Tweeting from the Town Square: Measuring Geographic Local Networks

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Abstract

This paper examines tweets about two geographically local events—a shooting and a building collapse—that took place in Wichita, Kansas and Atlanta, Georgia, respectively. Most Internet research has focused on examining ways the Internet can connect people across long distances, yet there are benefits to being connected to others who are nearby. People in close geographic proximity can provide real-time information and eyewitness updates for one another about events of local interest. We first show a relationship between structural properties in the Twitter network and geographic properties in the physical world. We then describe the role of mainstream news in disseminating local information. Last, we present a poll of 164 users' information seeking practices. We conclude with practical and theoretical implications for sharing information in local communities.

Introduction

News spreads quickly, especially when it is unexpected. When President John F. Kennedy was shot in 1963, 82% of people heard news of his shooting within the first hour (Banta, 1964). Although radio and television carried the news throughout the day, less than half of people heard through these channels; most heard through personal communication (Spitzer, 1964).

In August 2009, 46 years later, the news of Senator Ted Kennedy's death exploded through Twitter. Politicians, celebrities, and regular users tweeted tributes to the "Lion of the Senate" (Jurkowitz, 2009) and the Kennedy family itself launched a news account to inform the public about funeral activities. In both cases, the Kennedy's deaths were of national, and indeed, international interest (Jurkowitz, 2009) and news of each connected people on a global scale.

However, there is little information about how people connect to one another in local communities during events of local interest. What happens when a major road closes in town? What happens when the local school board changes the bus schedule? When people connect around local events, how long do their connections last, how do they interact, and do these interactions extend preexisting ties or form new ones?

In this paper, we examine two geographically centered events that took place in May 2009 and June 2009 in Wichita, Kansas and Atlanta, Georgia, respectively. The first was the shooting and death of Dr. George Tiller at a church in Wichita and the second was the collapse of a parking deck in Atlanta. Each event was local in nature, but expanded to national and international news coverage.

We first describe the outbreaks that took place after the Wichita shooting and the Atlanta parking garage collapse. We look at how news spread and when, and who was spreading it. We then analyze structural properties of the network of users who discussed the events, focusing on users who were most active in the network. Last, we present a poll of 164 users about the Wichita shooting in which we asked them how they found out about the shooting and where they went to find more information about it.

We are interested geographic proximity for several reasons. First, people living in close geographic proximity may share common characteristics, like age, ethnicity, and socio-economic status (Bishop, 2008). Connecting similar people can help them form ties, access information and resources, and build a support network (Hargittai, 2008; McPherson, Smith-Lovin, & Cook, 2001). This is especially critical for new Internet broadband users like rural dwellers and elderly individuals (Horrigan, 2009). Second, connecting people who live in the same neighborhoods, towns, and regions may foster community interest and participation (Wellman, 2002). Finally, there is room for more work examining the relationship between online social network structure and physical geographic proximity[1].

We address this gap by investigating how people are connected online by geographically local events. We analyze node indegree, outdegree, and centrality in relation to geographic proximity, and show some novel and emergent kinds of local network properties. Our analysis builds on two assumptions: local events will be of greater interest to people who live near where the event took place, and local news sources will cover local events more actively than non-local (e.g. regional, national) news sources. Based on these premises, we investigate the following questions:

[1] We use "physical" instead of "real-world" to indicate geography because online behavior is also considered real.

RQ 1: Do geographically local topics on have more dense Twitter networks than non-local topics?

RQ2: Are people who are central in the Twitter network more geographically central in the physical world?

RQ3: Where do people go for information about local events?

This research makes a few contributions beyond prior work. First, we show a relationship between network properties of online social networks and geography in the physical world. Second, we show that more active users tend to be geographically centered around local events. Last, we find that active participants report preferring local users and information sources to global ones. We conclude with limitations and practical implications.

Related Work

The Spread of News

Lazarsfeld and Katz's two-step flow model proposed that information was disseminated through opinion leaders rather than directly from mass media (Lazarsfeld & Merton, 1954). They found that personal contacts were mentioned far more frequently than exposure to radio or newspaper as sources of influence on behavior. This model was supported by many subsequent studies.

