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FINDING HER MASTER'S VOICE: THE POWER OF COLLECTIVE ACTION AMONG FEMALE MUSLIM BLOGGERS

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Abstract

Emerging cyber-collective movements have frequently made headlines in the news. Despite the exponential growth of bloggers in Muslim countries, there is a lack of empirical study of cyber-collective actions in these countries. We analyzed the female Muslim blogosphere because very little research attempts to understand socio-political roles of female bloggers in the system where women are frequently denied freedom of expression. We collected 150 blogs from 17 countries ranging between April 2003 and July 2010 with a special focus on Al-Huwaider's campaigns for our analysis. Bearing the analysis upon three central tenets of individual, community, and transnational perspectives, we develop novel algorithms modeling cyber-collective movements by utilizing existing social theories on collective action and computational social network analysis. This paper contributes a methodology to study the diffusion of issues in social networks and examines roles of influential community members. We also observe the transcending nature of cyber-collective movements with future possibilities for modeling transnational outreach.

Using the global female Muslim blogosphere, we provide understanding of the complexity and dynamics of cyber-collective action. To the best of our knowledge, our research is the first to address the lacking fundamental research shedding light on re-framing collective action theory in online environments.

Keywords: Collective action, Blogosphere, Muslim, female bloggers, opinion mining, community, influence, transnational.

1 Introduction

Social media provide an inexpensive, easy-to-use, and almost ubiquitous platform as well as dynamic, collaborative, democratic and un-regulated environment for Internet users to voice opinions, express beliefs, share thoughts, and participate in discussions. Using various forms of social media, individuals can also report first-hand accounts of numerous events and even organize mass protests and other types of collective actions that eventually may be transformed into social movements. The emergence of cyber-collective movements has driven much attention and frequently made headlines in news, as shown in recent coverage on Iranian twitter movement (Quirk, 2009), Jihad Jane online recruitment (Knickerbocker, 2010), and the Middle-Eastern Al-Huwaider campaign (Jamjoom, 2010). Using the global female Muslim blogosphere as a test-bed, our research reported here aims to understand the complexity and dynamics of cyber-collective action. The female Muslim blogosphere is selected for two main reasons: First, while research shows that three of four females online are active social media users (The BlogHer-iVillage, 2010), there is very little research attempting to understand social, cultural and political roles of female bloggers and collectivity among female social groups. Second, the domain epitomizes an important contrast that deserves attention, between socio-political systems where women are frequently denied freedom of expression and active political uses of social media by female Internet users. Female Muslim bloggers find the blogosphere as a digital recourse to exercise their freedom of speech if compared to their physical and repressively controlled spaces. On the larger picture, the voices of female Muslim bloggers, especially in authoritarian regimes, also represent the plural voices of marginalized segments of society needed to be heard. Paying attention to these voices is central to our understanding of the importance of the blogosphere, and social media in general vis-à-vis the rise of oppositional movements in authoritarian nations, such as the Middle East.

Essential questions to be addressed in this paper are: how does individual cause diffuse into collective cause? – Individual Perspective, what are the dynamics of influence in cyber-collective network? – Community Perspective, and is cyber-collective network capable of transcending the nation-state barriers? – Transnational Perspective.

In this paper we develop novel algorithms that help in modeling cyber-collective movements by reaching out to existing social theories on collective action and computational social network analysis bearing the analysis upon three central tenets of individual, community, and transnational perspectives. These advanced computational models will better our understanding of conventional social theories, assist in developing new ones, reinforcing the development of more accurate and efficient social interaction modeling algorithms for diverse environments, allowing us to determine the trajectory for emerging cyber-collective movements, creating greater synergies between social science and computational science. Moreover, our findings also point out a need to discover further pathways of knowledge to fully understand people's cognitive and social behavior, individually and collectively, in online environment with diverse social, cultural, and political backgrounds. The rest of the paper is organized as follows: Section 2 discusses the case study of Al-Huwaider Campaign, Section 3 reviews some related literature, Section 4 presents the data collection strategies followed by detailed research methodology coupled with the findings and analysis using the real-world blog data, and Section 5 presents the conclusion.

