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# **CROWDSOURCING INVESTIGATIONS: CROWD PARTICIPATION IN IDENTIFYING THE BOMB AND BOMBER FROM THE BOSTON MARATHON BOMBING**

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## **ABSTRACT**

In this paper we illustrate the ethical dilemmas that arise when large public investigations in a crisis are crowdsourced. We focus the variations in public opinion concerning the actions of two online groups during the immediate aftermath of the Boston Marathon Bombing. These groups collected and organized relief for victims, collected photos and videos taken of the bombing scene and created online mechanisms for the sharing and analysis of images collected online. They also used their large numbers and the affordances of the Internet to produce an answer to the question, "who was the perpetrator, and what kind of bomb was used?" We view their actions through public opinion, through sampling Twitter and applying a sentiment analysis to this data. We use this tool to pinpoint moments during the crisis investigation when the public became either more positively or negatively inclined toward the actions of the online publics. We use this as a surrogate, or proxy, for social approval or disapproval of their actions, which exposes large swings in public emotion as ethical lines are crossed by online publics.

## **Keywords**

Boston Marathon Bombing. Crowdsourcing. Twitter. First Responders. Ethical Participation. Social Responsibility.

## **INTRODUCTION**

The purpose of this paper is twofold. First, we illustrate the ethical dilemmas that arise when large public investigations in a crisis are crowdsourced. We do this by highlighting the case of the bombing of the Boston Marathon in April 2013. Secondly, we employ a new tool, sentiment analysis of social media data, to bring these ethical dilemmas to light. We use this tool to pinpoint moments during the crisis investigation when the public became either more positively or negatively inclined toward the actions of the online publics. We use this as a surrogate, or proxy, for social approval or disapproval of their actions, which exposes large swings in public emotion as ethical lines are crossed by online publics.

Much discussion has been made about the potential value of bystander data contributions via social media to police and emergency responders (Palen, 2008; Starbird, 2010; Rizza, et al. 2012). Social media has allowed an unprecedented level of participation in crisis response and crime scene investigation, which helps facilitate the capturing and sharing of information, videos, and photos between officials, bystanders and interested parties.

What are missing or under-reported in this discussion are the questions of ethical behavior in investigations; media, as truth mediators; and social responsibility. We note the powerful role the traditional national and international media have adopted for themselves as arbiters of truth as they filter the products of these online discussions, then feed the results to the national stage. In addition, this online discussion, intervention, and action have had

significant real-world implications that demand socially responsible, careful, considered action for future emergency responders. The participants, both bystander and media, are participating in a policing investigation without the same training, constraints or awareness as officials have; however, despite that lack of training, these participants perhaps have more power and reach than official responders can obtain.

Our case study comes from the immediate aftermath of the Boston Marathon Bombing. We focus on the actions of two online groups, Reddit and Anonymous. These groups collected and organized relief for victims, collected photos and videos taken of the bombing scene and created online mechanisms for the analysis of images collected online (Stableford, 2013; Abad-Santos, 2013). Both groups created online mechanisms to share and analyze the data collected. They also used their large numbers and the affordances of the Internet to produce an answer to the question, "who was the perpetrator, and what kind of bomb was used?" The actions of these two groups were very much in the public eye, and made more so by the focus of the FBI and the national media on the first "crowdsourced investigation." Because these groups engaged in amassing data, marking-up the data, and proceeding to identify the potential perpetrators, we can now view their actions through public opinion. We do this through sampling Twitter and applying a sentiment analysis to this data. This window into public opinion can be seen as taking snapshots in time of the approval and disapproval of the actions taken by these online groups. We treat this disapproval as a measurement for crossing moral or ethical boundaries.

In the remainder of this paper, we will present a short summary of the events surrounding the bombing of the Boston Marathon and of the investigation. We present a review of literatures concerning the role of social media and crowdsourcing in crisis response, and of bystanders in policing investigations. We present our dataset collected from Twitter and the tool we applied to it. We end with our findings, which include the exposure of moments of ethical challenges during these investigations, and a discussion of the pressure and implications of these challenges.

## **CONTEXT: THE BOSTON BOMBING AND CROWDSOURCING TRENDS**

On Monday, April 15, 2013, at 2:49 PM, the Boston Marathon was abruptly terminated when two bombs exploded 210 yards (190 m) from the finish line. These bombs killed three people and injured an estimated 264 others (Kotz, 2013). At least 14 people required amputations as a direct result of the blasts. Police, following emergency plans, diverted the remaining runners away from the finish line to Boston Common and Kenmore Square (LaGrone, 2013). The Massachusetts Emergency Management Agency suggested people trying to contact those in the vicinity use text messaging, instead of voice calls, because of crowded cellphone lines. Cellphone service in Boston was congested, but remained in operation, despite some local media reports stating that cell service was shut down to prevent cell phones from being used as detonators (Waldman, 2013). Within hours of the initial event, the FBI called for bystanders to share images and video of the bombing (McCullagh, 2013). Images came pouring in, and within three days, the US Federal Bureau of Investigation (FBI) released photographs and surveillance video of two suspects, Dzhokhar and Tamerlan Tsarnaev. It was unprecedented, but also predictable, that the FBI decided to crowdsource parts of its investigation into the Boston Marathon Bombings (McCullagh, 2013).

