

# **Social Media, Digital Activism, and Online Collective Action: A Tale of Two Overlapping Women's Rights Movements**

*Full Paper*

**Serpil Tokdemir Yuce**

University of Arkansas at Little Rock  
sxtokdemir@ualr.edu

**Nitin Agarwal**

University of Arkansas at Little Rock  
nxagarwal@ualr.edu

**Rolf T. Wigand**

University of Arkansas at Little Rock  
rtwigand@ualr.edu

## **Abstract**

Research on collective action (CA) dates back to at least the 1960s. However, the plethora of Internet-driven CAs warrants the need to revisit the theory of CA. By analyzing blog and Twitter postings for the two movements, “Women to Drive” and “Sexual Harassment”, we - (1) develop novel methodologies to model online CAs by utilizing existing CA theories and computational approaches for social network analysis, sentiment analysis, text mining, and content analysis, (2) establish a rigorous and fundamental analytical framework to understand the emergence, evolution, development and trajectory of CAs in complex online environments, and (3) study coalition formation, interorganizational communication, and transnational support of the two online CAs. The study also identifies cross-cultural aspects of the campaign network, where Arabic hashtags relate to the local factors and English hashtags connect with transnational and interorganizational support from various organizations such as human rights and women’s rights.

Keywords: ICTs, Social Media, Blogs, Twitter, CA Theory, Women’s Rights to Drive Movements, Sexual Harassment, SNA, Sentiment Analysis, Overlap, Communication, Transnational Support

## **Introduction**

The emergence of cyber-collective movements has captured much attention and frequently made headlines in the news. A number of studies attempt to understand collective action (CA) processes in online environments (Lupia & Sin 2003, Bimber et al. 2005), which can be defined as all activities 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 1993). A number of studies attempt to understand collective action processes in online environments (Lupia & Sin 2003, Bimber et al. 2005). Such efforts, however, have not answered many questions related to the emergence of various forms of Internet-driven collective actions.

We analyze social media postings that aim to depict the dynamics of two women’s rights movements, viz., Women’s Right to Drive and Sexual Harassment movements. While the Right to Drive movement is predominantly organized by Saudi women in opposition to the driving ban for women in Saudi Arabia, the Sexual Harassment movement is global in nature demonstrating the universality of this crime against women. Although the Right to Drive is specific to Saudi Arabia’s gender-biased laws, there is evidence of global support. The transnational support for the Right to Drive movement and the inherent global nature of Sexual Harassment movement both offer the opportunity to study the nature of cooperation between their respective campaign networks as reflected in social media. By studying cooperation between the observed CAs of distinct but related movements, we examine the transnational nature of online CA, thereby advancing the theoretical understanding of CA in contemporary forms of information and communication technologies (ICTs).

To further deepen the analysis of online CA's transnational and interorganizational communication aspects, we examine the information diffusion process and the roles of bridges and brokers by tracking the evolution of the campaign network on Twitter. From the resource mobilization theory (RMT) framework perspective, network bridges and brokering can be seen as a form of 'linkages' (McCarthy & Zald 1977) to expand resources. The linkages of these expanding, interconnecting networks, are the resources that are mutually shared by the two collective actions and that, in turn, support both actions in the pursuit of their respective objectives. Tweet-retweet, mention, and hashtags networks were used to analyze the campaign network. Given the definitive nature of hashtags, we investigate the mutual co-evolution of hashtag usage and campaign network growth, helping us to track the formation of collective action. The overarching research question studied here is: How can we track the formation as well as the process of online CA hashtags usage? Further, through the co-occurrence of the dominant hashtags, this study attempts to understand the implications of the cross-cultural nature of the campaigns over the transnational and interorganizational communication aspects of the observed online CA. The developed methodology is based on the extraction and depiction of the cooperation network among multiple related issues and examines the sentiments expressed in the interactions within the networks of the two social movements (viz., Women's Right to Drive and Sexual Harassment). By providing an observational delineation of the online CAs through two cases, we discovered that brokers help bridge two overlapping networks in disseminating the information, forming a coalition, and expanding their respective networks. This study identifies cross-cultural aspects within individual hashtag networks. We tracked the behaviors of users and discovered that, if the user is tweeting in English, the person is 80% more likely to use/pair another English hashtag within the same tweet. On the other hand if the user is tweeting in Arabic, that user is 96% more likely to use/pair another Arabic hashtag within the same tweet. When we compared the overlap between hashtag networks, the results show that 60% of the common hashtags were in English. English hashtags are more likely to bridge different clusters. While Arabic hashtags relate to local factors, English hashtags help in bringing transnational support from various human rights and women's rights organizations (Yuce et al. 2014).

Using social media based interactions, we aim to understand the complexity of cyber-collective movements and methodologically track their formations. Our research demonstrates how new insights and understanding of online CA may be garnered by developing a systematic methodology using various existing methods such as social network analysis, sentiment analysis, text mining, and content analysis. These contributions provide further opportunities to study more fundamental research questions such as: Can the networks of online CA be expanded beyond national boundaries? How does online CA evolve across multiple networks and shift between local, national, and transnational scales? What is the role of cooperative networks in online CA?

## **Literature Review**

By rethinking and potentially revising related theoretical domains, we gain ideas and better comprehension of applicable theories and techniques. Hopefully they will explain more comprehensively the analytical structure needed in examining the dynamics of online CAs.

### ***Collective Action and Social Movement in the Age of the Internet***

CA is an important concept for the understanding of collective behavior and social movements. Historically, the theory of CA started with Mancur Olson (1965) who proposed that individuals' contribution in CA is a rational and economic act. Social movement theories became prominent in the 1970s and 1980s. One of the earliest methods to social movement is based in collective behavior strategy, which views social movements as semi-rational, non-routine ways of CA aimed toward social change. Some important collective behavior theories include: mass society theory (Kornhauser 1959), relative deprivation theory (Davies 1971; Gurr 1970) and value-added theory (Smelser 1963). The fact that the uprising of the social movements in the 1960s, such as the Civil Rights movements, anti-Vietnam war movement, and the women's movements, have made scholars rethink collective behavior theories. The emergence of new media and information and communication technologies (ICTs) has transformed the landscape of CA and social movement. CAs are formed from social ties between individuals with the combination of strong ties (that are powerful in persuasion) and weak ties (that are important in facilitating information diffusion) (Granovetter 1973). In today's world, as the Internet and social media

heavily facilitate the formation of such ties, they also have potential for supporting the formation of CAs. While other scholars argue that ICTs encourage political participation by reinforcing and expanding strong ties (Campbell & Kwak 2012) and can facilitate protests and social movements by augmenting the weak ties among activists (Walgrave et al. 2012).

