COLLECTIVE SENSE-MAKING THROUGH THE TWITTER SERVICE DURING THE 2011 EGYPT REVOLUTION

Research in Progress Paper

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Abstract

This study explores the role of Twitter during the 2011 Egypt revolution. Drawing on the body of literatures on collective behavior in general and social movement in particular, we investigate the concept of sense-making which is considered as a key aspect of collective behavior. Our special focus will be placed on analyzing the changing patterns of hashtags by applying the Markov-Switching Model. The analysis of hashtags is expected to explicate (1) how the collective sense-making process emerges over time through Hashtags, and (2) what the implications of those sense-making processes are in the particular situation of the 2011 Egypt revolution. A few theoretical and practical implications will be discussed.

Keywords: The 2011 Egypt Revolution, Social Media, Twitter, Hashtag, Social Movement, Collective Sense-Making, Information Diffusion

Introduction

The 2011 Egypt revolution has opened fora for debates on the role of social media and social changes. Depending on its emphasis between the continuous spectrum of social media technologies at the one end and human intention at the other end, the debate seems to disclose three different views. Wael Ghonim, a young activist who was nominated as one of the most influential 100 people in 2011 by Time (Elbaradei 2011), is a strong advocate of social media technologies in describing the 2011 Egypt revolution, the demise of 30 years of dictatorial Mubarak regime. He anonymously created a Facebook page in July 2010, "We Are All Khaled Said," to protest the brutality of Egyptian polices who beat to death a 28 years old activist, Khaled Said. Using this page, he and the Facebook members shared photos and videos on the Egyptian government's abusive use of power, and coordinated street-level social protests to dispel the Mubarak regime from his 30 years of dictatorship. Ghonim argues that "this leaderless revolution" was the "Revolution 2.0" against corruption, injustice, torture, and unemployment (Ghonim 2012, p.294). In his CBS interview (CBS 2012), he emphatically emphasizes that "if there was no social networks, it [Egypt revolution] would have never been sparked. [...] Without Facebook, without Twitter, without Google, without YouTube, this would never have happened." In his other CNN interview (CNN 2012), he more strongly stresses that "Definitely this [Egypt revolution] is the Internet revolution, and I call it Revolution 2.0." Ghonim's description is framed around the intersection of social media technologies and its capability of aggregating a multitude of individuals. In that regard, his argument is close to the techno-centric discourse in describing the role of social media technologies and social changes.

At the other extreme end of the spectrum, supporters of human intention highlight that many revolutions have existed even before the advent of social media technologies as observed in the case of the French Revolution of 1789 and many other historical ones. Their shared arguments are that "People with grievance will always find ways to communicate with each other" (Gladwell 2011), or "The dozen or more protesters that self-immolated in Egypt didn't do it for the tweets" (Kravets 2011), or "An outraged and unified population is both" necessary and sufficient condition for a revolution (Coldewey 2011). For them, the social media technologies are considered as ancillary communication tools or resources that can be adopted, controlled, or even denied at will to achieve greater ends of human beings (Kravets 2011). These descriptions typically assume a hierarchy by considering human intention as a primary actor of social change and the social technologies as manageable resources to support the human goal. These types of arguments are close to the human-centric discourse in understanding and describing the role of social media technologies in social changes.

Somewhere in the middle of these two contentious discourses, academic pundits focus on the phenomena of machine mediated human communication. They approach the social media technologies as communication machines, and present varying modes of communication patterns mediated through social media websites (Maghrabi et al. 2011; Starbird and Palen 2012). For example, Lotan et al. (2011) report that, during the Tunisia and Egypt revolutions, situational news was co-constructed and rapidly distributed through Twitter to the globe through interplay of bloggers, activists, and mainstream journalists, which contributed to diversification of news sources. Howard et al. (2011) identify the pattern of sudden rise of revolutionary conversations in overall social media websites (e.g., Facebook, YouTube, Flickr, and Twitter) during the time period of Arab Spring. Starbird and Palen (2012) show how situational information was retweeted through interaction between people on the ground of Egypt and those who were not. This discourse focuses on various modes of machine mediated human communications to show how interactive features of social media technologies facilitated different types of information diffusion during the Arab Spring.