It was predictable because the technology available to the public allows it to be used in conjunction with existing forms of crowd-based help. The idea of the police seeking help

from the public during an investigation is by no means new. The earliest examples of public help are through police wanted posters. These wanted posters lead to crime tip lines, especially as telephones became more readily available, followed by television-lead call-in shows such as *America's Most Wanted*. Traditional tip lines call for the public to provide help regarding the identification of an individual based on a description or image, or to help identify elements of a crime. In the spirit of a new type of tip line, the FBI initially asked bystanders to contribute photographs and videos of the marathon in order to find better images of the suspects (McCullagh, 2013). This hybrid tip line and data repository worked well – thousands of photographs and short video clips were submitted to authorities. The practice of average citizens reporting on activities “on-the-ground” during a disaster is seen as increasingly valuable (Palen & Vieweg, 2008; Palen, et. al., 2009; Terpstra, 2012; Vieweg, et. al., 2008).

With the advent of the Internet and the maturation of social media, the ability to ask for help from larger and larger crowds has followed. The Internet had already begun to change official investigation by serving as a central hub of information that could allow responders to survey all relevant data from nearly anywhere in the world at any time. Data produced through social media has further influenced this change as these data are seen as more ubiquitous, rapid and accessible (Vieweg 2010). It is believed to empower citizens to become more situationally aware during disasters, and coordinate to help themselves or others (Perng, et al., 2013; Palen, et. al., 2010). There have been several noteworthy uses of social media by policing organizations that have led to arrests. For example, when investigators sought information about rioters in Vancouver in 2011, they received 5,000 hours of video from the public, which helped them find suspects (Marx 2013). An annual survey conducted by the International Association of Chiefs of Police found that in 2011, 40 percent of agencies were using social media to solicit tips from the public. In 2012, that percentage jumped to 56.8 percent (Glynn 2013). While this degree of adoption is significant, there has been little uptake by official responders and organizations to use social media (Tapia, et. al 2011 and 2013); however, after the Boston Marathon Bombing, this may no longer be the case. The Boston Bombing became a unique scenario because it was the first time crowdsourcing itself gained a degree of consciousness that allowed it to obtain a significant degree of communicative and investigative power.

What has typically been examined with regard to online bystanders could be described as “what are these groups doing?” Starbird and Palen (2012) reported that certain characteristics of crowd behavior could act as a collaborative filter for identifying people tweeting from the ground during mass disruption events in Egypt. Starbird, Munzy and Palen (2012) also examined the Occupy Wall Street movement to demonstrate the power of crowd-based action. However, in neither case did they see the crowd as a coordinated group effort, but as an analogue of the physical crowd itself. Starbird and Palen (2012) do discuss the emergence of what they term “remote emergency operators” via social media, but not in the capacity of crime solving. Munro (2010) discussed data collected during the earthquake in Haiti, and processed by online groups such as Ushahidi and Crisis Mappers. Ushahidi is an open-sourced, interactive platform for information collection, visualization, and mapping. Crisis Mappers is an online volunteer taskforce that provides ad hoc mapping needs around the globe during a crisis event. Each of these groups used a combination of crowdsourcing and computational techniques to collect relevant social media data, process and categorize the data, and plot the data on a map for the responding organization. While these online groups are examples of coordinated volunteer crowdsourcing, they are directed at humanitarian action rather than truth seeking, investigation, or collective crime solving.

## METHOD

Researchers have demonstrated the power of social media via the diffusion of news-related information (Kwak et al., 2010; Lerman and Ghosh, 2010). With the history of public participation of police investigation summarized above, a practical concern is that the web can facilitate, or exacerbate, crises by spreading misleading information at an incredible speed (Gonzalez-Herrero et al. 2008). News about a crisis can spread quickly and has no boundary or restriction (Bucher, 2002). There have been several studies recently that directly studied the propagation of information through microblogging. For example, in recent work by Mendoza, Poblete and Castillo (2010), it was found that immediately after the Chilean earthquake of 2010, there was significant evidence of the propagation of false statements on Twitter.

Each of those studies examined their data through a variety of means, but none have managed to unify the interrelation of the media, emergency responders, and social media bystanders. As such, we are interested in the phenomena of virtual bystander participation in emergency response situations through social media as it relates to the traditional media.

We chose Twitter as our data repository, and conducted analyses of tweets sent during the Boston Bombing. These data were scraped from the public Twitter search API using the hashtag #prayforboston, Boston, bomb, and bombs. There were approximately 23,642,905 tweets – that accounts for nearly all tweets posted between the dates of April 15 and April 25 about the Boston Bombing. We chose to investigate specifically how people responded to the activities of Reddit and Anonymous, online groups that sought to position themselves as investigating and crowdsourcing hubs or authorities.

### **Our research questions are:**

#### **RQ1- How does public opinion of online groups engaged in the Boston Marathon Bombing investigation vary over time?**

We measure public opinion via public Twitter conversations. We measure public opinion via sentiments (positive/negative and intensity) expressed concerning the investigating groups.