2 The Al-Huwaider Campaign

There are myriad incidents and stories demonstrating the formation of collective cause and its manifestation in the form of cyber-collective movements. Among these stories we choose the Al-Huwaider campaign story that is distinctive to the female blogosphere and also quite uniquely highlights

how individual cause diffuses within the cyber-network of interactions and shapes into cyber-collective cause as time progresses.

The Al-Huwaider Campaign refers to the series of online campaigns for women's rights originally initiated by Saudi writer and journalist Waheja Al-Huwaider and later became a regional phenomenon (Jamjoom, 2010). Her YouTube campaign started in 2007. On International Women's Day 2007, Al-Huwaider drove a car in the Kingdom of Saudi Arabia (KSA), where it is forbidden for women to do so, while videotaping a plea to Saudi officials. She posted the video on YouTube and it attracted international attention. Despite the obstacles placed by the Saudi government, Al-Huwaider continues to promote her ideas, through her writings online. Her articles analyze the Arab social situation, criticize the status of human rights, and vehemently protest discriminations and violence against women. Her online campaign has not only become an inspiration but also an influential voice for collective movements, calling for reform, among Middle Eastern women (Jamjoom, 2010).

This story illustrates the potential of social media in facilitating cyber-collective actions. It shows how individual cause diffuses within the network, shapes into collective cause, and transforms into collective action. The overarching question anchored in this story is: How are decentralized online individual actions transformed into cyber-collective actions? Are existing theories capable of explaining cyber-collective action?

3 Literature Review

3.1 Collective Action in the Age of the Internet

Collective action can be defined as "all activity involving two or more individuals contributing to a collective effort on the basis of mutual interests and the possibility of benefits from coordinated action" (Marwell and Oliver, 1993 in Hemetsberger, 2006, p. 9). Meanwhile traditional collective action theory can be traced to Ronald Coase's (1937) explanation on "how some groups mobilize to address free market failures" (Friedland & Rogerson, 2009, p. 2). New information and communication technologies (ICTs), especially the Internet, "have completely transformed the landscape of collective action" (Friedland & Rogerson, 2009). Online platforms have enabled "efficient communication, organization, and even deliberation [within collective actions] of any size" (Bimber, Flanagin & Stohl, 2005 in Friedland & Rogerson, 2009, p. 2).

Friedland & Rogerson (2009, p. 2) point out that "some experts believe the collective action effects of the Internet are overstated and may prove ephemeral" (McAdam, 1996; Etzioni & Etzioni, 1999; Van de Donk & Foederer, 2001). However, there are some examples of successful Internet-based collective actions, including the 1996 Zapatista rebellion in Mexico (Bob, 2005 in Friedland & Rogerson, 2009) and the 1998 Indonesian political revolution (Lim, 2002; 2003; 2004). Such examples have stirred "debates about theories of collective action," raising questions of whether collective action, profoundly dependent on the Internet and other new technologies, "is as effective or successful as collective action in more traditional modes" (Bimber et al., 2005, p. 366; Bimber, 2003; Norris, 2002). Lupia and Sin (2003 in Bimber et al., 2005, p. 366) point out that "collective action theory was developed at a time when key communicative possibilities", now easily available in public life (e.g., the Internet, mobile phone) "were impossible to imagine". The availability of ICTs "has prompted a reassessment of collective action theory, shedding light on the benefits and important costs for successful contemporary collective action efforts" (Bimber et al., 2005, p. 366). Simply put, new forms of collective actions reliant on information technology illuminate several fundamental aspects of collective actions that have remained theoretically obscure. This shows a clear need for fundamental research that can shed light on re-framing collective action theory in online environments.

3.2 Social Network Analysis (SNA)

With the rise of collective action facilitated by online social networking media, it is natural for social scientists to embrace the concept of social networks in collective action analysis. Most studies in this vein, however, look at how the involvement in networks affects individual behavior. The overall configuration of networks linking individuals is very rarely assessed in order to evaluate the potential for collective action in a given collectivity, a needed research direction which we will advocate below.