Although dissimilar views offer different insights, at the same time, they seem to obscure empirical dynamics that may occur when people collectively use social media technologies in practice. That means, because most discussions either take a binary approach (e.g., either techno-centric or human-centric approach instead of both) or pay attention to the general pattern of machine mediated human communications, they cause a murkiness in having situated understanding of the role of social media technologies in the specific condition of social movements. Mindful of these problems in research framing, the research questions in this paper are dovetailed to the body of previous literatures on collective behavior in general and social movement in particular. Especially, by focusing on the issue of collective sense-making process, which is considered as the most critical aspect of collective behavior (Turner et al. 1957), this study attempts to understand how the hashtag, a technological feature of Twitter

service, contributed in the large-scale sense-making process in collaboration with online citizens.

Hashtag (or hashtagged word or hashtagged keyword) consists of a word preceded by the hash (#) symbol. A hashtag can be written anywhere in the tweet message. It is normally used to direct people's attention to a specific theme or to follow certain threads of discussion. Once the hashtagged word is included in messages, it automatically turns into a clickable hyperlink such that all tweet messages that contain the same hashtag can be searched out of entire Twitter space and presented in reverse chronological order. The hashtag helps to quickly search hashtagged words out of a welter of Twitter messages with one click such that Twitter users can quickly have multifaceted views on the situation or ideas suggested by the hashtag.

The study herein broadly has three innovative contributions. First, we consider the hashtag as a performative agent which actualizes the large-scale sense-making potential of distributed online crowd through collective writing practices of specific hashtags. Because collective sense-making is known to be the most critical aspect of collective behavior (Turner and Killian 1957) and the social media have been known to play significant roles for the revolution (Ghonim 2012), having the understanding on how online crowd express themselves within the Twitter systems and how Twitter systems process their collective expression will shed light on explicating the role of social media for social changes. Second, this study, which treats both the crowd and the Twitter systems as performative agents, adds an empirical study to the call of emerging research method of sociomaterialism (Orlikowki 2005; Orlikowski and Scott. 2008). Given that underlying assumption of the sociomaterialism is to acknowledge the inseparably intertwined reality between humans and technologies as active agents, analysis of sense-making process through hashtags will show how non-human elements of machine languages (e.g., #, @ etc) performs essential roles to facilitate the collective sense-making process for online crowd. That means, along with the intended meanings of large-scale Twitter users, we need to understand that collective meaning is produced through the Twitter specific technological and linguistic constraints (e.g., less than 140 characters, hashtag, @mention, and Retweet etc.). In that regard, the technological and linguistic constraints perform the roles of active agent which enables production of collective meanings for a multitude of online crowd. In this approach, key is to (1) explicate how two different agents (crowd and Twitter system) perform different activities to construct collective meaning, and (2) interpret the produced meanings in the situated context of the Egypt revolution. By not offering privilege either to human or technology, but at the same time, by not sacrificing one agent for another, we may be better able to understand the role of Twitter at the situation of the 2011 Egypt revolution. Lastly, the study suggests an innovative method of Markov Switching model to quantitatively analyze the changing patterns of collective sense-making. We take advantages of the social media technologies which unobtrusively record human communications into a large number of text files. Therefore, our analysis of the Twitter texts transcends the limitation of face-to-face communication, which requires obtrusive observation, retrospective survey or interview to collect data to conduct collective sense-making study.