#### **RQ2- How do moments of rapid sentiment change in public opinion identify ethical challenges regarding crowdsourced investigations?**

We identify and explore the moments in which the emotional quality of online discussion regarding the online investigators changed. We find that these are moments in which ethical dilemmas are presented to online publics.

### **Sentiment Analysis**

Sentiment analysis has been widely researched in the domain of online review sites with the aim of generating summarized opinions of product users about different aspects of the products (Pang & Lee, 2008). However, there has been little work focusing on identifying the polarity of sentiments expressed by users during crisis events (Nagy, et al. 2012). Identifying sentiments expressed by users in an online social networking site can help understand the dynamics of the network; e.g., the main users' concerns and panics, as well as the emotional interactions among members.

Through this research, we seek to find mechanisms to automatically classify the

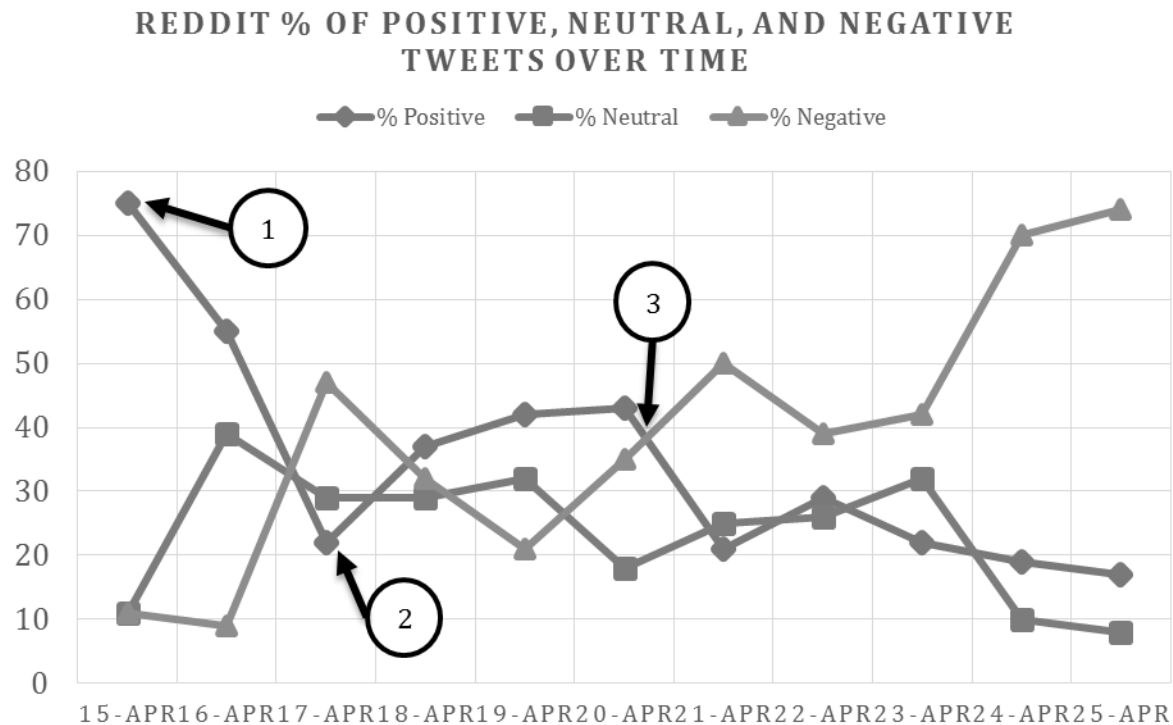
sentiment of users' Twitter posts during the Boston Marathon Bombing. Specifically, we formulate the problem as a classification problem, and use supervised machine learning approaches to classify a post, or tweet, into one of the following classes: positive, negative or neutral, based on the polarity of the emotion expressed in the tweet.

The sentiment classification of tweets faces many challenges, including dealing with very short texts; e.g., a tweet is, at most, 140 characters in length and contains unstructured text and noisy user input, like "ole" instead of "old," or acronyms, "smh." In this paper, to detect the sentiment of tweets, we propose to use a combination of bag of word and sentiment features, such as emoticons, acronyms, and polarity clues, as the feature representation provided for input to machine learning algorithms.

There have been very few works on identifying the polarity of sentiments expressed by users in social networking sites during disaster-related events. Nagy & Stamberger (2012) focused on sentiment detection in Twitter during the San Bruno, California gas explosion and the fires from September 2010. They used SentiWordNet to identify the basic sentiment of a tweet, together with dictionaries of emoticons and out-of-vocabulary words. Schulz et al. (2013) proposed a fine-grained sentiment analysis to detect crisis related micro-posts and showed significant success in filtering out irrelevant information. The authors focused on the classification of human emotions into seven classes: anger, disgust, fear, happiness, sadness, and surprise. As features, they used bag of words, part of speech tags, character n-grams, emoticons, and sentiment-based words compiled from the AFINN word list and SentiWordNet. Schulz et al. (2013) evaluated their models on tweets related to Hurricane Sandy from October 2012. Mandel et al. (2012) performed a demographic sentiment analysis using Twitter data during Hurricane Irene.