Whyte (Whyte, 1954) found that air conditioner purchases were influenced by a network of neighbors who exchanged product information "over the clothesline" and "across backyard fences", Katz and Lazarsfeld found that word-of-mouth was the most important source of influence in the purchase of household goods and food products, and Ibrahim et al. (Ibrahim, Ye, & Hoffner, 2008) found that more than half contacted others to share the news, and those who did so reported contacting an average of 3.4 other people.

More recently, researchers have studied the ways that information flows in large online social networks. Gruhl et al. analyzed information propagation in the blogosphere and found that topics are mostly a union of ongoing discussions among users and spikes of short-term, high-intensity discussion around real-world events (Gruhl, Guha, Liben-Nowell, & Tomkins, 2004). Leskovec et al. described the evolution of memes in news cycles using clusters of topics and keywords (Leskovec, Backstrom, & Kleinberg, 2009). These studies highlight the influence of real-world events on online interactions, but do not focus on the geographic nature of the event and the impact on local people for whom the event is relevant.

Local Networks and Distance

Fears that the Internet's global reach would reduce local interactions (e.g. (Putnam, 2000)) are countered with accounts of the Internet's role in connecting local communities and neighborhoods (Hampton & Wellman, 2003). Hampton and Wellman showed that the Internet supports increased contact with weak ties (Hampton & Wellman, 2003). Similarly, Gilbert et al. show that people living in rural communities have friends who live closer to home than those living in urban communities (Gilbert, Karahalios, & Sandvig, 2008). Finally, Bradner and Mark find that subjects are more likely to deceive and initially cooperate less with people they believe are in a far away city rather than the same city (Bradner & Mark, 2002).

However, local geographic interactions are governed by different kinds of ties than online networks. Indeed, studies of distance predate the Web. Latané showed in 1995 that social influence is heavily determined by distance (Latané, Liu, Nowak, Bonevento, & Zheng, 1995) and Carrothers showed in 1956 that the probability of interaction in a given neighborhood falls off with the geographic distance between them (Carrothers, 1956). Distance is masked with much of communication through Twitter unless users decide to reveal it. In the case of local events, Twitter users often do reveal location, which can help establish a sense of knowledge and legitimacy.

Twitter

Twitter is a microblogging service where users can post 140 character messages called tweets. Twitter users can follow other users (their "friends") and other users can follow them (their "followers"). Twitter differs from most graphs of social networks like MySpace and Facebook which are undirected. Twitter is a directed graph, meaning that ties between two individuals are not reciprocal. X can follow Y, but Y does not have to follow X back. A users' first degree network refers to all of her followers and friends. Most accounts are public and can be followed without requiring the owner's approval.

Twitter became mainstream in early in 2009 and grew dramatically. Early metrics suggest that Twitter traffic is driven by a combination of mainstream media (e.g. Michael Jackson memorial), celebrity influence (e.g. Ashton Kutcher and Oprah), eyewitness accounts (e.g. U.S. Airways Flight 1549), and user participation (e.g. Iran elections) (Bishop, 2008; Golder, 2009). A number of recent studies have examined Twitter at both the network level and at the social level.

At the network level, Krishnamurthy et al.'s (Krishnamurthy, Gill, & Arlitt, 2008) early analysis examined users and their behaviors, geographic growth patterns and current size of the network based on their crawl of 100,000 users. Java et al. (Java, Song, Finin, & Tseng, 2007) examined the follower network on Twitter, including over 1.3 million tweets and over 70,000 users over a two-month period. Their study reported high degree correlation and reciprocity in the follower network and revealed there is great variety in users' intentions and usages on Twitter. Huberman et al. (Huberman, Romero, & Wu, 2009) show that Twitter users only interact with a small subset of their social connections. Most similar to our work, Kumar et al. examined the growth and evolution of Flickr and Yahoo! 360 based on snapshots of the graph taken every week for 100 weeks. They describe

reciprocity, component properties, and structural properties (Kumar, Novak, & Tomkins, 2006).

