"It's Raining Dispersants:" Collective Sensemaking of Complex Information in Crisis Contexts

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Abstract

Addressing crises sometimes requires grappling with sophisticated technical or scientific content. To make sense of the BP DeepWater Horizon Oil Spill people had to grapple with uncertain and sometimes contentious, complex information. This empirical study shows that an emergent, connected crowd interacted to surface, share, question and discuss these complexities. While studies have observed collective sensemaking taking place via social media in other kinds of crises, this study extends our understanding of emergent crowd work as collective sensemaking where members of the public assemble and interpret evidence on complex topics in a crisis context, perhaps performing a kind emergent citizen science.

Author Keywords

Crisis informatics, sense-making, citizen science, Twitter, microblogging, social computing, information diffusion.

ACM Classification Keywords

H.5.3 Groups & Organization Interfaces: collaborative computing, computer-supported cooperative work; K.4.1 Public Policy Issues; K.4.2 Social Issues.

Introduction

Rendering meaning of events is an essential task in crisis response. *Sensemaking*—the process by which people render meaning—has been the subject of several studies in the crisis space. During crises, people may work together to render meaning. Such *collective sensemaking* can take place among emergent groups of actors who interpret information together face-to-face [3] or remotely through social media [2, 9]. This study extends understanding of *collective sensemaking* in crises by describing how people used Twitter to render meaning of a complex and ambiguous topic in the course of an emergency that took place of several weeks.

The 2010 Deepwater Horizon Oil Spill is the largest marine oil spill to date, flowing for 87 days from April 20, 2010 and impacting four US states. In the immediate aftermath 47,000 people were involved in efforts to burn, contain, recover or disperse oil. The event was characterized by a great deal of uncertainty about possible oil impacts and strategies for alleviating those impacts leading to its description as a "giant experiment" [4, 10]. One example of the complex and ambiguous information at play concerned the application of two chemicals that disperse oil, Corexit 9500 and Corexit 9527, which were deployed in unprecedented amounts and applied in novel ways. Their use became controversial among both experts the public. We investigate how the public understood—and more importantly, *how the public came to understand*—the risks of dispersant use. Elsewhere we report on several characteristics of the overall #OilSpill information landscape [8]. We now link these empirical findings to a theory of what motivates the observed interactions—collective sensemaking—as it concerns a single complex topic, the use of oil dispersants in this disaster.

Data and Methods

Data include 693,409 tweets with the hashtag #OilSpill sent between May and August of 2010 by 132,075 unique Twitter accounts. We also examined the content of web links that were shared in these tweets.

Exploratory Analysis

Analyses were conducted in several iterations. These alternated between qualitative analyses on samples derived through different sampling and algorithmic analyses on the total #OilSpill set. In this way we gained an understanding of the overall themes present as well as the broad patterns of information behaviors in the overall #OilSpill set.

In Depth Analyses on Two Samples

We then conducted in depth analyses on two samples. One sample of 254 tweets is drawn from a single contested and ambiguous technical topic—the use of oil dispersants. These were randomly selected from 11,146 tweets (1.6% of the set) that contain a dispersant related keyword. The second is a random sample drawn the total #OilSpill set excluding the topic of dispersants (246 tweets). In total, we analyzed 500 tweets from 387 unique Twitter accounts. This sampling strategy is more likely to capture high-volume #OilSpill tweeters—i.e. an account that sent 1000 tweets is 1000 times more likely to be selected for our samples than an account that sent one tweet. Users in the two samples sent a median of 39 tweets while users in the total #OilSpill collection sent a median of 1. We also reviewed the content of all retrievable URLs linked in the sample.

The Material Data Safety Sheet for Corexit appear in the #OilSpill set hundreds of times in different versions along with many other technical and scientific documents.

Uncertainty Drives the Dispersant Conversation
Anxiety and uncertainty are known to be drivers of sensemaking activity [1]. A general theme in the #OilSpill conversation and embedded links is a sense of uncertainty about many topics such as the degree of impact and the merits of specific interventions. There is evidence that many members of the public felt that some information they were receiving could not be trusted. Dispersant-related tweets focus on a smaller set of themes, yet also show uncertainty about many aspects of the response specific to dispersants.

Dispersant-related tweets were much more likely to refer to human health impacts than tweets that did not mention dispersants (13% to 2%). In some instances, such as the tweet (above left) by a local individual in the impacted area concerned about her daughter's exposure to dispersants, a sense of personal distress is palpable.

Reducing Uncertainty by Assembling Evidence
Unfortunately for these concerned individuals, the scientific understanding of dispersant use appeared inconclusive and ambiguous, with subject matter experts presenting conflicting views on the safety and efficacy of their use. Among those who engaged in the dispersant-related thread in #OilSpill (a broad group including local, unaffiliated users; journalists; NGOs; and event-specific accounts), the response to this uncertainty appears to have been intense and sustained information sharing activities that involved assembling a wide range of resources.

