles to the east) and two near the District Ranger station for the lodge owners and cabin owners who were at greatest risk. At these meetings, the IMTs managing the fire made efforts to explain exactly how they were managing the fire and the decision points for taking different actions. "…[T]he [Incident Commander] that was here at the public meeting last weekend, or whenever it was, made it very clear that [the IMT] weren't going to put it out and made it very clear why they were doing it" (Gunbarrel Fire, Local Agency Representative D). The IMT in charge of information had local officials talk at the meetings. These officials from the local forest and local government agencies as well as from the IMT remained after these meetings to answer questions.

> I think [the IMT Public Information Officer] did a great job limiting each one of the speakers and allowing plenty of time for questions and specifically asking for questions, and then we all stayed there afterwards. [The IMT Public Information Officer] coached us all that morning: don't stand in a group in front with your arms crossed, mingle around, don't stand together while you are waiting to speak (Gunbarrel Fire, Local Agency Representative B).

In addition to these many different interactive communication methods, more traditional unidirectional communication efforts were employed, including newspaper coverage, kiosks, and radio. "I get emails from them all the time…it says 'fire updates, fire updates' you know" (Gunbarrel Fire, Local Agency Representative A). Individual e-mails were sent to everyone who put themselves on a mailing list to receive daily updates and maps.

Reactions to the communication during the fire were very positive. "The relationship between us and the fire– whether it be the Incident Manager and his team, was really good on this fire" (Gunbarrel Fire, Local Agency Representative D.) "…it's all positive, I think so far on the fire part of it. I can't say enough about how they've been forthright…" (Gunbarrel Fire, Local Agency Representative A). These sentiments were echoed by Gunbarrel Fire Community Resident E, "As far as information, I don't think you could beat what they put out. It was just superb, excellent information on a daily basis to everybody-absolutely everybody. And anybody who didn't get the information-shame on them-because it's posted all over …" The IMT member in charge of information recalled that the effort made by the Shoshone National Forest staff was distinctive.

> …[T]he Zone [Fire Management Officer], … the District Ranger, and … the Forest [Fire Management Officer], were all making personal visits to most of these lodge owners at least every other day. It was kind of amazing for us to get that much interactive involvement from a host agency. It's unusual. I remember one evening

calling one of the lodge owners myself, and she said, 'Yeah, that's what [the Zone Fire Management Officer] just told me. He's here.'

Part of the success of the communication effort was attributed to the ground work that had been laid in the years preceding the fire.

> This forest has worked exceptionally hard…and this started before I got here…to promote fuels treatments in and around our structures, residences, summer home groups and lodges, and informing people that this needs to be done because we are very susceptible to large fires on this forest… People are fully aware that fire is something that's likely to occur each summer in this part of the world because of the nature of our forests in this point in time. We've done a lot of work with them in fuels treatment, we have been preaching and teaching to the best of our ability the benefits of fire in lots of the areas of the forest (Gunbarrel Fire, USFS Member D).

This pre-fire work was two pronged: fuels work to decrease hazards around structures and educational efforts to help people understand what was being done and why. Fuel projects around residential, commercial, and recreational residences and businesses had removed 8-10 million board feet of hazardous fuels through both mechanical thinning and prescribed burns. At the same time, the county worked with property owners on defensible space in partnership with the local Forest Service. The cumulative fire management goal was to create opportunities for using point protection for private property, while giving the fire opportunity to move across the landscape. The Shoshone National Forest Supervisor felt confident in the approach:

> I went down to brief the commissioners [after the last fire], and one of those commissioners down there said, '….it's time to let this burn. If you've got the structure protection in place, it's time to let it burn.' It's kind of remarkable and it's a lot of work that changes that community dynamic. I think most people are ready to have it done (Gunbarrel Fire, USFS Member A).