At the social level, studies have examined why people use Twitter, such as finding common ground and connectedness, as well as benefits for informal communication at work (Zhao & Rosson, 2009). Honeycutt and Herring (Honeycutt & Herring, 2008) describe conversational practices on Twitter based on the @ reply that is used to refer to others and to direct messages at others. boyd et al. examine conversational practices in Twitter based on retweeting and the ways that authorship and attribution are negotiated (boyd, Golder, & Lotan, 2009). Finally, Hughes, et al. (2009) and Starbird et al., (2010) discuss disaster relief through Twitter which relies heavily on local events and users. We draw from these strands of work by bridging network analysis with empirical analysis of what is happening "on the ground".

Parking Garage Collapse in Atlanta, GA

A section of a parking deck collapsed in Atlanta, Georgia midday on June 29, 2009, damaging or destroying 38 vehicles (Leslie, 2009). The parking deck was located in Midtown, Atlanta near a university campus and local corporate offices. It was used by university affiliates, corporate workers, and members of a weekday, and many employees of nearby offices tweeted eyewitness reports after the collapse. They continued to tweet through the day as the fire department and structural engineers came onsite. People who had parked in the garage were not allowed to retrieve their cars for two days after the collapse. Stories about how the collapse happened and who was to blame continued for days.

Church Shooting in Wichita, KS

George Tiller was a medical doctor who was shot and killed in a church on May 31, 2009 in Wichita, Kansas. He was one of three doctors in the U.S. who performs late-term abortions (Stumpe & Davey, 2009). He was shot in the head in the foyer of the church around 10:03am CST. The shooter, an anti-abortion activist named Scott Roeder, fled by car and was arrested three hours later. He was subsequently charged with first-degree murder. Local Wichita news stations were on the scene within hours, taking photos and posting updates to Twitter. The story broke to the Associated Press and became of national and international interest (Stumpe & Davey, 2009).

Methods

We used the Twitter API and multiple whitelisted accounts to track topics about the two events. For the church shooting in Wichita, we tracked hashtags like #wichita, #tiller, #abortion, #pro-life, and #pro-choice. For the parking garage collapse in Atlanta, we tracked phrases like "atlanta AND garage" and "garage AND collapse". We captured 11,017 tweets about the church shooting and 1,602 tweets about the parking garage collapse. The first dataset included tweets from 6,327 unique user accounts and the second from 1,139 unique user accounts.

We then crawled the first degree networks of each of these users (all their friends and followers). The Wichita dataset had 466,599 directed ties and the Atlanta dataset had 3,023,575 directed ties. All of our network analyses in this paper refer to the set of users and their first degree networks. We used Network Workbench (Team, 2006) and GUESS (Adar, 2006) to analyze network properties and create the visualizations. We shrank the network sizes by removing random nodes to create visualizations.

We conducted a poll to learn about people's perceptions and preferences on Twitter during the events. We polled users who had tweeted two or more times about the church shooting in the first 24 hours after it was announced to learn about their information-seeking practices. We used a Perl script and the Twitter API status update function to randomly select from this subset of active users and concatenate [@username] with the message: "hi, quick question, what sources did you look at for info about the George Tiller story? (part of [institution name] study) tks!"

We administered the poll within a three-five day window after the shooting occurred (between June 3-5, 2009). Research has suggested that in single-item studies, people often can recall how they heard about a major event, such as a political assassination (Chaffee & Frank, 1996). Our goal was to obtain as representative a sample as could be achieved within the limits of the time imposed and the tools available (Banta, 1964). We sent out 800 requests and received 164 responses. We replied to all the respondents with a thank you tweet and engaged in additional in-depth conversations with 97 of the 164 to ask for clarifications and more detail.

Results

Connectedness

RQ 1: Do geographically local topics have more dense Twitter networks than non-local topics?