Sense-Making View of Social Movement

Social crisis situation brings about external environment of informational uncertainty and situational ambiguity at the societal level (Bordia 1996; DiFonzo et al. 2007; Runyan 2006; Tilly 2004; Turner et al. 1957). This unfamiliar and uncertain external situation incurs a psychological anxiety (e.g., what happened?, what is happening, or what will happen?) and cognitive urgency (e.g., what should I do?, what are you going to do?, what should we do?) at the collective level (McPhail 1991). These collective anxious and urgent feelings force people to define the ambiguous situation, construct a shared meaning and normative structure that can guide their action through physical and verbal interaction process among heterogeneous people of diverse backgrounds (Aguirre 1994; Rose 1982; Turner and Killian 1957). Turner and Killian (1957) call this dynamic physical and communicational interaction as "milling" and "keynoting" process, which are considered two essential sub-components of the collective sense-making process. The main argument is that collective action is preceded by collective sense-making process, which continuously evolves from chaotic *milling* interaction into organized *keynoting* interaction. Main purpose of this large-scale social interaction is to collectively understand the ambiguous external situation, to expand shared awareness, to suggest or create new norms, and eventually to take collective action to solve common problems (Rose 1982; Turner et al. 1957).

Crisis literatures have consistently reported that collective sense-making processes precede collective behaviors, and they are primarily communicational (DiFonzo et al. 2007; Shibutani 1966; Turner et al. 1957). The collective sense-making process is manifested as behaviors of active information seeking and information sharing among discontented group of people to reduce the level of situational ambiguity and to collectively define the current situation such that they can take collective action toward a uniform goal. Therefore, it is no wonder that crisis situations almost always accompany high traffic of tweeting, linking, online posting, and texting etc. Indeed, collaborative and collective sense-making has been reported as repeated crisis behaviors from the time before Internet was born. Social media technologies simply have made the collective sense-making process much easier and cheaper than before, but with significantly different speed, scale and implications (Howard et al. 2011; Oh et al. 2010; Oh et al. 2011; Palen et al. 2009; Starbird and Palen 2012).

Turner and Killian (1957) describe the collective sense-making process with two key sub-concepts: "*milling*" and "*keynoting*". Their main point is that, facing the crisis situation, "people become highly suggestible and turn to others to find cues. This restless search for cues was analogous to cattle *milling* around, except in case of humans the milling is primarily verbal" (Bordia 1996, p.8; Turner and Killian 1957). The restless milling phenomena includes such behaviors as watching TV, listening to radio, calling their friends, gathering in the street to seek and share information, exchanging situational information, and interpreting the situation together etc. In that regard, "milling,…, is essentially a communication process," and it initially involves many different voices of diverse background in a chaotic manner (Turner et al. 1957, p. 64). At this milling situation of uncertainty and ambiguity, group behavior is spontaneous and adaptive, but no shared understanding, structured norms or standardized communication channel are fully developed yet. Recent social movements in Iran in 2009, Moldova in 2009, and Egypt in 2011 have shown that social media technologies afforded spaces for these milling group behaviors (Ghonim 2012; Bruns et al. 2009; Mungiu-Pippidi et al. 2009; Starbird et al. 2012).

For the milling process to develop into collective action of social protests, Turner and Killian (1957) argue that some strong and coherent voices, themes or symbols should emerge to override the divergent and chaotic opinions of crowd who are milling in the frame of uncertainty and ambivalence. "The presentation of a positive suggestion in an ambivalent frame of reference such as this" is called the "keynoting'" process (Turner et al. 1957, p. 117). That means, keynoting process indicates emergence of new lines of strong and coherent themes, which differentiates itself from multiple lines of milling voices and chaotic interactions. Differentiating from cacophonic and muddled sounds of milling crowd, keynoting process tend to be strong and focused enough to run counter to other divergent lines of conflicting and cacophonous voices. Along the line of evolving keynoting process, concurrent are cohesive symbols (e.g., pictures or banners etc.), unified slogans, chant, shouting, division of labor, structure, crystallization of norms, and clear direction to act toward revolutionary goal (Kane 1997; Tilly 2004; Turner et al. 1957). In the context of Twitter and Egypt revolution, we argue that, if the role of social media was significant in the Egypt revolution, and if the milling and keynoting processes are antecedents of social protests, then milling and keynoting processes should be detected through the analysis of Twitter data. As an exploratory study on the role of social media and social changes, therefore, this study investigates the evolving pattern of hashtags to gain insights on the emergence of coordinated collective action as social protests.

