

Examining Effects of Informational Use of Social Media Platforms and Social Capital on Civic Engagement Regarding Genetically Modified Foods in China

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Genetically modified (GM) foods constitute a hotly debated socioscientific issue in China, yet the topic is ostensibly absent from Chinese official media. Flourishing social media platforms appear to fill the void. To understand how the Chinese public engages in the GMO debate on various nationwide social media platforms, this study examines the role of social media and social capital (i.e., resources derived from social relationships, particularly in online communities) as predictors. Results of a large-scale online survey ($N = 1,370$) using a stratified quota sample showed that bridging social capital is a significant predictor of respondents' likelihood of expressing opinions on the controversy on Chinese social media platforms. Moreover, this relationship was found to be mediated by use of social media for GMO-related information—greater bridging capital leads to more informed respondents about GMOs, which in turn predicts their willingness to speak their mind about the issue online. Our study also discusses the implications for social media as an emerging networked sphere for public deliberation in media-rich, information-poor China.

Keywords: social media, social network sites, social media platform, genetically modified foods, social capital, public engagement, willingness to express opinions online

The prospect of the Internet and social media for facilitating citizen engagement with various public issues has drawn scholars' attention (Skoric, Zhu, Goh, & Pang, 2016). Papacharissi (2002) argued that the Internet has evolved into a public sphere. Researchers (e.g., Klein, 1999; Shirky, 2008) consider social media as effective tools in reducing barriers of communication and facilitating civic and political participation. Recent research testing the link between use of social media and citizen engagement has focused on non-Western

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countries, such as Singapore (Skoric, Ying, & Ng, 2009), Turkey (Tufekci & Wilson, 2012), and Iran (Faris & Rahimi, 2015). Scholars are concerned that social networks formed on social media in those countries are merely weak ties and are not enough to motivate any off-line behaviors (e.g., Gladwell, 2010), and that individuals living in those countries, though having unprecedented access to digital information, still face many practical difficulties, such as blocking and slowing down of the Internet and censorship of content (Denyer, 2016).

The role of social media in facilitating citizen engagement deserves special attention in China, where "media are rich, but information is poor" (Wei & Lo, 2015, p. 179). On the one hand, China has the world's largest Internet population of 772 million (China Internet Network Information Center, 2018). Similar to the growing trends of Web 2.0 technologies worldwide, more than two-thirds of China's Internet users (77%) use indigenous social media, including Weibo (a Twitter-like microblogging service) and WeChat (a micromessaging app equivalent to WhatsApp). Accordingly, technologically, China is ahead of the curve. On the other hand, the Chinese government has maintained tight control of the Internet by blocking Google, Facebook, YouTube, and Gmail in addition to Western news sites. The "great firewall" program made China "an information island" of 1.3 billion ("China's Tech Trailblazers," 2016). Under these circumstances of low information availability, Chinese Internet users have evaded the great firewall by using various VPN software (Murong, 2015). They turn to the less censored social media to seek information and participate in discussions about public issues of their concern (deLisle, Goldstein, & Yang, 2016; Wallis, 2011). According to recent statistics, microblogging platforms that are used for expressing opinions and seeking others' opinions about public issues are popular among Chinese Internet users. For example, 87.3% of Chinese Internet users used WeChat Moments, 64.4% used Qzone, and 40.7% used Weibo (China Internet Network Information Center, 2018).

As such, issues of public concern, such as genetically modified organisms (GMOs), could be discussed and addressed through social media (Hampton, Shin, & Lu, 2017), which has significant implications for a society like China where means of voting and other forms of political participation is rare. GMO is one of the most contested socioscientific issues in China's cyberspace. GMOs refer to living organisms whose genetic material has been artificially altered or edited through agricultural biotechnology. Scientists have reached a consensus on the benefits of GM technology (e.g., production of less expensive and arguably healthier food that is more nutritious, more resistant to disease and drought, and more customized to different environments). In contrast to scientists' views, consumers around the world are concerned whether GM foods are unsafe to eat, and they support explicit labeling of GM foods (in U.S., Funk & Kennedy, 2016; in UK, Cook, Robbins, & Pieri, 2006; in South Africa, Mwale, 2006). Although posts and comments on GMOs still suffer from heavy censorship in China, the discussion of GMO-related issues has continued in China's cyberspace in the past five years (Balzano, 2014). The Chinese public has expressed distrust and concern about the government's practices and regulations related to GMO issues (Zuo, 2015), although China has progressed in the research and adoption of GM cotton and GM rice. For example, in 2008, the U.S. Department of Agriculture sponsored a trial consumption of GM Golden Rice on a group of subjects comprising 24 boys and girls in Hunan, a rice-producing province in central China. This experiment caused furious discussion among Internet users on Weibo. The project was criticized for being a conspiracy that involved the United States, the Chinese government, and local scientists (Yang, Xu, & Rodriguez, 2014). The public resistance against GMOs has been strengthened by the involvement of academics and celebrities who have voiced their disapproval

