Connected Through Crisis: Emotional Proximity and the Spread of Misinformation Online

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ABSTRACT
During crises, the ability to access relevant information is extremely important for those affected. Previous research shows that social media have become popular for rapid information exchange between members of the online community after crisis events. This study focuses on the effects of proximity to a crisis on information sharing behaviors. Using constructivist grounded theory to guide our inquiry, we conducted interviews with eleven people who used social media in the aftermath of the 2013 Boston Marathon Bombings. Salient themes emerging from this study suggest that both physical and emotional proximity to a crisis influence online information seeking and sharing behaviors. Additionally, speed of information sharing and information access renders social media especially useful during crisis and particularly susceptible to the spread of misinformation. We view the latter as a consequence of the inevitable sensemaking process that occurs as individuals attempt to make sense of incomplete information.

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Social computing; social media; crisis informatics; rumoring; misinformation; information-sharing; collective intelligence;

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INTRODUCTION
Widespread adoption of social media has enabled members of the public to participate in disaster events as never before. Affected individuals, emergency responders, and remote participants from all over the world are repeatedly coming together on these platforms in the wake of disaster events to exchange information, comfort and support.

Foundational research in crisis informatics suggests that these tools and the behaviors they enable have a large potential to improve crisis response [36]. However, there is also a significant fear of the downsides of public participation, including a perceived vulnerability to the spread of misinformation. Emergency response professionals continue to cite fear of misinformation as a primary reason for not integrating social media into their formal work practices [20,22], and mainstream media has repeatedly called attention to the role of social media in spreading misinformation after disaster events [19,26,28].

Rumor has always been a feature of crisis, an outgrowth of the "natural" sensemaking process that takes place after events as people try to construct meaning from often incomplete and imperfect information [2,9,41]. Researchers in social psychology have developed a thorough body of literature outlining the theory of rumor, describing the dynamics of rumor propagation and the human behaviors that factor into its transmission.

Less understood is how social media mediate, amplify or otherwise alter these dynamics. Several studies have examined the network dynamics of rumor propagation online [e.g. 39,51], and a few have attempted to look at the human behavior through the lens of existing rumor theory [4,34,44]. The vast majority of these studies focus on quantitative measures calculated using the digital traces of online activity. Indeed, preliminary research for this work relied upon digital traces of Twitter data collected after the crisis event to understand rumor propagation [46].

Complementing studies of trace data, this study relies upon qualitative methods to explore relationships between social media tools, crisis events, and rumoring behavior. We focus on public participation around the 2013 Boston Marathon bombings and the subsequent events related to the MIT shooting and manhunt through Watertown, MA. These events catalyzed massive participation online, including a great deal of misinformation [28]. Expanding upon previous research [46] examining the flow of misinformation on Twitter after the bombings, this study consists of interviews with individuals who used social media to search for and/or share information during these events.

We began with a goal to better understand the relationship between crisis events, social media, and rumoring. In particular, we were curious about the effect of situated physical proximity on the spread of misinformation online. More broadly, we were interested in evolving online

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information-sharing practices during crisis events and how those practices relate to rumoring behavior. From these initial questions, we used constructivist grounded theory (CGT) to shape our method of inquiry. Our findings describe a number of salient themes that emerged.

BACKGROUND: SOCIAL MEDIA, CRISIS & RUMORING

Our research began with generative questions surrounding the relationship between an individual's physical proximity to a crisis event and their social media behavior.

Social Media Use during Crisis

A growing body of research in the field of crisis informatics shows that social media use has become a consistent feature of the community response to crisis events [18,36,37,42]. These tools are being utilized by members of the affected public, professional media, and, increasingly, formal crisis responders [22,36,38], and their usage during crisis events is causing disruption to the traditional models of information transmission during such a time [23].

Rumoring Behavior during Crisis Events

Rumoring is a long-established feature of crisis events [41]. Social psychologists have posited that rumoring is a reaction to information scarcity and ambiguity [2,9], which are common characteristics of disasters; when information is scarce or ambiguous, people try to fill gaps in understanding by creating their own versions of truth. DiFonzo & Bordia define rumors as "unverified and instrumentally relevant information statements in circulation that arise in contexts of ambiguity, danger or potential threat, and that function to help people make sense and manage risk" [9, p. 13]. In these contexts, rumors serve as a method for community members to cope with uncertainty through collaboration to reach a common understanding [34, 41].

Rumors are often viewed as a negative aspect of crises, something that we should seek to minimize. Aligned with this view, Caplow [7] theorized that rumors emerge and propagate in the absence of official information, and that messages from formal channels should dampen rumoring behavior. However, others see rumor as part of the natural sensemaking process that occurs after a crisis event [41]. Proposing a more positive view of rumoring, Shibutani [41] characterizes rumor as improvised news—a collective activity to create and impart meaning. Similarly, Bordia and DiFonzo [4] describe it as collective problem solving or "social sensemaking." Sensemaking in this context is a collective activity to impose meaning on the available information and to agree on a common understanding of the situation. Rumoring can also be seen as a social coping mechanism [41] in which sharing information serves a cathartic purpose [12].