In conjunction with the hazardous fuels work, local fire personnel (Forest Service and county) engaged in an effort to educate people, particularly property owners along the highway, about how a fire likely would be managed and why: Significant patches of dead and down timber from insect mortality meant conditions were ripe for a large fire and that a fire that was allowed to burn would be more ecologically helpful and serve local communities better than successive years of smaller fires that were immediately suppressed.

> …[W]e've really focused on the North Fork for quite a number of years. We took a number of trips up there and kind of explained on the ground what we were doing and why we were doing it. It seems like every year the newspaper comes in here and interviews us. We talk about the condition of the forest, and people are seeing the condition, and we're on the radio monthly. It seems like we are always getting questions about fires (Gunbarrel Fire, USFS Member E).

Local Forest Service employees worked cooperatively with local government, actively volunteered in their community, and held an annual picnic with property owners to ensure that they were visible and known to the people in the community.

> The Forest Supervisor and the District Ranger frequently meet with the Chamber of Commerce, with the County Commissioners. The District Ranger is on a local radio show at least once a month, and more often if we feel like there is something coming

up that we need [to get the word out about]. We do press releases when we think something is coming up that we want them to hear about from us first, so we do proactive outreach in person and throughout the media (Gunbarrel Fire, USFS Member C).

Although particular effort was given to the most directly affected community members, attention was also paid to communicating fire management information throughout the larger Cody population through a variety of channels. Two specific communication efforts are of particular note. Starting in 1989, the year after the historic Yellowstone fires, local schools began to implement a school-based fire education program.

…every sixth grader in Cody spends 2 days up in the mountains at a college camp. And one of the programs we do is on fire ecology. We do a half a day with each group on fire ecology. …And you know, the kids have been having that-the sixth graders since about 1989-so we have 25 year olds that may have had the program (Gunbarrel Fire, Local Agency Representative B).

More recently, a tour with local print media was organized to show the work that had been undertaken and to explain how a fire would likely be managed and why. This effort resulted in an article that was published in local newspapers, including the Billings Gazette, describing the issues discussed during the tour. The article was published on July 13, thirteen days before the Gunbarrel Fire started.

These pre-fire communication efforts seemed to pay off during the fire. "You know everything that I have heard, with very, very few exceptions is that the public understands. I think the Forest Service has done an excellent job the last few years on educating the public on the condition of the forest" (Gunbarrel Fire, Local Agency Representative B). This belief was reflected in our interviews with community members most of whom were well aware of the situation.

I think they laid out a picture of the future that is going to happen sooner or later because the conditions are all here, and that's one word you hear is the conditions. When the conditions are right, it is going to happen…When you get winds over twenty-five miles an hour, that's when things burn heavy and they move. That's a moving fire that sets crowning and all kinds of other things, and we learned about all these terms from the Forest Service too (Gunbarrel Fire, Community Resident E).

Some were not as pleased with wildfire use as an approach to manage the fire. Gunbarrel Fire Community Resident H commented, "Let it burn and bring it clear to the highway? It's like, huh? I think that really surprised me." And yet Resident H understood why the approach was being used: "…they talked to us before, and I went to the meetings, the fire meetings that we talked about, and the fuels mitigation projects…" So while Resident H was uncomfortable with the approach, he understood why it was being done and could accept it.

As summarized in Table 4, participants in the Gunbarrel Fire mentioned all of the characteristics for effective communication both before and during the fire. In particular, personnel on the Shoshone National Forest made great effort to reach out, explain, and relate to their local communities before the fire started. Years of communication work preceded the management strategies that were employed on the Gunbarrel Fire. Efforts to reduce vegetation around homes and to interact on a regular basis with residents and the broader public helped the local Forest Service employees understand how risk was perceived and what types of actions would be tolerated. Cumulative interaction over time