We calculated degree centrality and network density using Network Workbench for the Wichita shooting and the Atlanta parking garage. Degree centrality is a measure of ties to other nodes in the network (Wasserman & Faust, 1994). An individual who is very active in a network is likely to have the highest centrality, measured by number of ties to other nodes in the network. We calculated average indegree and outdegree (follower and friend, respectively, where each network, as stated above, consists of users and their first degree networks).

The average in and outdegree for the Wichita network was 0.4177 and for the Atlanta network was 1.7973 (see Table 1). The degrees are low compared to highly connected networks where most people know each other, like a sports club, but are high compared to a completely random network, like individuals at an airport. For comparison purposes, we compared the average in and outdegrees to the network produced by a trending joke hashtag (called #robotpickuplines) that consisted of mostly random and Twitter users posting jokes. The average in and outdegree for this topic was 0.1434. We see that the

	Avg. In/ Outdegree	Density
Atlanta	1.797	0.00098
Wichita	0.417	0.00019
#robotpickuplines	0.143	0.00012
Wichita (24 hrs)	1.898	0.00101

Table 1: Twitter network properties.

Atlanta network is more connected than the Wichita and #robotpickuplines networks.

We then compared network density between the three networks. Network density is the proportion of ties in a network relative to the total number of possible ties (Wasserman & Faust, 1994). A dense network is one where there are a lot of ties; a sparse graph has few ties. In social networks, density implies a connected community of people who know a lot of other people in the community. Density of the Wichita network was 0.00019 and of the Atlanta network was 0.00098 (see Table 1). The density of the #robotpickuplines network was 0.00012.

We had anticipated that the Twitter networks that have a geographically local topic of interest are likely to be more connected than those that do not. We observed this to be the case for the Atlanta network but not the Wichita network. To investigate why, we narrowed the bounds of the Wichita network to the first 24 hours after the event. With this bounded network, we calculated in and outdegree to be 1.898 and density to be 0.00101, both higher than the unbounded Wichita network. This may be because the Wichita shooting was politically divisive and attracted global attention, and thus those who heard about the story first (and tweeted about it first) might be more locally connected. We return to this in the discussion section.

Identifying the Town Criers

RQ 2: Are individuals who are central in the Twitter network geographically central in the physical world?

In a directed graph like Twitter, high indegree implies popularity or interestingness (i.e. celebrities and politicians). These individuals are often opinion leaders—the town criers—and influential because of their high degree. The reasons for having a high outdegree are more difficult to disambiguate, but may indicate that a user is gregarious, a marketer, or a spammer.

Figure 1 show indegree and outdegree distribution for each of the networks. We see that, as might be expected, a few users are most connected and most are not well connected or not at all. The Wichita distribution has a steeper slope than the Atlanta distribution, suggesting the Atlanta network is more tightly connected (because more people know more other people). To examine who was the most connected and what their geographic proximity to the event was, we looked at the most connected individuals, and their location in the physical world. Table 2 shows that central tweeters are geographically centered, particularly in the case of the Atlanta network where all but one are located in Atlanta. Again, the visualizations show the local community of Twitter users around the event.

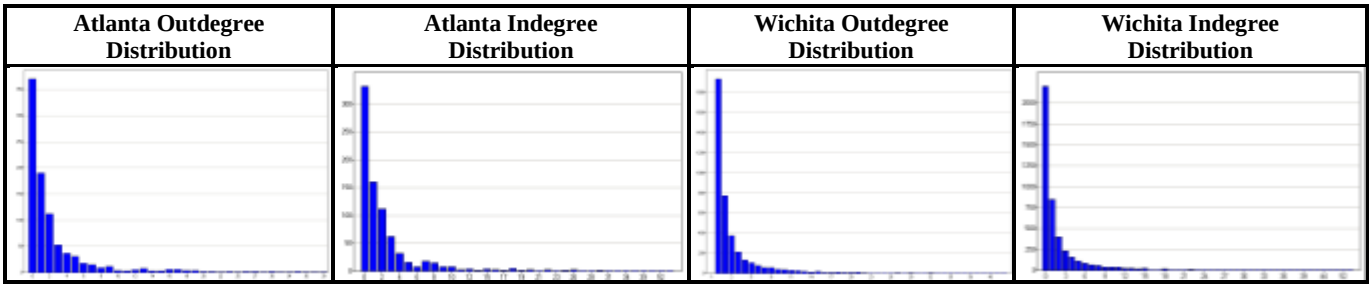

Figure 1: Twitter network degree distributions.

