Discussing Occupying Wall Street on Twitter:

Longitudinal Network Analysis of Equality, Emotion, and Stability of Public Discussion

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Abstract

To evaluate the quality of public discussion on Twitter and to understand the evolution of longitudinal discussion network, we analyze the tweets of occupying Wall Street lasting 16 days by investigating the relationships among equality, emotion, and stability of online discussion. The results reveal that, first, the discussion is highly unequal for both initiating a discussion and being spoken to in the conversation; and second, the stability of discussion for receivers is much higher than that of senders; third, inequality moderates the stability of online discussion; fourth, the emotion expressed in online discussion is relatively balanced and stable, however there is no significant relationship between emotion and political discussion (e.g. frequency, and standard deviation). The implications shed light in understanding the structural features and evolutions of public discussion, and linking political discussion with online social movement.

Key Words: Political Discussion, Social Movement, Twitter, Sentiment Analysis, Longitudinal Network

Introduction

Micro-blog has been considered as a revolutionary tool for reflecting public opinions, instead of elites' voices. Twitter in particular, has recently played a crucial role in contentious politics (e.g. revolution, social movement, strike waves, nationalism, democratization). The wave of Occupying Wall Street activity swept America in late 2011, in which protesters struggled for income inequality. The social movement continuously stimulates online discussions, especially on Twitter. Twitter users actively disseminated the latest information about the social movement by initializing conversations, sharing external links. From the online discussion of Occupying Wall Street, we witnessed a reverse influence from twitter to the offline social movement development.

Public discussion of social movement on twitter is expected to facilitate public expression in public space. However, the quality of the online discussions of the social movement remains a question. Online discussion is a longitudinal, dynamic process, which makes it hard to select an appropriate theoretical framework within which their findings can be interpreted (D.G. Freelon, 2010). Meanwhile, we saw heated discussions ongoing over the role Twitter playing in the social movement contributed from different perspectives. Therefore a framework for evaluating online public discussion is required before we rushed to measure various specific opinion concerns.

Deprived from prior studies, this paper proposes a general framework to evaluate the quality of public opinion as an outcome of discussion on Twitter, including three dimensions of public discussion: salience (e.g. intensity), valence (e.g. agree, disagree, neutral), and emotions (e.g., positive or negative, opinion extremity, angry, happy, etc.) (Gonzalez-Bailon, Banchs, & Kaltenbrunner, 2011). By tracing the discussion network of occupying Wall Street on Twitter,

this study sheds light in understanding the structural characteristics of online discussion by exploring the equality, stability, and emotion of online discussion.

Literature Review

The Quality of Online Discussion

A line of research dedicated to develop indicative metric for measuring the democracy of the online public spaces (Price & Neijens, 1997; Scheufele, 1999; Schneider, 1997).

Generally speaking about the quality of public opinion, Price (1997) argues it's inextricably bound to broader conceptions of quality in democratic decision making which is a complex process involving multiple phases and collective participants. First, decision making is an over-time process which consists several phases, including: (1) the elicitation of values, (2) the development of options; (3) the estimation of consequences, (4) the evaluation of alternatives, and (5) the decision itself. Second, political leaders, interest groups, journalists, attentive publics, and other mass audiences should be carefully distinguished and studied. Price et al (1997) distinguished the quality criteria for evaluating democratic decision making based on outcome and process. The outcome-oriented criteria focus on quality of opinions/decisions, and the process-oriented criteria focussing on quality of opinion formation/decision making.

Schineider gives a much narrower definition of the quality of public discussion. Schneider (1997) defined the quality of conversation as participants' likelihood to stick to the topic. Examining the public discussion in a computer-mediated environment as its closeness to the idealized vision proposed by Habermas, Schneider took three dimensions: equality, quality and reciprocity of online conversations.

Scheufele (1999) distinguished cognitive and affective dimensions of public discussion. First, citizens are rational in paying attentions to news events and issues (i.e. intensity of opinion), and

deciding to support or oppose (i.e. valence). However, second, they are also affective in making decisions of allocating their attentions and forming their attitudes (i.e. emotion).

It's necessary to note that, our definition of the quality of public discussion in this research is consistent with Price et al's thought in which stability is one aspect of the quality of public opinion (Price & Neijens, 1997), and we get beyond of Schneider's definition, since, actually, the definition of the quality of public discussion given by Schneider (i.e., the quality of conversation is participants' likelihood to stick to the topic) (1997) is conceptually the stability of public discussion. Price et al (1997) define stability of opinions on the individual level as the degree to which people's opinions remain consistent over time. However, to study the online public discussion, we extend the stability to participation. In this aspect, our definition of stability of public discussion is consistent with Schneider's.

Except of stability as one aspect of the quality of public discussion, consistent with Price et al, Schneider, and Schefele (Price & Neijens, 1997; Scheufele, 1999; Schneider, 1997), in this study, equality and emotion are brought back. Scholars in purpose of constructing an empirically ground beyond normative study have developed different models to measure the online discussion to capture the dimensions of online discussion, e.g., the focus of content, the ideological direction and participation equality. Focusing on quality of public opinion, we investigate into its three dimensions: equality, stability, and emotion of online public discussion.

Equality of political discussion. The equality of online discussion is considered as the extent to which contributions to discussion are evenly spread among all participants. Habermas in his well-known work considered it as a crucial feature of public sphere. The core vision of the internet as it facilitates free and equal access to political debates has been challenged, however, and the constrains of discussion is by no means equally distributed in so-called public space

(Albrecht, 2006). Despite normative study, the equality of participation becomes a criterion of identifying users' diverse social roles in the online social media.

Equality of participation in political discussion is relevant to the social role of online discussion. Scholars identify social roles in the online discussion groups by structural analysis (Himelboim, Gleave, & Smith, 2009; Turner & Fisher, 2006). For example, Himelboim et al. labeled people who are most likely to evoke contribution to the discussion as "discussion catalysts", and specify the social roles of discussion participants who filter, select and amplify the discussion by investigating the number of replies they received. The author emphasized the dominant impact of different social roles on flows of information in discussion process. Similar findings have been documented in other studies of twitter. Karnstedt et al.(2011) confirmed that people in large forum communities are more likely to be drawn towards 'leaders', implying that the structural feature does have impact on people's discussion behavior.

Stability of political discussion. Previous researchers have suggested stability as one dimension of political discussion. Schneider (1997) defines the quality of political discourse as its closeness to the idealized vision claimed by Habermas, and measures it by the participants' likelihood of staying "on-topic" in a newsgroup. Starting from this angel, stability of political discussion is defined as participants' continuing activity in a network, and measures the online discussion's non-fluctuations attributes. Stability reveals the duration of individual attention to one topic.