Sense-Making through Twitter: Milling and Keynoting

Social media technologies have changed the way of connecting, communicating, collaborating, and collective sense-making. In addition, ubiquitous cloud computing services have expanded the capability of large-scale coordination through open collaboration tools such as Google Docs. Added to these, mobile smartphones, equipped with still camera, video recorder, texting service, email, web browser, and file exchanger etc., has enabled real time propagation of situational information from the ground of protest. All these new technologies together have established themselves as essential tools in recent social movements, and also have brought about new forms of milling and keynoting processes.

The power of hashtag was notable for collective sense-making during the Egypt revolution. According to our preliminary data analysis, Twitter space was dominated by and structured around a few powerful hashtags, meaning that the most frequently used seven hashtags comprise 93% of total hashtags (49% for #Egypt, 26% for #Jan25, 6% for #Tahrir, 5% for #Mubarak, 3% for Libya, 2% for #Cairo, and 2% for #Tunisia). Collective writing practices anchored by those seven hashtags can be interpreted in two ways. First, it indicates people's expression of solidarity with the ideas implied in the hashtags. Second,,the

aggregated result of hashtagged messages represents collective sentiment on the unfolding situation of social movement. That means, according to our preliminary content analysis with 3,500 sample tweet messages, domination of a few hashtags (e.g., #Jan25, #Tahrir, #Mubarak, and #Egypt) can be interpreted as social support and collective desire to gather in the #Tahrir square on #Jaunary 25th to dispel the #Mubarak regime from the #Egypt. Therefore, we maintain that observation of evolving patterns of hashtags and understanding of its implications can offer insight to anticipate emergence of collective uprisings on the street.

Machine mediated sense-making and the production of shared meaning through hashtags provide insight to understand the diffusion of serial social movements on the ground of Egypt and other Arab nations. In other words, while previous face-to-face communication enabled the milling and keynoting processes at the territorial boundary, standardarized social media technologies and collective writing practice of hashtags have shown the possibility of de-territorialized milling and keynoting process with unprecedented speed and scale.

Background of the 2011 Egypt Revolution

Ghonim (2012) describes that his active engagement for the 2011 Egypt revolution goes back to June 10th, 2010 when he anonymously created a Facebook page, "We Are All Khaled Said." His first post was a horrifying picture of a murdered young man, Khaled Said, along with a blunt and emotional description that "Today they killed Khaled. If I don't act for his sake, tomorrow they will kill me" (Ghonim 2012, p. 60). The Facebook page was designed to protest against the notorious secret police officers of the Mubarak regime who beat to death an Egyptian young man, Khaled Said for the reason that his blog post criticized the corrupt Mubarak regime. Reflecting anger, frustration, and desire for freedom of Egyptian people, the response was immediate and more than 36,000 joined the page in the first day (Ghonim 2012, pp. 60-62). Through this Facebook page, Ghonim coordinated serial events of the "Silent Stands of Prayer for the Martyr Khaled Said" in major cities of Egypt from June through August in 2010 (Ghonim 2012). Using social media, many young participants shared pictures and videos of the events including polices' ill treatment of peaceful participants. As time goes by, "We Are All Khaled Said" page had become a central space to charge the corrupt government, express solidarity, encourage protest participants, perform online polls, and build strategy for street protests etc.

Encouraged by the successful serial "Silent Stands" events, and spurred by the Tunisia Revolution on December 17th 2010 through which the president Ben Ali stepped down from his 23 years of power, Egyptian people planned a large-scale non-violent civil resistance at the Tahrir square in Cairo on January 25th, 2011. The main goal of the protest was to peacefully express their grievances on oppressive emergency law, high inflation and unemployment, corrupt government officials, and, most importantly, to demand Hosini Mubarak to step down from his 30 years of presidency. For this protest, social media played a significant role in planning and coordinating the ensuing demonstrations until Mubarak announced his resignation on February 11th, 2011. For instance, Ghonim reveals that he documented and uploaded to Google Docs all information relevant to January 25th which includes "the reasons for protesting and for choosing this day and these locations" and "the unified chants [...] phone numbers for activists responsible for supporting arrested protestors and for redirecting demonstrators to other locations if the protests at any one place were obstructed" (Ghonim 2012, p. 164). This file was accessed by more than 50,000 people and distributed through "online forums, political websites, Facebook, and Twitter account" (p. 164).

