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Strategies affecting Twitter-based networking pattern of South Korean politicians: social network analysis and exponential random graph model

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Abstract This paper examines the Twitter networking pattern of "following" and "mention" relationships between South Korean politicians. The data were obtained from the Twitter profiles of Korea's national assemblymen and the most influential political figures. We conducted social network techniques including exponential random graph model and a regression method. The results suggest that these politicians employ two different strategies to establish relationships with other politicians on Twitter. One is "following" other politicians as a social ritual based on dyadic reciprocity, and the other is to "mention" other politicians as asymmetric political support based on the public popularity of their peers on Twitter.

Keywords Social network analysis · Politician · Twitter · Social ritual · Political support · South Korea · Exponential random graph model

1 Introduction

Social media have become alternative communication channels in everyday life (Jansen et al. 2009; Park et al. 2011). Understanding social media networks will enable us to map social relationships and information sharing (Hsu and Park 2011; Highfield et al. 2011). Since Twitter's launch in 2006 as a mobile social media platform, the number of Twitter users has increased dramatically and it has become one of the most representative and powerful social media. Recently, the wide dissemination of smartphones and tablet computers has accelerated

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Twitter use and the number of Twitter accounts has reached 200 million accounts (Bosker 2011).

Furthermore, Twitter has become a representative "networked public sphere" (Benkler 2007). Government institutions use Twitter as a tool for disseminating information, and politicians "follow" and are "followed by" the public. The public uses Twitter as an important information source and a reliable communication channel to obtain political information (Smith 2011). Indeed, the boundary between formal and informal political communication has blurred on Twitter, increasing its influence as an online public sphere. In this regard, previous studies considering the political aspects of Twitter have typically focused on the effects of Twitter on political mobilizations and election campaigns (e.g., Plotkowiak et al. 2010; Web Ecology Project 2009), paying little attention to social interactions between politicians.

Given the increasingly important role of new media in the political process and their open nature (Smith 2011), politicians' online networking behavior is likely to be as important as their behavior in the legislative or policy domain in terms of social informetrics research on computer mediated-communication because the pattern of their relationships in the online public sphere can be quantitatively observed (Kim and Park 2012). To explore online networks between politicians, this study examines their Twitter networking patterns. Like ordinary citizens who obtain information and share experiences through informal communication on Twitter (e.g., Zhao and Rosson 2009), politicians may "follow" and "mention" one another. One important difference between politicians and ordinary citizens is that the former need to better scrutinize the "representational dimension" (Dahlgren 2005) of the online public sphere. Every aspect of a politician's formal and informal Twitter activities is likely to receive considerable attention from the public. Therefore, politicians' social connectedness on Twitter can be as important as the connectedness between politicians and the public. In this regard, this study is guided by the following research question: How can we define politicians' relationships and communication with their peers on Twitter, an important public online space?

2 Literature review

2.1 Politicians and the public on Twitter

Because Twitter is a social media tool for facilitating interactions between people (Hansen et al. 2010), politicians are likely to perceive Twitter as a channel for sharing political information and connecting with their supporters. In the U.S., for example, conservative politicians tend to view Twitter as an "online soapbox, a way to reach large audience," and progressive politicians perceive it "more as a way to connect people with each other" (Newsweek 2009). Their ways of interacting with the public may be different, but they are the same in making use of the characteristics of the Twitter platform.

One of the most important characteristics of the Twitter platform for politicians is that Twitter is a unique tool that can help politicians to integrate their self-promotion and civic engagement activities simultaneously through a single communication platform. Naaman et al. (2010) described this as the "social awareness stream" (SAS) and suggested that SAS communication differs from other forms of communication in that the nature of SAS communication and conversation is public and conducted in a highly connected social space. This means that, for politicians, Twitter is a media platform that can help them not only to spread information neglected by traditional media outlets but also to collate bottom-up opinions from citizens (Newsweek 2009). For citizens, this implies they can directly share

their political sentiments and preferences for politicians and obtain more reliable political news from politicians (Smith 2011; Tumasjan et al. 2010). This characteristic can sometimes appear as a source of social pressure for politicians with respect to their Twitter adoption. For instance, Chi and Yang (2011) found that U.S. congressmen are likely to adopt Twitter through peer pressure.