In contrast to these works, we focus on the sentiment classification of tweets from the Boston Marathon Bombing into one of three classes: positive, negative and neutral. These data were analyzed through an application of the Affective Norms for English Words (ANEW) dictionary for subject specific sentiment by hour for each day. The subjects that were examined include the keywords: 4chan (N=8484), Anonymous (N=14,753), Reddit (N=39,435), and Sunil Tripathi + Reddit (N=1270), with the latter keywords being informed by the events, as we will explain below.

The ANEW dictionary contains approximately 1,034 words that represent different types of emotion. Each of these words is coded on a 9-point scale for positivity or negativity (1 = very negative, 9 = very positive), as well as how highly charged those words are (1 = not highly charged, 9 = very charged). The type of emotion the word represents is called valence. For example, emotions like rage are considered low valence (a negative emotion). The charge of an emotion is called arousal, and, in the sense of rage, this emotion would be considered high on the arousal scale. This dictionary is made so that every word has an arousal and valence value. To perform this analysis, each tweet is analyzed algorithmically. What this means is that each word is compared to the dictionary, and each tweet is averaged according to the sum of all words that appear in the tweet and in the dictionary of words. By adding an additional, temporal aspect to tweets, the sentiment behind the various facets of 4chan, Reddit, and Anonymous can be displayed over the course of each day.



### REDDIT: SENTIMENT CHANGE OVER TIME

From our 24 million tweets, we analyzed all tweets that contained the word "Reddit." Without context, we can say that these tweets maintained a steady value of arousal (intensity), and that the value fell between 5.19 and 5.87 on the ANEW 9-point scale. In order to gain a bit of clarity, each tweet that was averaged for sentiment was further coded as positive, negative, or neutral. The data above indicates the output of that analysis. This is to be expected as the emotional reaction to an act as tragic as the bombing is going to stay high until a resolution is achieved. However, the timing of the changes in positive value and negative value indicate events that needed to be further investigated. Herein, an analysis and comparison of sentiment to event takes place. In the first few days of the Boston Bombing, Reddit concerned itself with intelligence gathering and the organization of survivors.

#### 1. April 15<sup>th</sup> – Immediate Response Sentiment

At the beginning of this event, as evidenced by the number 1 on the chart above, we see that the percentage of tweets that were considered “positive” about Reddit exceeded 70 percent. This group of Internet-based bystanders gathered information and disseminated it to those in Boston who knew of, or belonged to, Reddit’s community, as well as anyone who would listen. Reddit members worked to organize pizza and water for survivors they could communicate with, including the Boston Police Department. They also worked to help get loved ones in touch with each other through word-of-mouth and a centralized Google document of known survivors. Our analysis through the ANEW dictionary indicates that public sentiment of Reddit began astoundingly high because of their speed and efficacy in arranging survivors and cataloging names. In addition, it was felt that Reddit was providing the best coverage of events on the ground.

*[TWEET] lol Boston Police Not Tryna Use Their Walkie Talkies Cuz They Know 80k+ People Listening To Them... #reddit*

*[TWEET] Surreal listening to Boston Police scanner (<http://t.co/cCtF67Atzh>) live as*

*this is all going down in #Watertown. Twitter Reddit WCVB too*

*[TWEET] Sorry @cnn but best coverage is on reddit - live Boston update thread.*

However, as time went on, and officials did not address the bystanders collecting information, this positivity was replaced with distrust and negative sentiment. Many Twitter residents felt that Reddit had overstayed their welcome as their efforts to maintain a stream of information relevant to the investigation began to fatigue the audience. In the meantime, media outlets began to mine Reddit for data, and eventually gave airtime to un-verified data about bombing suspects like Sunil Tripathi, who had committed suicide days before the bombing took place. When those news sources were proven to be incorrect, the media turned to a new portion of the data Reddit or Anonymous collected. This left the news surrounding the investigation with an aura of confusion and uncertainty.

## **2. April 17<sup>th</sup> – The FBI Asks for Help**

Again referring to the chart, we see number 2 as a radical shift in the sentiment about Reddit on Twitter vis-à-vis the public. When we match this shift to events during the Boston Bombing investigation, we see that the FBI, through Special Agent Richard DesLauriers, asked the public for help in identifying the suspects. He said, “For more than 100 years, the FBI has relied on the public to be its eyes and ears. With the media’s help, in an instant, these images will be delivered directly into the hands of millions around the world. We know the public will play a critical role in identifying and locating them.”

At this point, Reddit had begun to become a nuisance, and with a new focus and call-out from the FBI for help, Reddit took the task to heart. They poured over thousands of folders looking for other photos. They listened intently to the police band while trying to check on each lead they came across. As Reddit gathered and reported their data, public sentiment shifted radically in their favor. The public began to think very positively about Reddit. While the public was ready to call crowdsourcing during a criminal investigation like this a victory, the early positive sentiment was met with a resounding defeat. The defeat began with a tweet from one Greg Hughes (since deleted) that said, “BPD scanner has identified the names: Suspect 1: Mike Mulugeta Suspect 2: Sunil Tripathi” (April 19, 2:43A.M.).