Shocked by snowballing number of angry protesters and power of social media technologies, the Mubarak regime responded with rubber bullets, notorious security police forces, pro-Mubarak "thugs," and a unprecedented disconnect of Internet and national cellular wireless services. However, resistances of furious protesters had gotten more intense and international pressure increased against the oppressive Mubarak regime. Despite Mubarak's obstinacy to continue his position as Egypt's head of state, intensity of uprisings throughout the nation never died away. On February 11th 2011, the vice president Suleiman announced that Mubarak resigned his thirty years of presidency and delegated power to the Supreme Council of Egyptian Armed Forces. At last, revolutionary protesters celebrated the overthrow of 30 years dictatorship.

Research Method

Data Collection

As a primary goal of this study is to describe the collective-sense making process in terms of milling and keynoting process, we collected Twitter data with sufficient extra days before and after the time period of Egypt revolution ranging from January 25th to February 11th of 2011. Different from Google search engine, Twitter does not allow keyword search for historical data older than at best five days. The only way to access historical Twitter data is to retrieve the last 3,200 posts by back-tracking each user who might have tweeted surrounding time period of the Egypt revolution. Therefore, our data collection strategy consisted of the following three steps: (1) identify and collect Twitter user IDs who tweeted surrounding the time period of the Egypt revolution, (2) back-track all identified user IDs to retrieve their past tweet messages, and (3) clean out tweet messages that are irrelevant to the Egypt revolution.

On January 25th 2011, we began manual data collection eight times per day for an hour per each data collection. We used the "Egypt" as a search keyword and applied the "external data sources" feature in the Microsoft Excel software to retrieve the Twitter data in a XML format into Excel spreadsheet. During the 17 days from January 25th to February 11th, 2011, we collected total 50,778 Twitter user IDs. After that, we developed a Twitter API data collection tool, which can track back all Twitter user IDs and retrieve their tweet messages. Through this process, we collected total 1,915,429 Twitter messages for the entire 50,778 Twitter user IDs, ranging from January 12th to March 10th, 2011. We stored all these data into Microsoft SQL Server system for data cleaning. After that, we used the keyword "Egypt" again as a parameter to filter out unnecessary data from the collected data set. Finally, we retained total 343,581 Twitter data for 15,636 users from January 12th to March 10th 2011 for our analysis.

We acknowledge that Twitter was just one of many social media (e.g., Facebook, YouTube, Flickr and Google Docs etc.) that may have contributed in large-scale collective sense-making during the 2011 Egypt revolution (Howard et al. 2011). However, we believe that analysis of Twitter data can show a few important facets of collective sense-making process for two reasons. First, Ghonim (2012) describes that, due to its mobility of Twitter being well compatible with cell phones, it was a main tool to share and spread the situational information in near real time speed from the street. Second, as many local correspondents of mainstream media used Twitter to convey break news from the ground of protest and those break news were retweeted by many other Twitter users around the globe, Twitter data best show dynamic pattern of information diffusion at the intersection of amateurish social media and professional mainstream media.

Frequency Analysis of Hashtags: To understand what types of and how many hashtags were created and circulated during the Egypt revolution, we randomly selected 5,000 tweets from our total sample dataset. By reading through the selected 5,000 tweet messages, we found total 88 hashtags, which appeared at least 10 times. Using Structured Query Language (SQL), we counted frequencies of all 88 hashtags on a daily interval. Some exemplary hashtags include: Egypt (237,135; 49%), #Jan25 (125,728, 26%), #Tahrir (29,163, 6%), #Mubarak (#24,686, 5%), #Libya (12,320, 3%), #Cairo (10895, 2%), #Tunisia (9132, 2%), #Iran (4695, 1 %), #Bahrain (3,706, 1%), #Yemen (3,589, 1%) and so on. First number in the parenthesis indicates frequencies of the hashtags, and the second number indicates the ratio of the frequency of each hashtag to the total number (343,581) of tweets in our sample dataset.