Rumoring via Social Media and Crisis Events

Several research studies have examined rumoring behavior on social media during disasters [e.g. 30,34,44]. Social media provide new opportunity to study rumoring through its digital traces [4], and may also enable new dynamics of rumor generation and propagation.

Online spaces are often viewed as particularly vulnerable to the spread of misinformation [26,28]. Some emergency responders cite misinformation as one reason for resisting the incorporation of social media into their work practices [20,22]. The negative view of social media may hold for the general public as well. In a study of source credibility after the Fukushima disaster, Thomson et al. [48] found Twitter and other social media were seen as less credible than other sources (e.g. newspapers, radio, word of mouth).

Some researchers and members of the media have contested the perceived risk of misinformation by claiming that the online crowd is naturally self-correcting [e.g. 30]. However, though researchers examining the spread of misinformation after the Boston Marathon Bombings found evidence of the online crowd identifying and correcting rumors, they also noted that the corrections had a smaller volume, and often lagged behind the misinformation [2]; therefore corrections propagated less broadly than misinformation.

The Role of Proximity in Rumor Behavior

Previous research indicates that physical proximity plays a role in information-seeking activities. For example, Thomson et al. [48] found that individuals perceived those who were proximate to a crisis event to be more credible, and Starbird & Palen [45] claimed that members of the public, especially those affected by the crisis, value local sources and locally relevant information.

For this research, we are interested in the effects of proximity on information-sharing behaviors—i.e. are those closer to a disaster more likely to share misinformation? In a study based on analysis of Twitter data, Oh et al., [34] found strong support for personal involvement in a disaster to be associated with the spread of rumors, and weak support for the feeling of anxiety to influence rumor-sharing behavior. Berger [3] demonstrated experimentally that arousal, both positive and negative, increases social transmission of information. Rosnow [40] noted that follow-up studies to the early rumor research show that personal anxiety also plays a role in rumoring behavior. Our study seeks to further explore this relationship between proximity and rumoring within the context of information-sharing via social media during a major disaster event characterized by high levels of anxiety and uncertainty.

Physical vs Emotional Proximity

Our initial research questions focused on the role of physical proximity to an event—the physical distance between an individual and the disaster event when it happened. However, our analysis revealed that emotional proximity—an emotional connection to people who were affected by a crisis or a sentimental association to the crisis location—was a significant factor as well. This distinction between physical and emotional proximity is akin to differentiations between "place" and "space."

Notions of online interactions are riddled with spatial and territorial terminology, such as "sites" and "cyberspace" [16]. These metaphors underline a distinction between the concept of *place*, the geographic location, and *space*, which provides a more functional view of situated-ness. Giddens [13] argued that place and space are also increasingly distinct concepts as technologies collapse the notion of distance. He termed this a "disembedding" of social systems, or "the 'lifting out' of social relations from local contexts of interaction and their restructuring across indefinite spans of time-space" [13, p. 21]. Extending this argument, others have described this phenomenon as the "death of distance" by noting how connective technology further expedites this disembedding [6,49].

Summarizing a variety of conceptual treatments of relationships between place and space in the context of information technology, Graham rejects the view that technologies cause social and spatial change—i.e. the notion that distance effectively "dies" or "evaporates"—as deterministic, opting instead for a relational view based on actor-network theory [16]. In this view space is neither dissolved nor transcended, but continually constructed through socio-technical interactions within virtual and physical contexts. This idea of the construction of space is important for understanding relationships between social media, physical and emotional proximity, and rumoring.

Event Background: 2013 Boston Marathon Bombings, MIT Police Shooting and Hunt for Perpetrators

This research focuses on social media behavior immediately following the April 15, 2013 bombings at the Boston Marathon and during the subsequent, related events.

The Boston Marathon occurs every year on Patriot's Day, a regional holiday in the Northeast U.S. On this day, families gather on Boylston Street to cheer on participants in the world's oldest annual marathon. For many, going to watch the Boston Marathon is a family tradition, and hundreds of volunteers sign up months ahead of time. To the Boston community, watching the Marathon is a treasured past time.

Memories of the 117th Boston Marathon are stained by the chaos and fear that ensued after two bombs were detonated at the finish line, killing three and injuring hundreds more. The bombings precipitated "100 hours of intense drama" as crisis responders and law enforcement quickly worked to simultaneously evacuate marathon athletes and spectators, conduct a criminal investigation, and protect members of the community from follow-up attacks [27].

Three days after the bombings, on the night of April 18, 2013, MIT police officer Sean Collier was shot and killed by the perpetrators of the bombing. After the shooting, a manhunt for the suspects led to a firefight in Watertown, MA, and a citywide shutdown the following day. Those in the area were instructed to stay indoors for personal safety.