"Social network analysis (SNA) has emerged as a set of methods [geared toward] an analysis of social structures [and] investigation of their relational aspects" (Zhou, Ding, Wang, Cheng & Cao, 2009, p. 298; Wigand, 1988; Scott, 1992). SNA studies social relations among a set of actors assuming a varying degree of importance of relationships among interacting units. Growing interest and increased use of SNA has formed a consensus about the central principles underlying the network perspective. In addition to the use of relational concepts, Wasserman & Faust (1994) note the following as being important: (a) actors and their actions are viewed as interdependent rather than independent autonomous units; (b) relational ties (linkages) between actors are channels for transfer or flow of resources (either material or non material); (c) network models focusing on individuals and view network structural environments as providing opportunities or constraints on individual actions, and (d) network models conceptualize structure (social, economic, cultural, political) as lasting patterns among actors.

3.3 Computational Social Network Analysis (CSNA)

CSNA provides a rich set of SNA methodologies to observe and explain characteristic patterns including: community extraction, expert identification, and information diffusion, among others. Here, we will review community extraction and expert identification, two methods that are most relevant in understanding online collective actions.

Community extraction: Communities play a vital role in understanding the creation, representation, and transfer of knowledge among people, and are an essential building block of all social networks (Pathak, Delong, Banerjee & Erickson, 2008). However, the relationship of one individual to one another in a community is not easily formalized, or necessarily consistent, and thus how, exactly, one extracts communities from a social network (Pathak et al., 2008). There are three dominant approaches for community extraction: network-centric, content-centric and hybrid approaches (Agarwal & Liu, 2009). Network-centric approaches leverage network structural properties to identify communities within a social network (Fortunato, 2009). Assuming members of a community tend to talk about similar topics, content-centric approaches (Li, Zu & Zhang, 2007) extract communities based on the similarity of members' content. Hybrid Approaches leverage both content and network information to extract communities. The central tenet behind such an approach is: a set of blogs that are highly linked and tend to share similar content, reflect tighter communities (Java, Joshi & Finin, 2008). However, the sparse link structure and inherent differences between web pages and blogs (such as interactive and dynamic environment, highly-likely topic and user drift, low barrier to publication leading to extremely noisy data) demand novel approaches.

Information diffusion and opinion leaders: Influential blog sites exert influence over the external world and within the blogosphere (Gill 2004). The blogosphere, however, follows a power law distribution (Faloutsos, Faloutsos & Faloutsos, 1999) with very few influential blog sites that form the short head of the distribution and a large number of non-influential sites that form the Long Tail (Anderson, 2006). Regardless of the blog(s) being influential or not, influential bloggers always exist (Agarwal, Liu, Tang & Yu, 2008). Influence is often studied from an information diffusion perspective by identifying the key members who maximize the information spread by leveraging theories from epidemiology (Gruhl, Liben-

Nowell, Guha & Tomkins, 2004), viral marketing (Richardson & Domingos, 2002), cascade models (Goldenberg, Libai & Muller, 2001), greedy models (Java, Kolari, Finin & Oates, 2006), and submodularity-based models (Leskovec, Krause, Guestrin, Faloutsos, Van Briesen & Glance, 2007). Casual environment of the blogosphere, where not many blogs cite the actual source, presents significant challenges to employ the above-mentioned purely link analysis based approaches (Kritikopoulos, Sideri & Varlamis, 2006). Song, Chi, Hino and Tseng (2007) define opinion leaders as those who generate novel ideas and opinions, which is estimated using cosine similarity between their posts and the ones they refer. Goyal, Bonchi and Lakshamanan (2010) showed that the influence probabilities between users can be learned based on their community affiliation logs. Further, a few blogs list most active bloggers for a particular time window based on the number of submitted posts and comments received (Gill, 2004). Such statistics could easily mistake voluble bloggers for influential bloggers (Agarwal, Liu, Tang & Yu, 2008).

4 Research Methodology and Analysis of Findings

Information about individuals and their world views would be impossible to acquire from any other source, clearly showing the unique treasures and richness of information embedded in blogs begging to be discovered. Google's flu tracker is one of some examples how data mining search information can be used in discovering early signs of influenza outbreaks. This example demonstrates that the web, including blogs, could be mined to track information and data about emerging trends and behaviors in almost any area (e.g., political trends and opinions, drug use, racial tension, new films, new products, etc.). We have attempted to delve into emerging behavior patterns and their development into cyber collective movements from individual, community, and transnational perspectives, and in so doing delineate the challenges, propose research methodology, evaluate various strategies, and analyze our findings.