publicly on social media. For example, Cui Yongyuan, a big-name TV anchor, self-sponsored an anti-GMO documentary, which has been widely viewed on social media and has heated up the debate over GMOs.

Focusing on public debate over the GMO issue in Chinese social media space, the first goal of this study is to explore if and how massively popular social media emerge as a public sphere that fosters civic engagement in China. In a restrictive media environment like China, the relatively less-regulated social media, although subject to heavy censorship, may provide a viable arena in which citizens can voice their opinions and concerns on public issues (Hassid, 2012).

In an era of social media communication, social network sites (SNSs) represent a networked space for public deliberations (Papacharissi, 2002) where people can satisfy both their utilitarian needs for seeking information and hedonic needs for maintaining social relationships (Hilbert, 2009). Accordingly, the second goal of the current study is to explore the facilitating role of social media in engaging concerned citizens about GMO issues through the theoretical framework of social capital (Putnam, 2000; Williams, 2006). The findings may help build theory about social media and citizen engagement in nondemocratic countries.

Literature Review

Social Media and Citizen Engagement

Conceptually, social media are Web-based platforms that allow for social interaction, content sharing, personal expression, and public discussion (boyd & Ellison, 2007; Skoric et al., 2016). Social media include various platforms, including SNSs (e.g., Facebook), media-sharing sites (e.g., YouTube), microblogging services (e.g., Twitter), and blogs. One of the critical features that differentiate social media platforms from other forms of computer-mediated communication is that they enable users to develop and maintain a large network of social ties. In addition, social media platforms facilitate easy creation and dissemination of individualized, user-generated content. This content can diffuse across online social networks quickly, fomenting discussion, debate, and deliberation.

It is noteworthy that social media platforms have transformed from social networks into digital information networks (Dijck, 2011; Myers, Sharma, Gupta, & Lin, 2014), making news the most popular topics on SNSs (Kwak, Lee, Park, & Moon, 2010). As outlined earlier, because traditional media in China have been tightly controlled, social media have become an alternative source for news and information. Past research (e.g., He, 2008; Wei, 2014) has found that Chinese people sought user-generated information such as political satires and jokes via mass text messaging (known as *duan zi*). Almost all public events were discussed on the less censored microblogging platform of Weibo, and some breaking news was first disseminated in China through Weibo (Yu, 2011).

According to the deliberative model of democracy, being informed by news media and having a political conversation with others are critical steps for deliberation and subsequent participation in public affairs. As deliberative democracy theorists (e.g., Kim, Wyatt, & Katz, 1999; Wyatt, Katz, & Kim, 2000; Wei, 2014) argue, citizens rely on news media to be informed about public issues; informed citizens then can think and talk about their thoughts on the issue in public. Political discussion with others helps them organize and

refine opinions and provides them opportunities to consider a given issue from different standpoints, resulting in reasoned opinion and participatory behaviors.

Furthermore, social media platforms can expose users to diverse and conflicting viewpoints. Previous research (e.g., Lee, Kwak, Campbell, & Ling, 2014; Park & Karan, 2014) reported that using SNSs, whether for information or recreation, and concurrent exposure to dissimilar perspectives may result in more active engagement in political and civic affairs. As Mutz and colleagues (Mutz, 2002, 2006; Mutz & Mondak, 2006) argued, exposure to diverse perspectives across lines of political difference (i.e., cross-cutting perspectives) can encourage tolerance and thoughtful processing of opposing viewpoints, leading to more active involvement in political activities and enhanced prospects for deliberative and participatory democracy. Cantijoch, Cutts, and Gibson (2016) called it a spillover effect—accessing online information acts as a gateway or as a stimulus to more active types of political participation both online and off-line. Empirically, Cantijoch and colleagues (2016) found that accessing news and information online during political campaigns was a significant predictor of online political discussion. Hampton and colleagues (2017) reported a positive relationship between the use of Facebook as a source of information on a political issue (i.e., Edward Snowden's revelation of classified information about the surveillance programs of the U.S. government) and individuals' willingness to discuss that issue on Facebook.