According to McCarthy and Zald (1977: 1213), RMT “examines the variety of resources that must be mobilized, the linkages of social movements to other groups, the dependence of movements upon external support for success, and the tactics used by authorities to control or incorporate movements”. To serve the purpose of our study, here we apply McCarthy and Zald’s reference to “linkages” to the study of more loosely configured online CAs. Network linkages, which can happen in the online environment as two or more CA networks connect to each other, are not scarce resources like other resources that social movements use to achieve their objective. To better understand contemporary CA in the age of the Internet, Bimber et al. (2005: 385) suggest several alternative directions for research (vis-à-vis conventional ones), namely work that examines collectivism embracing the blurring boundaries of private and public, emerging structures, the relationship between social capital and CA, and the development and utilization of social networks.

### ***Social Network Analysis (SNA)***

The increasing influence of social network media in organizing CA warrants a closer examination of CA theory in online environments using social network analysis (SNA) concepts. SNA uniquely as well as elegantly lends itself as a fruitful method to track the flow and directionality of interactions as well as relationships in general. A set of connected individuals engaged in CA represents a social network. As decisions for individuals to participate in any CA are interdependent, social networks do matter. In addition to studying complex network dynamics, SNA is also valuable in examining structural properties of large social networks and identifying various roles of actors in the network depending on their positions and tie strength (Wasserman & Faust 1994). As mentioned earlier, in online CA settings, network linkages, though not scarce, play an essential role in affording a platform for awareness and coordination of an online CA and possibly coalition development among multiple CAs. Other measures pertaining to diversity (heterogeneity) in the group composition are also relevant in studying CAs. Diversity among groups is assessed based on the social structure (role, position) of the members, social capital possessed by the members, and disparate processes or shared orientations manifested as relationships among members. Several SNA measures exist that estimate social capital (Borgatti et al. 1998) and diversity, such as the Gibbs-Martin index (Gibbs & Martin, 1962), Blau’s heterogeneity index (Blau, 1977), UCINET Egonet Composition (Borgatti et al. 2002).

### ***Interorganizational Cooperation and Coalition Formation***

Blogs may be seen as social systems, i.e. systematic ensembles of interdependent, inter-human activities attempting to achieve joint objectives by coordinating joint efforts of a group of people following a predetermined program of conduct (Wigand 1979). In analyzing the broad relationship between the two CAs analyzed, here we follow an information model that considers the environment as a source of information. Within this environment blog participants operate and exchange information. This information perspective then is pertinent to interorganizational settings because interorganizational structures manifest and evolve while handling information flows and exchanges.

Of central interest here is also the notion of coalition formation. Numerous researchers have addressed the theory of coalition formation within several social science disciplines (starting with Gamson 1961). A coalition is an alliance among individuals, manifesting itself by mutual interest and joint action, even though each action is in their respective own self-interest. The authors posit that coalitions are formed to maximize the expected utilities. Stevenson, Pearce and Porter (1985) examine the concept of coalition in the organization theory and research literature in their seminal review.

We pose that the two blogger networks examined here and their coalition formation, expressed in the terms of mutual support and information exchanges, can be broached through theoretical discussions of interorganizational cooperation and coalition formation. This, in turn, also explains why coalitions are often temporary forms of organization. Such collaborative efforts and processes can accomplish political and social influence and may initiate social movements.

## Online Collective Action on Women's Rights

### Women's Right to Drive Movement

Saudi women face some of the most inequitable laws and practices when compared to international standards, including the prohibition of driving motorized vehicles. Until recently, Saudi women have only been granted the right to ride bicycles. In order to create awareness about these inequitable laws and practices, Saudi women have organized several campaigns as part of a bigger movement. More than a decade later, in September 2007, under the leadership of Wajeha al-Huwaider and Fawzia al-Uyyouni, a group of Saudi women submitted a 1,100-signature petition requesting King Abdullah to reverse the driving ban (Coomaraswamy 2008). On International Women's Day in 2008, the YouTube video of Wajeha al-Huwaider driving had garnered the interest of social media sites and women across the world making her protest international news (Young 2009).

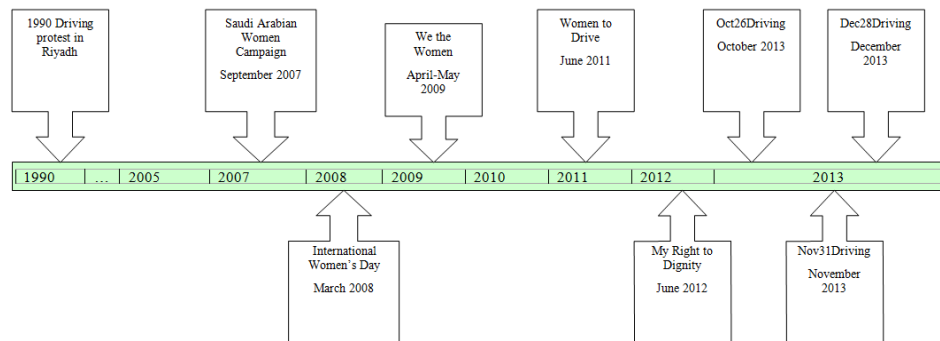


Figure 1: Timeline for the Women's Right to Drive collective actions

Following the al-Huwaider protest, in 2011, a group of women led by Manal al-Sharif, started the Facebook campaign supporting women's driving rights in Saudi Arabia, 'Women to Drive.' In subsequent months of the campaign, al-Huwaider videotaped al-Sharif driving a car and posted the video on YouTube and Facebook. During the following days, several Saudi women protesters posted videos of themselves driving in protest of al-Sharif's arrest. In June 2012, to celebrate the anniversary of the June 2011 driving campaign, a member of the 'My Right to Dignity', a women's right campaign, drove her car in Riyadh. Figure 1 depicts the timeline of various campaigns and events organized as part of the Women to Drive movement. Since 2013, however, with the Oct26Driving campaign, Twitter became one of the most widely used platforms to coordinate and mobilize protests around the right to drive movement. The Oct26Driving campaign is considered as one of the most successful campaign in the history of Saudi Arabia led entirely via social media, especially Twitter. The Oct26Driving campaign is a part of Women's Right to Drive movement in order to create awareness about inequitable laws and practices, especially the ban on driving. Our earlier studies (Agarwal et al. 2011a; Agarwal et al. 2011; Yuce et al. 2013; Yuce et al. 2013) have analyzed these campaigns to understand various aspects of online CA. In this earlier work, we offered a new framework to understand the evolution and the diffusion of sentiments in online blogger networks, and, ultimately, a new understanding of the relationship between online collective actions and the rapidly changing online environment. In this research, we aim to study the dynamics between two distinct but overlapping online collective actions, namely, 'Women to Drive' and 'Sexual Harassment'. Specifically, we attempt to study the interactions between the two networks—whether they signify any cooperative and supportive mechanism—by observing the evolution and transformation of individual opinions into collective sentiments in their respective networks and mapping any connections created between the members of the two networks.