The uncertainty surrounding the bombings, the police officer shooting, and the subsequent manhunt prompted massive online participation via social media. Within that discussion, several rumors developed and spread through social media and other channels. With the goal of helping law enforcement find the perpetrators, online volunteers combed through photos of the crime scene; this effort backfired when Reddit users infamously misidentified one suspect as missing Brown student Sunil Tripathi, a problem made worse when some traditional news outlets confirmed Reddit's detective work as truth [28].

METHODOLOGY

In this section, we offer a short description of how we used constructivist grounded theory to guide our methodological approach. Then, we discuss the participant recruitment process and give an overview of the data generation procedure.

Using Constructivist Grounded Theory For Social Media Research During Crisis Events

Grounded theory is a systematic qualitative research technique used to generate theories rooted in observation. Researchers who take a grounded approach allow theories to emerge from the data [15]. Several variations of grounded theory have been developed to support the array of flexibility required by researchers in diverse fields of study [11]. The constructivist approach employed here is a permutation of the classical grounded theory developed by Glaser and Strauss, and is popularized by the work of Strauss and Corbin [14,31,47].

Differences between the traditional approach and the constructivist approach appear in several aspects [8,31]. In particular, Glaser [14] of the traditional approach advocates that researchers should begin with as little previous knowledge as possible. In contrast, Strauss and Corbin of the constructivist approach argue that theories are interpretations made by researchers based on pre-existing perspectives. Following this constructivist approach, we entered the data collection and analysis phases with existing knowledge of relevant literature.

The core elements of the constructivist grounded theory offer an appropriate process to study the influence of disaster events on people's behavior on social media. The constructivist approach developed by Strauss and Corbin [47] is well documented with strategic methods of analysis that offer a high level of flexibility that befit our research requirements. Muller [32] points out that CGT is gaining popularity and usage by researchers in the CSCW and HCI communities. We chose to follow this approach for our study because we are exploring a subject area without a dominant theory, and our goal is to view the research question from various perspectives in order to gain a well-rounded understanding.

Participant Recruitment Process

To capture the richness and depth of experiences social media users encountered during the aftermath of the Boston Marathon Bombings, we adopted theoretical sampling for recruitment. To begin, we chose five Research Level 1

universities where affiliated members were likely to be varied in proximity to the crisis location yet situated in similar educational and social environments. These included MIT[1], another university in the Boston area, one in the U.S. Northeast, and two on the U.S. West Coast.

Researchers on our team are affiliated with each of these universities, which allowed us to identify opt-in email lists at each of the schools and contact the appropriate email list managers. We utilized several university-based list-servs to distribute a recruitment email with a link to a pre-interview survey instrument. We explicitly chose an email recruiting strategy rather than a social media recruiting strategy in order to avoid bias towards heavy social media users.

We received 151 responses to our screener survey, to which 57 expressed interest in a follow-up interview. After excluding survey respondents who indicated that they did not use social media to seek and share information during the event, we contacted the remaining participants to schedule an interview. Many of our follow-up inquiries were met with no response; we interviewed the eleven individuals who replied.

These interviews took place about one year after the event; thus, participants did not always remember their specific actions and thoughts concretely. To support them in remembering their own experiences, we provided facts about the event whenever the participants requested. Additionally, some participants chose to look back in their social media history as a memory aid during the interview.

Data Generation

In-depth, semi-structured remote interviews were conducted with eleven participants (five male and six female) through their preferred method of participation (one face-to-face, eight using Skype voice, and two using the phone). Participants were all affiliated with a university; most, but not all, were students. Interviews were 30-50 minutes long and were all recorded. Because the topic of discussion could be a sensitive subject for some, we gave participants the opportunity to stop the interview at anytime. We developed an efficient memoing method that captured all of the dialogue timestamps as well as contextual details that arose during the interview session. Afterwards, the interviewer transcribed critical sections using the timestamps on each interview memo from the corresponding audio recording.

ANALYSIS AND INTERPRETATION OF DATA

In analyzing the interview data, we used theoretical coding which enabled us to organize the interview transcripts and discover patterns from the data. Theoretical coding requires researchers to merge concepts into groups during the entire analysis process [11].

Stage 1: Open Coding

We began with an open card sort to collaboratively process five of the interview transcripts, placing every statement and observation from each interview onto a card, and then grouping cards together based on their similarities. Through this process, we generated a large set of individual categories. Using these initial categories as a guide, we double-coded the remaining six interview transcripts in a closed card sort, adding a small number of new codes for excerpts that did not fit into the initial categories.

Stage 2: Focused Coding

Next, we selectively combined smaller categories developed in open coding into higher-level categories, subdivided categories that were too large, and eliminated less useful categories. Through this process, we began to organize codes into larger, underlying themes. The themes salient to our research questions relate to the topics of information sharing, rumoring, and proximity to the crisis event. We present them in the next section.