## **3. April 19<sup>th</sup> – Sunil Tripathi and Anti-Reddit Sentiment**

Here, on number 3 from the chart on the previous page, we see a radical shift in both valence and arousal for Reddit, as a whole, beginning in the afternoon of April 19. Reddit’s reputation would not rise again due to a particularly tragic series of media augmented events surrounding Sunil Tripathi, the bombing suspect. Tripathi was a 22-year-old Brown University student who was labeled by Reddit as a suspect in the Boston Bombing, along with another name, Mike Mulugeta. When Reddit learned he was missing, and had been reported as missing as early as March 16, a search began with the media, reporting that Tripathi was a suspect. While the intent of this was not to create a witch-hunt, the ensuing media blitz created a public image issue that Reddit may not ever recover from. Here, an example shows just how charged sentiment against Reddit became.

*[TWEET] I am actively angry about irresponsible amateur sleuthing on reddit/4chan/etc about Boston. Its disgusting and dangerous.*

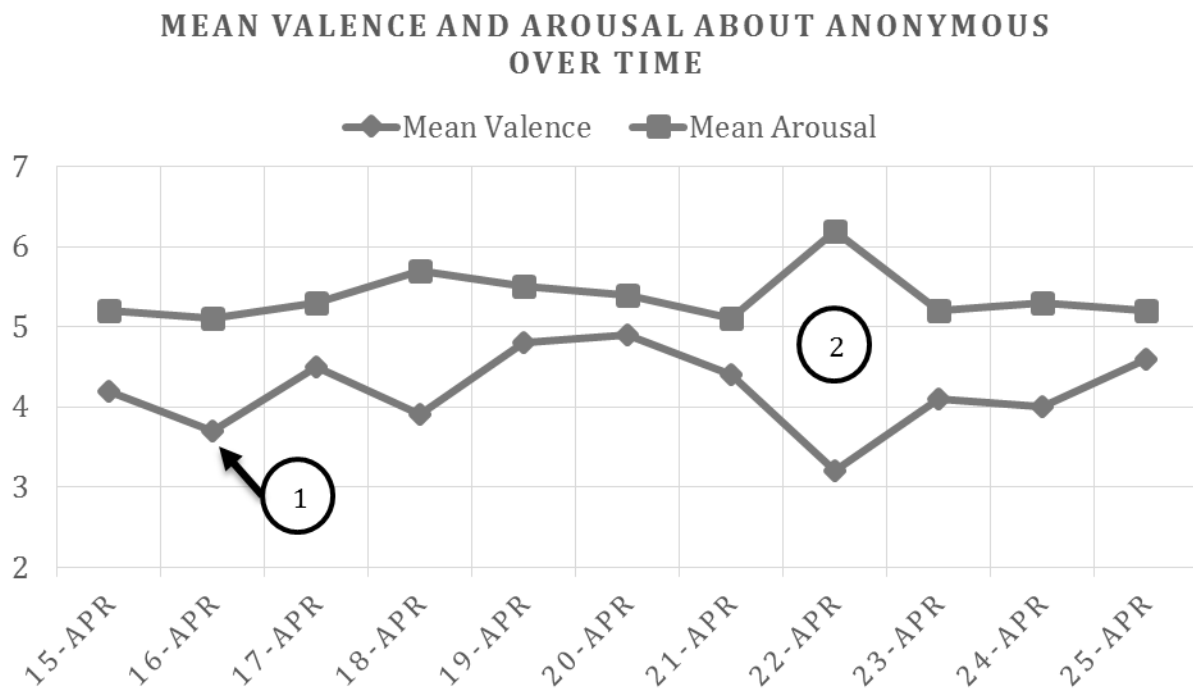
*[TWEET] Much angst over Reddit misidentifying Boston bombing suspect. Did feds do the same thing in the ricin case? <http://t.co/AAogimNJLH>*



*[TWEET] Why is everyone giving Reddit and 4chan grief for not catching the Boston bombers? Theyre teenage armchair detectives whatd you expect?*

The FBI, at 12 PM on April 19, 2013, officially announced that Sunil Tripathi was not a suspect. Beginning with this announcement, and during the rest of data collection, sentiment about Reddit went from positive to very negative. This trend is also reflected in the “neutral” sentiment line as it rapidly declines after the April 19. On April 24, Sunil Tripathi was found dead in the Boston River. The Twitter data reflects the spike in negative sentiment that followed.

Interestingly, Reddit was blamed for the resulting witch hunts associated with naming Sunil Tripathi as a suspect. It remains to be seen if Reddit itself simply fell victim to a hoax, as evidenced by 4Chan activity later, or actually believed that Tripathi was a suspect. Review of the police scanner has repeatedly shown that there was no actual mention of the suspect’s name, nor that of Mike Mulugata. While the public has made their decision about Reddit in this regard, we may never actually know where that name came from, or how it initially showed up on the radar of Reddit.