User (Outdegree)	Location	User (Indegree)	Location	User (Indegree)	Location	User (Outdegree)	Location
Gtcomputing (43)	Atlanta	secretsig (52)	Atlanta	Pinkomomma (50)	N/A	Kmers (54)	N/A
Hkmr (39)	Atlanta	keithmcgreggor (47)	Atlanta	ViktorTarm (52)	Wichita	ViktorTarm (52)	Wichita
Ajaimk (38)	Atlanta	ajaimk (39)	Atlanta	stephbarnard (51)	Wichita	ksuchoice (48)	Wichita
pfreet (36)	Atlanta	atlantatech (37)	Atlanta	corinne1952 (50)	California	TLM_MD (47)	CA
360venturelaw (35)	Atlanta	bperdue (34)	Atlanta	Miriamzperez (48)	Washington DC	Shadowfax_rulz (44)	Washington, DC
andrewwatson (35)	Atlanta	ardell (33)	Atlanta	travisheying (45)	Wichita	Uncucumbered (43)	Wichita
Timdorr (34)	Atlanta	rkischuk (31)	Atlanta	KMers (41)	N/A	rosiered23 (40)	N/A
JonnyBird (31)	Atlanta	cindycheatham (30)	Atlanta	AdoroTeDevote (40)	Minneapolis	stephbanard (40)	Minneapolis
Petereilly (30)	Atlanta	shbbll (30)	Atlanta	SharkFu (40)	St Louis, MO	corinne1952 (39)	St Louis, MO
Rjurney (30)	Monroe	venturelab (28)	Atlanta	joshdutcher (39)	Wichita, KS	PPNYC (38)	New York

Table 2: Highest degree users and their locations for each Twitter network.

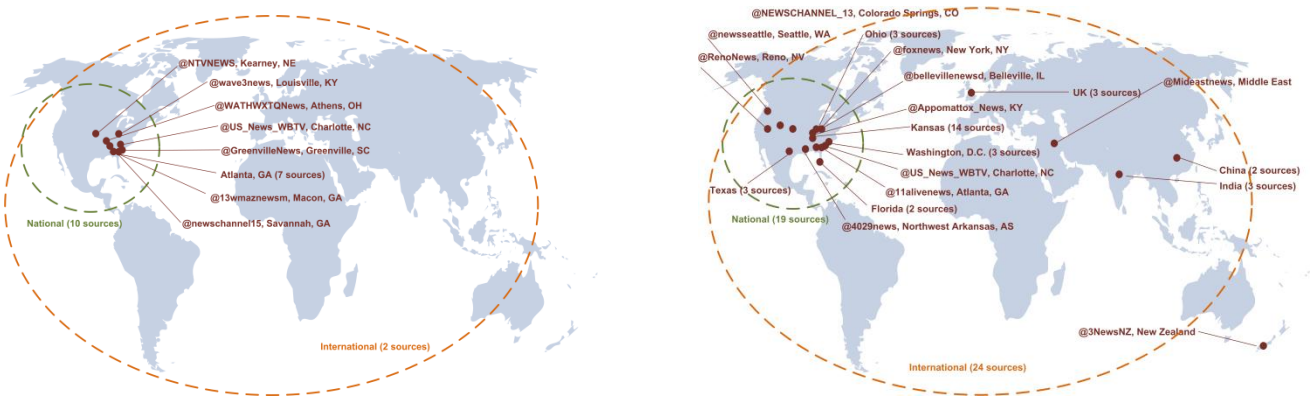

Figure 3a, b: Location of Twitter news accounts reporting the Wichita and Kansas events. The parentheses () indicates number of news stations from that particular location if there is more than one (and individual handles are omitted for space).

