Disaster Management as a Socially Distributed Information System

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Abstract

This paper traces the shifts in internet-enabled disaster response over the past eight years through the lens of Project EPIC's research in the area, from individual reactions and the emergence of 'virtual groups' to, increasingly, regularized networks of digital aid workers, providing insights into the future of emergency management practice and policy.

Keywords

crisis informatics; emergency response; social computing

Extended Abstract of Panelist Contribution

As documented by sociological research, members of the public have always played an essential role in disaster response—they are often in the "first responders" in disaster events, especially in the case of structural collapse (Dynes, 1973). People take into account the actions of others during periods of warning; disseminate information when they have it to share; provide food and shelter during and after events to neighbors; transport people to medical facilities when the emergency medical response system is taxed; support the needs of formal responders; clean up debris, and so on (Fischer, 1998; Tierney, Lindell & Perry, 2001; Tierney & Quarantelli, 1989; Kendra & Wachtendorf, 2003). However, this socio-behavioral phenomena is something that most federal-level emergency management policies do not take into account in their implementations; for example, some have argued that the US National Incident Management System (NIMS) does not adequately take into account what the capacities and these inevitable actions by the public (Wegner, Quarantelli & Dynes, 1990; Buck, Trainor & Aguirre, 2006). Rather, emergency management policies tend to focus on policing the far less occurring negative behaviors, creating an imbalance between plans and reality.

The general misconception of the true value of the public in disaster response makes it difficult to appreciate the digital-abetted behaviors coming from the public sphere (Palen, Anderson et al., 2010). The new visibility of actions by members of the public through networked computing makes the helper-oriented social behaviors even more apparent, to the point that to many, the behaviors seem new. However, the motivating behaviors that we see displayed on line are not new, but the kinds of hazards-related *tasks* that can be accomplished are (Palen, Vieweg et al., 2009; Starbird & Palen, 2011; Starbird & Palen, 2013). Though it is true that not all information produced by the public is valuable, this does *not* mean that *none* of it is valuable (Palen, Vieweg & Anderson, 2011).

The information stemming from the digital-abetted public sphere has moved from the simple posting of photos to Flickr in the aftermath of the Dec 24 2004 Indian Ocean Tsunami (Liu, et al, 2008) to include far more complex acts of multi-step problem-solving. In 2007 in the wake of the Virginia Tech shooting, students and concerned others collaboratively and accurately deduced the victim-status of members of their community in part through absence and presence in on-line forums, before the victims names were officially released (Palen, Vieweg, et al 2009). In the aftermath of the January 12 2011 Haiti earthquake, digital volunteer groups sprung up in the Twittersphere, after compassionate viewers around the world were motivated to help. They found a role in 'filtering' the vast amount of information on-line to make it more available to others and 'amplifying' important messages. They brokered needs to offers of help that they discovered on-line; and eventually worked together in more complex arrangements to distribute labor around innovative tasks, such as collecting cell phone numbers of Haitian Americans helping those on the ground and 'filling up the minutes' on their cell

phone plans to enable the work to keep going (Starbird & Palen, 2011, 2013). In a series of organizational transformations that model a form of emergence that Kreps and Bosworth (1994) describe, a subgroup of the Haiti "voluntweeters" went on to incorporate as non-profit organization (Starbird & Palen, 2013) who have continued to formalize what it means to be a digital volunteer. Also after the Haiti earthquake, a volunteer team from the budding Humanitarian Open Street Map Initiative mapped the country of Haiti so rapidly that it was able to directly support relief and humanitarian efforts (http://hot.openstreetmap.org).