Stability of online discussion changes dramatically along the time. Online discussion is a collective social behavior and has impact on interplay of different participants. As a result, it is deemed as lack of thorough thinking since the interactions among users grow and die quickly. Hill and Hughes (1998) pointed out that the online discussion platform, in their case Usenet and

AOL, supporting short line space and make snap comments, thus leading to fast pace of chat instead of thoughtful ones.

Stability, theoretically, is determined by the capacity of public attention, which is proved to be limited. Twitter users are firstly exposed to the latest tweets, which distract them from sticking to a niche of topic.

In addition to the scarcity of public attention, stability will be modified by equality. First, the stability of online discussions will also be shaped by the allocation of public attention. Further, if the individual occupies the more central position in the discussion network tend to be more stable, since they have more motivations to stick on the topic. Second, the social role in online public discussion will also influence the stability of online discussion. The activists who hold more perceived issue salience tend to consistently stay in the discussion, and most of them are discussion initiator who actively starts a conversation with others.

Emotion and political discussion. In the last twenty years studies tagged with emotions have exploded into the political science research and it is a still-growing flow of articles and books ever since (Jasper, 2011). The perspective taken by relating studies have been shifting from the cognitive-only approach to cognitive-plus-affective approach (Marcus, 2000), which gives emotional component of attitudes more weights.

The popular social media websites draw researchers' interests, they investigate in the sentiment reflected by posts from online social network websites, and link it with stock market (Johan Bollen, Mao, & Pepe; Das & Chen, 2007), president polls (O'Connor, Balasubramanyan, Routledge, & Smith, 2010), consumers' opinions of a brand or product (Barbier, Tang, & Liu, 2011; O'Connor, et al., 2010), and outcome of debate (Diakopoulos & Shamma, 2010). And treating poll's result as comparison baseline, O'connor et al.'s study (2010) demonstrated that

aggregated public opinions could be a competent supplement for expensive and time-consuming polling survey with emotion enclosed.

They desire rational and deliberative aspects of public opinion, as Price et al. pointed out, they could not avoid non-rational factors (Price & Neijens, 1997).

First, emotion enables a channel for persuasion. Emotions' role in politics is pervasive, since it enables past experience to be encoded and current situations to be evaluated (Marcus, 2000). As affect is considered as a role in persuasion in psychology (Petty, Gleicher, & S.M., 1991), and a remarkable number of studies have developed upon this foundation. Specifically it plays a role of stirring people up and causing them to abandon habitual commitments, therefore playing a central importance in evaluation, judgment and action in social movements. It is firstly used as an internal factor driven by personality and its impact on political leaders' performance and public's decision-making. In the studies of emotions impact on political participation, Schemer et al. (Schemer, Wirth, & Matthes, 2007) find positive and negative affections are significant predictors of voters' attitudes, and in addition, anger enhances political participation and fear weakens political participation (Schemer, et al., 2007).

Second, emotion gives group members consciousness of groups and motivation to participate in collective endeavors, thus playing a positive role in maintaining the online discussion, given its dramatic role in mobilizing people in political participation or social movement.

Third, emotions are associated with issue salience. Given that those important events render a relatively small fluctuation in sentiment strength. Practically it implies that sentiment strength would be a better detector for major events than that of volume. Thelwall et al. (2010) provide strong evidence that important events are associated with increases in negative sentiment strength in average. Time series analysis has been adopted to identify the emotion trend, both in

the online and offline setting. A study confirms that twitter mood covariate with social, political, cultural and economic events (J. Bollen, Goncalves, Ruan, & Mao, 2011).

Forth, emotions have impact on popularity of tweets. In addition to resembling group members and maintaining the population's enthusiasm, emotion also arouses attention and then enlarges the influence to broader population. Quercia et al. (2011) find that sentiment expression determines the influential degree of tweets, and negative mood is a desirable factor in terms of problem solving, idea production and social influence. Naveed et al. (2011) find that tweets with annoying or displeasing contents and emotion icon tend to get retweeted more often. In terms of cintizen activism in cyberspace, Hill and Hughs (1998) came to the conclusion that the discussion cascade is related to the impoliteness of the messages.

Online Discussion as Political Participation

Participants in online social networks have potential effect on the likelihood of political participation. Scholars have been enchanted about the power of social network long before various kinds of social media swiping the world. By analyzing the interaction between media and special movements, organization and spontaneity of the social movement, researcher link social networks with the continuously emerging social events and came to the conclusion that, first, organizations are important, in regarding with their roles in coordinating and sustaining protest campaigns, especially in initiating protest; second, media becomes a significant role in the middle or the latter stage of certain events in inspiring people's interests because of its coverage and reports of the event; and the interpersonal discussion of the event plays an equivalent part in this process (Diani, 2003).

Internet's potential in the aspect of mobilization has already been documented by previous studies (Hooghe, Vissers, Stolle, & Maheo, 2010; Krueger, 2002), however, heated debates are

held in regarding to the position social media stands in more recent world events. Ng and Detenber's experiment supports that twitter is perceived as more informative than persuasion (Ng & Detenber, 2005). Consistent with this result, Zhao and his colleges (2011) analyze the content of tweets and argue that Twitter users tend to use it to disseminate news rather than express their own opinions on news in the topic categories such as world, business, while topic about style, travel and sports tend to trigger more personal opinions. Knoke (1990) proposes that online discussion would create opportunities to diffuse information to a more heterogeneous group of people, which may eventually help in expanding supports for social movement. Similar to instant message, social media, especially Twitter, has great potential in sharing ideas and coordinating activities, yet more dynamic. Some researchers argued that twitter does not primarily function as a social network, but as a role of spreading news or other information (Kwak, Lee, Park, & Moon, 2010, Krishnamurthy, Gill, & Arlitt, 2008). The shared information includes minor daily activities by ordinary users (Java, Song, Finin, & Tseng, 2007 & Tseng, 2007), and information dissemination by organizations (Wigand, 2010). Besides being treated simply as a source of information, online discussion is thought to stimulate more active participation, according to Mcclurg's study of how informal interaction generated during informal interaction among discussants could contribute to participation probability (Mcclurg, 2003).

Online social networks have great potential in mobilizing people by integrating the organizations of social movement, mass media, celebrities, and interpersonal communication. The connection pattern determines the function to a great extent among twitter users. An important feature of twitter is the function of mention, that is, users could include a symbol "@" and other user' name in their texts, and accordingly the mentioned users would receive the

information. Users mention other users using @ to direct one's attention, which composes a complex conversational ecology of twitter (Boyd, Golder, & Lotan, 2010). To mention means that users are actively interacting with other users in the network. Specifically, in a niche of topic, users mentioning other users indicate their attention on one thing as well as their motivation to draw one's attention. Therefore, it offers us another lens to study users' online discussion in this event.

Theoretical Framework

Since the uprising of social media, a number of studies have used network analysis to identify key actors (Welser, Gleave & Fisher, 2007; Bodendorf & Kaiser; 2009), and the impact on citizen journalism and professional journalism respectively (Lotan et al., 2011) . However, one fundamental gap, the quality of online discussion, is missed from the prior research.