Figure 1. Hashtags Used during the 2011 Egypt Revolution

As the most frequently used seven hashtags comprise 93% of total hashtags, we believe that analysis of those seven hashtags can show how Twitter space was semantically structured around those hashtags. Figure 1 shows hashtag cloud. The hashtag cloud in the left column represents rank-ordered frequencies for each hashtag. The hashtag cloud in the right column illustrates frequencies of hashtags in raw number in which the larger words signifies higher frequency of each hashtag. From the view of collective sense-making process, the hashtag cloud can be conceptualized as a visual representation of milling process out of which a few number of dominant hashtags emerge as potential keynoting ideas and a number of marginal hashtags die away without being developed. However, as all those hashtags do not automatically represent the emergence of keynoting ideas, more rigorous time series analysis will be carried out.

To detect the emergence of a few keynoting ideas out of many milling ones, we perform rigorous tests to determine which hashtags exemplify the stable and distinct keynoting process. It is important to mention that the high frequency of specific hashtags may not necessarily indicate the emergence of keynoting process per se. The main reason is because unstably fluctuating frequency of specific hashtags over the sample time period is closer to the *milling* process in that it cannot deliver focused messages with clarity for collective action. As an example of *milling* process which involves a high frequency of communication, Turner et al. (1957) indicates that "rumor is a form of milling" (p. 60). That means, despite the large volume of communication, rumor lacks cognitive clarity, and, at best serves as "a means of releasing pent-up, nervous energy" at the collective level (p.59). In that regard, rumor is qualitatively different from the keynoting process which sets the clear direction of collective action with focused and consistent messages. Therefore, as a criterion to detect the emergence of keynoting process during the sample period, our study considers both *frequencies* of hashtags and the *stability* of their structural changes over time.

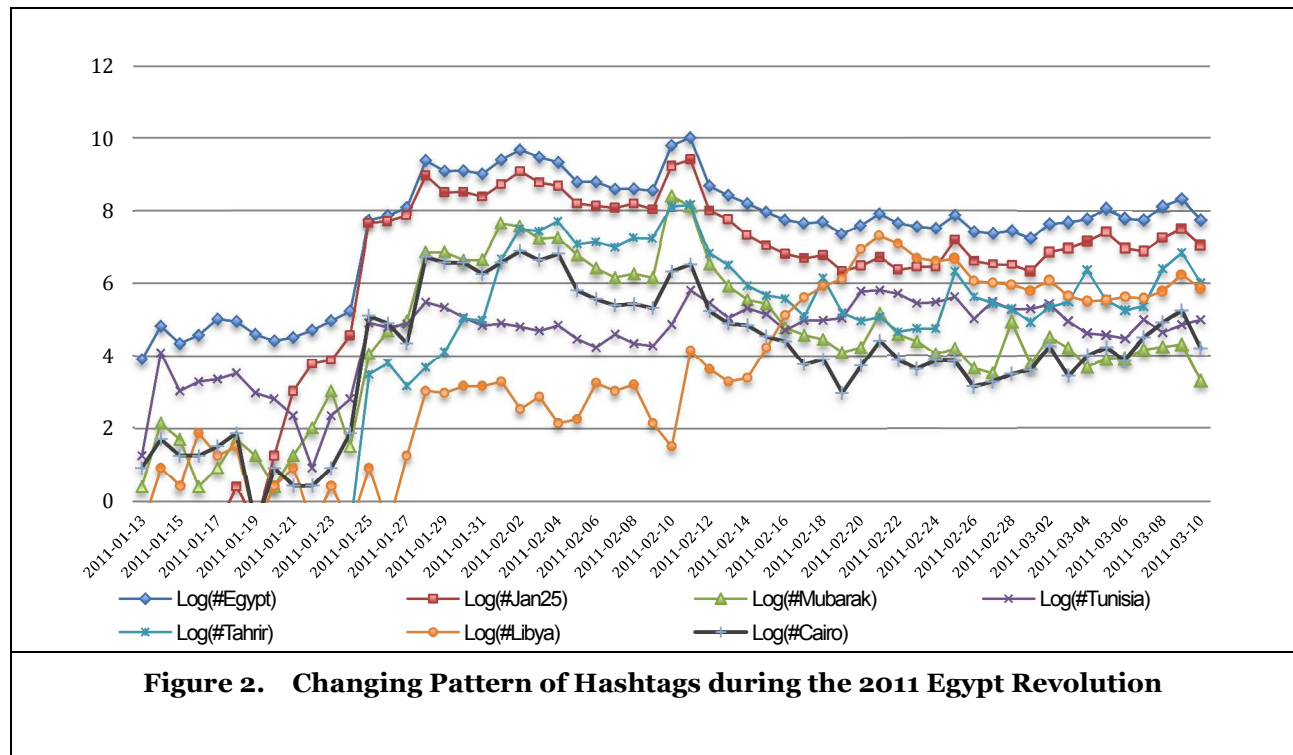**Figure 2.   Changing Pattern of Hashtags during the 2011 Egypt Revolution**