Project EPIC—Empowering the Public with Information in Crisis—at the University of Colorado Boulder aims to theoretically and descriptively explain these new social-technical phenomena arising out of a changing information ecosystem. We have developed our methods for empirical data collection and analysis since 2007 (eg., Palen et al 2009; Starbird et al 2010, Sarcevic et al, 2012, Mark et al 2012), evolving expertise as the social media-abetted socio-behavioral phenomena itself has changed. The approach combines qualitative and quantitative investigation over a large number of data points. It is ethnographic in the sense that researchers are committed to knowledge about the domain of hazards from scholarly and practice-based points of view. We are committed to understanding not just *who* and *how much* one is publicly posting, but rather is concerned with the *whys* and *the means* in which people do this. We examine the connections between people, the transformations of information representations. In addition to data-driven exploration of very large data sets, we align socio-behavioral phenomena with social science theory, particularly with that of the sociology of disaster. Much of what we see exhibited in the physical world is exhibited anew online—including, for example, self-organizing behavior among spontaneous convergence of people and resources—though naturally with distinguishing characteristics that spring from the affordances of the on-line interaction medium.

The demonstration of the emergent behaviors from spontaneous on-line reaction; from virtual groups (both fledgling and mature); and, increasingly, a regularized network of digital aid workers who are developing sophisticated ways of interacting with each other and the global events with which they engage, are all rapidly pushing the discussion of what the future emergency management practice and policy should look like. The future institution of emergency management will adapt so that it can appropriately and safely operate in a more socially distributed information environment. The work of people researching, developing and practicing in the crisis informatics sphere is to *design that future*, with the closest of attention to ethics, effectiveness and sustainability.

Acknowledgments

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Regulate, or Adopt: Government Strategies to Social Media during Armed Conflict Crises

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Abstract

In this paper, we examine three strategies government might take in response to the citizen adoption of social media during crises caused armed conflicts. We analyze the case of three locations afflicted by the Mexican Drug War and their government's strategies to social media, and propose a set of guidelines for governments dealing with similar issues.

Keywords

crises; warfare; government; social media; twitter

Case Studies

The first case is a government that despite the heavy use of social media to report violence does little to regulate or to adopt it, seeing the emergence of a community of amateur reporters. This is the case of the state of Nuevo Leon, where despite rampant Drug War-related violence the local government has, for the most part, ignored social media as a vehicle for informing its citizenry about the violence. Coupled with increase mainstream media's self-censorship, the lack of information has turned many people into citizen journalists, some of whom become de facto war correspondents (Monroy-Hernandez et al., 2013).

The second case is a government that in response to the spread of misinformation decides to regulate it through legal mechanisms, possibly leading to a decrease in engagement on social media. For this, we examine the case of the state of Veracruz where challenges with trust and government regulation arise. More specifically, on August 25, 2011 at 11:56 AM, a Twitter user reported that five kids had been kidnapped at a school. The message was retweeted by twelve people, including an account with more than 5,000 followers. The rumor started to spread like wildfire. People spread the news through Facebook, e-mails, and text messages. By noon, only four minutes after the first tweet, the governor of the state of Veracruz tweeted that the rumor was false and asked people to disregard the reports. However, by then it was either too late, or the governor was not considered a reliable news source. Dozens of parents rushed to pick up their children from school, causing massive traffic, chaos, and panic across the city. Three hours later, the governor tweeted that his administration would go after those who spread the rumor charging them with terrorism. The same day, a state government website listed sixteen Twitter accounts involved in the rumor. By Saturday, two people had been arrested. Many "tuiteros" countrywide rallied in opposition to the arrests, jokingly calling themselves "Twitteroristas" (e.g., Monroy-Hernández (2011). After much pressure, the state government released the Twitter users but enacted a new law that penalizes the use of social network sites for spreading misinformation that might cause panic.

We found some evidence to suggest that the events of August 25 had a "chilling effect" on the level of participation in Veracruz. First, we looked at the people who tweeted with the Veracruz hashtag (#verfollow) before August 25. We then calculated their mean number of tweets (with or without #verfollow) per day before August 25 and compared it to their own mean after August 25. We found

that the mean dropped from 1.70 tweets per day to 1.23 (t = 14.3141, df = 1376.226, p < 0.001). More work is needed to see if perhaps this reduction could have been caused by a decrease in the violence itself or perhaps the use of a different hashtag.