This characteristic of the Twitter platform can be applied to politicians' Twitter networking through mentions. On Twitter, a politician's activity for personal relationships is open to a direct examination by those citizens who are willing to share information with others and tend to be highly connected. In addition, when a politician mentions another politician and if a Twitter user "follows" both of the "mentioning" politician and the "mentioned" politician, then this mention is directly exposed to the user. Once exposed, the content of the mention is no longer a private message. Therefore, a politician needs to pay attention to his or her relationships with other politicians who will be perhaps the subject of discussions by other Twitter users in the future. This feature resembles what Habermas (2006, p. 411) saw as the imagination of the public sphere: "public sphere as an intermediary system of communication between formally organized and informal face-to-face deliberations in arenas." Recently, Twitter has exhibited this characteristic to some extent as a network-based online public sphere in which formally organized and informal deliberations coexist. This raises the question of how this characteristic of the Twitter platform influences the pattern of politicians' relationships based on their connections to and discussions with one another in this networked public sphere.

However, previous studies concerning politicians' Twitter activity have focused more on how they adopt and use Twitter than on how they form relationships with one another. Chi and Yang (2011) delineated that peer pressure is a key factor influencing legislators' Twitter adoption but did not examine how this pressure influences them after their Twitter adoption. Glassman et al. (2010) found that U.S. congressmen are more likely to use Twitter as a one-way communication tool than a two-way interactive one with respect to the public but did not consider the interaction between these politicians. That is, few studies have examined how politicians interact with one another on Twitter, an important new SNS (social networking site) platform.

Therefore, this study examines the following two types of Twitter networks of politicians in the context of South Korea (hereafter "Korea"): "following–follower" and "mention" networks. A following–follower network refers a message-subscribing network on Twitter for following (or being followed by) other Twitter users, and the mention network refers to a direct communication network formed by Tweets targeting a specific user. By analyzing these two Twitter networks, this study explains the characteristics and patterns of politicians' social connectedness on Twitter, an open and networked online public sphere.

2.2 Embededness of Twitter and politicians' networking

The coexistence of their peers and the public on the Twitter shapes two different contexts of embeddedness: network boundaries and the representation of the public. The embeddedness argument emphasizes the influence of interpersonal relationships on human behavior (Granovetter 1985) and describes social actors facing "different sets of resources and constraints than those who are not embedded" (Moody and White 2003). A simple but strong indicator of socio-communicational embeddedness is the extent to which one actor is influenced by his/her friend B's relations and activities (Monge and Contractor 2003). In other words, social network researchers assume that actors are enmeshed within the network-based mechanism of mutuality that is measured based on the dyadic level of analysis (Borgatti et al.

2009). Therefore, politicians on Twitter are embedded in an online platform that is more likely to constrain the networking boundary of their peers than other types of political networks (e.g., bill-cosponsorship networks or hyperlink networks of homepages or blogs). In a hyperlink network of politicians' homepages or blogs, politicians take independent action to choose and link to other politicians. These homepages or blogs are not entirely dependent on a given platform in terms of finding other politicians or being accessed using the same platform. In a bill-cosponsorship network, a politician's decision to cosponsor a certain bill considers not only the content of the bill but also his or her relationships with other politicians who support the bill. In this case, the relationship boundary includes only those considering their support for the bill, not all politicians in the legislature. Therefore, the boundary here works as a signal to other politicians about the content of the bill and exerts some persuasive power over these politicians at the individual level (Wilson and Young 1997; Fowler 2006). On Twitter, it is neither about choosing other politicians without a clear network boundary nor about selecting a limited set of politicians who support a bill. Joining Twitter means all politicians on Twitter are immediate networking candidates because they use the same media platform. Holland and Leinhardt (1972) demonstrated that transitivity is "a very important structural tendency in a social network" (Wasserman and Faust 1994), and this context is more likely to arise as a highly dense network of politicians on the Twitter platform than on other online platforms such as homepages or blogs.