Instead of chewing over twitter's role in social movement in general, this study aims to study the conversational aspects of twitter discussion and understand how it evolves with the development of event.

Drawing on prior studies, and based on the level of analysis, relevant theories, and key conceptions, we formulate the theoretical framework for online discussion in the aspects of agent, structure, content, and time (see Table 1).

Table 1 about here

Research Question and Hypotheses

Straightforwardly deriving operational frameworks from theories of deliberative democracy (D.G. Freelon, 2010), the present study aims to address research questions about equality, stability and emotion of public discussion. Firstly, about the aspect of equality, we ask that how

does public discussion over Occupy Wall Street stretch on Twitter. We could hypothesize the extent involving in a conversation is unequally distributed in the network. We also interested in that to what extent twitter conversation is constrained by users' structural in the network. And the conversation is emotion-free, thus it's beneficial to rational discussion and public opinion. Besides, for both initiator and receivers of the conversation, the stability decreases along time. And lastly, the stability of activists is much higher comparing with the stability of non-activists. The proposed framework is beyond investigating in three dimensions as viewing them independently. After an initial understanding of network features, we will spend our effort in addressing the question about the interactions among three factors.

To test the previous research finding, we propose our first hypothesis that a small proportion of users are predominantly mentioned by other users.

It is more worth noticing that there should be a certain level of sustained membership during the process to keep the discussion moving forward. And more importantly, we wonder whether there are any interaction effects among these three factors. The stability of online discussion on a certain topic is guaranteed by a core cluster of contributors, coordinated by a greater size of participants who come and go. The duration of users' attention to one topic is influenced by other active users. Later studies found that centrality of users notably impact on churning action in online community (Marcel Karnstedt, Matthew Rowe, Jeffrey Chan, Harith Alani, & Conor Hayes, 2011 & Alani, Hayes, 2011), especially in a busy and dense network.

We label discussion participant who has been extensively mentioned as the "general" of the discussion, and those who are active in posting by frequently mentioning or initiating discussions with others the "soldier". By analyzing the role and positions (discussion initiator VS. conversation receiver) in the online discussion, we expect to see that the general stays in the

barrack, while the soldiers come and go. Thus we propose that the active users have bigger stability of participating in the online discussion.

H2a: Discussion initiator is less stable than conversation receiver.

H2b: For discussion initiators, those who are more central in the discussion are more stable.

H2c: For conversation receivers, those who are more central in the discussion networks are more stable.

Emotion would have a non-trivial impact on structural features of public discussions (e.g., equality and stability). We propose our research questions related with emotion dimension: how sentimental expression in tweets relates to the other structural features of online discussion.

First, according to prior literature, emotions have impact on popularity of tweets. Thus, the emotional tweets will be more popular and attract more public attentions, which will shape the equality of public discussions. Thus, we have the following hypothesis:

H3a: emotions have significant influence on equality.

Second, as we have discussed in the literature review part, emotion plays a positive role in maintaining the online discussion by building group members' consciousness of groups and motivation to participate in collective endeavors, thus emotions of tweets are helpful in the stability of public discussion. Thus we formulate the following hypothesis.

H3b: emotions have significant influence on stability.

Methods

Predominant guideline focused solely on deliberation related criteria baffle researchers to embrace and explore characteristics of online discussion that pertaining to real situation (D. G. Freelon, 2011). The Internet provides a good opportunity for both collecting data and matching different theoretical statements about an ideal public sphere with the unobtrusive observations.

Our data is retrieved from twitter on a single spike of interest – topic about Occupy Wall Street by R-shief[1], and it contains 1353413 tweets in 16 days (between Sep 24th 2011 and Oct 10th 2011), among which, 88601 discussions (i.e. mention, and reply) are identified by the symbol of "@".

Extraction of Discussion Network

Twitter is inherently a platform for online discussion. There are four types of messages in twitter: singleton, retweet, comment, and conversation.The interactive network is considered as higher value. By extracting the interaction network in twitter with @username in the conversation, we focus on the in-degree and out-degree of different users thus gaining a comprehensive understanding of how conversational interactions develop in twitter network.

By analyzing the correlation matrix of individual's participation of political discussion lasting16 days, we study the node centrality over 16 time windows (16 days of tweet network). Braha & Bar-Yam (2006) propose that discussion network is time-based, and they find node centrality changes dramatically from day to day, thus they suggest to adopt the dynamic centrality and dynamic network, instead of static centrality and aggregate network. Similarly, the change of triad is also studied by investigating the Triad Transition Matrix (Juszczyszyn, Budka, & Musial, 2011).

Sentiment Analysis of Tweets

To evaluate the features of public opinion expressed on twitter, we adopt sentiment analysis to measure the positive and negative emotions for each tweet. Sentiment analysis facilitates us to detect and measure emotion online. Of particular interest here is whether sentiment is embedded in the posts during the process of social movement, and how it develops along the time.

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[1] http://www.r-shief.org/

Following the line of psychological research, we distinguished emotion from mood since emotion requires a triggering event while mood does not, while sentiment refers to emotions that turn into generalized long-term beliefs (Marcus, et al., 2000; Neuman, Marcus, Crigler, & MacKuen, 2007; Redlawsk, 2006).Thus we may say that so far as actual experience is concerned, the sentiment is constituted by the manifold emotions in which it manifests itself. The emotion is temporary, yet separated conditions constitute sentiment, in which manifests itself. The character of emotion is varied with on the specific sentiment on which it depends. Therefore, in this study, we will measure online discussants sentiment by tracing their twitter texts, categorizing into two directions of positive and negative.

Affective reactions are a ubiquitous aspect of human perception (Marcus, 2000). Yet dilemma has posed in the early works, mainly attributed to the lack of valid and reliable measurement (Marcus, 2000). Basically we are interested in the absence or presence of sentiment words in a post. It has been pointed out that potential flaws may occur in the process of analyzing subjectivity and polarity of the message, while a high error rate for detecting a noisy measurement is rarely attached with the aggregated sentiment detector.

We measure the emotion by detecting the wording and phrasing of each post. Specifically, the wording in each post is about to be compared with the lexicon, which contains lists of words that are precoded for polarity, and their occurrence frequency indicates the emotion strength (Taboada, Brooke, Tofiloski, Voll, & Stede, 2011). In order to explore how the discussion is evolved with over time, another part of our research is the longitudinal analysis. We use aggregate data into days to produce daily time series. The strength of emotion reflecting in each post per day is then constructed, given by a numerical value.

[Figure 1 the shift of discussion, monologue, and sentiment score]

Results

To test the first hypothesis relating to equality, we look into the network measures of centrality (i.e. degree, in-degree, and out-degree). First, the attributes of discussion network, that is in-degree and out-degree of network follows the power law distribution. This result confirming the our first hypothesis.