In the context of China, where the government tightly controls all forms of media, examining the effects of social media use on citizen engagement appears to have important implications. Drawing on the growing body of literature on the positive effects of social media use—particularly the use of social media for information—on citizen engagement (Skoric et al., 2016), the first hypothesis was proposed:

H1: Use of social media for GMO-related information in China will be positively related to the likelihood of expressing opinions on GMOs online.

Social Media and Bridging and Bonding Social Capital

In addition to the information shared on social media platforms, social relationships facilitated by social media also are likely to be associated with citizen engagement about GMOs largely because communication and interaction on social media platforms are networked deliberations (Chadwick, 2008; Papacharissi, 2002). People are interconnected through social media and can exchange ideas freely and equally, making social media a virtual space for deliberation and more open public debate. During this process, users may build and maintain large, diverse networks based on social ties and social interaction through various technical functions that social media platforms provide (e.g., profiles, display of connections, private messaging, comments; boyd & Ellison, 2007). Research has demonstrated that users obtain various forms of resources from these online social networks, such as trust, emotional support, expectation of reciprocity, information and knowledge, and capacity to organize (Putnam, 2000).

Putnam (2000) used the term "social capital" to describe resources that people derive from their social interactions to achieve their interests. He argued that the larger and more diverse an individual's network of contacts off-line or online is, the more social capital he or she possesses. Prior research has mainly focused on two types of social capital—bridging and bonding social capital (Putnam, 2000; Williams, 2006).

The former describes the weak and heterogeneous relationships among individuals who would provide useful information and new ideas and perspectives but little emotional support. According to Putnam (2000), the bridging relationship is inclusive, as it bridges across gender, race, ethnicity, or geography. Bonding social capital, on the other hand, refers to strong and homogeneous ties among individuals and their kinships. Unlike bridging social capital, bonding social capital emphasizes building and maintaining close relationships, which always involve a high degree of interpersonal trust, psychological support, and a sense of belonging. Compared with bridging, the bonding relationship is more exclusive and usually occurs within tightly knit groups, such as family, ethnic groups, church, a political organization people support, or even a smoking cessation site they join for help.

It is plausible that social capital acquired through interactions with online networks would prompt social media users to seek more information about public issues. However, the two types of social capital—bridging and bonding—appear to play different roles in information seeking. Hampton (2011) argued that diverse information usually came from peripheral weak ties rather than from core strong ties. Users may be motivated to learn about a specific issue during their interactions with weak ties who vary across a range of socioeconomic factors, personal characteristics, attitudes, beliefs, and behaviors and usually bring new and cross-cutting ideas and perspectives. On the other hand, strong ties, by the nature of the intimacy and homophily they provide, tend to be high in closure, trust, and shared norms (Burt, 2001), but low in unique resources and information compared with weak ties (Burt, 2001; Lin, 2001). Hence, the bonding capital may not be useful for sharing and diffusing diverse information, because homogeneity within core ties tends to prompt biased processing (Petty & Cacioppo, 1990; Wojcieszak, 2011) and inoculation (Nir, 2005) through which people resist opposing messages. Hampton (2011) found that the diversity of a person's overall social network (signified in bridging networks) was more likely to be associated with citizen engagement than the size or heterogeneity of core networks (as in bonding networks). Accordingly, Hypothesis 2 was proposed:

H2: Bridging social capital will be more likely to be positively related to use of social media for GMO-related information than will bonding social capital.

Scholars (e.g., Cross, Parker, & Sasson, 2003) have argued that, whether networking with kinships or mere acquaintances, bridging social capital offers information and knowledge on public and civic issues, which may result in future behavioral changes. As Klein (1999) explained, citizens use online spaces (e.g., blogs, SNSs) for discussion of and participation in public and civic affairs. Communication and interaction in these virtual spaces are usually based on anonymous, textual messages, and the standard aural and visual cues of social identity (e.g., age, gender, race) are removed (Skoric et al., 2009). Under such a circumstance, networks of users are more easily formed simply based on shared interests.