Reliance on scientific source material and scientists
Dispersant-related tweets were more likely to have URL links. For example, the #3 most retweeted account in #OilSpill, @SaintsFan1, was highly active on the dispersant topic. Over 80% of her tweets contain links to external sites. In both tweets and links, dispersant-related content contains a surprising number of

resources developed for technical and scientific audiences such as academic articles, government reports and technical data sheets. Likewise those in the dispersant thread appeared to value the voices of a diverse set of scientists. While only 1 of 246 (.004%) tweets in our non-dispersant related sample mentions *scientist, researcher, chemist or biologist*, 16 of 254 dispersant related tweets (6.2%) do so. Looking at the titles of named individuals quoted or cited in tweets demonstrates an even stronger reliance on scientists. 46% of dispersant-related and 22% non-dispersant tweets mention or quote individuals or institutions with identifiable scientific credentials. These scientists were a diverse group with titles such as ocean and marine scientist, toxicologist, biologist, environmental scientist, chemist, geologist, and engineer.

Questioning, discussing, interpreting, engaging
Importantly, the social media crowd that assembled this diverse set of information resources also made efforts to interpret that information. Tweets and embedded links demonstrate that individual participants were cognizant of others in the information space and actively engaged each other. For example, @SaintsFan1 posed questions about dispersant use respectively to BP, official response, and the crowd at different times. She commented on the accuracy of information and attempted to dispel incorrect information. Within these processes individuals and the group at large defined their own goals and methods, similar to how digital volunteers have self-organized "crowdsourcing" efforts in response to other crisis events. These acts can be viewed as form of collective action. Over the arc of the event, it appears that the social media crowd who participated in the dispersant conversation became increasingly concerned about their impact—a convergence that suggests that the collective action and collective sensemaking did not resolve the ambiguity around the science but did lead to a convergent perspective on their use. Though both the crowd on Twitter and the official response turned to experts in order to understand dispersant use, the

"sensemaking trajectory" [5] of these two groups went in different directions with the crowd becoming less certain of their use and official response becoming more certain as time went on [4].

Collective sensemaking as citizen science?

Research in the emerging field of citizen science is demonstrating the potential for citizens to contribute to scientific studies through data collection and analysis [6, 7]. We posit that the collective sensemaking that took place around dispersant use can be viewed as an emergent form of citizen science. Motivated by a sense of concern regarding a complex and ambiguous topic, individuals responded with sustained and intense information sharing activities that both fostered and made use of a rich information space. Participants collectively assembled complex scientific information that was in turn provided by community members in the impacted area, journalists, researchers, the government and BP. Among these resources, scientists and scientific information quite literally were given high currency. These individuals also worked together to interpret the assembled resources. Performing as citizens, some attempted to engage stakeholders such as BP and response officials on the topic. These behaviors align with the patterns of emergent work in crisis contexts that have now been observed many times. This example extends our understanding of both the capacity and willingness for emergent participants to fill information gaps in crisis contexts which suggests a potential avenue for citizen science to take place as part of future crisis response efforts.

References

[1] Bordia, P., & DiFonzo, N. "Problem solving in social interactions on the Internet: Rumor as social cognition." *Social Psychology Quarterly* 67.1 (2004), 33-49.

[2] Heverin, T. & Zach, L. Use of microblogging for collective sense-making during violent crises: A study of three campus shootings. *J. of the Am. Soc. For Info. Sci. & Tech,* 63, 1 (2012), 34-47.

[3] Kendra, J. & Wachtendorf, T. "The Waterborne Evacuation of Lower Manhattan on September 11: A Case of Distributed Sensemaking." (2006).

[4] Khatchadourian, R. The Gulf War: Were there any heroes in the BP oil disaster. *The New Yorker.* (March 14, 2011) .

[5] Paul, S. & Reddy, M. "Understanding together: sensemaking in collaborative information seeking." *Proc. of CSCW* (2010).

[6] Rotman, D., Preece, J., Hammock, J. Procita, K., Hansen, D., Parr, C., Lewis, D., & Jacobs, D. Dynamic changes in motivation in collaborative citizen-science projects. *Proc. of CSCW 2012*, 217-226.

[7] Silvertown, J. A new dawn for citizen science. *Trends in Ecology & Evolution,* 24, 9 (2009), 467-472.

[8] Starbird, K., Dailey, D., Hayward Walker, A. Leschine, T., Pavia, R. & Bostrom, A. Social Media, Public Participation, and the 2010 BP Deepwater Horizon Oil Spill. *Human and Ecological Risk Assessment: An International Journal. (2014)*

[9] Vieweg, S., Palen, L. Lius, S., Hughes, A. & Sutton J. Collective Intelligence in Disaster: Examination of the Phenomenon in the Aftermath of the 2007 Virginia Tech Shooting. *Proc. Of ISCRAM 2008.*

[10] Winter, A. Gulf Oil Spill Creates 'Giant Experiment' in Marine Toxicology. *New York Times (*May 21, 2010).