Figure 2 about here

For the second hypothesis about stability, we find that, along the time, participation of the people who were spoken to (i.e. receivers) is relatively higher than that of the people who speak to others (i.e. senders). Thus we confirm H2a.

Figure 3, 4, 5 about here

The correlation coefficient of local hub of receiver is larger than non-local hub of receiver. Thus we confirm the hypothesis of H2b

However, we find a reversal outcome for H2c, that is, non-local hub senders are more likely to follow a repeated initiating conversation behavior.

Third, compared with the inequality of participation in online discussion, the emotion expressed in the online discussion is relatively balanced and stable. We found no significant relationship between individual emotion and equality and stability of political discussion (e.g. frequency, and standard deviation). Thus we failed in confirming the hypotheses H3a and H3b.

Figure 6 about here

Discussion and Conclusion

Drawing on diverse literature, this paper aims to investigate into the patterns of online discussion of social movement in terms of the equality, stability, and emotion aspects. Based on a general theoretical framework of online discussion, the findings reveal that both emotion extremity and political discussion are power-law distributed, and emotion has strong linear influence on both frequency and stability of political discussion. Further, the inequality of political discussion has influence on the stability of daily participation of online political discussion along time.

Moreover, by investigating in discussion network, this study could better interpret the "hidden" network of actual interaction rather than a massive and passive follower network, which meanwhile contributes a new perspective to study online discussion network in this field. Specifically, we scope it to a niche of topic, which allows us gaining deeper understanding of how twitter may account in this kind of social movement uprising worldwide. We argue that mentioning other people using @ draws the attentions of the target users serves as one way of mobilizing people.

When the mass audience is truly empowered to voice for themselves, it is difficult to separate the process of organizing the social movement with public's discussion of the issue. People's attention towards the issue is translated into the real action, be it composing tweets in the twitter or retweeting the news of this issue. The practical case is that people may not intentionally discuss about the issue, instead they contribute their attention by following the current case, yielding to a loosely connection to the event. Therefore when new issues taking place in the same platform compete for users' attention, we could predict a shift from old topic to more latest one. Moreover, the stability is positively related with one's centrality in the network.

We could see from the data that those users who received more attentions from other users would stick to the issue for a longer time.

Following abundant conclusions drawing from previous researchers and combining the specific case in twitter usage, we argue that it is more easily to speak in the online discussion forum than to be heard, thus the conversational pattern is unequally among different users. Consistent with previous conclusions, it has been noted a strong concentration of contributions in a small core of very active users. The results show that people highly unequally participated in the online political discussion, and the conversations tend to be emotion-free, in other word, no dramatic expressiveness is detected from tweets. Given open and equal access of Internet, online discussion is shaped by the highly unequal priority given by individuals. Thus the discussion is unequal among individuals. And the appearing in reverse chronological order on the public timeline on one's Twitter page has undoubtedly impact on user attention, inclining to give more attentions towards newly posted tweets, thus sustaining short than that in a traditional forum website. And the conversation does not aim to launch a thorough discussion, but more likely to capture the attention from another user, and as a result it decreases its power of influence. However, the active mentioning can be an efficient indicator of one's attention submitting to a certain topic, since users' attention is the rarest source in the information overload era.

The emotion which is found out to be small amount may due to several reasons: first, although the participants are active and passionate, they are relatively objective; second, the number of words in a tweet constrain tweet users from uttering to much affective words; and third, this study focuses on the online discussion, and when people speak to someone else, it's necessary to keep polite and calm.

Further, the initiation of political discussion on twitter is self-organized and relatively unstable, and there is a participation cycle for the senders (7 days). We found that while the possibility of being mentioned by other users is apparently declining within 16 days, the senders' possibility first declining, and then arise, indicating that users are contributing their attention to the event after a week. Given that the individual senders are more likely to keep mentioning other users. Individual receivers' possibility of receiving a conversational tweet is declining, indicating that there might be more individuals involved in twitter conversation later on. While the stability of the people being mentioned in the discussion decrease over time, which implies that along the development of social movement, the people being mobilized shift with time. But to cool down the discussion of deliberative democracy, we argue that online discussion shall not be an ideal battlefield for deliberative discussion – for that it is insofar not a place for forming a sustainable topic, an outcome that the deliberative need to achieve at least, given that consensus is not necessary in this process.

For the discussion of the emotion of online discussion, intuitively it seems that a significant and influential event should be related with a certain kind of emotional reaction. And for the field of social movement, it is supported by a rich amount of literature that a certain level of emotion would play a role of connection and catalyst for the proceeding of the issue. But results of our study tend to endorse that twitter users are communicating and exchanging their messages of informing the external events, in which hardly contains their strong emotion towards the event. Some researchers argue that it is mainly for preexisting personal goals, but it requires further confirmation via a well-designed content analysis.

Taken together, we see that online discussion is important both in physically transmitting the information and the information released in this platform itself – especially when it transmit the

information containing the face-to-face image that relating with everybody. The weak ties decrease homophily in information sharing brought by social media. More specifically, in our case, Twitter is a place for news diffusion and a place for opinion expression. However, opinions expressed in this platform are characterized more as informal, personal or even non-attitudes rather than rational reasoning and meaningful claiming for deliberative discussion. Unlike traditional online forum containing a great deal of negotiations and dialogues, texts shown in the twitter are more about individuals' flash thoughts, or say quick-and-ambiguous-position, which is difficult to form stable and sustainable dialogues. Because of such mixture of expressions in twitter, the dialogue could be a good representative of the attention of the public trend, instead of a valid proxy of public opinions.

The identities of top 100 active users are manually coded and categorized into nine categories to have a better knowledge of who participated in this discussion. The graph demonstrates that the largest proportion of conversation receivers is news media, followed by individual activist. Individual celebrities from entertainment industry, such as singers or movie stars are frequently mentioned by other users, so do newspaper or magazine column writers. Interestingly we found that twitter accounts registered as the official-like represent received just satisfactory amount of mentions when comparing to other indirectly relating users, which implies that twitter users are intentionally to mobilize the elites, politicians, and journalistic community by initializing discussions with them.

Figure 7 about here

The contribution of this paper is that it provides another perspective to investigate and sketch public opinions. Previous theories of public opinion concerns how mass media and political

elites shape public opinion in terms of agenda-setting, spiral of silence, Zaller's ABS model, etc. While our study reveals that the social media users are active in mobilizing the elites and the mass media. We try to portal it from the position of "audience" and see how they actively initiate the conversations. This new perspective shed light on the study in the prosperity of social media.

This paper isn't without limitations, e.g., it's necessary to evaluate the quality of the lexicon used for sentiment analysis, and the categorization of the sentiment should it be categorized into more fractions.