Table 4 Gunbarrel Fire effective communication characteristics

	Pre-fire	During fire
Engage in interactive processes or dialogue to understand risk perspectives and how they might be addressed	+	+
Strive to understand the social context so that message and content can fit the appropriate circumstance	+	+
Provide honest, timely, accurate, and reliable information	+	+
Work with credible sources who have local legitimacy, including authority figures where appropriate	+	+
Communicate before and during crisis to leverage established relationships	+	+

created credibility for the Forest Service when the fire came. During the fire, interactive as well as unidirectional efforts were employed. Forest Service and IMT members repeatedly reached out in person and on the telephone to those residents at greatest risk. They also made efforts to reach the broader community. IMT members worked with the local forest to understand the local context. Having been working with the local community on their pre-fire work, the local Forest Service was attuned to community concerns and how best to communicate within this local context. Due to the previous interaction, the Forest Service had credibility with the locals. The communication was perceived to be truthful and timely.

7 Discussion and implications

Managing natural hazards poses complex challenges. As societies evolve, the most appropriate response to the hazard often must also evolve. However, such shifts in appropriate response to a hazard, whether at the individual or at the societal level, are rarely straightforward: Closing the gap between desired practice and current practice requires effective communication. Although there is a significant literature on how to encourage mitigation before an event and how to communicate during an event, there is less work tying the two together or on how to communicate shifts in larger scale societal response to a natural hazard. In this study, we address how effective communication practices before and during an event are associated with a type of desired management change (more flexible fire management).

Leveraging the literature on risk, crisis, and wildfire communication allowed us to triangulate on common characteristics associated with effective communication across a temporal gradient. In general, the literature on risk and crisis communication drew more heavily from theory, while the wildfire communication was focused more on applied results in the field. Bringing these two aspects together strengthened the overall approach to understand what practices work best and why. Together mental models (Maharik and Fishhoff 1992; Bostrom et al. 1994; Morgan et al. 2002; Zaksek and Arvai 2004), social constructivist (Beck 1992; Heath et al. 2009; Paveglio et al. 2009), and adult learning theory (Toman et al. 2006; Eriksen and Prior 2011) provide more robust explanations for *why* some of the applied approaches, such as focusing on interactive processes with credible sources, can be effective. These approaches reduce uncertainty and give people a sense of control by providing timely messages via trusted messengers and in a format that takes into account adult learning preferences for active participation in information

exchange. The literature and our empirical data suggest that interactive communication that strives to address local contextual concerns, explain actions, and provide honest, timely, accurate, and reliable information while leveraging local relationships may be most effective, especially if the communication is conducted over a time span that precedes the crisis and carries into the event.

In addition to bringing practice and theory together, we wanted to understand how communication practices related to new approaches in wildfire management. Our findings support our working hypothesis: Effective communication before and during the fire is associated with acceptance of more flexible fire management during the fire. However, what our data suggest is not necessarily that effective communication leads directly to acceptance of more flexible strategies but simply that there is a relationship between effective communication characteristics and positive results, whatever the natural hazards strategy. The Gap Fire met the fewest number of effective communication characteristics both before and during the fire. It also had higher levels of public dissatisfaction expressed with the fire's management, despite the fact that it utilized a full suppression strategy, which as the more traditional response is often assumed to be the strategy least likely to cause dissatisfaction. The Cascade Fire satisfied two pre-fire communication characteristics and all of the during fire communication characteristics. It utilized a modified suppression/perimeter containment strategy and had few indications of dissatisfaction with communication. The Gunbarrel Fire met all of the pre-fire and during fire communication characteristics. We found little evidence of dissatisfaction with its use of the most flexible, and sometimes seen as more publicly controversial, strategy of wildfire use. Individuals who were not fully supportive of the strategy did not object because they understood why these strategies were being used. These findings suggest that effective communication before and during the event, while not determinative of the fire management strategy, may create opportunities for more flexible strategies to be utilized by fire managers and accepted by the local public. Additionally, the desire to use a strategy that is perceived as less conventional may lead to greater effort to communicate effectively ahead of the event, as well as during the event itself, to ensure it can be executed competently.