The other embedded context influencing relationships between politicians is the co-existence of the public and politicians. When social media users submit content, they consider two groups of audiences: traditional audiences for which the content is prepared and hidden audiences with access to the content (Hogan 2010). The coexistence of these two types of audiences—peers and citizens—influences the content of social media. Social media users tend to post content that is normatively acceptable, finding the lowest common denominator for users. As such, for politicians, this audience effect can restrict their social relationships on Twitter in terms of the public representation of personal relationships. Previous studies of politicians' online networking have also supported this argument in the context of the hyperlink network of politicians' homepages or blogs (Hsu and Park 2011; Park et al. 2004; Park and Kluver 2009; Kim et al. 2010). A hyperlink network is often "declared" as a representational network instead of a network of real relationships (Shumate and Lipp 2008). For instance, a hyperlink network of politicians' blogs tends to reflect their offline popularity and influence, and therefore it is generally consistent with their offline relationships and partisanship. In this regard, a hyperlink network of politicians' homepages or blogs, can be a way to announce one's affiliation with other politicians to the public through online media.

While there have been several studies to examine the embeddedness in the politicians' networks in the legislative, policy, or homepage/blog domain, we have a little knowledge about politician's social networking behavior in Twitter. In order to fill the gap, we have examined the network of the following–follower and of mention between politicians, with reference to South Korea.

3 Research propositions

Before discussing the embededness of the Twitter platform, which can influence the network of politicians, it is necessary to delineate various types of connections that politicians can form on Twitter. In short, there are two ways to form social connections on Twitter: information subscribing and direct communication. Information subscribing refers to a following–follower network that does not necessarily accompany communication between politicians.

Subscribing to others' accounts is referred to as "following" others and does not require their permission. In this sense, Twitter is not grounded on a mutual relationship and is different from Facebook, in which a "friend" relationship requires both parties' mutual agreement. Direct communication refers to "mentions." A user can talk directly through another user's ID by leaving a personal message on Twitter. In doing so, the ID owner can read the message on his or her personal Twitter page. This raises the question of how these two types of connections are related to the embededness of the Twitter platform, which not only functions as a source of social pressure for politicians to network with other politicians but also makes them to view their connections to other politicians as the public representation of personal relationships.

3.1 Proposition 1: following–follower as a social ritual of networking

Politicians usually consider their offline social and political relationships when generating online connections (Park and Kluver 2009). However, unlike in the case of other types of online connections such as hyperlink connections on politicians' homepages or blogs, the embeddedness of the Twitter platform, which restricts the boundary of politicians' networks, can function as a source of social pressure for politicians using Twitter. In addition, politicians need to strike a balance between their personal relationships with peers and their representation to the public to maintain an effective social networking relationship. As a result, politicians' networking strategy may be guided by their intense social pressure to connect to as many peers as possible. In this regard, we propose the following hypothesis:

Hypothesis I The network density of a politician's Twitter network is higher than that of his or her other online networks such as those based on homepages or blogs.

However, their social pressure to connect to other politicians through direct communication on Twitter may be less intense than that for following–follower networks because mentions require more commitment than followings. Because mentions carry messages for delivery and are usually exposed to followers of a politician's Twitter account, the politician is likely to carefully manage his or her account and be less active. After all, Twitter is, for most politicians, just one of many ways to communicate with other politicians.

If so, the reciprocity of networking in following–follower relationships may be stronger than that in mention relationships because the social pressure to connect may be stronger in the former and personal relationships between politicians are typically based on the reciprocity of relationships (Burkett and Skvoretz 2001). In this regard, we propose the following hypotheses:

Hypothesis I-1 The network density of politicians' following–follower network is higher than that of their mention network.

Hypothesis I-2 The reciprocity of relationships in the following–follower network is stronger than that in the mention network.

These hypotheses posit that the networking strategy of following–followers by politicians can be seen as a form of networking based on social rituals as a way of making social gestures to other politicians and representing their relationships to the public.