FINDINGS

As often happens after crisis events [21,24], the 2013 Boston Marathon Bombings prompted a convergence of information seekers who were looking for the most up-to-date information. The interviews suggest that social media was a primary source for some of those hoping to find more information—five participants learned about the bombings through Facebook, three found out through Twitter, two through text alerts, and one through TV news.

Turning to Social Media after a Disaster Event

After a disaster event, one immediate need is information [37]. Participants in our study, both local and remote, converged onto social media to learn more about the situation, and many of those who were in the Boston area immediately after the bombing explained that the traditional news outlets did not have the updated, real-time, and locally relevant news that they were looking for.

Social Media for Real-time News

Alex (P9), who was flying into Boston on the day of the event, explained why he turned to Twitter for the real-time information he craved:

> *There wasn't a lot of news coverage because there's so much uncertainty. I remember at the Philadelphia Airport I was just sitting there trying to scrape Twitter as much as I could to get some idea of what was happening and piece together coherent narratives….I don't know if I would have had any information on the situation without that kind of stream.*

A perceived lack of information from traditional news sources after the MIT shooting also drove Emily (P6) to seek out news on social media. Emily was in her dorm room at MIT when she learned about the police shooting there:

[1] We chose not to anonymize MIT because several of the interviewees were at that university after the shooting of a police officer there, and this contextual information becomes vital for interpreting their responses.

I remember being frustrated I wasn't getting information about what was going on from the news outlets I usually go to. The first one I tried to turn to was the Times. That was when I really got frustrated. I want to know what's happening right now! I mean I know why they're doing it; it was because they had to verify all their information; but like it was really frustrating because stuff was happening now and they didn't have a story on it. So that's when I turned to Reddit for my main source of information"

Emily's comment indicates that she understands, on some level, the institutional constraints that the media face in meeting the expectations of a public now accustomed to receiving real-time news [33], but this was still a source of frustration for her at the time, and it led her to seek out information from other sources. Emily, along with another interviewee who lived near the event, eventually turned to Reddit as a source of continuously updating information.

Participants physically distant to the event—i.e. who were not in the Greater Boston area—also expressed that they found social media to be faster and more accessible than traditional news. Brianna (P3) was surprised at how quickly information about the event spread through Twitter:

…[Her friend's] friends started tweeting and I don't know how they got that information so quickly because it was maybe a minute, maybe a minute and a half after the first bomb and she was like 'wow my twitter feed is blowing up [about] the marathon' and we'd just heard something but we don't know what's happening.

Brandon (P4) who was at his office desk in Hollywood, CA at the time of the bombings shared a similar point, stating, "[Twitter] is so instantaneous, it was constantly refreshing."

Across eight of the interviews, the *speed of information transmission* emerged as a salient theme, both in the context of its benefits—in terms of using social media for real-time news—and its potential role in the spread of misinformation. We expand on this finding below.

Social Media for Locally-Relevant Information

Judy (P7), who was in D.C. when the bombs went off, had learned during a previous event that Twitter was helpful for getting crisis-related news, and turned to that site again:

I became active on Twitter probably in the last year and a half…mainly because there was something …like we had a tornado warning or something like that and I wasn't getting the information I was looking for as far as where we lived. So I went on Twitter and I just started using search trends and that's how I found out wow this is great and responsive that I can get the information that I'm looking for really quickly and it's like a customized information just for me.

This remark underscores two interesting points regarding the use of social media during disaster events. One supports previous research suggesting that disasters can lead to new appropriations of tools that, for some, are then adopted into information practices going forward [43]. The second point suggests that timeliness is not the only factor in the heightened utility of social media during disasters. The ability to access locally relevant, "customizable" news is another perceived benefit.

This idea appeared in other interviews as well. Michelle (P10), an MIT student who was returning via train to Boston from New York when she heard about the bombing, explained that mainstream news did not have the kind of information that she needed to make decisions:

I started looking and I just googled Bomb and Boston and Copley and a bunch of news articles popped up. They didn't have that much information. I was looking for… Were [metro] trains running? Is it safe to go outside? and Could I get from Boston to MIT? I just didn't really know where to search for that.

Max (P8), who had been at the finish line hours before the bombings, also wanted more than the news sources could provide. He explained that he wanted to find out more about what was going on in the community and how local groups were helping. To Max, social media was the best place to look for efforts to help the affected community.

These responses demonstrate that speed was not the only advantage that social media had over mainstream media for interviewees, but that getting customizable, locally-relevant information was important as well.

Trusting Friends and Locals

As social media channels become more efficient at supplying timely information than traditional media, those seeking reliable information online have to develop criteria for assessing and verifying that information.