A group of Saudi women activists set October 26th, 2013, as a day for defying the state's ban on driving for women and launched an online petition website ([www.oct26driving.com](http://www.oct26driving.com)) on September 25, 2013. Known as "The 26th October Campaign", it quickly gained momentum with its online petition garnering more than 16,000 signatures (according to the official campaign website) despite the Kingdom's restrictions on protests. The October 26th campaign is a grassroots campaign with the participation of the women and

men of Saudi Arabia and aims to revive the demand to lift the ban on women driving. Supporters shared videos of previous campaigns and uploaded new videos and selfies while driving to protest the driving ban.

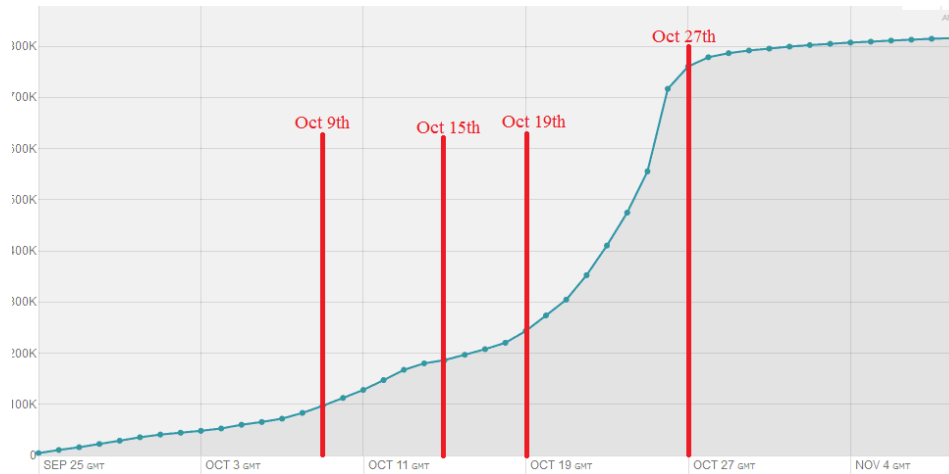


Figure 2: Cumulative tweet activity for Oct26Driving campaign

### Sexual Harassment

Evident by the large and growing number of online initiatives aimed at addressing the endemic issue, sexual harassment is an important concern for many of the Muslim bloggers surveyed. While the concern is global, like the Women to Drive movement, most sexual harassment campaigns are anchored in specific localities and developed to address this concern in specific contexts. HarassMap (<http://harassmap.org/en/>), for instance, was born out of the desire of Egyptian women to walk down the street without unwanted groping and endless streams of insults and propositions. Based on a survey conducted by the Egyptian Center for Women’s Rights (ECWR 2008), 83% of Egyptian women admit to have been sexually harassed on the street. Since the initiative’s inception, HarassMap has been contacted by organizations in several other countries, such as Indonesia, Pakistan, Turkey, and Palestine, for technological advice on implementing Ushahidi-based interfaces (<http://www.ushahidi.com>) and other similar mapping/alert technologies already exist in India, Bangladesh, Lebanon, and elsewhere. In a similar vein, people in other countries are using blogs, Facebook, and Twitter to spread awareness about sexual harassment. Although the origins of the SlutWalk movement mainly aim at countering perpetuated myths that result in victims being blamed for their rapes, many of such movements in Muslim countries, such as Women Choufouch (originally SlutWalk Morocco), have appropriated ‘Slutwalk’ and redefined themselves as an anti sexual harassment movement. Figure 3 illustrates the timeline of several campaigns and events organized as part of the Sexual Harassment CA.

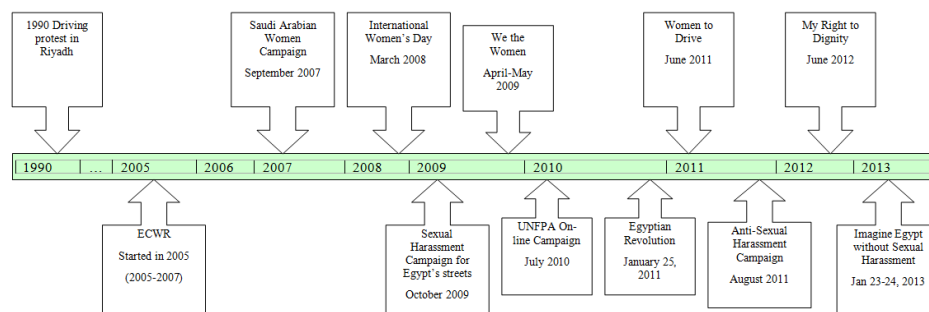


Figure 3: Timeline for the ‘Women to Drive’ and ‘Sexual Harassment’ collective actions. Events/campaigns related to the ‘Women to Drive’ are depicted above the timeline and those related to the ‘Sexual Harassment’ are depicted below the timeline (Abbass 2010; Shmuluvitz 2011)

## **Methodology**

The web, including social media, 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.). Moreover, such data may also demonstrate and reveal information about precisely how ideas diffuse and how trends develop and take hold.