3.2 Proposition 2: mentions as political support through networking

As discussed earlier, one context of the embeddedness of the Twitter platform is the coexistence of politicians and the public. In this context, politicians may promote their visibility on

Twitter by taking advantage of other politicians' public recognition. In other words, it is the gravity of the political engagement of their peers with the public that attracts politicians to make connections with their peers who gained popularity from the public on Twitter. Because this course of action comes from some intention to increase personal visibility with respect to the public, politicians need to take action to expose their relationships to the public. Podolny (2001) referred to this action "an informational cue" to draw inferences about the values of an actor or those of connected actors. In this sense, the public can view mentions without any difficulty because checking a specific user's following–follower connections to determine whether the user is following others requires a substantial amount of time (i.e., it takes a substantial amount of time to view users' profiles or followers).

Therefore, the more a politician is linked to other politicians through communication, the more likely he or she is to have public followers and Tweets because of the gravity of his or her political engagement with the public. However, this link is conditional on the politician's political affiliation. If politicians want to maximize the benefits of Twitter communication with other politicians, then they need to increase the size of supporters whose political orientation is similar to, not different from, their own. Previous studies have suggested that the community structure of political networks usually reflects politicians' political orientation (Chang 2008; Park and Lee 2008; Park and Thelwall 2008; Zhang et al. 2008). In addition, the public generally gathers around the same political views (e.g., Bimber 2000; Hindman 2009; Sunstein 2007). In this regard, we propose the following hypothesis:

Hypothesis II The number of mentions a politician receives from other politicians (the indegree of the mention network) with the same political orientation increases with the politician's popularity with the public (the number of followers) and the number of his or her Tweets.

This implies that the number of mentions received from other politicians (the indegree of the mention network) follows a power-law distribution because mention links tend to follow the principle of preferential attachment, which refers to the tendency of new links to target already well-connected nodes in a network (Barabási and Albert 1999; Kim et al. 2010; Park and Thelwall 2008). By contrast, a following–follower network tends to follow a linear function because of the reciprocity principle of making network links. In this regard, we propose the following hypotheses:

Hypothesis II-1 The indegree of a mention network follows a power-law distribution.

Hypothesis II-2 The indegree of a following–follower network follows a linear function.

These hypotheses posit that the networking strategy of mentions by politicians on Twitter can be seen as a form of networking for political support as a way of providing support to other politicians who are highly visible through their political engagement with the public on Twitter.

4 Data and the method

4.1 Political use of Twitter in Korea

Compared to other global internet services such as *Google, Yahoo!*, and *Youtube*, Twitter has been popular and has influenced Korean society. In the initial stage around April/May, 2009, Twitter accounts of celebrities were distributed by traditional news media and subsequently,

news articles reported their timelines. In addition, news stories about the effect of Twitter communication on political events (e.g., the 2010 National Assembly elections and provocations by North Korea) have accelerated Twitter use among Koreans. These serial news events have intensified Twitter's success in Korea. According to the Twitter Korean Index by OikoLab (http://tki.oiko.cc/service/count), the number of Korean Twitter accounts has continued to increase since April 2009, reaching approximately 5.5 million on December 5, 2011. In comparison with 37.1 million internet users in Korea as of 2010 (Korea Internet Security Agency 2011), 5.5 million Twitter users may appear to be a relatively small number, but Twitter content can be easily accessed through portal sites by using keywords. In addition, the number of Twitter users has already reached a critical threshold, allowing this online platform to have considerable influence on Korean politics.

Korean politicians use various tools for internet-based public communication. However, adoption rates for such tools vary widely. For example, Hsu and Park (2011) found that, as of January 2010, 97.23 % of the 18th National Assembly members maintained official homepages, 59.86 % managed blogs, and 24.91 % had Twitter accounts. Although fewer politicians have Twitter accounts, Twitter adoption by Korean politicians has increased sharply. As of November 2010, approximately 60 % of the 18th National Assembly members had Twitter accounts. Politicians' online and offline activities are dynamically intermingled in Korea. Tweets by Korean politicians are now considered as a new tool for obtaining their commentaries and political information, which are often unavailable through traditional news coverage (Kim and Park 2012). This suggests that politicians' networking behavior on Twitter may be as important as their offline networking behavior. Therefore, Korean politicians' online networking reflects not only their online activity but also their active presentation to the public as a method for facilitating their political promotion and engagement.