Johnny (P1) was in Seattle, WA when he found out about the bombings. Having run the Boston Marathon previously, the news came as a shock. Additionally, he had close friends running in the marathon, and was worried. He used Facebook to get in touch with friends and to find out more about the unfolding events. He remembered seeing posts from acquaintances in the area, and explained that he vetted information based on the number of corroborating sources he could find. Three other participants also expressed that they use corroboration as a method to determine the truthfulness of information seen on social media sites.

Participants also reported vetting information through friends. Alex, who was in London during the event, explained that after the MIT shooting he turned to friends who lived at the scene for news updates:

Absolutely the stuff coming out of friends, or things being shared by friends…There were a lot of secondary sources from friends or friends of friends who were saying things like 'I can look outside my office and see this is taped up' or 'I can see there's this massive amount of police cars' etc. So that was the most verifiable and the most trusted information that was coming out.

Michelle also stated that she tends to trust her friends more:

People on my Facebook, they are my friends, they are my acquaintances that I trust, and um I doubt they would post some thing like that, especially during a time when there was a bombing at the finish line at the marathon. I don't think they would joke about things like that. I also did see a lot of people posting it, so that also confirmed it.

These comments indicate that trust is in some cases related to an emotional connection between the information-seeker and information-provider. This supports research showing that social ties increase trust in online communication [5].

Max claimed that his carefully curated Twitter following list assured that "worthy" information found him. He further explained that he believed first-hand sources near the scene to be more newsworthy than the mainstream media reports:

I wasn't looking at Boston Globe I wasn't looking for Boston Fox Affiliates. I wasn't looking for that. I was looking for either photos shared by individuals who were at the scene or near the scene at the time. Or tweets of individuals and then information from groups and what groups were doing to either help or spread information.

Several participants expressed that they place the most trust on sources that are physically close to the developing situation, a finding that aligns with research assessing source credibility during disasters through digital traces [48]. Brandon was clear on this point:

I trust people that were in close proximity to the situation. I mean they were there. The news people were just getting the information from those people. Getting the news from the source I feel is more accurate.

Alex also cited a preference for "raw info" from those on the scene as opposed to commentary from people who are not there. These kinds of comments, which were shared by seven of the interview participants, demonstrate a shift in trust—at least among the young-adults in this study—from journalists and mainstream media to social media users who are either physically close to the event, or emotionally close to the information-seeker.

Feeling the Effects of Physical and Emotional Proximity

For many interviewees, the events surrounding the Boston Marathon Bombings were a source of excitement, anxiety, fear, and/or sadness. Though we did not intentionally design the interview protocol to measure emotional impact, eight interviewees explicitly mentioned being personally, emotionally affected by the event. For example, Brianna was with a neighbor in her dorm, looking out the window, trying to figure out what the loud sound was:

Her room faces Boston, and it's right on the bridge connecting Boston to Cambridge. Right after it happened she was looking outside and there were hundreds of people running across the bridge. It was pretty scary.

On the night of the manhunt, Emily was afraid for her life when the policeman was shot on her school campus:

I was [src] really freaked out...what if they come into the dorm or something...I was much more personally freaked out than when I heard about the bombings.

Michelle remembers that parents and friends of those in the Boston area were very concerned and shared information on Facebook to show sympathy and pass along warnings. She also felt a sense of solidarity within the MIT community after the police shooting and during the manhunt:

I definitely think that when it's really close...like at MIT…I felt like a real community connection more than ever at this huge school. Like everyone was sharing all this on Facebook and posting all these sites.

Even among those not located in Boston at the time, many expressed an emotional connection to the event, some because they had lived there previously. A few noted a strong connection to the marathon itself, either because they had run it before or knew what it meant to the community.

Judy: *…The last thing that I did before I left my home was going to the marathon with my family in 2010. So it's like bringing back memories of my last memories that spring before we moved to DC and just realizing that totally could have been me. 'Cause I literally was standing with my family very close to where the first bomb went off (before I left). Every year I would go to the marathon, it was like a thing you do growing up in the Boston area…So it just kind of like put it in perspective 'like wow' and then it was scary like 'OMG are any of my friends affected?' and then just trying to find information and news. So it was emotional, scary for a bit there.*

For several interviewees, the emotional connection related to having friends or family that may have been affected. For example, Johnny was worried for his friends who were running in the marathon:

I had one really close friend and another two close friends running it…saw stuff on FB pretty early on [and] I posted on her wall to say "hey Cindy let us know if you're okay."

These emotional connections may have played a role in information-seeking behaviors in general and social media use in particular. Alex explained how social media helped him cope with the emotional impact of the situation:

There was this certain sense of violation. There's this great day...there's a sense of community around Patriot's day and there's a bit of violation. The information coming from social media was just something to prevent you from feeling paralyzed or completely useless. It was just something to hold on to. I think without social media the end result wouldn't have been anything different. But at the time, it gave me a coping mechanism. Having that direct connection to friends getting that immediate

response. That was new for me and just gave me a more personal connection to the events.