The third case examines a government that adopts social media as an additional channel of communication and interaction with citizens, which succeeds to some extent in providing a hybrid citizen-government information ecosystem. Although several local governments have been reluctant to publicly accept the severity of the violence in their regions, others have turned to social media to deal with what they perceive as false rumors spread online. Some local governments have created Twitter accounts to connect with their citizens and report "risk situations", as the violent events are euphemistically called. Examples of this are the Attorney's Office of Coahuila (Vanguardia, 2012) and the city government of Reynosa. These governmental accounts are not without controversy; often citizens claim that these accounts stay quiet in midst of major events, while others have questioned the reliability of the information posted there.

An interview with the spokesperson of the Attorney's Office of Coahuila, who is in charge of the official Twitter account, describes the process of verification before he or his staff tweet an alert, which occurs within 5 minutes of receiving a report. The spokesman also encourages people to be more careful about their tweeting and even started a campaign on social media for "responsible tweeting", he explains: "It's very easy for some people [to] post things to social networks right away […] without firsthand knowledge, sometimes because they heard something from a cousin, or a nephew, or someone else. We cannot do that."

Conclusions

As social media permeates society, its role in armed conflict is poised to rise in prominence. From the Arab Spring to Occupy Wall Street, social media is one of the information platforms used in a wide range of moments. This will undoubtedly make it more challenging for different actors to assess the veracity of information on these platforms and put pressure on governments who were used to have full control of information. Based on our preliminary analysis we put forward the following recommendations for government officials to make productive and democratic use of these new technologies:

1. Broadcast prompt and relevant messages. Publish timely and relevant information related to public safety. Do not wait hours or days to release information that can help people avoid risky situations. Do not use social media only as another platform to publicize the administration's accomplishments.

2. Engage with citizens. Establish public channels of communication with curators and the public at large. Build relationships over time. Join public conversations, but expect criticism and push back. Social media is expected to be participatory, but governments often forget to interact with their audience. Plus, in Mexico's specific case, the traditional cultural relationship to government has not always been "participatory" in this way.

3. Avoid regulation of social media. Regulation is ineffective at reducing misinformation and has the side effect of dampening civic engagement. While well-meaning, government interventions often have unintended negative consequences.

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Crisis Research and the Limits of Social Media Datasets

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Abstract

The current focus on networked technologies in crisis informatics research has brought exciting new insights into how we understand communication during disaster events. However, there are limits inherent in crisis data which can produce particular kinds of analytical oversights. The use of Twitter data to reflect activity during a crisis event cannot account for the many communities that are either not using social media, or are living in areas where post-disaster ICT infrastructure is damaged or overwhelmed. Crisis data is sometimes used with an implicit acceptance of short timeframes, without accounting for the context that preceded a disaster or the long recovery period. Twitter data can reveal fascinating trends, but does not always take into account for the context of social media use by affected communities. We offer ways forward for studying "disaster data" that remain connected to critical histories of how disasters are understood and addressed, and suggest approaches to address current limitations.

[140]

Keywords

Crisis communication; disasters; crisis informatics; bias; differential vulnerability.

Extended Abstract of Panelist Contribution

The current emphasis on Twitter data as a source of insight on acute events cannot fully account for the many people and communities that are either not using social media, or are living in areas where ICT infrastructure is damaged or overwhelmed (Crawford 2013). Crisis events have always presented the difficulty of differential vulnerability: some communities and individuals are hit harder than others (Oliver-Smith and Hoffman 2002). Those who are older, less wealthy and not living in urban centres are less well represented, resulting in data that the geographers Crutcher and Zook observe is "colored by the fundamental divides pre-existing in society and in some cases can amplify them" (2009, 532-533).