There are several implications for future researchers. First, previous studies are standing in the position of opinion leader and see their relating information diffusing action. But switching to perspective examing the ordinary people provides a comprehensive knowledge of how people are interacting with each other and how the latter group of users contributes in this process. Second, in this line of research, it is also valuable and meaningful to compare online discussion process with offline social movement. E.g., how public opinion reflecting in the virtual world relates with the size of population, or how the online public opinion matches, or departs from the media opinion? Third, emotion is by all ends a component of public opinion, but researchers in this field have merely take advantage of this method to gauge the public opinion. Facilitated by the techniques in the web science, there would be a great potential for an evolutional improvement of public opinion study. Mentioned that the result does not come without caution, it is encouraging to take a leap from the traditional survey method, to embrace a more substantially improved and suited lens to gauge the public opinions. Last but not least, to discuss twitter's role in human communication, some may argue that the present ephemeral passion would one day give its way to some skepticisms, and all the favors and fascination on this social media would one day bleak out just like what we witnessed when email, blog, and all other stars emerging in

the internet before. It should be very cautious when jumping to the conclusion about its

revolutionary role based on what we observe in the twitter network. But considering its

tremendous performance during a series of social events, it is fairly hard to cover its shining in

human history.

References

Albrecht, S. (2006). Whose voice is heard in online deliberation?: A study of participation and representation in political debates on the internet. *Information, Communication & Society, 9*(1), 62-82.

Barbier, G., Tang, L., & Liu, H. (2011). Understanding online groups through social media. *Wiley Interdisciplinary Reviews: Data Mining and Knowledge Discovery, 1*(4), 330-338. doi: 10.1002/widm.37

Bollen, J., Goncalves, B., Ruan, G. C., & Mao, H. N. (2011). Happiness Is Assortative in Online Social Networks. *Artificial Life, 17*(3), 237-251.

Bollen, J., Mao, H., & Pepe, A. (2010). *Determining the public mood state by analysis of microblogging posts.* Paper presented at the Alife XII Conference, Odense, Denmark.

Boyd, D., Golder, S., & Lotan, G. (2010, 5-8 Jan. 2010). *Tweet, Tweet, Retweet: Conversational Aspects of Retweeting on Twitter.* Paper presented at the System Sciences (HICSS), 2010 43rd Hawaii International Conference on.

Braha, D., & Bar-Yam, Y. (2006). From centrality to temporary fame: Dynamic centrality in complex networks. *Complexity, 12*(2), 59-63.

Das, S. R., & Chen, M. Y. (2007). Yahoo! for Amazon: Sentiment extraction from small talk on the web. *Management Science, 53*(9), 1375-1388.

Diakopoulos, N. A., & Shamma, D. A. (2010). *Characterizing debate performance via aggregated twitter sentiment.* Paper presented at the Conference on Human Factors in Computing Systems (CHI).

Diani, M. (2003). Introduction: Social Movements, Contentious Actions, and Social Networks: From Metaphor to Substance ? In M. Diani & D. McAdam (Eds.), *Social Movements and Networks: Relational Approaches to Collective Action* Oxford University Press, USA.

Freelon, D. G. (2010). Analyzing online political discussion using three models of democratic communication. *new media & society, 12*(7), 1172.

Freelon, D. G. (2011). Talking among Themselves Online Youth Civic Communication in Managed and Autonomous Environments. *Information Communication & Society, 14*(2), 198-218.

Gonzalez-Bailon, S., Banchs, R., & Kaltenbrunner, A. (2011). Emotions, Public Opinion and US Presidential Approval Rates: A 5 Year Analysis of Online Political Discussions.

Hill, K. A., & Hughes, J. E. (1998). *Cyberpolitics: citizen activism in the age of the Internet*: Rowman & Littlefield.

Himelboim, I., Gleave, E., & Smith, M. (2009). Discussion catalysts in online political discussions: Content importers and conversation starters. *Journal of Computer-Mediated Communication, 14*(4), 771-789.

Hooghe, M., Vissers, S., Stolle, D., & Maheo, V. A. (2010). The Potential of Internet Mobilization: An Experimental Study on the Effect of Internet and Face-to-Face Mobilization Efforts. *Political Communication, 27*(4), 406-431.

Jasper, J. M. (2011). Emotions and Social Movements: Twenty Years of Theory and Research. *Annual Review of Sociology, Vol 37, 37*, 285-303.

Java, A., Song, X., Finin, T., & Tseng, B. (2007). *Why we twitter: understanding microblogging usage and communities.* Paper presented at the 9th WebKDD.

Juszczyszyn, K., Budka, M., & Musial, K. (2011). *The dynamic structural patterns of social networks based on triad transitions*.

Karnstedt, M., Rowe, M., Chan, J., Alani, H., & Hayes, C. (2011, June14-17). *The effect of user features on churn in social networks.* Paper presented at the WebSci'11, Koblenz, Germany.

Karnstedt, M., Rowe, M., Chan, J., Alani, H., & Hayes, C. (2011). *The Effect of User Features on Churn in Social Networks.* Paper presented at the ACM Web Science Conference 2011, Koblenz, Germany. http://oro.open.ac.uk/28846/

Knoke, D. (1990). *Organizing for collective action*. Hawthone, NY: Aldine de Gruyter.

Krueger, B. S. (2002). Assessing the potential of Internet political participation in the United States - A resource approach. *American Politics Research, 30*(5), 476-498.

Lotan, G., Graeff, E., Ananny, M., Gaffney, D., Pearce, I., & Boyd, D. (2011). The revolutions were tweeted: Information flows during the 2011 Tunisian and Egyptian revolutions. *International Journal of Communication, 5*, 1375-1405.

Marcus, G. E. (2000). Emotions in politics. [Review]. *Annual Review of Political Science, 3*, 221-250. doi: 10.1146/annurev.polisci.3.1.221

Mcclurg, S. D. (2003). Social Networks and Political Participation: The Role of Social Interaction in Explaining Political Participation. *Political Research Quarterly, 56*(4), 449-464. doi: 10.1177/106591290305600407

Naveed, N., Gottron, T., Kunegis, J., & Alhadi, A. C. (2011). *Bad news travel fast: A content-based analysis of interestingness on Twitter*. Paper presented at the WebSci'11, Koblenz, Germany.

Ng, E. W. J., & Detenber, B. H. (2005). The impact of synchronicity and civility in online political discussions on perceptions and intentions to participate. *Journal of Computer-Mediated Communication, 10*(3).

O'Connor, B., Balasubramanyan, R., Routledge, B., & Smith, N. (2010). *From Tweets to Polls: Linking Text Sentiment to Public Opinion Time Series.* Paper presented at the Proceedings of the International AAAI Conference on Weblogs and Social Media.

Petty, R. E., Gleicher, F., & S.M., B. (1991). Multiple roles for affect in persuasion. In J. P. Forgas (Ed.), *Emotion and Social Judgments* (pp. 181-199). Oxford: Pergamon.