In our study, we aim to understand the dynamics between two distinct but overlapped online CAs, namely, ‘Women to Drive’ and ‘Sexual Harassment’, by tracking the process of the formation of online CA using hashtags. Given the definitive nature of hashtags, we investigate the co-evolution of hashtag usage and campaign network growth, helping us to track the formation of collective action. The overarching research question studied here is: How can we track the process of the formation of online CA using hashtags? Further, through the co-occurrence of the dominant hashtags, the study attempts to understand the implications of the cross-cultural nature of the campaigns over the transnational and interorganizational communication aspects of the observed online CA. Specifically, we attempt to study the interactions between the two networks—whether they signify any cooperative and supportive mechanism—by observing the evolution and transformation of individual opinions into collective sentiments in their respective networks and mapping any connections created between the members of the two networks. Existing techniques for social network analysis, sentiment analysis, text mining, and context analysis are leveraged to develop a systematic methodology that serve the purpose of our study. Our methodology involves the following steps:

1. Collect data for the women’s rights online CA,
2. Preprocess and filter noise (i.e. indexing the data and selecting social media posting, specifically blogs and tweets, related to ‘Women to Drive’ and ‘Sexual Harassment’ movements),
3. Perform classification of users to identify activists participating in the different networks, viz., ‘Women to Drive’ and ‘Sexual Harassment’,
4. Construct networks for the two online CAs and visualize,
5. Observe if there is any interaction between the networks, and
6. Observe the polarity of sentiments expressed in the interactions to understand whether the interactions are supportive or not.

Since, the online initiative was boosted by the fact that residents of Saudi Arabia are highly active on social media, especially Twitter and YouTube, data collection and analysis efforts cannot overlook Twitter. The definitive nature of Twitter hashtags provides a means to examine the evolution of the campaign network. We examine the Twitter activity for ‘Oct26Driving’ campaign and collected the data, starting from September 25, 2013 to November 14, 2013. The study considered several hashtags associated with the campaign and analyzed the dominant ones, viz., ‘#oct26driving’ and ‘# ر ادة 26 التوقي #’. Our research identifies cross-cultural aspects with individual hashtag networks, with the Arabic hashtags relating to local factors and English hashtags helping in bringing transnational support from organizations such as human rights and women’s rights. We followed a similar methodological approach (i.e. data classification, overlap detection, and, network construction and visualization) that was performed for analyzing blog data.

### **Data Collection**

Next, we describe our data collection efforts for blogs and Twitter.

#### **Blog Data**

The content from around 300 blog sites from 23 different countries was collected. Bloggers are included based on three shared characteristics: they are women over the age of 18, they are Muslim, and they primarily blog in English. Other available demographic information, such as nationality, current residence, and name is also included. Since these blogs are updated with frequencies varying between two to three blog posts per day to one blog post per month, a crawler (viz., Web Content Extractor, [www.newprosoft.com/](http://www.newprosoft.com/)) was configured with the above mentioned nuances running constantly to automatically collect, parse, and index the data.

From the crawled blog sites, 111 blog sites consisting of 1,380 blog posts were discussing ‘Women to Drive’ or ‘Sexual Harassment’ at different time periods. 73 out of these 111 blog sites were discussing ‘Women to Drive’ and ‘Sexual Harassment’ campaigns in different posts, and 26 blog sites were discussing both in the same post.

### **Twitter Data**

The content of about 70,000 tweets from 116 different countries was collected. 152 unique hashtags were created by users and associated with the campaign. Two most dominant hashtags, i.e. ‘#oct26driving’ and ‘# رادة\_26 التوقي #’, were selected. Other available tweet information, such as language, user name, retweeted user name (RT), and other hashtags, was parsed. Since these tweets are updated with frequencies varying between hundred to thousands of tweets per day, a crawler (viz., ScraperWiki, [www.scrapewiki.com/](http://www.scrapewiki.com/)) was configured to run continuously to collect, parse, and index the data. Collected data includes the unique ID of the tweet, the URL of the tweet, tweet content, the timestamp when the tweet was created or retweeted, the language of the tweet, screen name of the tweeter, name of any mentioned user in the tweet, the hashtags included, and the number of retweets. From the crawled tweets, as mentioned above about 70,000 tweets were posted for the Oct26Driving campaign at different time periods (from September 25, 2013 to November 14, 2013). However, to address the goal of this study, i.e. to track the formation of online CA, our analysis focuses on the October 9, 2013 to October 30, 2013 time period.

### ***Sentiment Extraction with Linguistic Inquiry and Word Count (LIWC)***

After the blog posts were collected, sentiments were extracted using LIWC ([www.liwc.net](http://www.liwc.net)) software, in order to study the transformation of individual opinions to collective sentiments. LIWC provides an efficient and effective method for studying various emotional cognitive and structural components present in individuals’ verbal and written speech samples. LIWC helps analyze affective processes including 406 positive emotion words (e.g., love, nice, sweet) and 499 negative emotion words (e.g., hurt, ugly, nasty). Negative emotions are further categorized into anxiety, anger, and sadness feelings. Scores for positive and negative emotions were obtained from LIWC for the blog posts and the associated comments. In LIWC’s external validity and internal reliability measures (Cronbach’s alpha) report highly correlated results. Validity judges reflect simple correlations between judges’ ratings of the category with the LIWC variable (Pennebaker & Francis, 1996). Using LIWC output and judges’ ratings, Pearson correlational analyses were performed to test LIWC’s external validity. Results reveal that the LIWC scales and judges’ ratings are highly correlated ( $\bar{x}=0.45$ ). These findings suggest that LIWC successfully measures positive and negative emotions, a number of cognitive strategies, several types of thematic content, and various language composition elements. The level of agreement between judges’ ratings and LIWC’s objective word count strategy provides support for LIWC’s external validity. Cronbach’s alpha for the internal reliability of the specific words within each category was calculated by LIWC yielding a  $\bar{x}$  of 0.83 for 64 terms.

### ***Classification and Overlap Detection***

#### **Blogs**

We filtered the indexed crawled blog entry contents by performing keyword searches that are related to ‘Women to Drive’ and ‘Sexual Harassment.’ Our first aim was to focus on the entries that contain relevant keywords such as: ‘women’, ‘drive’, and ‘women to drive’ for the ‘Women to Drive’ movement and ‘sexual’, ‘sexual harassment’, and ‘sexual abuse’, for the ‘Sexual Harassment’ movement. As a second filtering mechanism we added the entries that are labeled with user defined or system defined tags, which include the same keywords. We realized that users do not always necessarily tag their entries by specific keywords, although they are talking about the same issues. Since our crawled data includes blogger information, we created the network classes for both events by grouping bloggers under ‘Women to Drive’ and ‘Sexual Harassment’ result sets. The result sets were compared to identify the common members.