We began our research and analysis by collecting the blog posts of female Muslim bloggers from 17 different countries. We handpicked a set of 150 blogs primarily written in English but also containing text in Arabic, Indonesian, and French. Bloggers were included based on three shared characteristics, also known as the 'triangulation' strategy, (1) explicit self-identification of gender and religious orientation – women over the age of 18, Muslim (verified through self-identification or Islamic references in their postings), and primarily blog in English; (2) evidence gathered from the blogger's friends and/or relatives; and (3) evidence gathered from the blogger's participation in other social media – we leveraged bloggers' registration on multiple blogs and multiple social media (such as MySpace, Twitter, Facebook, etc.) and cross-linking features.

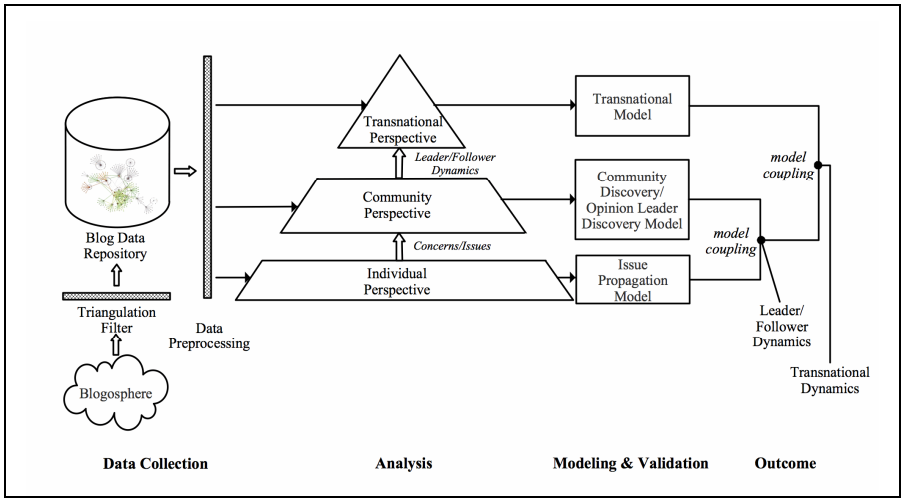

Figure 1. Overall Architecture of the Research Design.

In order to cogently address the research questions posed in Section 1, we pursued a three-phased approach: phase 1, Individual Perspective; phase 2, Community Perspective; and phase 3, Transnational Perspective (see Figure 1).

4.1 Individual Perspective

The Al-Huwaider campaign shows how an individual cause can be transformed into collective cause. This scenario demands exploration as to how personal issues and concerns evolve and propagate in social networks and how they converge and form collective concerns. In exploring the Al-Huwaider campaign case, we preprocessed related blogs, identified issues and concerns representing individual cause, modeled their diffusion along the network and time, and analyzed their convergence to collective cause.

Preprocessing and extracting cause: For each event related to the Al-Huwaider campaign, we analyzed pre-event, during-event, and post-event blog reactions. Probabilistic and statistical content analysis techniques such as Latent Semantic Analysis, Probabilistic Latent Semantic Analysis, and Latent Dirichlet Allocation were explored to identify, segregate, and tease out relevant topics. Blog posts containing relevant topics were summarized to reduce off-topic chatter narrowing in on the key information (Coombs, Ulicny, Jaenisch, Handley & Faucheux, 2008). We started with the original narrative of Wajeha Al-Huwaider's cause to lift the ban of driving for Saudi women as a source of issues and concerns. Representative keywords were then extracted using a tag cloud generator. We repeated the extraction for each blog within Al-Huwaider's network to seek whether Al-Huwaider's issues and concerns were diffused to these blogs. Our finding (Figure 2) shows the occurrence of similar keywords representing similar issues and concern across these blogs (e.g. Saudi, women, cars, drive/driving, right/rights). This figure shows how an individual cause of Al-Huwaider was propagated in social networks and converged and formed a collective cause.