Price, V., & Neijens, P. (1997). Opinion quality in public opinion research. *International Journal of Public Opinion Research, 9*(4), 336-360.

Quercia, D., Ellis, J., Capra, L., & Crowcroft, J. (2011, 9-11 Oct. 2011). *In the Mood for Being Influential on Twitter.* Paper presented at the Privacy, security, risk and trust (passat), 2011 ieee third international conference on and 2011 ieee third international conference on social computing (socialcom).

Schemer, C., Wirth, W., & Matthes, J. r. (2007). *The Emotional Underpinnings of Democracy - The Impact of Positive and Negative Affect in a Political Campaign in Switzerland*. Paper presented at the World Association for Public Opinion Research, Berlin, Germany.

Scheufele, D. A. (1999). Deliberation or dispute? An exploratory study examining dimensions of public opinion expression. *International Journal of Public Opinion Research, 11*(1), 25-58.

Schneider, S. M. (1997). *Expanding the Public Sphere through Computer-Mediated Communication: Political Discussion about Abortion in a Usenet Newsgroup.* Degree of Doctor of Philosophy in Political Science, Massachusetts Institute of Technology.

Taboada, M., Brooke, J., Tofiloski, M., Voll, K., & Stede, M. (2011). Lexicon-Based Methods for Sentiment Analysis. *Computational Linguistics, 37*(2), 267-307. doi: 10.1162/COLI_a_00049

Thelwall, M., Buckley, K., Paltoglou, G., Cai, D., & Kappas, A. (2010). Sentiment strength detection in short informal text. *Journal of the American Society for Information Science and Technology, 61*(12), 2544-2558.

Turner, T. C., & Fisher, K. E. (2006, 04-07 Jan. 2006). *The Impact of Social Types within Information Communities: Findings from Technical Newsgroups.* Paper presented at the System Sciences, 2006. HICSS '06. Proceedings of the 39th Annual Hawaii International Conference on.

Wigand, F. D. L. (2010). *Twitter in government: Building relationships one Tweet at a time.* Paper presented at the Seventh International Conference on Information Technology, Washington: DC.

Zhao, W., Jiang, J., Weng, J., He, J., Lim, E.-P., Yan, H., & Li, X. (2011). Comparing Twitter and
Traditional Media Using Topic Models. In P. Clough, C. Foley, C. Gurrin, G. Jones, W. Kraaij, H.
Lee & V. Mudoch (Eds.), *Advances in Information Retrieval* (Vol. 6611, pp. 338-349):
Springer Berlin / Heidelberg.

Table 1 Theoretical Framework of Political Discussions

Level of Analysis	Theory	Conception
Network Structure	1. Public sphere	1. Centrality (inequality)
	2. Deliberation	2. Reciprocity
		3. Transitivity
Temporal Change	Dynamic centrality	longitudinal trend (Stability)
Content of discussion	Social movement	1. Quality
	User-generated content	2. Emotion
Individual Attributes	Homophily	1. Spatial proximity
	Social capital	2. SES
		3. Activity & Popularity
		4. Self-disclosure