#### **Twitter**

The indexed tweets were filtered based on their hashtag usage, particularly the two dominant ones, i.e. ‘#oct26driving’ and ‘# رادة\_26 التوقي #’. The tweets were further grouped based on their inclusion of either



or both of the hashtags. Our first aim was to focus on the cumulative traffic of the tweets and tracking the development of online CA. Tweet-retweet networks were created during the time periods corresponding to the formation of CA. These networks helped us track the hashtag diffusion among the supporters and compare with network growth. This coevolution of the hashtag usage and the network further elucidated the formation of the online CA. To study the role of each of the dominant hashtags in the evolution of online CA, as a second filtering process, we created a hashtag network for each of these hashtags. The networks and their respective growth patterns were compared to identify the overlap(s) between these two networks. The overlaps were further examined to study the cross-cultural importance of the Arabic and English hashtags in the evolution of the online CA.

### **Network Construction and Visualization**

The classification result sets were analyzed by Gephi to study their structures and visualize the relationship of members within the respective movement. We measured the modularity of the network to detect and study the compartmentalized classifications of the network. The method consists of two phases. First, it looks for “small” communities by performing local optimization of the modularity. Second, it accumulates nodes of the same community and builds a new network across the communities. These steps are repeated iteratively until maximum modularity is achieved.

### **Results and Analysis**

First we focused on the events occurring during 2007 and 2011 and the data we collected from blog sites. Next we focused on blog entries belonging to both ‘Women to Drive’ and ‘Sexual Harassment’ CAs (see Figure 4). Networks of bloggers were constructed based on the filtered posts and comments. These networks help in identifying the common set of actors between the two online CAs, i.e. actors that span both boundaries, thereby identifying and specifying the cooperative network, discussed next.

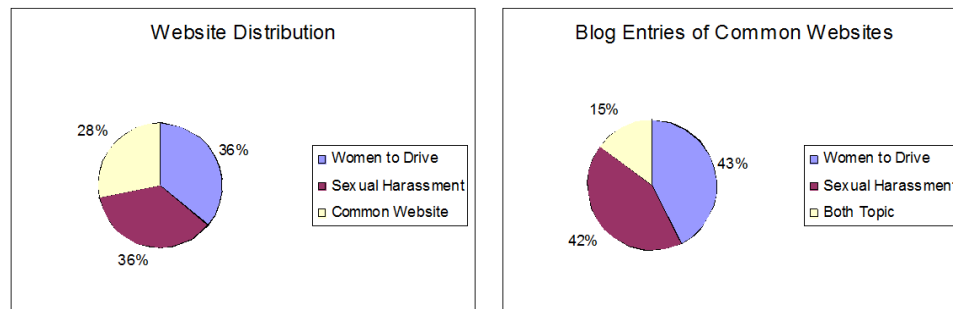


Figure 4: Distribution of the bloggers between ‘Women to Drive’ and ‘Sexual Harassment’ online collective actions

The cooperative network allows us to understand support mechanisms and transnational dynamics of both CAs. To show the interaction and support mechanisms between networks of the two women’s rights CAs, we focused on bloggers belonging to both ‘Women to Drive’ and ‘Sexual Harassment’ network classifications (as shown in Figure 5). Thus we eliminated the entries of those users belonging to only one CA. Figure 6 shows a sample of the interactions in the cooperative network between members common to both networks within our larger blogger network. The results indicate that there is a strong presence of an inter-network cooperation between the two CAs. As shown in Figures 5 and 6, the inter-network cooperation is manifested particularly through the existence of bloggers acting as brokers while bridging two overlapping networks. The brokering and bridging processes can facilitate the diffusion of information and expansion of the networks. As hypothesized earlier, the two online CAs are not isolated networks. There is a common context of promoting awareness of and CA against toward furthering women's rights. Next, we analyze the sentiments observed among bloggers who interacted with each other to study the transnational aspects of the support mechanisms between the two CAs.



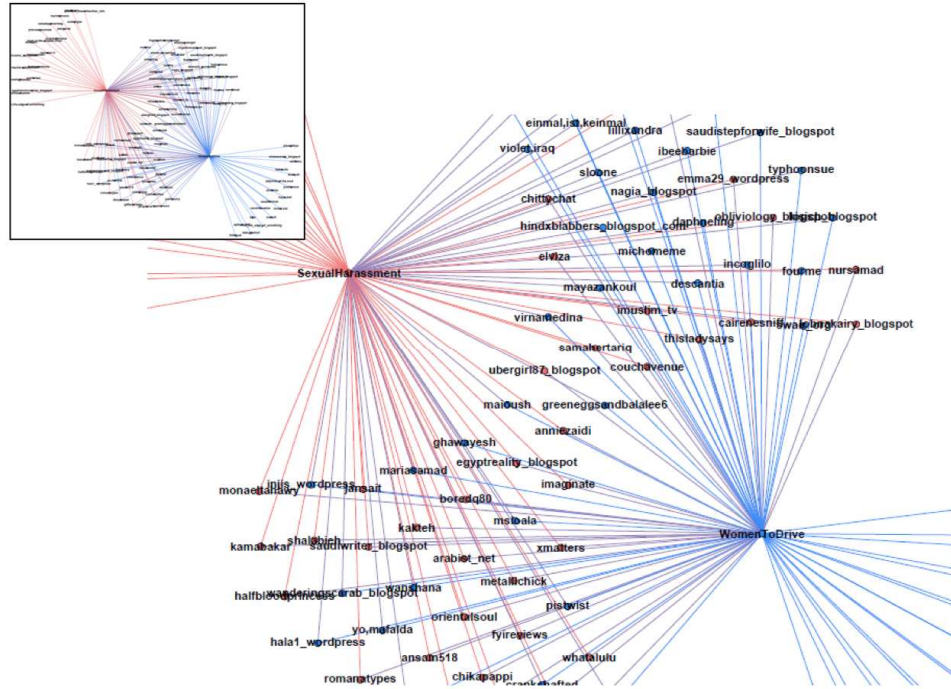


Figure 5. Network of bloggers for ‘Women to Drive’ and ‘Sexual Harassment’ online collective actions

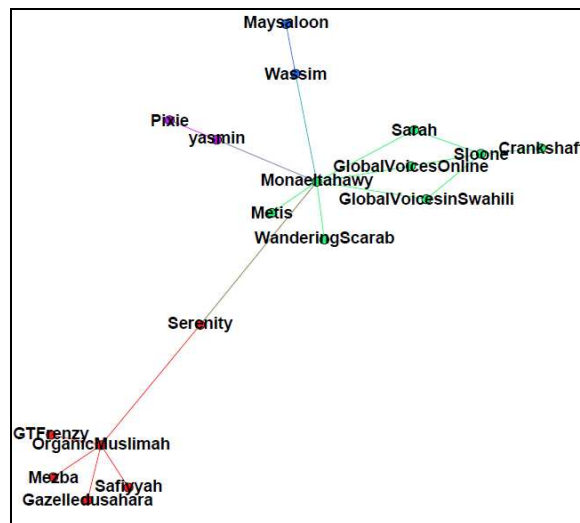


Figure 6. Interactions in the cooperative network between the members common to both collective actions within the larger blogger network

We ran LIWC on the text data obtained from the interactions observed in the cooperative network. The interactions were extracted from comments exchanged by the members in the comment sections of individual posts or the text around the blog links. Individual blogger sentiments are identified for specific movements.