Our network visualizations also show the connectedness of local networks. We depicted both networks using the Generalized Expectation Maximum algorithm in GUESS. Figure 2a-e shows the Wichita and Atlanta networks. The top row (figures 2a-c) shows the Wichita network which has 160,907 strongly connected components and the largest connected component consists of 70,405 nodes. The bottom row (figures 2d and 2e) show the Atlanta network which has 23,145 strongly connected components and a largest connected component of 1,424 nodes. Neither network contains any isolates nor are they strongly connected. In comparison, the #robotpickuplines network had 11,098 strongly connected components and a largest connected component of 824 nodes. These graphs depict the relatively connected nature of local networks, and the Atlanta network in particular.

In addition to location of information seekers, we examined locations of news sources that were covering each event. To do this, we performed a keyword search across all user handles and profiles for each event, then qualitatively examined them to determine which were official news sources (e.g. affiliated with a newspaper, radio, TV, or web-based news station). We plotted these sources by geographic location (see Figures 3a and 3b). We drew location from the profile field, which was possible (unlike with regular Twitter users) because we observed that news stations consistently and accurately specified their location by city, region, national, or international news source. Figure 3 again shows the geographic centrality of news coverage. We return to this theme in the discussion.

Information-Seeking Preferences

RQ3: Where do people go for information about local events? Finally, we polled users who had tweeted about the Wichita shooting and asked them where they heard about the story and where they went for more information. We also polled local and national news sources who covered each of the events and their locations. We describe users' information-seeking preferences and whether they sought out local or non-local sources of information (we kept Twitter usernames public to give credit for responses). We also describe other kinds of information-seeking preferences that were reported by subjects—these were primarily ideological or political in nature because of the political nature of the abortion debate. It is important to note that we were interested in active and central users in the network. The poll is likely to have oversampled both among more active Twitter users in general and those who tweeted about the Wichita shooting.

We sent out the poll 3-5 days after the event. Of the 164 respondents, we manually identified 42 to be local based on their profiles. In the poll response itself, 27 said that they were local and therefore went to local news sources when we asked where they went for information:

> brainboy316: I live in Wichita so I went directly to the local news sites and twitter feeds from local reporters.
>
> nicki2377: most came from my local newspaper (@Wichitadotcom), then from MSM outlets. being in Wichita helped.

Local users also told us they actively followed local news sources. @eaglephotos was tweeting photos of the event and was the most retweeted account in the dataset, followed by @KAKEnews and @Wichitadotcom. Other sources that respondents mentioned were @rsylvester and @SuzanneTobias, both of whom report for the Wichita Eagle:

> brainboy316: several. Mainly rsylvester, stephbarnard and the Eagle's photo team who was on-site taking pics.
>
> cacardinal: Primarily local newspapers in KS. Wichita Eagle, LJ World, the KC Star. I also followed many active tweeters in the KS area.
>
> Msdrpepper: I believe the Mother Lode of Dr Tiller news is @Wichitadotcom @KAKEnews since Dr Tiller is right here in Wichita.

We also polled some of the news reporters on Twitter about their reporting sources. Most responses came from the reporters at the Wichita Eagle, who described a network of sources and contacts:

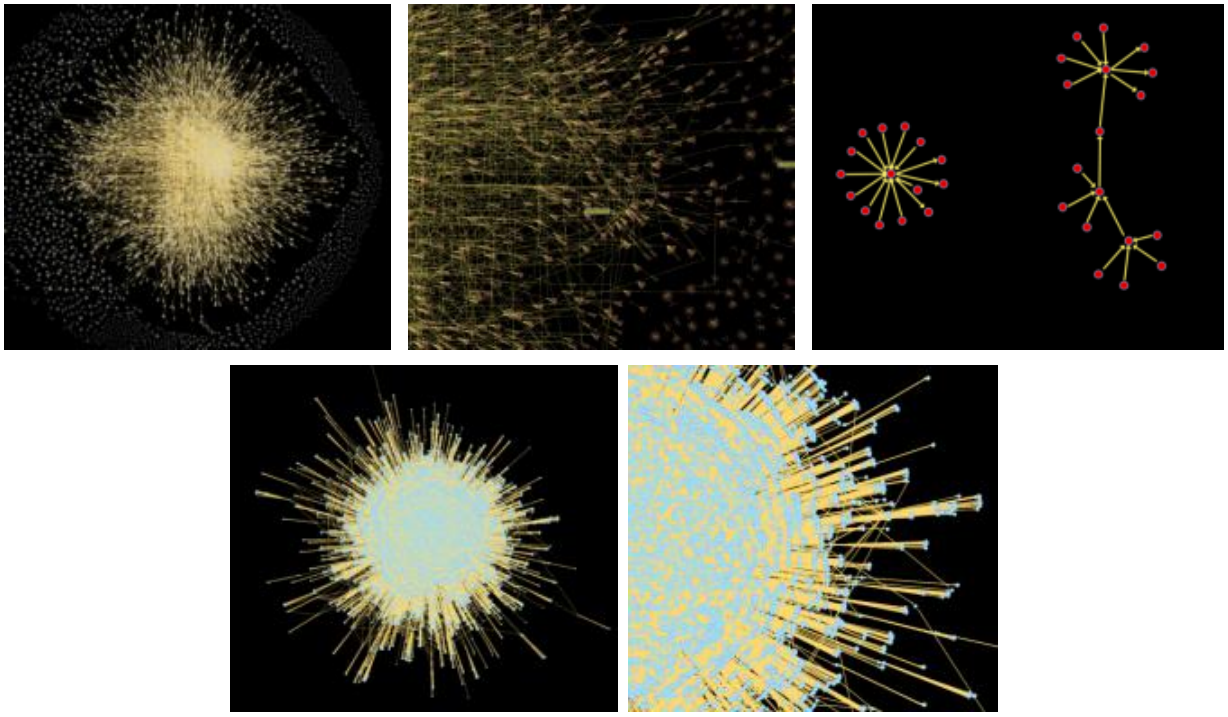

Figure 2a (top left) Wichita network, 2b (top middle) Wichita network zoomed in, 2c (top right) Wichita network zoom on outer nodes, 2d (bottom left) Atlanta network, 2e (bottom right) Atlanta network zoomed in. Recall that the Atlanta network is more connected than the Wichita network and few nodes are isolates.

> EaglePhotos: Sorry for late reply. Took a few days off. Sources were individuals on scene at the church. Police, etc.
>
> MikeMathia: mostly other local media outlets here in Wichita. All via Twitter and the radio station I work at.
>
> rsylvester: I am a journalist in Wichita. Much of what I get on Tiller is from original reporting by me or my colleagues at Wichita.com

The last tweet is from @heycameraman, a photojournalist who has worked in the field for the past 17 years:

> Heycameraman: as I was drivin 2 cover tiller story, i used twitter search 4 info of things as they were developing. 4 background info used google

His tweets indicated that although he was local to the event, he used Twitter just like anyone else might around the world to learn about what was happening in real time. We return to this point in the discussion section.

Information-Seeking Biases

In addition to prioritizing location, it is worth noting that we observed many users reporting that they went to particular ideological or politically motivated sites for news. One respondent said:

> Ticklemepinktoo: @breakingnews informed about the murder. Went to fox news, nothing for 23 minutes,. searched their archives for old stories.
>
> [researcher]: Did you look for information in other places?
>
> Ticklemepinktoo: no just read old stories until news broke -- 23 mins later

Ticklemepinktoo privileged loyalty over timeliness for his preferred news source. Others responded that they followed multiple news sources, which were frequently ideologically aligned. For example:

> sandbar17: I'm in the pro-life movement, So I rely less on MSM 4 pro-life news. I think Fox News was my only other source … Twitter, LifeNews, Google Alerts on Abortion. I really didn't have to search for it. It came to me.
>
> ATimeForChange: I watched CNN, MSNBC, read NYT, Wash Post, watched Rachel Maddow and articles on Twitter from various news sources
>
> ZephyrK9: Rcvd initial info frm a twittr follower so heard about his murder on twittr first b4 story was picked up by MSM All othr info frm FOX

This ideologically motivated kind of user replied primarily on existing media sources for their news. Many of these respondents were hesitant to reply to our requests until they knew more about our research—which we confirmed was without a political agenda—at which point they freely responded. A number of news sources also actively covered the Wichita shooting, such as @RightWingNews, @JoeBidenNews, and @prolifenews. Although location is the focus of this paper, ideological information seeking is a rich area for future work.