Figure 2 shows evolving pattern of hashtags over time from January 12th, 2011 to March 10th, 2011, which is represented by a logarithm of time-series of raw hashtags plus 0.5. The selected top seven hashtags comprise total 93% of total hashtags (49% for #Egypt, 26% for #Jan25, 6% for #Tahrir, 5% for #Mubarak, 3% for #Libya, 2% for #Cairo, 2% for #Tunisia). It shows that the Twitter space during the 2011 Egypt

revolution was structured around a few strong hashtags and milled around a large number of weak hashtags. As these seven hashtags represent 93% of total hashtags, those seven dominant hashtags are considered for further rigorous analysis of keynoting process.

Analysis of Hashtags: Markov-Switching Model

This section introduces the Markov-Switching model that we will use to analyze the dynamic time-series pattern of hashtags. Its goal is to empirically show how the line of keynoting process emerges out of many milling voices. We consider that the keynoting process emerge at some point of time by interacting with online users and external situations. In particular, the definition of keynoting process enables us to hypothesize that the process shall exhibit structurally different but stable pattern of specific hashtags after specific date at which the keynoting idea emerges. For this reason, we adopt a concept of *model instability* in the time-series econometrics, which is defined as a switch in parameters governing the process of keynoting. An F-test proposed by Chow (1960) could be applied in testing the structural changes in the underlying keynoting processes, provided that the dates at which the structural break occurs are known. Because there is little information on the dates when the keynoting process may emerge, we need to make inferences simultaneously about the date of structural changes as well as significance of the parameter shifts. A state-dependent Markov-switching model, first introduced by Hamilton (1989), enables us to achieve this goal by treating a structural change as *endogenous* in the model. Using the Markov-switching model, as a proxy of the emerging keynoting process, we will detect the switching point in the structure of evolving hashtags as well as the significance level of parameter shifts.

In specific, we shall consider the following autoregressive (AR) Markov-switching model of order one with first-order two-state Markov-switching mean model:

$$y_t - \mu_{s_t} = \phi\left(y_{t-1} - \mu_{s_{t-1}}\right) + \varepsilon_t,$$

where y_t represents a log-transformed frequency value of each hashtag at time t, and the state-dependent mean μ_{S_t} equals μ_1 if S_t=1, and μ_{S_t} equals μ_2 if $S_t = 2$, where $\varepsilon_t \sim i.i.d. N(0, \sigma^2)$. The discrete state variable S_t evolves like a 1st order Markov switching process; formally speaking, we presume that $\Pr[S_t = j | S_{t-1} = i] = p_{ij}$ for $i, j = 1,2$, and $\sum_{j=1}^{2} p_{ij} =$. Implementing the Markov-switching model above, we will estimate the model parameters for $\mu_1, \mu_2, \phi, \sigma^2, p_{11}, p_{22}$ by maximizing the log likelihood function of y_t. Also, we shall calculate the filtered transition probabilities $\Pr[S_t = j | \Psi_t]$ for $t = 1,2, \ldots, T$ by running the Hamilton filter (Hamilton 1989). Along with the filtered transition probabilities, we will obtain the smoothed transition probabilities $\Pr[S_t = j | \Psi_T]$ for $t = 1, 2, \ldots, T$ by applying Kim's smoothing algorithm (Kim 1994). Note that the filtered transition probabilities are formed based on the partial information up to t, while the smoothed transition probabilities utilize the full information up to T and thus are considered being more accurate.

Conclusion

Our data analysis on the changing mode of hashtags on the 2011 Egypt revolution will include (1) identification of the date when the keynoting process might have occurred and (2) significance level of low mean μ_1 and high mean μ_2, so that the emergence of hashtag-mediated keynoting process shall be tested rigorously by using the Markov switching model. Two criteria will be applied to determine the emergence of keynoting process. First, specific hashtag concerning the keynoting process should show *structurally* two different time-series patterns in terms of different mean levels before and after some point at which the keynoting might have occurred. Second, different hashtag patterns after some time period of *t* should show a *stable* pattern. If the changing pattern is fluctuating instead of being stable, it will not be considered as a *keynoting* process, because unstably fluctuating frequency of specific hashtag is conceptually closer to the *milling* process which involves some level of ambiguity (Turner et al. 1957). Given the changing patterns of different hashtags in figure2, we anticipate that some significant changing pattern may emerge surrounding the time period of January 25th, which is the first day of large-scale social protest in the Tahrir square of Egypt.

Along with the report on the result of data analysis, practical and theoretical implications on the hashtag-mediated sense-making process will be discussed. In practice, although the notion of collective sense-making process have been considered as a critical aspect of collective behavior, empirical study on

the concept was very rare. Most studies have used ethnographic or interview methods to describe the sense-making process in general and the emergence of keynoting process in particular. It may be due to the difficulty of obtaining the quantifiable empirical data for the nature of social movements involving high level of environment risks. However, social media technologies which record detailed human communications as computer files provide unique opportunities to access and collect quantifiable data to empirically measure the emergence of keynoting process. We believe that our study will be the first case to test the notion of keynoting process with empirical data.

We also suggest a notion of "*sign-ification*" (with hyphen included) to highlight the existence of *sign* which involves the process of sense-making. For Derrida (1973), the notion of signification is radically different from that of meaning, intention, or intended meaning which have provided taken-for-granted infrastructures to explicate the sense-making process. Derrida criticizes the traditional notion of *meaning* which attempts to discover its core from the *intention* of a subject. For him, the attempt of equating 'what I *meant*' with 'what I *intended*' is a very human centric approach in that it does not take into consideration the non-human elements of *signs* which exist outside the realm of human mind. However, we shall confirm (or disconfirm) through the analysis of the hashtag-mediated sense-making process that, although the hash sign (#) is no more than a notation in computer language which exists outside the human bound, it is actively involved in the collective sense-making process. In that sense, the notion of the sign-ification describes the collective sense-making phenomena as an inseparably intertwined interplay of signs, machines, and humans. That means, to adequately understand the Twitter mediated sense-making process; we should accept an inseparably intermingled reality of sign, human, and technology. Only then we can properly describe the issue of sense-making and the rapid development of serial revolutions in Arab nations. This notion is in line with the theoretical position of sociomateriality which is emerging as a critical theoretical angle in information systems and organization science domains (Leonardi 2011; Orlikowski 2005, 2008). More details regarding implication of sign-ification for will follow in our complete research paper.

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