In addition, Putnam (2000) and Norris (2002) argued that the social and psychological assets gained from bonding networks would motivate people to take actions on certain public and civic issues by reinforcing like-minded beliefs and homogeneous attitudes toward the issue. Specifically, the Chinese society is characterized by *guanxi*, a culture in which pervasive social ties among various parties intertwine to form an intricate matrix of social networks (Yan, 1996). The concept of *guanxi* has a special focus on reciprocity, which guarantees reliability of information and sources, emphasizes mutual obligations and norms of action, and embodies empathy and solidarity. As such, *guanxi* resembles typical bonding ties. Liu's (2017) interviews

showed that participants of recent protests and strikes in China were motivated by reciprocity with their *guanxi* to disseminate mobilizing messages through mobile phones beyond the reach of censorship and follow such messages to engage in protests. The reciprocity can help them overcome fear and anxiety and develop a sense of moral duty to engage in politically sensitive activities. Other empirical evidence showed that bridging capital was significantly associated with online political participation, and bonding capital was significantly associated with off-line participation (Skoric et al., 2009). Zhong (2014) also reported that both bridging and bonding social capital were significantly associated with Chinese college students' off-line and online civic engagement, such as contacting government or media about civic issues and doing volunteer work. Specifically, Hypotheses 3 and 4 were proposed:

H3: Bridging social capital will be positively related to the likelihood of expressing opinions on GMOs online.

H4: Bonding social capital will be positively related to the likelihood of expressing opinions on GMOs online.

Finally, the proposed hypotheses above construct a model (see Figure 1) whereby bridging and bonding social capital are expected to be directly related to the likelihood of expressing opinions on GMOs online.

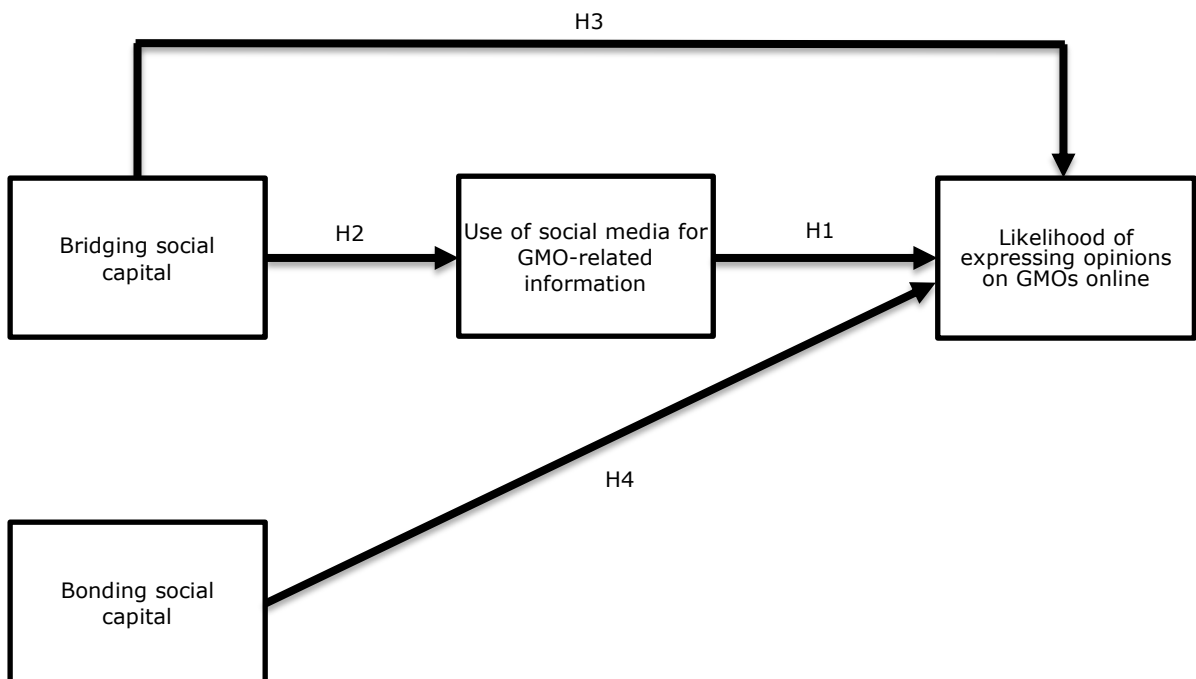


Figure 1. Proposed hypothetical model of bridging and bonding social capital, use of social media for GMO-related information, and likelihood of expressing opinions on GMOs online.