Researchers in critical geography (e.g. White, 1974; Hewitt, 1983) and sociology (e.g. Erikson, 1976) and anthropology (see summary by Oliver-Smith 1996; Oliver-Smith and Hoffman 2002) have noted the problematic definition of a disaster as an unforeseen outside agent. Rather, a long trajectory of research has emphasized that the way disasters are understood is socially constructed. This is particularly evident when we consider the temporal framing of disasters: the interactions between state actors, NGOs and mainstream media to define the length of what Tierney describes as the disaster "event" (2007). Delimiting time around a disaster can often make it difficult to comprehend long term structural issues that make for a traumatic event, and to notice how long recovery takes. As two legal scholars make clear: "The aftermath of catastrophe is typically a drawn-out process of social reconfiguration in which different forms of legal intervention are used to shape a future that usually looks nothing like the pre-catastrophe past" (Sarat and Lezaun 2009: 5). After the attention of the public is a gone, the "aftermath" is when the hard work of attempting to rebuild "the familiar" occurs (Erikson 1976; Biel 2001). One needs to look for years, even decades after a disaster to understand its impact.

However, social media data looks at a disaster in a specific and often short time-period, typically defined by the spike or "burstiness" in Twitter messages (Burgess and Crawford 2011). This can make

it difficult to understand the causes of disaster and the entire period of aftermath where the impact is realized, further reifying problematically short-term conceptions of disaster. In this sense, analysis of social media during and after a disaster resembles the limitation of traditional media coverage, which has been often accused of paying attention to only the most sensational stories in a truncated timeframe (Button 2002; Sangari 2009).

Social media data sets focus on the aggregated responses of individuals and their reactions to events, alerts and public information. There is a need for a more critical account of the way in which different kinds of institutional disaster responders engage with communities, from local police, to FEMA, to groups such as Occupy Sandy. Many dynamics shape tweeting practice and institutions and individuals use Twitter to pursue goals that go beyond 'witnessing' an event. Twitter use is often described as performative (e.g. Papacharissi, 2012; Mariwick and boyd, 2012). Institutions or people who tweet about disasters 'perform' roles with predetermined ideas about the makeup of their audience (Chouliaraki 2013). Focusing on aggregated Twitter data can make it difficult to parse out the role of major institutions in defining a disaster.

More broadly, by expanding the lens of crisis data to include the wider ecologies of data generated by humans and code, and by considering who is and is not represented, we can see that single data channels are both narrow in capacity as well as skewed in particular ways. Social media data is always partial and incomplete. Our research attempts to grapple with how Twitter and other social media resources help different groups of people (including researchers) make sense of a disaster. As we consider the epistemological and ontological challenges with research using crisis-related social media data, we have observed techniques which help us attempt to address these challenges. These include placing social media-based crisis research within the wider historical and critical disaster research tradition, developing conventions for the ethical use of sensitive data, making explicit the biases in data, and using multi-disciplinary approaches to disaster research.

Critical approaches to disaster research have explored the "emergency imaginary" which reproduces the definition of a disaster as existing in a concentrated time and space as the result of an outside agent. Research that makes use of crisis data can aim to situate findings within these critical approaches. Additionally, augmenting crisis data with reviews of work that considers structural problems that underpin a disaster will add richness to analysis. Second, when people tweet or text, they may not intend for their data to be used in a research project, let alone be used months or years after the event. Internet researchers have a productive history of considering ethical research design. Ethical standards, like those developed by AOIR researchers, need to be discussed in conjunction with analysis such that widely agreed upon approaches are adopted.

Researchers choose the data they work with, and different research traditions have their own ways of documenting the interpretive moves that shape their datasets. We have techniques for cleaning data, incorporating (or removing) data from bots or parody accounts that need to be explicit to readers. As researchers, we need to consider the best practices to make explicit to other researchers and the general public what is missing in our datasets. Multi-disciplinary research groups are another way that epistemological limitations of social media datasets can be addressed, by bringing different types of data and analysis to bear on a research question. Research designs with methodological diversity have the potential to both take advantage of the opportunity to use social media data to learn about trends with acute events, but also to appreciate the context in which media is produced.