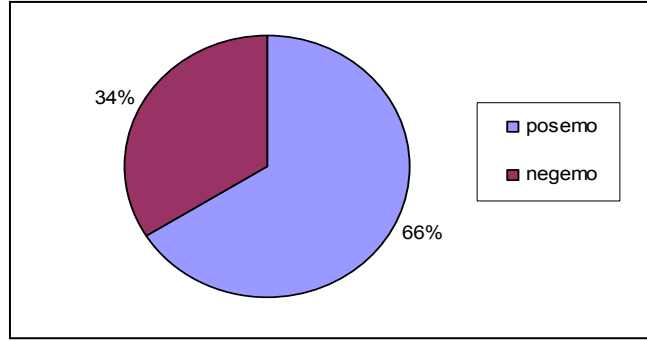


Figure 7. Distribution of positive and negative emotions for the interactions observed in the cooperative network

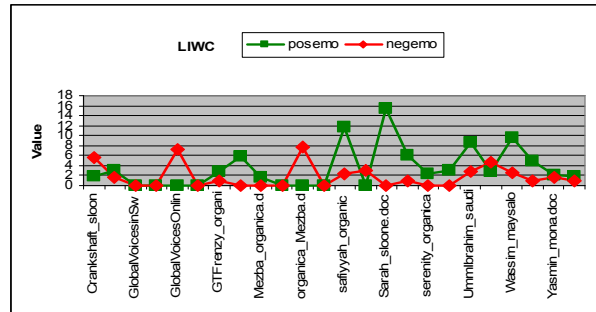


Figure 8. Distribution of the emotions for the comments among the bloggers

These bloggers act as brokers who bridge distinctive but overlapped networks of CAs. Followers’ sentiments about ‘Women to Drive’ and ‘Sexual Harassment’ were largely positive, indicating there is cooperative support and interaction among the members of the two blogger networks. In addition to measuring positive emotion, we also used assent verbs (e.g., agree, OK, yes, etc.) to measure levels of agreement. Assent implies agreement or approval, especially as the result of deliberation. An increasing use of assent verbs, therefore, suggests increased group consensus and agreement. In our data, 86% of the blog entries have assent verb scores higher than the average value (see Figure 9) signaling high levels of agreement. From the LIWC results, we observe the interconnectedness and closely linked interactions between ‘Women to Drive’ and ‘Sexual Harassment’ blogger networks.

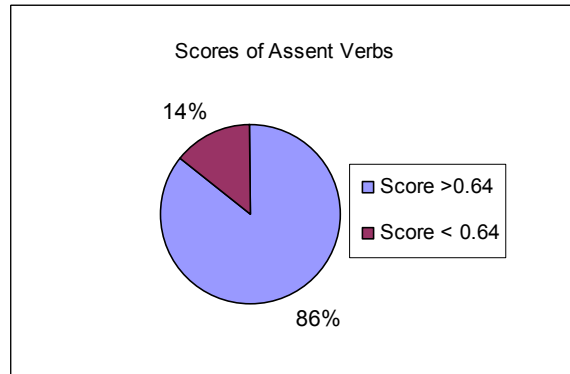


Figure 9. Distribution of the assent verbs scores observed in the cooperative network

The strong positive emotions indicate that the members of the two networks are extremely supportive of each others’ efforts, which, in turn, can help to sustain both CAs and the linkages between the two. Given the definitive nature of hashtags, we studied the co-evolution of hashtag usage and the campaign network. The movement started gaining online awareness by October 9, 2013 when the official Twitter account was created for the movement. In order to track the formation of online CA we picked the dates when there

was a spike in the web traffic (noted as peaks in Figure 2) and created tweet-retweet networks for each date (as shown in Figure 10).

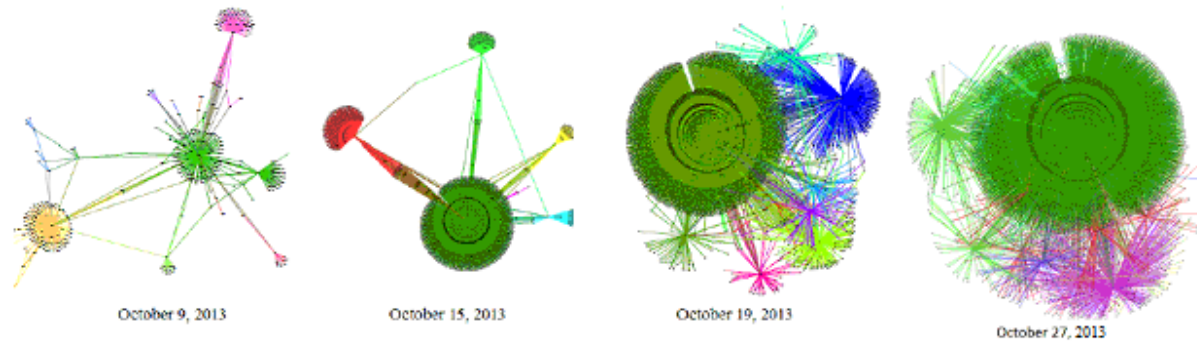


Figure 10: Tweet-Retweet network for Oct26Driving campaign at different dates with considerable web traffic. Green cluster denotes the @oct26driving Twitter account

With the diffusion of dominant and other related hashtags, the clusters become increasingly connected. As the cumulative activity in the tweet-retweet network increases, the modularity of the network decreases from 0.607 (on October 9, 2013) to 0.225 (on October 27, 2013), reflecting connectivity increasing between nodes and different clusters to start uniting. Figure 3 shows the snapshot of the tweet-retweet network for October 27, 2013, the day after the actual driving (as advocated in the campaign) happened. As hypothesized earlier, increased co-occurrence of the hashtag results in formation of online CA and tracking the growth of the campaign network could be observed.