In addition, the direct relationship between bridging capital and likelihood of expressing opinion on GMOs online will also be mediated by use of social media for GMO-related information. The proposed model that tests the effect of social media use through the perspective of social capital is particularly meaningful in China where means of formal, political participation is rare, and public discussion about GMOs is ostensibly absent from official media.

Method

Data for this study were collected in an online survey of users of various social media platforms in an eastern province of China (Jiangsu, one of China's economic powerhouses neighboring Shanghai) in a two-week period from October 11 to October 27, 2016. Wen Juan Xing, a professional survey firm in China, was hired for conducting the survey. A stratified quota sampling plan was used to establish a baseline quota of key demographics of the sample, such as age and gender, to obtain respondents who resembled the population parameter of Jiangsu Province. An online panel of 164,320 adults in Jiangsu Province from a pool of more than 2,600,000 adults was sampled. A total of 1,370 individuals participated in this survey. After 84 cases were removed because of incomplete or invalid data, the final sample size was 1,286, resulting in the response rate of 5.1%, which was slightly lower than similar surveys on social media use and civic engagement in other countries (e.g., in the U.S., Gil de Zúñiga, Jung, & Valenzuela, 2012).

Sample Profile

Of the sample, 27.4% are young people under 30 years old ($n = 352$), 18.1% between 31 and 40 years ($n = 233$), 52.7% between 41 and 60 years old ($n = 678$), and 1.8% above 60 years old ($n = 23$). In terms of gender ratio, 50.3% are male ($n = 647$), and 49.7% are female ($n = 639$). Other descriptive statistics show that the education level of the sample is high, as 47.1% have a college degree or above ($n = 605$), 27.3% have an associate degree ($n = 351$), and 25.7% are middle school or primary school graduates ($n = 330$). Most of the respondents (41.3%) have a monthly income of 2,001–5,000 yuan ($n = 531$), and 8.6% earn less than 2,000 yuan per month ($n = 110$), 34.8% between 5,001 and 10,000 yuan ($n = 447$), and 15.3% above 10,001 yuan ($n = 198$). The majority of the respondents (80.9%) have identified themselves as nonreligious ($n = 1,040$).

In addition, we compared the sample statistics with the population parameters of Jiangsu Province on key demographics, such as age, gender, and education (Jiangsu Statistics Bureau, 2017). Results of a one-sample chi-square test (see Table 1) showed that the gender of the sample did not differ significantly from that of the population of Jiangsu Province ($p = .99$), but the age of the sample differed significantly from that of the population ($p < .001$). Further analyses showed that our sample included fewer people less than 18 years old, 31–40 years old, or more than 50 years old, but included more young people ages 19–30 years and middle-aged people 41–50 years old. The education level of the sample also differed significantly from that of the population ($p < .001$). Further analyses showed that our sample included fewer middle school and primary school graduates, but included more respondents with higher degrees.

Table 1. Comparison of Sample Statistics and Population Parameters of Jiangsu Province on Gender, Age, and Education.

	Sample statistics (%) (<i>n</i> = 1,286)	Population parameters (%) (<i>N</i> = 79.986 million)	Chi-square
Gender:			.00
Male	50.3	50.3	
Female	49.7	49.7	
Age in years:			606.32***
<18	1.2	5.6	
19–30	26.1	20.4	
31–40	18.1	18.7	
41–50	47.4	23.9	
51–60	5.3	21.2	
>60	1.8	10.2	
Education:			390,946***
Postgraduate degree	7.1	.01	
College degree	40.0	.07	
Associate degree	27.3%	.09%	
Middle school graduate	23.7%	57.4%	
Primary school graduate	1.9%	26.1%	

****p* < .001.

Measurement

Respondents were first asked to identify various GMO-related social media platforms (e.g., Weibo, WeChat, wiki site, scientific educational community) and then focus on these platforms and answer questions that measured bridging and bonding social capital, use of social media for GMO-related information, and likelihood of expressing opinions on GMOs online; all measures were informed by previous research (see a list of questionnaire items in the Appendix).