Figure 1 the shift of discussion, monologue, and sentiment score.
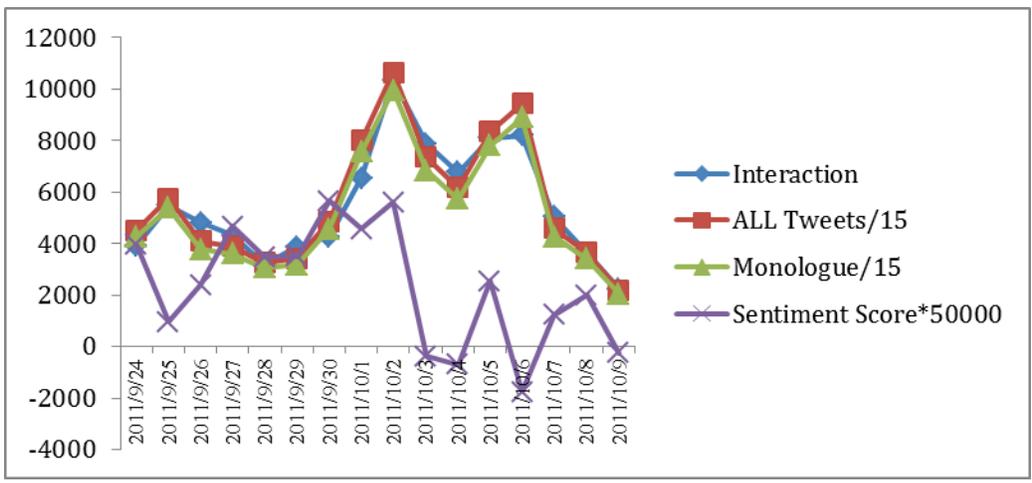
Figure 2 Degree distribution of the discussion network
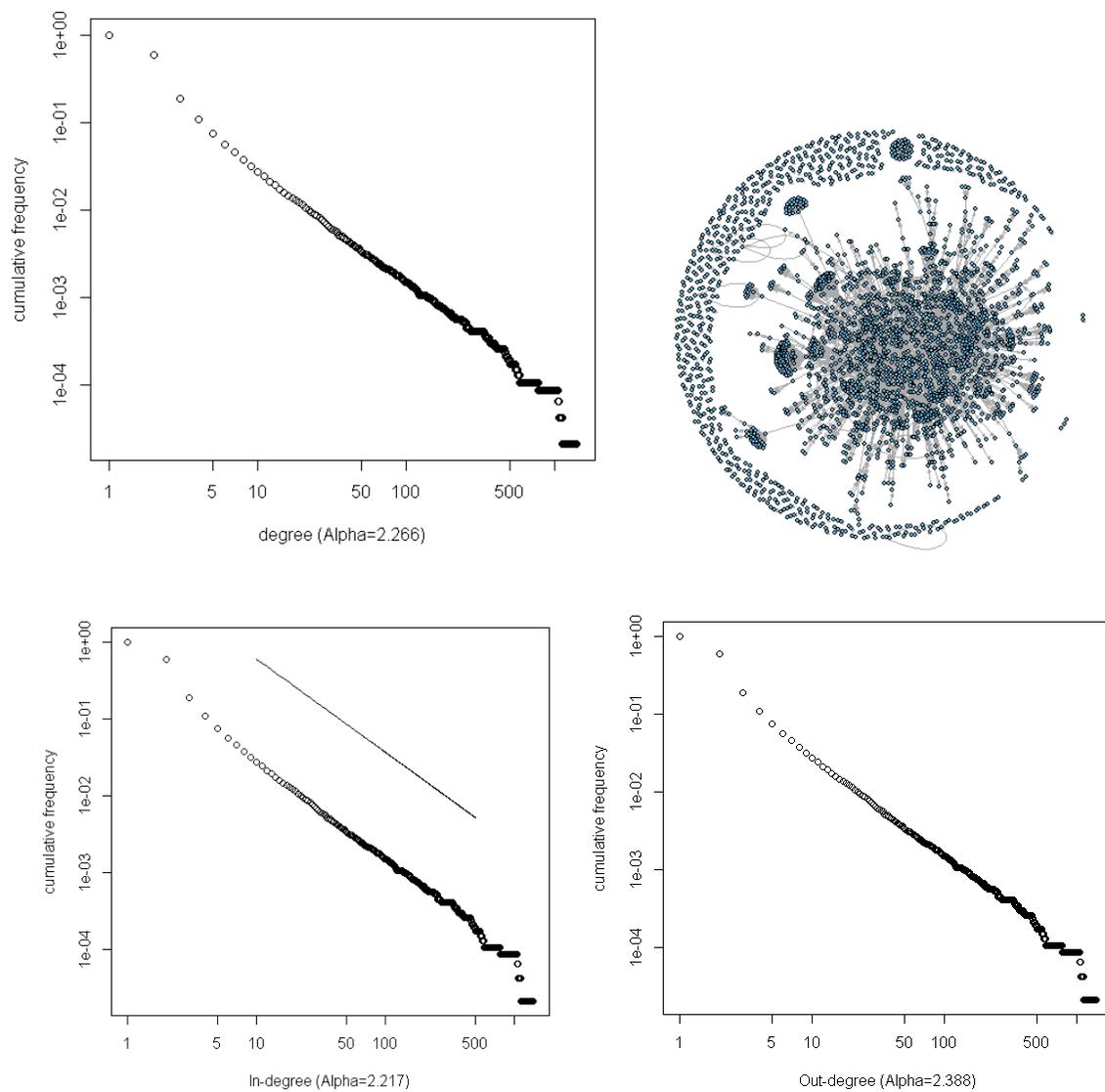
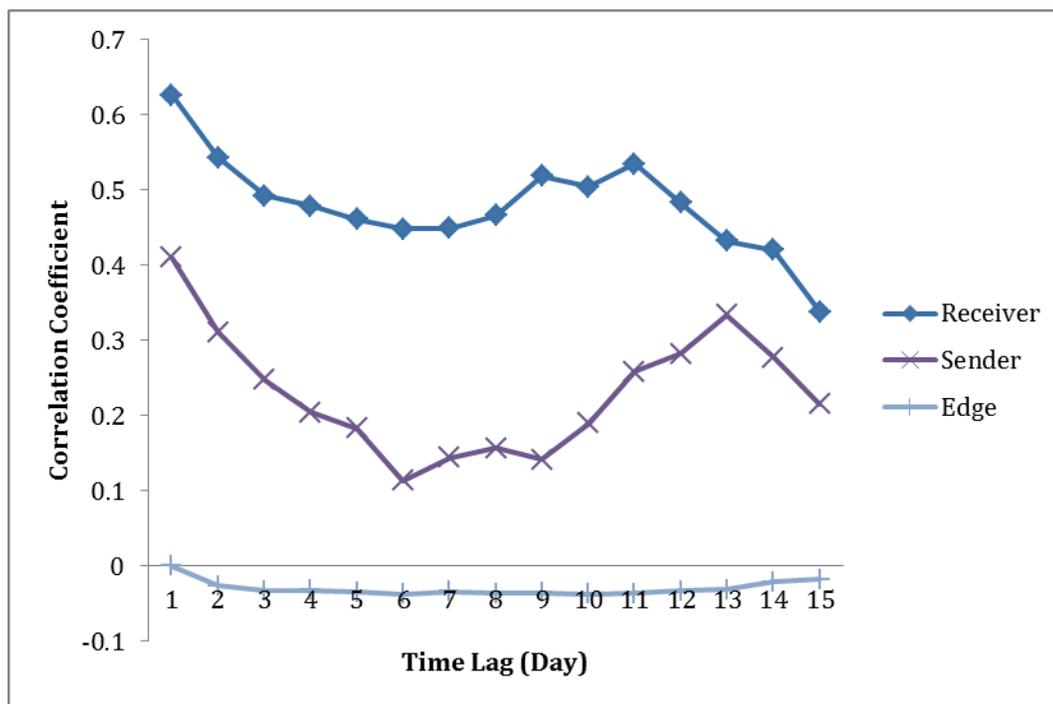**Figure 3 The Stability of the Participation of Senders (left) and receivers (right) over Time**
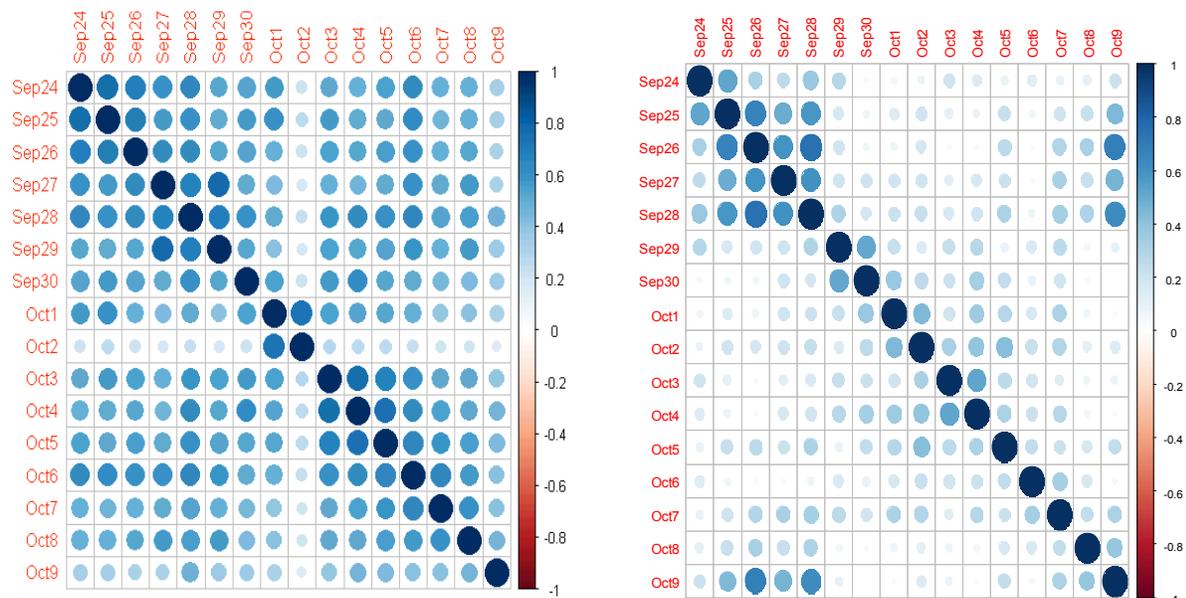
Figure 4 Stability of the discussion network