[963 words]

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Cumulative and Comparative Social Media Analytics for Crisis Communication

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Abstract

This paper draws on comparative analyses of Twitter data sets – over time and across different kinds of natural disasters and different national contexts – to demonstrate the value of shared, cumulative approaches to social media analytics in the context of crisis communication.

Keywords

social media analytics; twitter; natural disasters; methodology

Background

The sub-field of crisis communication research that is focused specifically on internet-based and mobile communication has moved through a number of distinct phases, roughly corresponding to paradigmatic shifts in or 'versions' (Allen, 2012) of web culture. For example, alongside the rise of 'web 2.0' as a concept and a set of practices, attention was paid to the role of citizen journalism and user-created content (like Flickr photos) in communicating about, witnessing, and responding to crisis events, from civil violence to natural disasters (Palen & Liu, 2007; Liu et al, 2008). The strong current interest in the use of 'social media' during such events is associated with the much broader uptake of platforms like Twitter, Weibo and Facebook, among others, as well as with powerful new approaches to accessing and analysing user-generated communicative data at high volume. These form part of a wider range of new research methodologies based around 'big social data' (Burgess & Bruns 2102). This has also opened up the field to a broader range of disciplinary inputs – from computer science to cultural studies – than was the case in the previous, more specialised phase of crisis informatics work (Bruns et al. 2012; Cheng et al. 2011; Cheong & Cheong 2011; Hughes & Palen 2009; Kongthon et al. 2012; Lotan et al. 2011; Mendoza et al. 2010; Palen et al. 2010).

Despite this significant shift in the volume and impact of the research conducted on social media's role in crisis communication, the field remains disorganised and disconnected: multiple research teams around the world are studying very similar topics and problems, using common data sources (such as Twitter hashtag data sets or the Twitter firehose feed) and remarkably similar sets of metrics, but with little sense of lateral coordination or cumulative theoretical development. Further, much of this research remains focused on individual case studies – of particular crisis events, in particular national or local contexts. In this paper, we contribute to efforts to move beyond 'snapshot'-style studies of individual incidents and to develop methodologies capable of identifying patterns – and departures from those patterns – across different kinds of crises within different contexts and constituencies, and across time.

There is in fact a standard set of metrics, while not commonly recognised as such, that can be and is being applied to the Twitter data associated with any 'acute event' (Burgess & Crawford, 2011). In our own research, we typically identify the following:

1. Key patterns of activity volume within the temporal space of a particular event and across events;

2. Key actors and their levels of individual activity, as well as the extent to which they are referred to, retweeted, and otherwise relied upon by other actors (that is, their visibility);

3. Key themes, topics and uses, and their rise and fall across the duration covered by the data set (informed by qualitative analysis).

Our work has focused particularly on geographically proximate natural disasters – including a series of cyclones and floods in Queensland, Australia (Bruns et al, 2012); and of earthquakes in Christchurch, New Zealand (Bruns & Burgess, 2012). The recurring nature of such disaster events in the same locations provides us with a unique opportunity to undertake a longitudinal study of the development of social media use in crisis communication contexts: we are able to compare a standard set of metrics for very similar events over time.