Bridging Social Capital

Social capital refers to the resources generated in one's social networks that can be accessed for collective action (Lin, 2008). Informed by prior research (e.g., Gil de Zúñiga et al., 2012; Skoric et al., 2009; Williams, 2006), measurement and scales for the two dimensions of social capital—bridging and bonding—were developed in the context of GMO-related social media platforms. Respondents indicated their agreement with 10 statements that evaluated their bridging social capital on a 5-point Likert scale (1 = *strongly disagree*; 5 = *strongly agree*). Responses were averaged to create a new index of bridging social capital (*M* = 3.40, *SD* = .64, Cronbach's *α* = .92) after an exploratory principal component factor analysis with varimax rotation, which showed a single-factor solution (eigenvalue = 5.77, variance explained = 57.72%), indicating the question items measured one underlying concept.

Bonding Social Capital

On the same Likert scale, respondents were asked to indicate their agreement with five items that measured their bonding social capital. Results of a factor analysis of the five items using principal component extraction with varimax rotation showed a single-factor solution (eigenvalue = 3.24, variance explained = 64.86%). Responses were then averaged to create a new index of bonding social capital ($M = 2.81$, $SD = .75$, Cronbach's $\alpha = .86$).

Use of Social Media for GMO-Related Information

Use of social media for GMO-related information refers to the frequency of using social media platforms for news and information about GMOs. Respondents were first asked to identify various social media platforms that were involved in the discussion of GMO-related topics, including Weibo and WeChat. Then, they were asked to focus on these social media platforms and report their frequency of use of these social media for eight GMO-related activities. Responses were given on a 5-point scale ranging from 1 (*never*) to 5 (*very often*). The eight items formed a reliable measure of use of social media for GMO-related information ($M = 2.37$, $SD = .90$, Cronbach's $\alpha = .93$) after an exploratory principal component factor analysis with varimax rotation, which showed a single-factor solution (eigenvalue = 5.48, variance explained = 68.55%), indicating they measured one underlying concept.

Likelihood of Expressing Opinions on GMOs Online

Likelihood of expressing opinions on GMOs online describes respondents' intention to speak up about GMO-related issues on social media platforms. Five measures were adapted from previous research on civic engagement (e.g., Skoric et al., 2016; Wen, Hao, & George, 2013). These items were subjected to an exploratory principal component factor analysis with varimax rotation, which showed a single-factor solution (eigenvalue = 3.59, variance explained = 71.83%), indicating they measured one underlying concept. They were then combined into a composite measure of likelihood of expressing opinions on GMOs online ($M = 3.59$, $SD = .74$, Cronbach's $\alpha = .90$).

Results

Descriptive Findings

Among the sample, 89.8% of the respondents had heard of GMOs ($n = 1,155$) at the time of the survey, whereas 10.2% had not heard of GMOs ($n = 131$). The subsequent analyses relied on responses of those who had heard of GMOs ($n = 1,155$). In addition, the social media platforms that respondents indicated to have used for GMO-related information included news websites (79.8%), online forums (53.7%), WeChat Moments (45.2%), wiki sites (e.g., Baidu Knows, 42.9%), WeChat public accounts (34.4%), Weibo (30.6%), scientific educational communities (e.g., Guokr, 29.8%), QQ (27.4%), WeChat groups (25.4%), and Q&A websites (e.g., Zhihu, 20.5%).

Hypothesis Testing and Model Construction

The strategies for data analysis include hierarchical multiple regression and path analysis using structural equation modeling. Hierarchical multiple regression analyses were used to test the proposed hypotheses because multiple regression examines the paths of hypothesized relationships separately. Path analysis is preferred to test a complex model, which consists of multiple variables, because it affords analysis of the relationship between independent variables and dependent variables simultaneously (Jeon, 2015). Another advantage of path analysis is that it enables researchers to decompose correlations among variables to get the total effect, the direct effect, and the indirect effect via mediation, which enhances the interpretation of patterns of relationships (Jeon, 2015).

Table 2. Regression Analysis of Use of Social Media for GMO-Related Information and Likelihood of Expressing Opinions on GMOs Online.