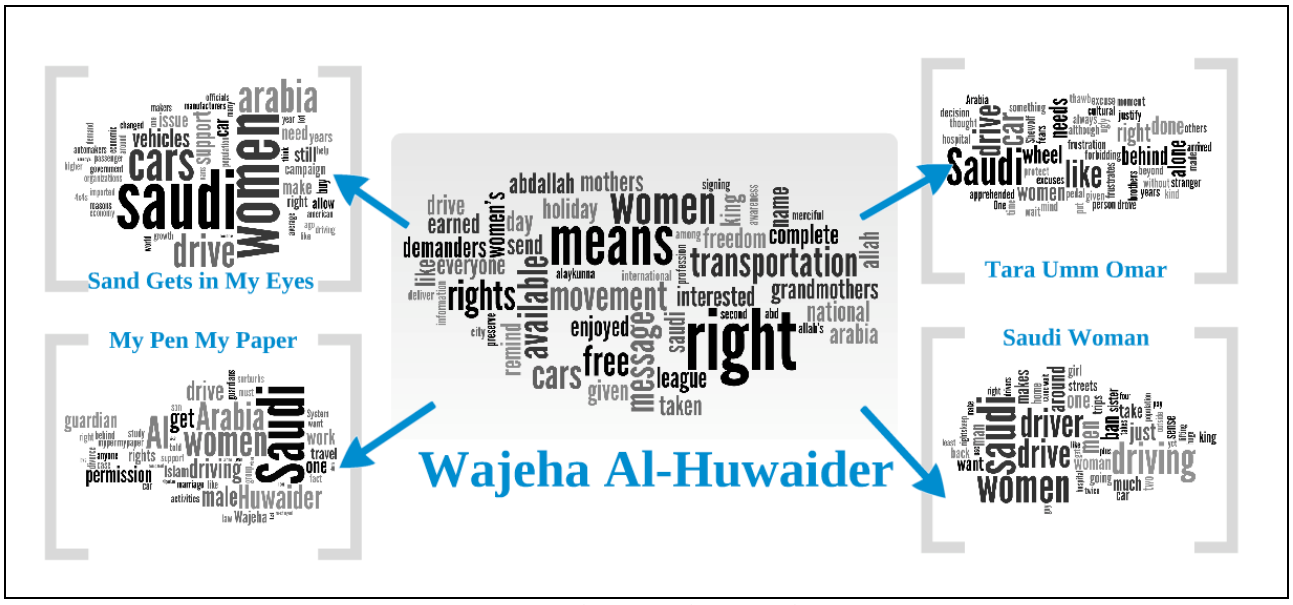

Figure 2. Analysis of Al-Huwaider Campaign.

Modeling the diffusion of cause: We analyzed the extracted issues and concerns representing a certain cause and study their propagation. Specifically, we explored how network ties affect an individual's concerns. The proposed diffusion model extends the existing information diffusion models (linear

threshold, independent cascade, etc.) described in Section 3.3 by considering concerns as the information chunks that propagate over the social network of bloggers. Since the underlying social network remains the same, the structural properties of the concern diffusion are no different than information diffusion characteristics. In other words, leaders of the community who are responsible for the fastest information diffusion also tend to be the major influencing factors on the individual's issues and concerns and hence the collective concerns of the community.

The finding from individual perspective leads us to think about possible trajectories for future research. Beyond extracting issues and concerns, similar approach can be used to extract individual sentiment and track how it is diffused into collective sentiment. The exploration of existing sentiment analyzers in combination with the use of sentiment word thesaurus (sentiwordnet) will enable us to label the polarity and degree of the opinion word. For the future research agenda, we propose to longitudinally analyze the extracted issues, concerns and sentiment and to identify the factors involved in their propagation. We also propose to utilize existing cognitive and behavioral theories to gain deeper insights into the adaptation of individual behavior stemming from social interaction and cultural ties. These theories will form the basis of our exploration, aided by the development of novel statistical and stochastic diffusion models focusing on the transformation and propagation of sentiments along network ties over time. The model will help in advancing sociological as well as computational understanding of how collective sentiment shapes and will be improved upon in later phases of the analysis by incorporating community and transnational factors.