Three Examples of Cumulative and Comparative Analysis

Cumulative knowledge practices in the Christchurch earthquakes

The sequence of four major (M6-M7) earthquakes in Christchurch, New Zealand, from September 2010 to December 2011, and the recurring use of #eqnz (short for Earthquake New Zealand) as the central coordinating hashtag for Twitter-based discussion of these events, provides an opportunity for a unique longitudinal study of social media use in identical disasters affecting the same urban centre. Our analysis of the use of Twitter in these events shows the gradual development of an increasingly sophisticated network of leading Twitter accounts which provided crucial information during these emergencies and/or coordinated the dissemination of such information; however, it also documents how some actors were considerably more successful at establishing themselves as key information sources across all four events than others (Fig. 1). The same is true also for the #eqnz hashtag itself: while in the immediate aftermath of the first earthquake, a brief 'hashtag war' (Seitzinger, 2011) finally settled on #eqnz as the central space for communication, such debates were not revisited in subsequent events.
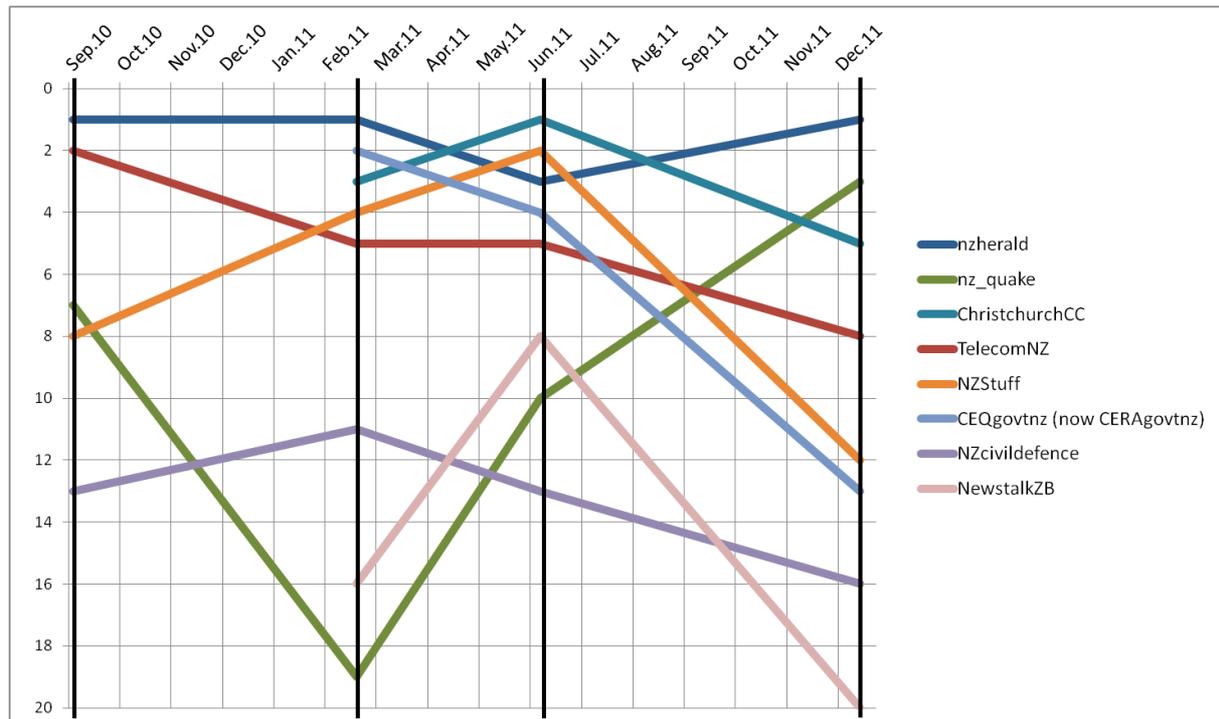

Figure 1: leaderboard of most visible accounts across the four #eqnz events, for selected leading accounts. (1 = greatest number of @mentions and retweets for that account in the data set for a specific earthquake event.)

Overall user activities also show a notable development in their sophistication from one event to the next; however, due to the more limited severity of the June and December 2011 earthquakes, and the substantially more limited interest from non-local Twitter users which results from this, these later events operate at a significantly lower volume than the earlier earthquakes. This should not be equated

with a decline in the importance of Twitter as an emergency medium in these contexts; rather, while the total number of active participants may have declined, it is likely that those who have remained are significantly more likely to have been directly affected by these subsequent earthquake events.