4.2 Data and the method

4.2.1 Data

We collected the data from Twitter by using an API-based research application we developed. We employed this application to automatically retrieve data on politicians, including their followings, followers, and mentions, and to obtain basic Twitter statistics such as the total number of followings and followers for all Twitter users, the number of Tweets, and the Twitter membership date.

For the politicians, we considered the members of the 18th National Assembly and 12 well-known political figures who were mayors of politically important cities or potential candidates of future presidential campaigns. As a result, we identified a total of 309 politicians. Among these 309 politicians, 192 had Twitter accounts as of November 2010. Because 3 set their accounts as "protected," the final sample included 189 politicians. Table 1 shows the distribution of these politicians.

As shown in Table 1, the party distribution of the politicians was heavily skewed to the ruling party (the Grand National Party), and the number of politicians in opposition parties ranged from 1 to 56. Although the sample was based on the outcome of the 2008 election, we divided the politicians into the following two political groups—the ruling party and opposition parties—to reflect the political landscape of cooperation and competition between various political parties in Korea. In addition, we examined whether this classification matched their sub-group affiliation based on the network structure. We employed the block modeling method CONCOR (CONvergence of iterated CORelations) to classify these groups. The results of a correlation analysis indicate that the network blocks based on

Table 1 Distribution of politicians

	Total	Twitter account holder	Ruling party versus opposition parties
Grand National Party	173	110	110
Democratic Party	92	56	79
Democratic Labor Party	5	5	
New Progressive Party	3	3	
Liberty Forward Party	16	4	
Creative Korea Party	2	2	
Future Hope Alliance	8	3	
Federation of Citizen-Centered Party	1	0	
Citizen Participatory Party	1	1	
Independent	8	5	
Total	309	189	

Table 2 Group classification: correlations between attribute-based affiliations and network blocks

	Attribute	Network	
	Affiliation groups	Following–follower	*N*
Following–follower	0.957**		189
Mention	0.920**	0.871**	128

** $P < 0.01$

[a] Groups were coded as 0 or 1 for the correlation analysis

the CONCOR method matched attribute-based politicians' affiliation groups (Table 2) and verify that the politicians' Twitter networks were generally clustered based on their political affiliation (i.e., the ruling party vs. opposition parties).

4.2.2 Method

We conducted a social network analysis and a statistical analysis. First, for the social network analysis, we employed various cohesiveness indices such as network density and (dyadic) reciprocity. For network density (the ratio of connected links to theoretically possible links), we compared Twitter networks with other types of online networks as well as following–follower networks with mention networks. In addition, we used the exponential random graph model (ERGM) to determine the difference in the network configuration between following–follower and mention networks for Hypothesis I. The ERGM is a statistical modeling method for networks that can test whether "the local interactive process may impact on global network structure" (Peng et al. 2009) and facilitate the development of structural properties of a network (Robins et al. 2007).

Second, we conducted a statistical analysis to analyze the politicians' Twitter networks with respect to Hypothesis II. The statistical analysis was based on a regression method using maximum likelihood estimation. When Twitter variables such as the total number of

Table 3 Description of Variables

	Variables	Scale	Description
Political Information	Affiliation	Binary	Ruling party versus opposition parties
Twitter Information	Date of adoption	Continuous	Days from the first adoption by a politician
	Total Twitter followers	Continuous	Total number of Twitter followers
	Total Tweets	Continuous	Total number of Tweets posted
Network index	Mention indegree	Continuous	Indegree of mentions of politicians

followers and Tweets were used, they were the total number for a politician for all Twitter users, not the total number for all politicians. We employed this method not only to test the hypotheses but also to avoid the potential problem of network autocorrelation (Doreian et al. 1984; Leenders 2002). Although this problem was not likely in this study's negative binominal regression, we analyzed the model by using the generalized estimating equation (GEE) model. Table 3 summarizes the variables in the statistical model.