Discussion

Our analysis shows a relationship between structural properties in the Twitter network and geographic properties in the physical world. We find that the local networks are denser than the non-local (#robotpickuplines) network and central individuals in the Twitter network are also located centrally in the physical world. We also show that users who are geographically local report going to local news sources for information about an event.

These results have a number of implications for the way that information is shared on Twitter and through social media more generally. It is not surprising that local events are of most interest to local citizens—city planners and sociologists have long emphasized the benefits of local community—what is less studied is the use of social media to do so. While many early studies of the Web emphasized the ways it enabled people to connect across long distances, we are interested in returning to the local. The ability to observe, document, and discuss shared local events can connect people to others who want to participate in the same conversation but who otherwise may not have been able to find one another.

Practical Applications

Milgram's small-world discovery was a basis for a model for generating network properties (Watts & Strogatz, 1998) and many recent experiments have looked to show the existence of small worlds in the real-world (Milgram, 1967). We could do more to utilize local short paths for disseminating information. Schools have long used an "emergency phone tree" with a specified number of branches (e.g. teachers) and leaves (e.g. parents); we should be able to build on some of the emergent structures of online social networks for timely notification of unexpected events (see Hughes, et al. (2009) and Starbird et al., (2010). Watts and Strogatz explained that nodes (e.g. people) would be highly clustered at a local level and the whole network (e.g. human society) will have a low path length. In other words, most people are connected to a small number of other people, and the average distance between any two people is small.

Whether an event is planned or unplanned, local news sources and local eyewitness accounts can be central actors in shaping the spread of the story. Twitter users who are central in the network are similarly powerful. An actor with a high centrality level is indeed "where the action is" (Wasserman & Faust, 1994) in a network. Number of followers has more social value than number of following, and we can impute some amount of status, importance, and attention from a Twitter user who has a high number of followers. Users with many followers like Shaq and Ashton Kutcher can spread information quickly and easily.

Limitations

We were unable to crawl geographic location in user profiles because location fields were inconsistent. Many users either left the field empty, filled it in with a joke (e.g. "the universe"), or had changed it to Tehran during the Iran elections. We also could not crawl users' first degree networks before and after the event and thus cannot tell using the Twitter API when a tie was formed between two individuals. This is a difficult limitation that can be overcome only by somehow predicting events and crawling first degree networks before the event and again after, which is computationally expensive, or through a change in the Twitter API that makes link formation date and time available.

A number of broader directions exist. Real-time reporting during an ongoing event is complicated; benevolent citizen reporters have an opportunity to positively alter or influence the outcome of the event, but malevolent reporters can also abuse this opportunity. People can inadvertently report false information and reports of celebrity deaths and nonexistent fires are extremely difficult to control on Twitter (Sutter, 2009). Misinformation is both difficult to detect and difficult to stop from spreading.

Conclusion

Analyses of large-scale online networks have focused primarily on network properties such as density and centrality. Our goals are to characterize network properties in relation to local geography. Our results suggest a number of possible avenues for future work: during real-time local events, does network centrality indicate authority or trustworthiness? Are central individuals in Twitter usually geographically centered and thus well-positioned to provide firsthand reports? Similarly, are they well-positioned to disseminate information about an event as it is playing out because of their high connectedness?

In future work we would like to examine smaller events, like road closures or school snow days. The Web was heralded for its ability to connect people across long distances; however, it can also help people connect locally. Internet access has grown tremendously, and is continuing to expand into diverse populations including marginalized communities like rural users, low income users, and seniors (Horrigan, 2009). As more people go online—from large urban cities to small towns to rural areas—they can use the Internet to connect to those who are near to them.

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