Not all of the participants were emotionally affected by or physically close to the crisis situation. Molly (P5) was in California when the bombings took place, and though she remembers being worried about the bombings being a terrorist attack, she was so far removed that she did not realize the MIT shooting was related to the Boston Marathon Bombings. Ajay and Mary shared similar sentiments. Often, these more distant (both physically and emotionally) participants did not remember the event details well, and explained that they were not as invested or interested in this event as they had been for other crises.

Mary explained that even though she does have friends in the Boston area, they were not affected by the bombings:

I was more interested in the outcome of that event than [the] wildfires currently going on in California because it's closer to home. But far less interested than I'd be say if let's say if it involved a personal friend, family member or was happening where I live or work now.

The Perception that Sharing Is Helping

Information about the Boston Marathon Bombings propagated quickly on social media as a result of users posting and reposting information that they thought was important. Four participants believed that sharing information would be helpful to others. Judy made this connection in a comment about her posting activity in general. Michelle remembered posting to her Facebook page telling family and friends where to find more information, indicating a motivation to help inform others. Molly expressed that the main reason she shared information was to inform her followers on Facebook:

I was mainly trying to inform the people 'cause I know I don't watch the news and I know a lot of my family members also don't watch. So I was definitely trying to reach out to them and show them the video that they probably would not have seen without the Facebook.

Max was extremely engaged with the manhunt because a close friend in Watertown was close enough to see and hear the activity. He remembers the increased flux of information on social media that he was actively passing along without worrying about being right or wrong. His main goal was to help his friend stay informed:

The night of the shootings…that was a flurry of information. It would end up being retweet this, reply about this, get new information and go back to the retweet and reply the 'no that's not right, it's this' and whatever. It was a lot of fast activity of trying to help people and help myself [and] everyone kind of get on a similar page about the information that was going on there.

Previous research examining the role of social media during live events has noted an inherent trade-off between speed and accuracy [33]. Max's comments suggest that some social media users are aware of this trade-off, even as they choose to optimize for speed.

Reflecting on Their Role in the Spread of Misinformation

As we noted in the background section, there was considerable misinformation propagating online after the 2013 Boston Marathon bombings. Previous research suggested that there were several types of rumors, including simple Internet memes like the photo of the young girl who was purportedly killed while running the race, conspiracy theories such as one about the Navy Seals carrying out the bombings as some kind of "false flag" attack, and—perhaps the most problematic—a widespread online effort to identify the suspects where the crowd drifted from digital volunteerism to digital vigilantism [46].

Initially, this study set out to examine social media behavior particularly as it related to the spread of misinformation and situated physical proximity to the crisis. Interviewees were asked specific questions about their memories of certain rumors. Few participants remembered any of the "Internet meme" rumors, and only one participant—who was not physically proximate to the event—recalled a conspiracy theory that she initially thought had some merit. A larger percentage recalled some of the activity around the search for suspects, though some had to be reminded about the incident before they recalled the details—including Johnny who later admitted to having shared rumors related to that activity via social media. Another interviewee referred to that sequence of events as a "witch hunt."

When asked to reflect on their own social media actions, some participants expressed remorse for some posts, and many offered explanations for why they might have spread misinformation. Johnny grew uncomfortable when we he began to reflect on his posts on Twitter. He said he felt guilty for contributing to the rumor that falsely accused Sunil Tripathi of being involved in the bombings:

I'm usually pretty wary with the stuff I post. I usually try to be certain about things. With this one…I even waited when I heard that…I waited till I was really sure. By the time I posted, everyone sounded sure. But it came out that it was not. But then they found out that he died right? I feel like I remember hearing that and it was really sad. I remember feeling really bad that I did that.

Max did not remember if he retweeted unconfirmed rumors, but he acknowledged that to be likely and commented on the sharing of information in a crisis event in general:

It was just the reaction … it was just part of the process of finding out what's going on. Then I corrected myself.

After Spreading a Rumor: Retract, Delete or Let It Be

Participants disclosed different strategies for dealing with existing posts to social media after they learned that they had shared a false rumor. While Max claimed that he would go back and correct the misinformation, Molly related that she would likely just "wait for it to blow over" or delete the

post without mentioning it again, "Because I don't like to be wrong. And I don't like people to know that I'm wrong."

Judy told us that she thinks she would have done the opposite, explaining that she cares about being credible. After mentioning that she did post something that she was not quite sure was true, she describes her likely actions:

Credibility is important to me. I would have gone back to retract it. You can't really delete it because it lives forever. That probably would've been worse than not doing anything.

This comment suggests that Judy believes deleting a tweet is not a good approach–i.e. it is worse than doing nothing–and that she would have gone back and posted a follow up tweet correcting her earlier post.

Reflecting upon her actions, including sharing some insensitive and unconfirmed posts, Molly said that she would do things differently in a future crisis:

I will not pass on any more rumors that are not confirmed, and I would be a lot more cautious about that and I think that whenever I do post I will send the actual link of where I did find the information.