We here note a few technical points. First, by definition, a following–follower network is a directed binary network, whereas a mention network is a directed valued (i.e. not binary) network. This means that users can communicate with one another more than once, whereas they can subscribe to a particular user/account only once. We adjusted for this difference by treating a mention network as a binary network of zero (no mention) and one (at least one mention) when necessary. We indicate when a mention network was treated as a binary network. Second, the numbers of politicians who actually established relationships with other politicians varied. In this study's data set, all politicians in the following–follower network were connected to one another. However, in the mention network, only 128 (out of 189) received mentions from other politicians. To compare network measures, we excluded isolated politicians for the purpose of a matching comparison. However, for the EGRM analysis, we used data on all 189 politicians.

5 Results

Figure 1 shows the politicians' following–follower and mention networks. There were substantial differences in the pattern of relationships between the two networks, but they were similar in that the politicians were fragmented according to their political affiliation (the ruling party vs. opposition parties).

5.1 Analysis for proposition I

As discussed earlier, the embeddedness of Twitter can influence the network boundary of politicians' Twitter activity, and therefore they may feel the social pressure to connect to as many politicians on Twitter as possible and to be connected mutually. To verify this argument, we compared this study's results for the politicians' Twitter networks with previous studies' findings on hyperlink networks of politicians' homepages and blogs.

As shown in Table 4, the network density of the politician's Twitter networks (both following–follower and mention networks) was higher than that of homepage/blog networks, providing support for Hypothesis I. In addition, the density of the following–follower

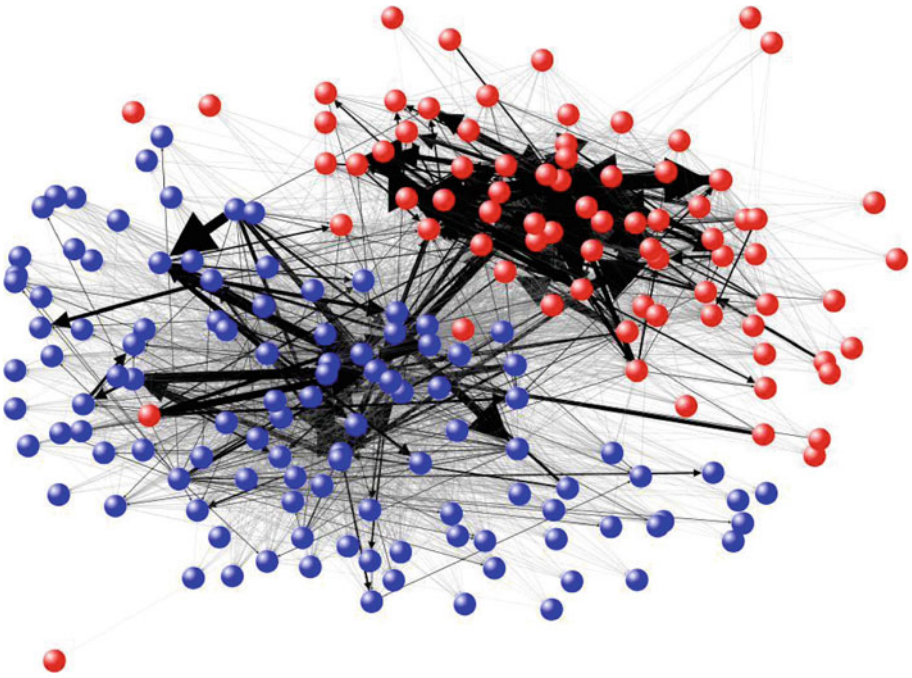

Fig. 1 Politicians' Twitter networks: following–follower and mention networks. The *gray line* indicates following–follower relationships, and the *black line*, mention relationships. *Blue* ruling party and *red* opposition parties. (Color figure online)

Table 4 Network density: Homepages, Blogs, and Twitter networks of politicians

	N	Density
Homepage[a]	115	0.002
Blog[a]	71	0.005
Twitter: followings–followers	189	0.203
Twitter: mentions	128	0.033

Including members of the 18th National Assembly and excluding isolated nodes
[a]Hsu and Park (2011)

network was approximately six times higher than that of the mention network, providing support for Hypothesis I-1.