We created a hashtag network for each dominant hashtag ('#oct26driving' and '#قيادة\_26\_اكتوبر') and compared their growth with each other. First, we filtered our tweet data and grouped the English hashtag and the Arabic hashtag tweets separately. When we compare the volume of tweets, the Arabic hashtag is used more frequently than the English hashtag, meaning more tweets are associated with the Arabic hashtag. Figure 11 shows the distribution of tweets using these two dominant hashtags.

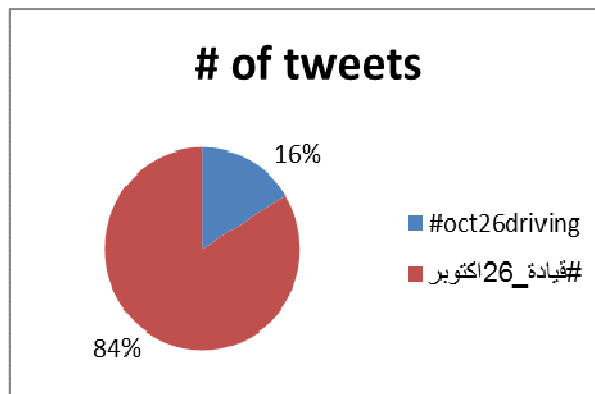


Figure 11: Distribution of English and Arabic hashtags

We tracked the behaviors of users and discovered that, if the user is tweeting in English, the person is 80% more likely to use/pair another English hashtag within the same tweet. On the other hand if the user is tweeting in Arabic, that user is 96% more likely to use/pair another Arabic hashtag within the same tweet. When we compared the overlap between hashtag networks, the results show that 60% of the common hashtags were in English. English hashtags are more likely to bridge different clusters. While the Arabic hashtags are more likely to relate to local factors, such as the discussed *effects of driving on women's ovaries*, English hashtags are helping to promote transnational and interorganizational support from various organizations such as human rights and women's rights, viz., Women2Drive Campaign. Figure 12 shows the network of both English and Arabic hashtags illustrating the interconnected nature of online CA observed in this campaign.

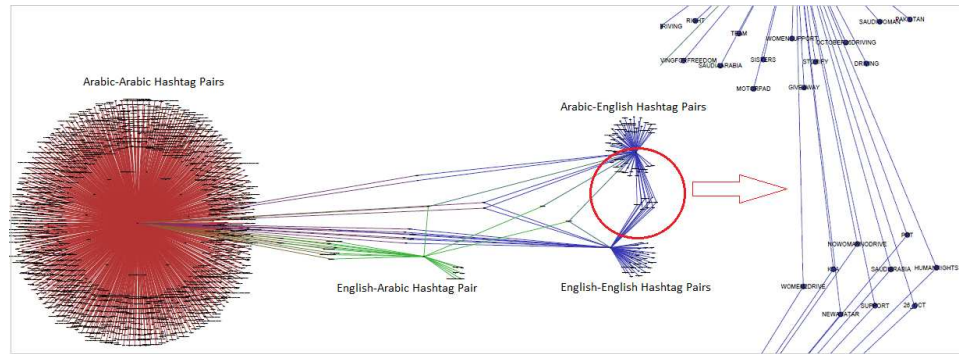


Figure 12: Distribution of English and Arabic hashtag. Arabic hashtags are depicted in red color on the left and English hashtags are depicted in blue and green colors on the right

## Conclusion

In this study we propose novel methodological approaches highlighting several key contributions to the fundamental research of online CA as well as computational studies of social media. By analyzing social media postings about two women's rights movements, specifically Saudi Women's Right to Drive movement and a more global Sexual Harassment movement, we study the role of cooperative networks between online CAs and found that individual opinions evolve and find traction in the interconnected networks through brokering and bridging processes. From the information perspective (Aldrich 1979), this kind of interconnectedness can support and enhance organizational effectiveness. Our findings also demonstrate that emotion is central to the coalition formation processes between two networks of CAs and, in turn, can help sustain both.

We studied the formation process of online CA by examining the diffusion of hashtags. Through the definitive nature of hashtags, we investigated the co-evolution of hashtag usage and campaign network growth, helping us to track the formation of CA. Considering the dominant hashtags dedicated to the Oct26Driving campaign, viz., '#oct26driving' and '#التوير26 قيادة', the study identifies cross-cultural aspects from individual hashtag networks. While Arabic hashtags are relating more to the local factors, English hashtags help in bringing transnational and interorganizational support from various human rights and women's rights organizations.

The coalition formation of the two online CAs, interorganizational communication, and transnational support examined here implies a synergistic effort that can help increase political and social influence affecting the direction or outcome of social movements. This research demonstrates how new insights and understanding of online CA may be garnered by leveraging existing methods such as social network analysis, sentiment analysis, text mining, and content analysis. We envision that this research will help advance our understanding of interconnected CAs conducted through modern social and information systems.

Our plan for future research in this area focuses on additional analyses of social networks, diffusion patterns, information flows as well as the demonstration of collective action behavior and coalition formation within collective action, and how they influence public opinion and policies. Further, future research should also explore cross-cultural aspects of interconnected online collective actions. At a broader level, the research helps to examine the role of information and communication technology (ICT) mediated communications in the formation of emergent organizations with implications to business, marketing (viral behaviors) and many other settings.

## Acknowledgements

This research is funded in part by the U.S. National Science Foundation's Social Computational Systems (SoCS) program and Cyber Human Systems (CHS) program (award numbers: IIS-1110868 and IIS-1110649) and the U.S. Office of Naval Research (award numbers: N000141010091 and N000141410489).