### **ANONYMOUS: SENTIMENT CHANGE OVER TIME**

From the 24 million tweets, we also search for the term "Anonymous." Like Reddit, Anonymous was also gathering information, though it was of a different kind. This group was interested in the presence of two different strangers that the media did not seem to be reporting about (Sheets, 2013). The first was an elite mercenary group present near the finish line before the blasts, and the second was a person on the roof of a building who was unintentionally captured in a picture taken right after the blast. In addition, Anonymous was also interested in its own brand of Internet crime solving.

This crime solving agenda involved the timing of the blast close to the passing of the Cyber Intelligence Sharing and Protection Act (CISPA) legislation, which granted the government a variety of powers to invade the privacy of all Internet users. These two acts

(focusing on conspiracy images and timing of legislation) are related to the image Anonymous seeks to present. Unlike Reddit, the story of Anonymous begins with a stigma that served to inform public reaction to their participation during the Boston event.

Anonymous is a collective of interested computer-augmented activists that have most recently been labeled as hacker activists, or “hacktivists.” Anonymous came to power through a worldwide protest of the Church of Scientology, but gained the world’s attention as they worked to undermine the negative press being used to discredit and destroy the website Wikileaks. While successful, the methods through which they pursue their activism have led to Anonymous being labeled as “tricksters” and “juvenile” by both network security experts and the press. This predisposition to mistrust Anonymous is evident in the sentiment analysis of tweets about them over the course of the event.

### **1. April 15<sup>th</sup> – Immediate Response Sentiment**

Unlike Reddit, who participated in the event as a reactionary measure to community members being present in and around the bombing, Anonymous was watching the Boston Marathon very closely before the bombs exploded. This was due to a post made on the website 4chan that predicted the bombing just a few days before (Sheets, 2013). It was felt that this event would allow the government to perform a few acts they would normally not be able to do because of the chaos surrounding the event. These events are often referred to as “False Flags.” A False Flag is typically an event that occurs covertly (in this case, the Boston Bombing secretly being a US military operation) that allows for another event to occur (Jones, 2010). Anonymous believes that the act of blaming a domestic act on a foreign national can direct attention away from crucial, controversial legislature, like CISPA.

As seen from the valence and arousal at the beginning of this section, the tweets reflect events. However, this illustration indicates a much more varied and lower degree of valence. This is indicative of the baggage Anonymous brought with it to this event. The similarities of the two groups in their actions are indicative of the efforts required by the event. Like Reddit, Anonymous began to produce possible solutions to the Boston Bombing mystery, and on April 18 and 19, after the FBI produced the photos of their suspects, it looked like they were on the right track. However, like Reddit, Anonymous got caught up in the anti-crowdsourcing sentiment that came through the misappropriation of blame for Sunil Tripathi. Anonymous is a group with very low public trust to begin with, so their tweets began with a very low valence (negative emotions), and never escaped it. Interestingly, the valence for this group of Internet tricksters rose in a similar fashion to those of Reddit. The difference between Reddit and Anonymous during this event is an interesting one, and is something of a dialectic of what is good and bad about massive public participation via online tools.

During the Boston Bombing, Anonymous concerned itself with a picture that stunned many media outlets. This picture was of the Boston Bombing immediately after the bombs went off. The stunning portion of this picture was that a figure on a rooftop could be seen walking away from the blast on top of a nearby building. This activity prompted the involvement of Alex Jones, of infowars.com, who began to call the Boston Marathon a “False Flag.” To Jones, the bombing was a giant, waving, pretend flag in an effort to distract the public while Congress sent through the controversial Cyber Intelligence Sharing and Protection Act (CISPA).

### **2. April 17<sup>th</sup> – The Westboro Baptist Church Confrontation**

While Jones and the Internet scoured crime scene photos to prove the existence of a “False Flag” operation, another battle began via Twitter with the Westboro Baptist Church.

On April 17, 2013, the Westboro Baptist Church indicated that they felt the bombs exploded when they did because God had ordained the gay marriage laws of Massachusetts a sin against nature. Through their Twitter account, the WBC announced that they would be protesting during the aftermath at all funerals and memorial services for the deceased. Anonymous stepped in, threatened them with an attack similar to what the WBC had experienced from Anonymous during the Sandy Hook Elementary aftermath, and waited to see what the WBC would do next.

In figure 2, we can see that the valence of tweets about Anonymous is much lower than those of Reddit (below 5 as opposed to Reddit's consistent score above 5.5). This is indicative of Anonymous' past activities as an unpredictable, often interfering entity, during large-scale public events. However, valence, while mostly negative, goes up during the days that news stories about Anonymous' threats against the Westboro Baptist Church. For example:

*[TWEET] There is justice. The Westboro Church which wanted to protest the funerals of the Boston Marathon victims has been hacked by Anonymous.*

*[TWEET] Hacking group warns Westboro not to picket Boston Marathon funerals: The online hacker organisation Anonymous ... <http://t.co/ImQW6T1Wgq>*

The goodwill gained by fighting the WBC began to fade quickly. As you can see in figure 2, Anonymous' valence value went to its initially highest point before goodwill was decimated by the tragedy surrounding Sunil Tripathi. While Anonymous' actions during this event are closer to conspiracy theorists than Reddit's crime solving attempts, the fact that these two units are so closely aligned in the public's eye is demonstrated by exceedingly similar movements in positive versus negative emotions throughout the crisis response period.