These comments indicate that lessons learned about social media use during this event might lead to new social media behaviors in a future event.

DISCUSSION

This study explores the phenomena of information propagation online in the aftermath of the Boston Marathon Bombings and the subsequent manhunt for the perpetrators through interviews with eleven individuals who had used social media during those events.

Salient themes that emerged from these interviews suggest that social media sites—such as Twitter, Facebook, and Reddit—were used by some Internet users as primary sources of real-time news after the bombings and especially during the police chase after the MIT police shooting. When confronted with a 'flurry of information' online, study participants tended to trust information coming from sources who were 'on the ground' as well as from friends. Information that could be corroborated by several people was generally deemed more trustworthy. One motivation for sharing information on social media was to help others stay informed. Sometimes this resulted in passing along erroneous information; some participants experienced guilt and many chose to either retract their online posts or correct themselves to resolve their misinformed posts.

Aligned with existing theories about rumoring during disasters [e.g. 2,3,7,34], our findings suggest that the spread of misinformation on social media sites is a complex process that occurs within a short time period and is influenced by a range of social and psychological factors. This study raises concerns for understanding the nuances of how people's emotional and physical proximity to a crisis influence the spread of misinformation online and highlights areas for future research.

Emotional Proximity and (Mis)information Sharing

Though this research began with questions around physical proximity, through our CGT approach, emotional proximity emerged as a more salient theme. We define emotional proximity as a connection between a person and a disaster event. This connection can be mediated by an interpersonal connection, i.e. a close relationship with someone who is physically affected by a disaster, or through an experiential connection to the geographic location of the event. This feeling of connectedness is therefore both related to past experiences and integrated into the physical and virtual spaces where the event is unfolding.

Six interviewees shared stories indicating that they were personally affected by the bombings through a sentimental connection to the city of Boston, the annual marathon, or to a loved one who was in the area. One participant experienced heightened emotional proximity to the events surrounding the manhunt because a close friend was in the Watertown area that night. Another was shaken by the fact that he had run the marathon in a previous year—perhaps feeling, as Judy expressed, that "it could have been me."

From our study, we found that emotional proximity did not always correlate with physical proximity. Even for those who were in the Boston area, the intensity of emotional proximity varied somewhat according to sentimental connections that individuals had for the city, the marathon, and those who suffered through the traumatic event on April 15. Similarly, interviewees from within the MIT community expressed deeper emotional proximity to the MIT police shooting and manhunt (April 18–19) than those outside of that community.

This research suggests that emotional proximity affects the information seeking and sharing behaviors of social media users, and illuminates a role played by emotional proximity in the propagation of misinformation. This proposed relationship between emotional proximity and rumoring aligns with previous research that shows anxiety leads to increases in rumor sharing in general [40] and online [34], A few interview responses indicated that a heightened emotional state influenced their information sharing practices. For example, Max, whose friend was in Watertown during the manhunt, talked about the night of the shootings being a "flurry of information" where he and other members of the crowd tried to keep up, often having to correct previous information that turned out to be untrue.

Emotional proximity may also have been a motivating factor for some who wanted to help out. For interviewees in this study, helping out was often equated with passing along useful information "to make sure everyone's on the same page," as one participant reflected. These findings support previous research [12] showing altruism plays a role in interpersonal transmission of news. Unfortunately, the

public record of this event shows that online "help" also took the form of a public search for suspects that turned into a "witch hunt" and spawned several false rumors [28, 46]. Thus, it is clear that well-meaning contributions online can lead to the generation and propagation of misinformation, and it is likely emotional proximity plays a role in these phenomena as well.

These findings also suggest that social media offer a virtual space for those who are feeling emotionally proximate to converge, and—aligning with theories of emotional contagion online [1,17,25]—therefore likely contribute to a sense of emotional proximity. For example Alex, who expressed a sense of violation after the MIT shooting, saw social media as a collective coping mechanism in a crisis situation as well as a way to establish both direct connection to friends on the scene and a "personal connection to the events." His comments suggest that social media allowed him to experience a heightened sense of emotional proximity.

Thus, building upon Graham's relational view of space [16], we found emotional proximity for social media users during a crisis event to be a dynamic attribute constructed through online activity, through interactions in the physical "place" of a disaster event (before, during and/or after impact), and through perceived connections with others who are physically or emotionally proximate. Critically, these spaces where emotional proximity is constructed are also interconnected, and social media plays a role within each. Our research suggests complex interactions between social media use, emotional proximity, and rumoring behavior, though more in depth research would be needed to specify these relationships. Specifically, these results lead to dual hypotheses that social media plays a role in the development of emotional proximity, and that this emotional proximity has a mediating effect on the spread of misinformation during disaster events.