Comparing social dynamics across different natural disasters

Fig. 2 compares the most visible accounts (as measured by the @replies and retweets received) across the January 2011 south east Queensland floods and February 2011 Christchurch earthquake. It shows a considerably more diversified Twitter ecology for the Christchurch case, likely as a result of the experience of Twitter use in the preceding September 2010 earthquake; by February, a wide range of Twitter accounts representing local and national authorities, media organisations, and communications utilities are present and active. By contrast, the Queensland case is more strongly centred around one major authority, the Queensland Police Service's @QPSMedia account, and otherwise features a selection of media organizations only.
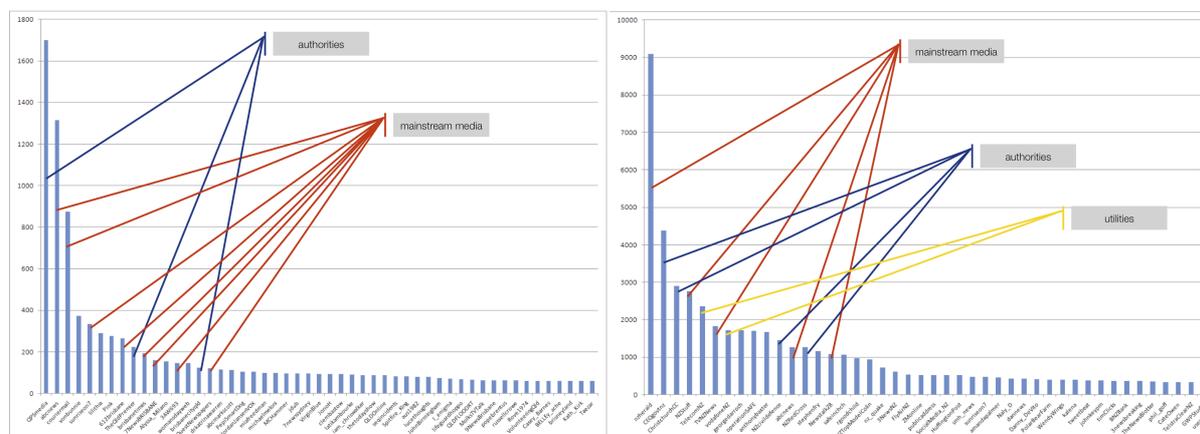

Figure 2: most visible accounts for #qldfloods (Jan. 2011; left) and #eqnz (Feb. 2012; right)

The identification of such influential accounts is important for a number of reasons. First, it provides direct feedback to the operators of such accounts – especially to emergency services organisations and other key information sources – on whether their social media activities are effective, that is, whether other Twitter users are seeing and responding to their messages. Second, especially from a comparative perspective it identifies gaps in the existing crisis communication ecology which may need to be addressed in preparation for future disaster events, especially if such events are likely to reoccur for geographic or climatic reasons – in the Queensland case, for example, the central role of the Police Service account highlights the comparative absence of Twitter accounts for Fire, Ambulance, or State Emergency Services as key sources of disaster information. Third, the correlation of these patterns of visibility with different disaster types also sheds light on the relative information needs of the general public across these diverse crisis situations, and can inform further social media communication strategies.