We determined whether this difference was grounded on differences in networking behaviors between following–follower and mention networks by conducting two analyses. In the first analysis, we compared the cohesiveness indices between these two networks. As shown in Table 5, there were many dyad-based reciprocal links and cross-links between different political affiliations, and this made the following–follower network denser. Note that E–I index, which measures the ratio of external ties to internal ties within a group,[1] of the following–follower network was higher than that of the mention network, which implies that

[1] The E–I index ranges from −1 (all ties in a network are internal ties within the group) to 1 (all ties in a network are external ties to different groups). For further details, see Wasserman and Faust (1994).

Table 5 Comparison of network cohesiveness: following–follower and mention networks of politicians

	Following–follower	Mention
Density	0.204	0.040
Clustering coefficient	0.628	0.235
Avg. geodesic distance	1.896	2.895
Reciprocity (dyad-based)	0.631	0.184
E–I index*	−0.558	−0.752

[a] Mention networks were treated as binary networks

the following–follower network had a high proportion of cross-links between different political groups, whereas the mention network had a low proportion of cross-links and a high proportion of internal ties.

In the second analysis, we conducted an ERGM analysis to test the structural pattern of the network configuration between the two networks. There are various methods for estimating structural parameters (Robins et al. 2007), but we employed the Markov chain Monte Carlo for maximum likelihood estimation for the model fit.[2] We constructed the model to identify the propensity of the dyadic reciprocity pattern for the two types of networks. As shown in Table 6, the reciprocal relationship in the following–follower network did not accompany that in the mention network. Instead, mentions between the politicians were asymmetric even when there was reciprocity in the politicians' following–follower network. In addition, only the ReciprocityAAB parameter was significant ($P < 0.05$), and the converged T-ratio was less than 0.10. Further, the probability of this relationship was approximately 3.3 times higher than the random probability of such a relationship.

Therefore, the results in Tables 5 and 6 provide support for Hypothesis I-2. That is, the politicians followed their peers as a social ritual.

5.2 Analysis for proposition II

We assumed that the networking strategy of mentions, a network based on direct communication, would be based on networking for political support because of the context of the Twitter platform, in which the public and politicians coexist. Therefore, we examined whether this context would influence the way the politicians communicated with one another.[3]

Table 7 shows the results for Hypothesis II. The politicians tended to mention those belonging to the same political party who enjoyed a high level of public visibility on Twitter. Table 7 presents two factors that increased the indegree centrality of politicians based on mentions from the same political group: the total number of Twitter followers and the total number of Tweets. These factors were positive estimators, and the effect of the total number of Tweets was somewhat greater than that of the total number followers. As discussed earlier, we analyzed the data by using the GEE model to avoid the potential problem of autocorrelation between the variables but found consistent results.

In addition, the results indicate the tendency to mention popular politicians only in the mention network, providing support for Hypotheses II-1 and II-2. Figure 2 shows the

[2] We used XPNet, which was developed by the MelNet team. For further details, visit http://www.sna.unimelb.edu.au/index.html.

[3] Note that the results of the comparison of Twitter networks indicate that the politicians typically mentioned other politicians in the same political group (E–I index in Table 5) and that a mention network was asymmetric even when they followed one other on a mutual basis (EGRM in Table 6). In this regard, these results provide support for this study's proposition.

Table 6 Multivariate exponential random graph modeling: following–follower and mention networks

	Multiplex relationship	Configuration	Estimate	SE
ArcA	Followings only		−2.642	0.025
ArcB	Mentions only		−6.092†	0.122
ReciprocityA	Followings and followers		3.592	0.052
ReciprocityB	Symmetric mentions		2.786	0.997
ReciprocityAAB	Followings/followers and asymmetric mentions		3.344*,†	0.135
ReciprocityABB	Followings and symmetric mentions		−10.410†	3.487
ReciporictyAABB	Symmetric followings and mentions		20.066*	6.932

Network A and the *black line* indicate following–follower networks and their ties, and Network B and the *gray line* indicate the mention network and its ties

* $P < 0.05$

† The convergence of parameters to t-ratios <0.10

Table 7 Negative binomial regression analysis: the indegree of politicians in the same network