Evolving Practices around Information Sharing during Disasters

For this study, we recruited individuals who had used social media during the events surrounding the 2013 Boston Marathon Bombings, and selected participants based on those who remembered sharing and finding information online about the event as well. Therefore, it is not surprising that most of these interviewees had turned to social media as their first and main source for information—i.e. they learned about the event through social media and they continued to follow it primarily through social media.

Several participants commented that they thought social media were better sources than mainstream media, citing the speed and location—the ability to follow the real-time developments of the event from first-hand sources—as two major reasons for this preference. As Palen [35] has discussed, "hyper-temporality" and "hyper-locality" are critical value attributes of crisis information. Social media seem to align well with these value attributes because they can provide information in real-time, often from those located at or near the event. This information may be imperfect, but for many interviewees it was better than nothing. Especially for those who lived near the affected areas or had friends near those areas, hyper-local and real-time information was a necessity, and misinformation was "just part of the process."

In the long view of history and the development of practices around information sharing during crisis events, social media represent a nascent information/interaction space, where norms and rules are still being negotiated. Taken as a whole, these interviews describe an environment that can be characterized by rapid change, emerging practices, trial and error, and lessons learned. When asked to reflect, some interviewees shared lessons learned and intentions to behave differently in the future. We can also consider the more spontaneous public apologies on Reddit after the actual suspects were identified, and how the incident led to changed norms and even formal rules within that site to prevent future mishaps [50]. The visible discourse around these lessons learned suggests that we, as a public, are still in the process of establishing norms around information sharing in this evolving information space.

We recognize this evolution as a multi-faceted one. Our research findings provide evidence of a shift in trust from traditional news media to a more complex array of information sources. The social media users in our study are observed making decisions about source veracity based on mixed-measures of physical and emotional proximity—emotional proximity to the source and the source's physical proximity to the event. However, complications emerge as a result of these new behaviors. Where mainstream media was seen by interviewees as too slow, some participants acknowledged that social media was moving too fast, and that the constant influx of information contributed to the spread of misinformation.

From a more positive perspective, our findings also indicate that social media users are becoming savvy about social media use; they are establishing new norms, and learning through reflection—and to some extent public reprimand.

LIMITATIONS

This study has some important limitations. A substantial amount of time passed between the event and the interviews, which means that interview responses are likely subject to misremembering. Capturing the behaviors and emotions at the moment of the event may have provided a greater level of detail and accuracy. However, as researchers have noted in the past, real-time research is exceptionally difficult in the domain of disaster response [10,29]. And, while research on digital traces may allow for examination of a disaster event as it unfolds, trace data does not necessarily convey the whole picture. For example, the post-event accounts analyzed here include informed reflections that would be absent in real-time studies.

Additionally, the participant selection process likely produced a biased sample. We tried to recruit participants from communities in different geographical locations in the United States. However, individuals who responded to the screener survey were self-selected, resulting in a set of participants who may have been more personally affected by the event. In support of this observation, our recruitment efforts from universities near Boston resulted in far more survey responses than those distributed at less proximate universities. This means that the observations here are particularly valid for those who were emotionally connected to an event, but may be less applicable individuals with limited social media engagement.

CONCLUSION

The 2013 Boston Marathon Bombings and the subsequent events surrounding the search for suspects drew widespread attention from the local community and online crowd. This research focused on recollections of eleven individuals who used social media during that event. We used constructivist grounded theory to guide our study; this enabled us to gain deeper understandings of the insights participants gained during that event, the observed social media behaviors, and the motivations behind those behaviors.

We identified emotional proximity as a key factor in online information seeking and sharing behavior. Amidst the chaos of the bombings and after the police shooting, it was likely that the spread of misinformation was a natural derivative of the fast sense-making process; information traveled quickly between social media users at a time when their main concern was to develop a coherent understanding of the situation. The interviewees reflected on the importance of real-time, locally sourced information. Even though the information on social media was often unconfirmed, it became an important channel for the wider community to cope through the crisis and to develop a shared understanding of what happened.

The record of the events discussed in this study confirms that misinformation is propagating through social media after crisis events, an issue that many have come to view as a specific danger of online interaction. However, as Max pointed out during his interview and as rumor theory has long contended, misinformation is a natural byproduct of the community sensemaking process that has always occurred after crisis events. This research shows that social media users are aware of and are concerned about the transmission of misinformation online. Furthermore, we found that many individuals are reflecting on past information sharing behaviors and continuously refining their online actions to develop better strategies for handling future crisis events.

Because information sharing practices of social media users are changing rapidly, it is important to acknowledge and respond to the increasing importance of social media as a useful tool for those affected in a crisis. Currently, some crisis responders are averse to using social media in their formal work practices due to a perception of widespread misinformation [20,22]. However, these platforms are rapidly becoming a primary venue for information-sharing and sensemaking by those who are emotionally or physically affected by the crisis event. Despite the threat of misinformation—and *because of that potential*—it may therefore be vital for crisis responders to engage in and help shape the online conversation during crisis events.

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