4.2 Community Perspective

As mentioned earlier, Al-Huwaider was a major factor in mobilizing individual bloggers with similar concerns (towards various issues) into a community and in leading the movement, i.e. transitioning individual cause to collective cause and ultimately manifesting into a cyber-collective movement. This also correlates with our findings in the individual phase, where the community leader was identified as the most significant influence over the individuals' concerns. To model this phenomenon, we analyzed the community of bloggers, and identified the opinion leaders of the community, which enabled us to delve into the following issues: How do decisions travel across the network from leaders to followers?; Do followers consistently follow the same leader(s) or is the influence of opinion leaders time-variant and/or topic-variant?; and is there a hierarchical structure in the rank of opinion leaders and can the model identify it? To address these questions, we constructed and analyzed the community of bloggers and identified the opinion leaders.

Community identification: Often in the blogosphere users do not explicitly specify their community affiliation or their social, cultural, and political orientation. The discovery of communities through network-centric approaches has been extensively studied (Fortunato, 2009). However, as pointed out by Kritikopoulos, Sideri & Varlamis (2006), blogs are extremely sparsely linked due to the casual environment that does not necessitate users to "cite" the sources that inspire them. Moreover, spam links generated by malicious users could connect completely unrelated and/or irrelevant blogs, affecting the performance of community discovery process. Further, spam may also adversely affect content-oriented community identification approaches, as mentioned in Section 3.3. We identify their implicit community affiliations and orientations leveraging the network structures (social ties, participation on other forms of social media) and sentiments identified in the individual perspective phase.

Specifically, we explored both network and content-induced interactions between blogs to detect communities. The content-induced interactions approach, leveraging issues and concerns extracted from the individual perspective phase, not only guides the network-centric community extraction (while considering the relevant links and ignoring the spam/irrelevant links) but also complements it through

revealing new potential links. Leveraging the insights from our prior study, the purpose of which was to identify communities from blog networks by examining the occurrence of shared concerns on particular events/causes, we unveiled interactions through the observation of individual concerns. Continuing with the example presented in Figure 2, we identified the occurrence of various Al-Huwaider's causes in three blogs, "Tara Umm Omar", "Saudi Woman", and "Sand Gets in My Eyes." If the concerns of these blogs were similar we assume the blogs were themselves similar. Column-vectors in this matrix are compared to compute (cosine) similarity between any two pair of blogs (as demonstrated in eq. 1 where B_m and B_n are the two blogs represented by the column vectors P_m and P_n, respectively) and unsupervised data mining algorithms such as *k-means* are used to identify communities.

$$Sim(B_m, B_n) = \frac{P_m \bullet P_n}{\|P_m\| \|P_n\|} \quad (1)$$

Al-Huwaider's Causes	Tara Umm Omar	Saudi Woman	Sand Gets in My Eyes
Women's right to drive	drive, car, like, wheel, right, behind, alone, needs (+)	driving, drive(r), want, around, make, men, ban, sense, king, right (+)	cars, drive, vehicles, right , support, make, issue, allow, campaign, right, changed (+)
Black Ribbon Campaign to end the Mahram /guardianship	guardianship, system, children, legal, denied, rights (+)	black, ribbons, campaign, rights, women's, November, guardian (+)	Al-Huwaider, actions, oppression, change, system, state, laws, guardianship (+)
Child Marriage	(-)	Marriages, change, allowing, child, justice, guardianship, conservative (+)	guardians, marry, father(s), ignorance, old, man, daughters, marriage (+)
…	…	…	…

Table 1. Occurrence of shared issues and concerns in each blog for different causes (overused words such as Saudi, Arabia and women are omitted).