	General linear model (GLM)			Generalized estimating equation (GEE)		
	Est.	(SE)	Odds ratio	Est.	(SE)	Odds ratio
Constant	−2.830	(0.539)		−2.790	(0.513)	
Date of Adoption	0.001*	(0.001)	1.001	0.001	(0.001)	1.001
Total number of Twitter followers (log)	0.282***	(0.077)	1.326	0.284***	(0.072)	1.328
Total Tweeter messages (log)	0.432***	(0.059)	1.541	0.430***	(0.062)	1.537
Opposition parties	0.142	(0.176)	1.152	0.090	(0.113)	1.094
df			90	QIC		−6118.415
Log-likelihood			3097.3895	QICu		−6118.404
N						95

* $P < 0.05$; *** $P < 0.0001$

indegree distribution of the two types of networks for the same political group. As shown in Fig. 2, the indegree of the mention network tended to follow a power-law distribution, whereas that of the following–follower network, a linear function. Because of the node size of the mention network was very small, there might have been some finite-size bias in the verification of whether each political group strictly followed a power-law distribution. However, a rough estimation of the model fit indicates that the scaling parameter for

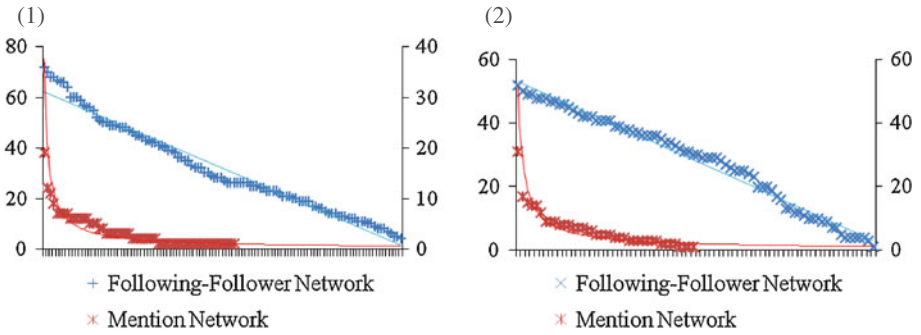

Fig. 2 Indegree centrality distribution of the same political groups: following–follower and mention networks. (*1*) Ruling party and (*2*) opposition parties. The figure excludes zero indegree centrality for the same political group

each indegree distribution was approximately 3.5 for the ruling party and 3.1 for opposition parties.[4]

6 Conclusion and discussion

We examined two types of Twitter-based networking strategies employed by Korean politicians: followings as a social ritual and mentions for political support. Although a number of studies have examined Twitter relationships between politicians and the public or between individuals with different political views, no study has examined politicians' Twitter strategies for networking with their peers. This study fills this gap in the literature by considering the following two contexts of the embededness of the Twitter platform: social pressure to connect to others by establishing network boundaries and the coexistence of the public and politicians.

In this study, we focused on whether the politicians would choose followings as a social ritual and mentions for providing their peers with political support. The results indicate that the embeddedness of the following–follower network's clear boundary induced intense social pressure to follow other politicians such that its density was higher than that of all other forms of networks of politicians based on new media, including the mention network on Twitter. In addition, there were more reciprocal relationships in the following–follower network than in the mention network, providing support for the use of followings as a social ritual.

However, in the mention network, the politicians chose a different networking strategy. Because of the coexistence of the public and politicians and their embeddedness, the politicians tended to mention popular politicians on Twitter who belonged to the same political group. In doing so, they attempted to increase their visibility on Twitter and provide popular politicians with political support. These results verify that the indegree of the mention network closely followed a power-law distribution. In addition, the more a politician's followers and Tweets, the more likely he or she was to receive mentions from other politicians in the same political group.

Although we examined the structural patterns of politicians' Twitter networks, this study has some limitations. First, because we considered only Korean politicians, the generalizability of the findings to other cultural settings may be limited. Second, the data reflected

[4] This distribution property applied only to those politicians who had at least one mention.

the political landscape in Korea at the time of data collection. That is, results may vary according to political issues (e.g., elections), and therefore the mention network may provide different results in other settings. Finally, we did not examine the content of mentions. In this regard, future research should conduct a content analysis of mentions by politicians to provide a better understanding of how they provide their peers with political support, how their messages vary across political groups, and how their messages vary according to their audiences.

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