## References

- Agarwal, N., Lim, M., Wigand, R.T.: Finding her master's voice: The power of collective action among female Muslim bloggers. In: Proceedings of the 19th European Conference on Information Systems (ECIS), Helsinki, Finland, June 9-11, Paper 74 (2011a).
- Agarwal, N., Lim, M., Wigand, R.T.: Collective action theory meets the blogosphere: A new methodology. In: Fong, S. (ed.) NDT 2011. CCIS, vol. 136, pp. 224–239. Springer, Heidelberg (2011).
- Agarwal, N., Liu, H., Tang, L., and Yu, P.S. (2008). Identifying the influential bloggers in a community. In Proceedings of the 2008 International Conference on Web Search and Data Mining, pp. 207-218, ACM
- Agarwal, N., Liu, H., Tang, L., and Philip, S. Y. (2012). Modeling blogger influence in a community. *Social Network Analysis and Mining*, 2(2), 139-162
- Bimber, B., Flanagin, A.J., Stohl, C.: Reconceptualizing collective action in the contemporary media environment. *Communication Theory* 15, 389–413 (2005)
- Blau, P. M. (1977). *Inequality and Heterogeneity: A Primitive Theory of Social Structure*. Free Press New York
- Borgatti, S. P., Jones, C., and Everett, M. G. (1998). Network Measures of Social Capital. *Connections*, 21(2):27–36.
- Blau, P. M. (1977). *Inequality and Heterogeneity: A Primitive Theory of Social Structure*. Free Press New York
- Bourdieu, P. (2008). 15 The Forms of Capital. *Readings in Economic Sociology*, 4:280, pp. 280-291
- Burt, R. S. (2004). Structural holes and good ideas. *American Journal of Sociology*, 110(2), 349-399
- Campbell, S.W., & Kwak, N. (2012). Mobile communication and strong network ties: Shrinking or expanding spheres of public discourse? *New Media & Society*, 14(2), 262–280
- Centola, D. (2010). The spread of behavior in an online social network experiment. *Science*, 329(5996), 1194–1197
- Davies, J.C. (1971). *When Men Revolt and Why*. Free Press, New York, NY.
- Gamson, W. A. (1961). A theory of coalition formation. *American Sociological Review*, 26(3), 373-382
- Gibbs, J. P. and Martin, W. T. (1962). Urbanization, Technology, and the Division of Labor: International Patterns. *American Sociological Review*, 27:667–677.
- Granovetter, M. (1973). The strength of weak ties. *American Journal of Sociology*, 78(6), 1360–1380.
- Gruhl, D., Guha, R., Liben-Nowell, D., and Tomkins, A. (2004). Information diffusion through blogspace. In Proceedings of the 13th international conference on World Wide Web, pp. 491-501. ACM.
- Gurr, T. (1970). *Why Men Rebel*. Princeton University Press, Princeton, NJ.
- Kornhauser, W. (1959). *The Politics of Mass Society*. Free Press, New York, NY
- Kritikopoulos, A., Sideri, M., and Varlamis, I. (2006, October). BlogRank: ranking weblogs based on connectivity and similarity features. In Proceedings of the Second International Workshop on Advanced Architectures and Algorithms for Internet Delivery and Applications (p. 8). ACM
- Lupia, A., Sin, G.: Which public goods are endangered? How evolving technologies affect the logic of collective action. *Public Choice* 117, 315–331 (2003)
- McCarthy, J. D., & Zald, M. N. (1977). Resource mobilization and social movements: A partial theory. *American journal of sociology*, 82(6),1212-1241.
- Newman, M. (2009). *Networks: an introduction*. Oxford University Press, Oxford, UK.
- Olson, M.: *The Logic of Collective Action*. Harvard University Press, Cambridge (1965)
- Oliver, P. (1993). Formal models of collective action. *Annual Review of Sociology*, 19, 271-300.
- Postmes and Brunsting (2002). Collective action in the age of Internet: Mass communication and online mobilization. *Social Science Computer Review*, 20, 290-301.
- Putnam, R. (1993). *The Prosperous Community: Social Capital and Public Life*. *The American Prospect*, 13(4). Available online: <http://prospect.org/article/prosperous-community-social-capital-and-public-life>. Last accessed February 6, 2014
- Scott, J. (1992). *Social Network Analysis*. Sage, Newbury Park, CA.
- Stevenson, W. B., Pearce, J. L, and Porter, L. W. (1985). The Concept of ‘Coalition’ in Organization Theory and Research. *Academy of Management Review*, 10(2), 256-268
- Smelser, N. (1963). *Theory of Collective Behavior*. Free Press, New York, NY.
- Wahba, M.A., and Lirtzman, S.I. (1972). A Theory of Organizational Coalition Formations. *Human Relations*, 25(6), 515-527.

- Walgrave, S., Bennett, W. L., Van Laer, J., & Breunig, C. (2011). Multiple engagements and network bridging in contentious politics: Digital media use of protest participants. *Mobilization*, 16(3), 325–349
- Wasserman, S., and K. Faust. (1994). *Social Network Analysis*. New York: Cambridge University Press
- Wellman, B. Quan-Haase, A., Boase, J., Chen, W., Hampton, K., Díaz, I., & Miyata, K. (2003). The social affordances of the internet for networked individualism. *Journal of Computer-Mediated Communication*, 8(3), [doi://dx.doi.org/10.1111/j.1083-6101.2003.tb00216.x]
- Wigand, R.T. (1979). A Model of Interorganizational Communication among Complex Organizations. In K. Krippendorff (ed.), *Communication and Control in Society*, pp. 367-387. Gordon & Breach, New York, NY (Portions of this chapter are reprinted in Arthur G. Bedeian (1980), *Organizations: Theory and Analysis*. First and Second Editions. Dryden Press, Hinsdale, IL)
- Wigand, R.T. (1988). Communication Network Analysis: A History and Overview. In G. Goldhaber and G.A. Barnett (Eds.). *Handbook of Organizational Communication*, pp. 319-358, Ablex, Norwood, NJ.
- Young, J. (2009). Wajeha Al-Huwaider: A Brave Heart! Al Waref Institute. Available at: <http://www.alwaref.org/fr/component/content/article/37-figure-of-the-month/191-wajeha-al-huwaider-a-brave-heart>. Last accessed February 6, 2014.
- Yuce, S.T., Agarwal, N., and Wigand, R.T. (2013). Mapping Cyber-Collective Action among Female Muslim Bloggers for the Women to Drive Campaign. *Proceedings of the 2013 International Conference on Social Computing, Behavioral-Cultural Modeling, & Prediction (SBP 2013)*, pp. 321-340, April 2-5, 2013, Washington, D.C. Springer.
- Yuce, S.T., Agarwal, N., Wigand, R.T., Lim, M., and Robinson, R. (2014). Studying the Evolution of Online Collective Action: Saudi Arabian Women's 'Oct26Driving' Campaign on Twitter. *Proceedings of the 2014 International Conference on Social Computing, Behavioral-Cultural Modeling, and Prediction (SBP14)*, pp. 404-411, April 2-4, 2014, Washington DC. Springer.