## DISCUSSION

In the case of the bombing of the Boston Marathon, the FBI asked the public to share its images and videos of the event, and even called back to the history to help as a guide (McCullagh 2013). They harnessed the crowd through an automated tip gathering service after supplying the crowd with official evidence and asking for more information. In doing this, the FBI created a mechanism for crowdsourced intelligence, thus creating an interoperability between the FBI, the crowd, and other parts of the investigation team (Büscher et al., 2013). This form of participation is seen as a resounding success, and resulted in the identification and eventual capture of Dzhokhar Tsarnaev. While the data itself became a problem, it was not because of the crowd, but was due to the lack of interaction between the investigation teams and the crowd. Reddit knew more about the situation at ground zero in a more efficient and structured way than emergency responders did, despite these bystanders' lack of physical presence anywhere near the event itself. Reddit and Anonymous simply stitched together available, older technologies, but used them in new ways. The flow of information; despite flowing between all interested parties, was filled with a variety of ethical issues through which much of the investigation was hurried, created privacy problems for unintended individuals, or resulted in the public being misinformed (Büscher, Wood, Perng, 2013, Rizza, et al. 2012)

The freely broadcast police band was focused on scouring for names of victims, names of suspects, and any news that could be gleaned out of the confusion. Internet-Relay chatrooms on the freenode IRC server began immediately at #bostonbombing, and served as a realtime chat between 4chan, Anonymous, and Reddit. Along with these communication tools, other Redditors began collecting many pictures, videos, and news stories of the event.

All of this was done before official response could be established and stabilized. In essence, the lack of bureaucracy that can slow down, or even stall official responders, was not present for Reddit. This agile group of loosely connected virtual volunteers organized survivors and offered numerous crisis response tools for the victims of the bombing.

These tools included a place to stay for the night (private residences, apartments, or couches), food, and on-the-ground person finding. Almost all of this organization was done voluntarily, but also automatically. Volunteers would post comments with data, and that data would be organized, cleaned, and placed into spreadsheets without much in the way of communication. The initial thread of the bombing was an initial collection of tweets from reporters and early listening of the police band. A justin.tv stream was put up of the police and EMS band after it began to suffer enormous bandwidth issues. By 5:50 PM, almost three hours after the event, Reddit and other Internet related services like Google's person finder were up and running.

By 7:04 PM, Reddit had established a spreadsheet through Google documents of places to stay--that included Redditors opening their houses to other Redditors. The Reddit threads contained very detailed information concerning evidence publically announced, and even some evidence that was not announced. Reddit out-performed the mainstream media, and beat them to a number of pieces of information. Reddit also managed to organize food and shelter for residents of Reddit who were in Boston to participate in the Marathon, or to watch someone participate. Reddit was able to maneuver themselves into assembling and establishing credible data very quickly. They fared better than Anonymous because of a more conscious community and a system where true information could be "upvoted," and false information could be "downvoted." Reddit quickly established text-based communication, a database of those on the ground, photographic evidence of the crime scene, food and shelter for those who had an account on Reddit, and a timeline of events that was unmatched by the rest of the media.

While this organization of information and survivors served to justify the presence within the event, this was not to last. As the victims began to filter out of the city, Redditors looked for new ways to participate not only in the aftermath, but also in the investigation itself. Instead of being simply the supplier of information, the crowd also shared information with each other. This led to crowdsourced crime solving. The crowd also sought to participate in the investigation as detectives, and it is here that many media reporters and technology critics call this participation a failure (Gayomali 2013). The failure rests on the single event of misidentifying a suspect who was in the midst of their own very tragic story. While some signs point to a hoax perpetuated by 4Chan against Reddit, the fact that it happened is evidence enough for a massive public shift against the idea of crowd-based crime solving.

The consequences of misnaming these suspects has had long lasting impact on the inclusion of crowdsourced investigation capabilities like Reddit provided in Boston. To that end, four individuals were incorrectly identified as suspects (Gayomali, 2013). The name Sunil Tripathi gained more traction when the FBI released photos of suspect one and two (McCullagh, 2013), and collages of side-by-side comparisons were posted on the web comparing Sunil Tripathi to Suspect 2 (Reddit thread "is"). The speculation led to several witch-hunts, and a massive demand for Reddit to apologize for the pain and suffering inflicted on the family of Sunil Tripathi, who had been missing for quite some time before the bombing took place. While Reddit was blamed for this, while our sentiment analysis points to this event as the single focal point of negative sentiment associated with Reddit, they did not put forth this name on their own.

Dozens of notable news agencies, reporters, and investigative journalists re-tweeted

the misinformation thousands of times. Redditors were proclaiming an early victory: “If Sunil Tripathi did indeed commit this #BostonBombing, Reddit has scored a significant, game-changing victory.” Greg Hughes gave advice: “Journalism students take note: tonight, the best reporting was crowdsourced, digital and done by bystanders. #Watertown.” Others added: “This is historic Internet sleuthing.” “Reddit solved the bombing. Before the Feds Solved the Bombing.” The media had turned to reporting what Reddit had found, and this hyper-gain in legitimacy was only met with a resounding defeat.