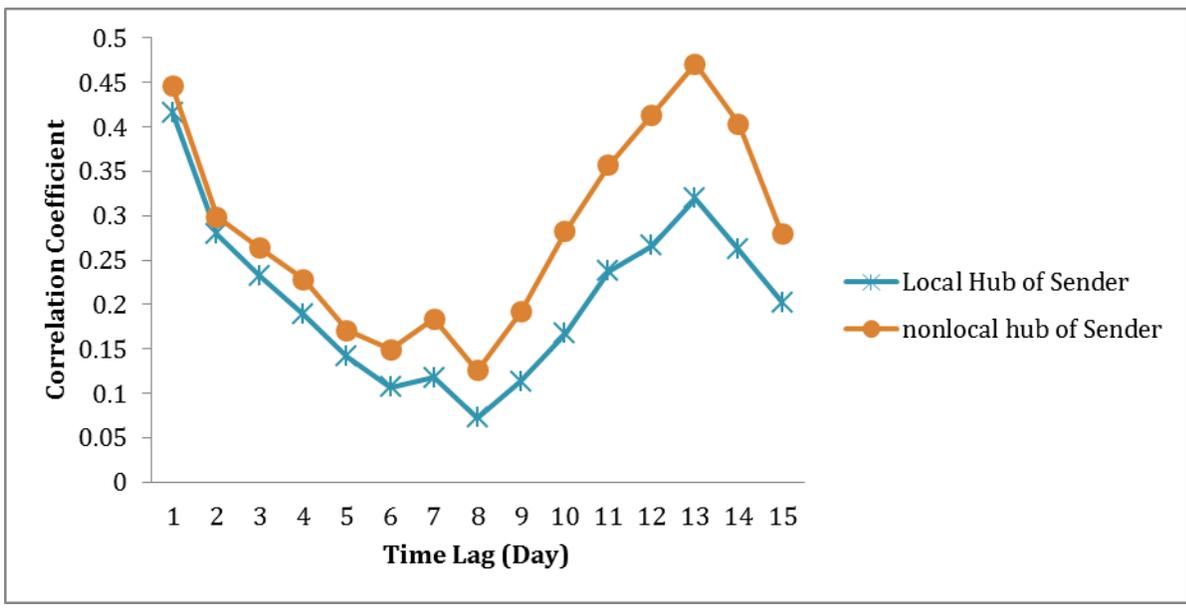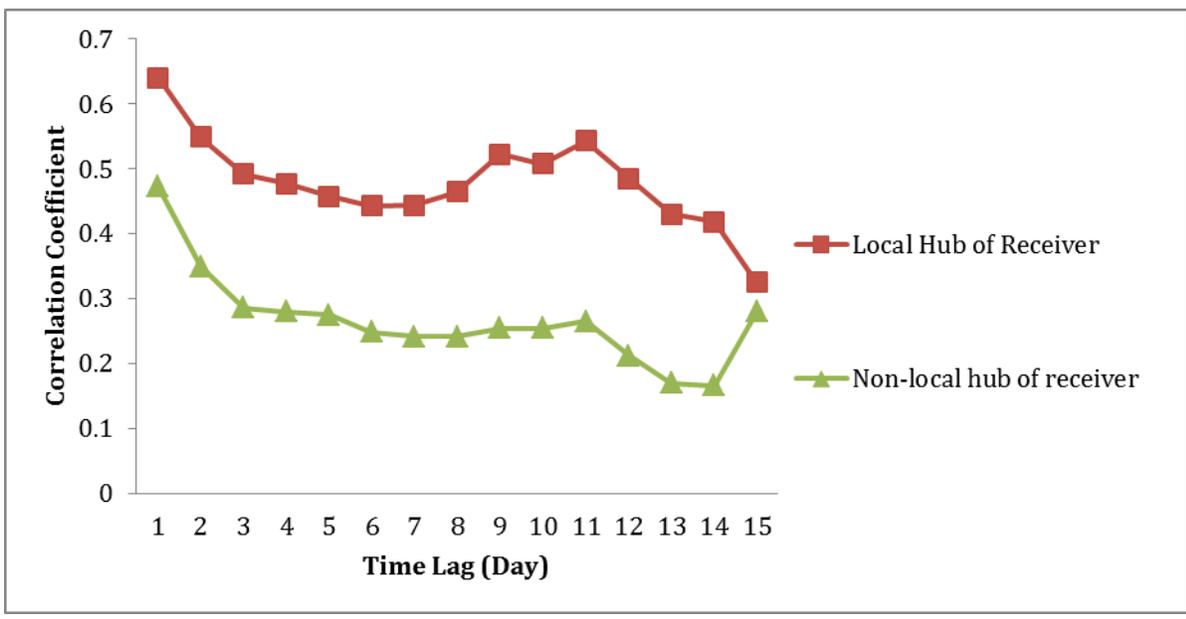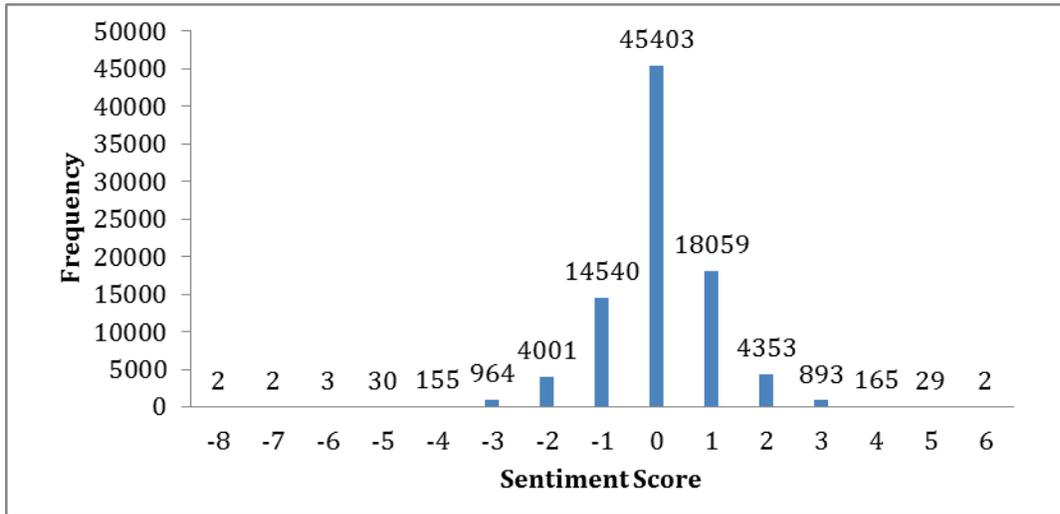**Figure 5 Equality and Stability of Online Discussion**

Figure 6 Sentiment score (level of analysis is tweet)

Figure 7 Categories of Top 200 discussion receivers