Comparing dynamics across multiple kinds of events

Fig. 3 compares two key metrics – the percentage of tweets containing URLs in each data set, and the percentage of direct retweets in each data set – across a wide range of hashtag datasets relating both to crisis and to other major events of recent years. At the centre of the graph is an obvious cluster of clearly crisis-related events, characterized by a substantial percentage both of URL tweets and of retweets. This cluster is clearly distinct from another cluster which represents widely televised political and entertainment events which feature few URLs or retweets.
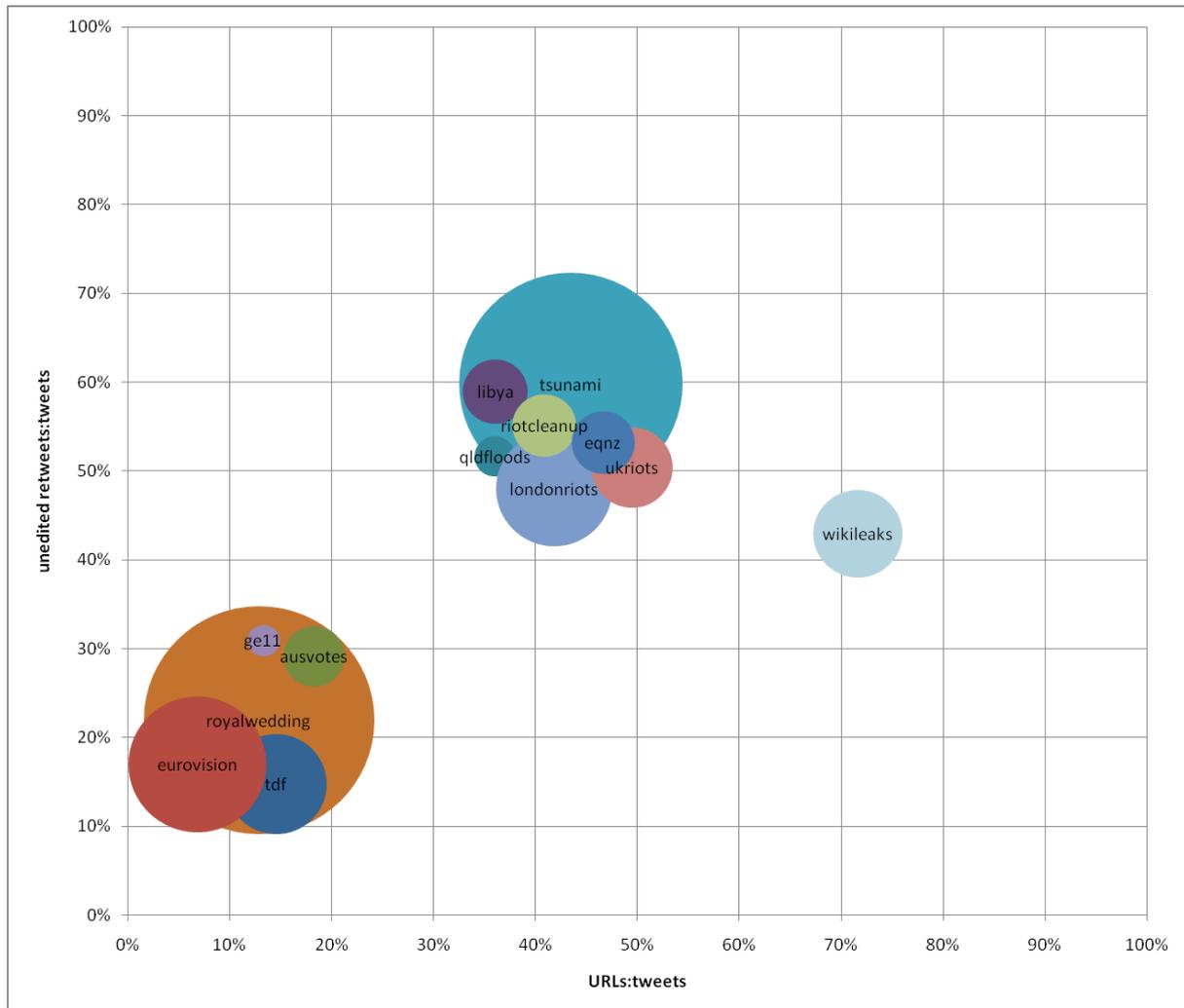
Figure 3: correlation between percentage of URLs and percentage or retweets, compared across several hashtag datasets. Size of circles indicates size of the overall dataset, measured in the number of tweets.

This preliminary analysis of only one of many possible correlations between the standard social media analytics metrics which Bruns & Stieglitz (2013) have outlined already points to the likelihood that there are relatively stable behavioural patterns in the responses of Twitter users to major events; such assumptions must be explored further through the addition of a greater number of data points to this study. If such patterns are indeed found to be stable, then, this may also aid in the development of early crisis detection mechanisms that build on Twitter data.

Acknowledgments

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