The defeat came as the FBI cautioned media outlets about reporting leads without verification (FBI timeline). Neither Reddit nor Anonymous not receiving any sort of official recognition is not without disappointment. Some argued that they are unstoppable due to the nature of the Internet, with the only hope being that errors that cases such as this would lead to future caution. Despite being associated as a mob, and being accused about having a mob mentality, Reddit issued a public apology (Hueypriest, 2013), and has taken steps to ensure it is more careful about pursuing and reporting leads as it finds them. The take-away from this event is that there is a massive amount of people with computational literacy and computational power who can be engaged to answer questions, or give their best guess. Despite the problems faced during this event, it is not without some regret that most would want to abandon crowdsourced crime solving as a possibility.

## CONCLUSIONS

In this paper, we have told a version of the story of the bombing of the Boston Marathon. Our story is told in three parts. First, two online groups gathered images, video and textual information concerning the bombing of the Boston Marathon, and shared these with the FBI, and amongst themselves. Secondly, these groups created mechanisms to conduct their own investigation into the identities of the perpetrators. Finally, the larger national media followed the results of these online group investigations and reported these as fact to a national audience.

Considering information gathering, this extended traditional policing tip line moves into the realm of crowdsourcing where scale, scope and speed brought incredible results in the form of thousands of images and videos to officials. Considering crowdsourced investigations, the online groups brought new tools and massive numbers of users with a combined processing strength not possessed by officials. This processing led to results with unprecedented speed. Unfortunately, we learned that the crowdsourced investigation was fueled by misunderstandings and misinformation, and was further amplified by the nature of retweeting and social media. All groups identified the wrong people as perpetrators. This alone would have shown the limitations of crowdsourced investigations, but would not have led to the persecution of wrongly identified men. In the age of social media, the actions of online bystanders have become more problematic than the inaction of physically present bystanders (Fletcher, 2007). Internet-based communication technologies have allowed the technologically literate to gain unprecedented oversight during crime scene investigation, especially when the event is large in scale. Most alarming here is the influence both groups had on the official responders. They pressured the FBI to abandon their desired time schedule for releasing information to the public because of the accelerated nature of the parallel online group investigation. They also provided leads to the FBI, which were accepted and responded to as if they had come from a traditional vetting process.

Most importantly is the problematic role of the national media. The national media periodically took results from the online group processes of Reddit and Anonymous, and

treated the results with the national media's authority as though they were from official processes. They published these results as fact, influencing the official responders and the public. This brings to the fore the concept of media responsibility. A concept we have considered is the phrase "run amok." We interpret running amok to be to boldly and heedlessly run into conflict in a frenzied, uncontrolled way. Amok, in this case, can be seen as allowing the fear and intensity of the bombing, as well as the speed and massiveness of the Internet forums, to cloud the judgment and practices of media producers. The media can run amok, shaping a public understanding of events that is not accurate. We also find that the national media has the potential to run amok with information gleaned from online sources.

We note the powerful role the traditional national media have adopted for themselves as arbiters of truth as they filter the products of these online discussions and feed the results back to the national stage. This online discussion, intervention, and action has had significant real-world implications that demand socially responsible, careful, considered action. The participants, both bystander and media, are participating in a policing investigation without the same training, constraints and awareness as officials, but with more power and reach. The right to participate in public dialogue has always come with the price of social responsibility. One cannot cause hate, fear or damage with one's words, even in an open society. While this practice is not yet institutionalized among Internet forum participants, it has been part of the code of conduct for broadcasters and journalists for decades. Media must inform and expose and sometimes entertain, but they also must provide privacy and dignity, while not causing additional harm.

There have always been significant rewards in the media industry for being the first to broadcast a story of high interest or value. Internet technologies have not changed this desire, but have amplified the quest for the goal. The 24-hour news cycle of cable television was just the beginning of a trajectory, which now includes citizen reporters and public participation through forums, comments, images and video. The news cycle has become a nowcast, rather than a broadcast, at instantaneous speed with broad participation. *New York Times* editor Greg Brock said: "In the Twitter age, the pressure is worse than ever to be fast – it's become more difficult. Some of the pressure is coming from readers." The speed and participation have changed, but the need to responsibly report the news has not. Broadcasters and journalists must create a new code of conduct that establishes clear values, shows leadership in embedding those values, and establishes policies and processes for ensuring they don't fall short of them. The media must resist the lure of speed, strive to report only what is correct in a fair and balanced manner, and must remain faithful to its social responsibility.

The traditional media could play an enormously valuable role by separating fact from fiction, and providing verified, trustworthy information. Instead, most outlets just repeated false claims made online, providing a megaphone to erroneous statements. Gathering all information, even irrelevant information, was part and parcel of the investigation. The media, should they be involved with researching social media like Reddit at all, should receive more training into how to distinguish false leads from positive leads. Official response controls and maintenance with these entities could control the flow of information, and provide a means through which to address mistakes on both the bystander and media sides of an investigation. This case study displays the need for such controls.

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