Identifying Influentials: After extracting the communities from blogs, we set out to identify community leaders. Given the sparse network structure of blogs, we leveraged both network and content information to identify influentials. We examined how social gestures of "Influentials" could be approximated by collectable statistics from the blogs. We gathered network-based statistics from the blog graph (e.g. inlinks, outlinks, blogger social network, comments) and content-based statistics from blog text and comments to map the social gestures. Knowledge from prior work on identifying influential bloggers, iFinder (Agarwal et al., 2008), enabled us to model community leaders factoring in socio-cultural traits of the community that bootstraps our understanding of opinion leaders. The model analyzes how issues and concerns travel across the network from leaders to followers and identify if there exists a hierarchical structure in the rank of opinion leaders. We analyzed a set of 75 blogs that discussed Al-Huwaider's campaigns and identified top 10 influential blogs, as illustrated in Table 2. Due to space limitations we could not present the analysis of other blogs. However, all the 75 blogs had an average influence score of 198.306, a maximum influence score of 833, a minimum influence score of 1, and a standard deviation of 269.892. Representative tags, extracted using Worlde.net specified next to the blog posts to give contextual background, demonstrate that influential blogs facilitate the diffusion of issues in the social network. The evaluation framework leverages large-scale surveys through social media sites such as Digg (www.digg.com) and blog search engines such as Technorati (www.technorati.com) to validate the model and identify opinion leaders.

The individual perspective phase provides an understanding of how issues and concerns propagate along the network. The outcome of the community perspective phase enlightens us with a deeper understanding of leader-follower dynamics. Together outcomes from both the phases lend insights into the emergence of cyber-collective movements in socio-culturally diverse environments. As a possible future direction, longitudinal analysis could be performed to address questions such as, whether followers consistently

follow the same leader(s), or is the influence time-variant, offering deeper understanding of group dynamics.

Blog	Representative Tags	Influence Score
http://hotair.com/archives/2009/07/12/saudi-feminist-blocked-from-leaving-country/	Saudi, Al-Huwaider, Arabia, border, male, passport, permission, activists, rights, guardian	833
http://jezebel.com/5552458/japan-likely-to-reject-ban-on-sexualization-of-minors-playboy-model-jailed-for-boob+grope	Women, minors, drinkers, Japan, Yousef, freedom, infected, prisoners, police, jail, charges, allegations	824
http://volokh.com/posts/1245159018.shtml	Saudi, Arabia, HRW, Human, rights, links, mail, organization, government, Israel, workers	739
http://thelede.blogs.nytimes.com/2009/03/12/saudi-woman-drives-for-youtube-protest/	Saudi, Huwaider, driving, BBC News, Arabia, Arab, women protest, video, Fattah, car, youtube	702
http://www.memeorandum.com/100418/p4	Saudi, women, driving, Arabia, raped, reform, issues, populace	695
http://www.moonbattery.com/archives/2007/10/the_nobel_joke.html	Afghanistan, Navy, Murphy, bad, gore, Arafat, combat, killed, Marxist	690
http://latimesblogs.latimes.com/babylonbeyond/2010/06/saudi-women-use-fatwa-in-driving-bid.html	Women, Saudi, drive, Islamic, Wajeha, maternal, breastfeed, Obeikan, cars, ban, campaign	665
http://www.hrw.org/english/docs/2006/10/20/saudia14461.htm	Saudi, human, rights, police, detained, government, mabahith, Arabia, khobar, freedom	644
http://www.hrw.org/en/news/2006/10/30/saudi-arabia-lift-gag-order-rights-campaigner	Rights, al-Huwaider, Saudi, Arabia, human, september, mabahith, khobar, Abdullah, interrogated, police, officers,	644
http://globalvoicesonline.org/2008/08/12/saudi-arabia-bans-women-from-olympics/	Feminist, Burundi, Olympics, Wajeha, Macha, Women, muharram	627

Table 2. Top-10 influential blog posts discussing Wajeha Al-Huwaider's campaigns along with their influence scores and representative tags extracted using Wordle.net.

4.3 Transnational Perspective

In this phase, we studied and analyzed whether collective concerns in communities transcended nation-state barriers and converged into transnational cyber-collective action or not. Analyzing the emergence of transnational actors and networks, structures relating to fluidity, and boundless organizational architecture, is key to deeper understanding of transnational underpinning of cyber-collective movements. One such actor identified in our analysis was Wajeha Al-Huwaider. Despite the cultural, ethnic, political, social, and geographical diversity of Al-Huwaider's supporters as illustrated in Figure 3 below, the sense of

community superseded differences and converged individual concerns into collective action. Social networking platforms have undoubtedly intensified the degree of connectivity by building up capacity to circulate ideas and to transfer content very quickly across all barriers.