Theory helps explain why this may be the case. When new hazard management approaches are used, like more flexible fire management, taking greater care to work with affected publics ahead of the event can help clarify the social context in which the new approach will be situated. Striving to understand the social context in which the event is situated provides an opportunity to frame, present, and discuss the risks with the intended audience (Beck 1992; Palenchar and Heath 2002; Heath et al. 2009; Sellnow et al. 2009). Ahead of the event, interactive processes or dialogue can help people understand reasons for changing practices laying the ground work for better support for desired outcomes (Parkinson et al. 2003; McCaffrey 2004; Toman et al. 2006; McCaffrey and Olsen 2012). When using a more traditional response, like suppression, less attention may be paid to working with affected publics and understanding their social context because the approach is a known quantity and fire managers may assume they fully understand the social context.

Work ahead of an event to lay the foundation for using a more novel response strategy also may pay dividends for crisis communication during the event. During the event, the delivery of accurate, timely, and useful information with appropriate sensitivity may be easier if pre-existing relationships have already been established (Seeger et al. 2003; Seeger 2006). If those relationships have not been established, then creating them during the height of the event can be difficult and may result in trust issues. Theory suggests that working with credible sources during the event can be important (Seeger et al. 2003; Seeger 2006; Vaske et al. 2007; Olsen and Shindler 2010; LaChapelle and McCool 2012).

This kind of trust can come from two pathways—shared values and confidence in past performance (Earle et al. 2007). Without pre-existing relationships on which to assess values and or performance, the affected public is left making immediate, intuitive decisions about whether or not a new and unfamiliar approach makes sense.

It is important to qualify our findings. We investigated three very different fires in different geographic parts of the Western United States. Perhaps, most importantly, the Gap Fire, which experienced greater communication problems, occurred in a much larger and more heavily populated wildland urban interface, places where there may be significant challenges on effectively communicating with the diverse populations both before and during a fire. Smaller communities within a rural culture may be easier to reach. Additionally, the Los Padres National Forest faced two fires concurrent with the Gap Fire and their forest level resources were stretched thin. Clearly, different contexts make a difference in what is possible. Notably, the same IMT managed both the Gap and the Cascade Fires, which suggests that differences in local context, particularly actions taken before a fire starts, may matter more than the approach of the IMT in shaping outcomes. Recall bias also may be at play with perceptions of poor communication retroactively shaping perceptions of experience prior to the fire.

While our findings are qualified, we believe the work provides an important step in investigating an area where natural hazard-related communication research has paid little attention. The findings point to some communication characteristics that could be constructive in wildfire events. On a practical level, the matrix developed and applied to these three fires provides insight into steps land managers can take to ensure they are using the full range of constructive communication actions with their local cooperators and communities before a natural disaster strikes. Likewise, the checklist could help emergency responders evaluate whether they are working most effectively to communicate with local agencies and communities during a natural disaster.

Finally, using the checklist throughout the disaster cycle could facilitate any effort to shift large-scale societal response to a specific hazard. In particular, our findings linking the pre-fire communication work to the during fire communication work illustrates how ongoing efforts over the temporal gradient relate to the potential for greater flexibility in fire management. By setting the stage in the pre-fire period, fire managers and other personnel are poised to leverage their relationships during the crisis. Our qualitative data here are merely suggestive of these relationships. This area is ripe for more rigorous empirical testing and research.

In conclusion, effective communication is at the heart of better natural hazards management. In a world of changing climate, creative responses will be required to manage these threats effectively. Continual and interactive communication with the public about new strategies and the reasons for their use may help foster understanding and acceptance of the changes. Results from our study support risk and crisis communication scholarship that indicates that providing people with clear and specific information that takes into account local conditions can help minimize the inherent uncertainty of a natural hazard and in so doing help minimize potential dissatisfaction. While such continual communication does require resource commitments, our results suggest that these investments could be key to ensuring community expectations are reasonably aligned with future management directions.

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