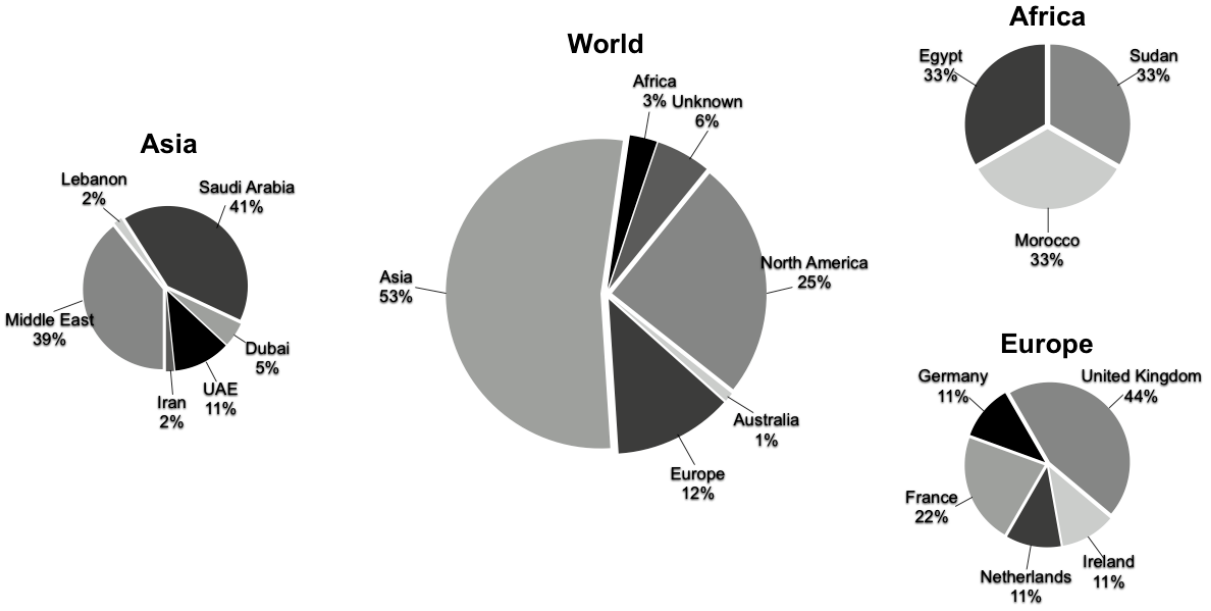

Figure 3. Transnational Support for Wajeha Al-Huwaider's Campaign.

This finding prompts us to seek answers for further questions such as the following: can transnational social movements be autonomous from national constraints in terms of discourses, strategies, and resources?; can the shifting scale (from local and national to global and transnational) also bring about a change of culture and identity of these movements?; with respect to outcomes and goals, can the transnational social movements deliver concrete strategies to overcome the unpredictability of their mobilizations?; with respect to their internal dynamics, can the transnational social movements encourage their perpetuation through mitigating the individual convictions of the collective actions/movements?

For future research agenda, an intensive issue-network observation can be performed for a certain period of time. The issue can be mapped periodically to detail the development of the issue-network. The mapping process can identify each blogger and classify her in one or more clusters (e.g., an Egyptian Canadian female blogger who resides in Arizona, United States belongs to three clusters: Egypt, Canada, and United States). The map of transnational collective movements then will show the overlap of various clusters and the expansion of networks. With access to more data, we can generate an issue network for Al-Huwaider's campaigns following our analysis in Figure 3. Such issue networks can help decrypt the dimensions of: issues (on local, global, global-local levels), clusters (nation or content-based), political affiliations (conservative, liberal), time, and scale (network links, number of individuals, issue clusters) from actor and network perspectives.

5 Conclusion

We sought to understand the complexity and dynamics of cyber-collective actions. By reaching out to existing social theories on collective action and computational social network analysis, we have proposed novel algorithms to model cyber-collective movements from individual, community, and transnational perspectives. The findings in this paper also enable us to outline a future research agenda that is geared

towards the development of more advanced computational models. Such models would better our understanding of conventional social theories, assist in developing new ones, reinforcing the development of more accurate and efficient social interaction modeling algorithms for diverse environments allowing us to identify political issues and influences as well as to determine the trajectory of emerging cyber-collective movements.

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