	Likelihood of expressing opinions on GMOs online
Age	-.05
Gender (1 = male, 2 = female)	.01
Education	.10**
Monthly income	.01
Religion (1 = no, 2 = yes)	-.12***
R^2_{change}	.03***
Use of social media for GMO-related information	.29***
R^2_{adjusted}	.10***
R^2_{change}	.08***
<i>df</i>	1,148
<i>F</i> value	95.88***

$N = 1,155$. ** $p < .01$. *** $p < .001$.

Specifically, to test Hypothesis 1, a hierarchical multiple regression analysis was performed to examine the relationship between use of social media for GMO-related information and likelihood of expressing opinions on GMOs online. In the regression run, respondents' age, gender, education, monthly income, and religion were controlled in the first block of independent variables. Use of social media for GMO-related information was entered in the second block, and likelihood of expressing opinions on GMOs online was treated as the dependent variable. As results in Table 2 showed, use of social media for GMO-related information was positively associated with likelihood of expressing opinions on GMOs online ($\beta = .29, p < .001$). Hypothesis 1 was supported.

To test Hypothesis 2, another hierarchical multiple regression analysis was performed to examine the relationship between bridging and bonding social capital and use of social media for GMO-related information. The control variables were entered in the first block of predictors, followed by bridging and bonding social capital. Use of social media for GMO-related information was treated as the dependent variable. Results in Table 3 showed that bridging and bonding social capital were both positively

associated with use of social media for GMO-related information (bridging: $\beta = .37, p < .001$; bonding: $\beta = .26, p < .001$). In addition, a comparison of the coefficient values showed that bridging social capital was more positively associated with the dependent variable than was bonding social capital. Hypothesis 2 was supported.

Further, to test Hypotheses 3 and 4, a third hierarchical multiple regression analysis was performed to examine the relationship between bridging and bonding social capital and the likelihood of expressing opinions on GMOs online. Similar to earlier regression runs, respondents' demographics were controlled and entered in the first block. Bridging and bonding social capital were entered in the second block, and the likelihood of expressing opinions on GMOs online was entered as the dependent variable. As results in Table 3 further showed, bridging social capital was positively associated with likelihood of expressing opinions on GMOs online ($\beta = .38, p < .001$), whereas bonding social capital was not ($\beta = .03, p = .26$). Hypothesis 3 was supported, but Hypothesis 4 was rejected.

Table 3. Regression Analysis of Bridging and Bonding Social Capital and Use of Social Media for GMO-Related Information and Likelihood of Expressing Opinions on GMOs Online.

	Use of social media for GMO-related information	Likelihood of expressing opinions on GMOs online
Age	-.23***	-.05
Gender (1 = male, 2 = female)	-.05	.01
Education	.07*	.10**
Monthly income	.14***	.01
Religion (1 = no, 2 = yes)	-.16***	-.12***
R^2_{change}	.11***	.03***
Bridging social capital	.37***	.38***
Bonding social capital	.26***	.03
R^2_{adjusted}	.37***	.17***
R^2_{change}	.26***	.15***
df	1,147	1,147
F value	241.09***	104.90***

$N = 1,155$. * $p < .05$. ** $p < .01$. *** $p < .001$.

Finally, to simultaneously test the hypothetical model of the influence of social capital on the likelihood of expressing opinions on GMOs online, a path analysis using the LISREL program (Jöreskog & Sörbom, 1996) was conducted. To achieve both model parsimony and control, age, gender, education, monthly income, and religion were controlled using the residualization procedure (Cohen & Cohen, 1983). This involved regressing all the studied variables (i.e., bridging and bonding social capital, use of social media for GMO-related information, and likelihood of expressing opinions on GMOs online) on the control variables, and then using the residuals of these variables in the substantive analysis. Figure 2 showed the significance of individual path coefficients.

Results showed that the relationships as proposed by Hypotheses 1–3 were significant, whereas the relationship between bonding social capital and the likelihood of expressing opinions on GMOs online (Hypothesis 4) was nonsignificant. The chi-square statistics were significant ($\chi^2 = 204.93$, $df = 2$, $p = .00$), but other indices of model fitness were adequate (Root Mean Square Error of Approximation (RMSEA) = .30; Normed Fit Index (NFI) = .75; Non-Normed Fit Index (NNFI) = .25; Comparative Fit Index (CFI) = .75; Goodness of Fit Index (GFI) = .93). Taken together, the model accounted for 15.6% of the variance in the likelihood of expressing opinions on GMOs online and 23.3% of the variance in use of social media for GMO-related information (see Figure 2).

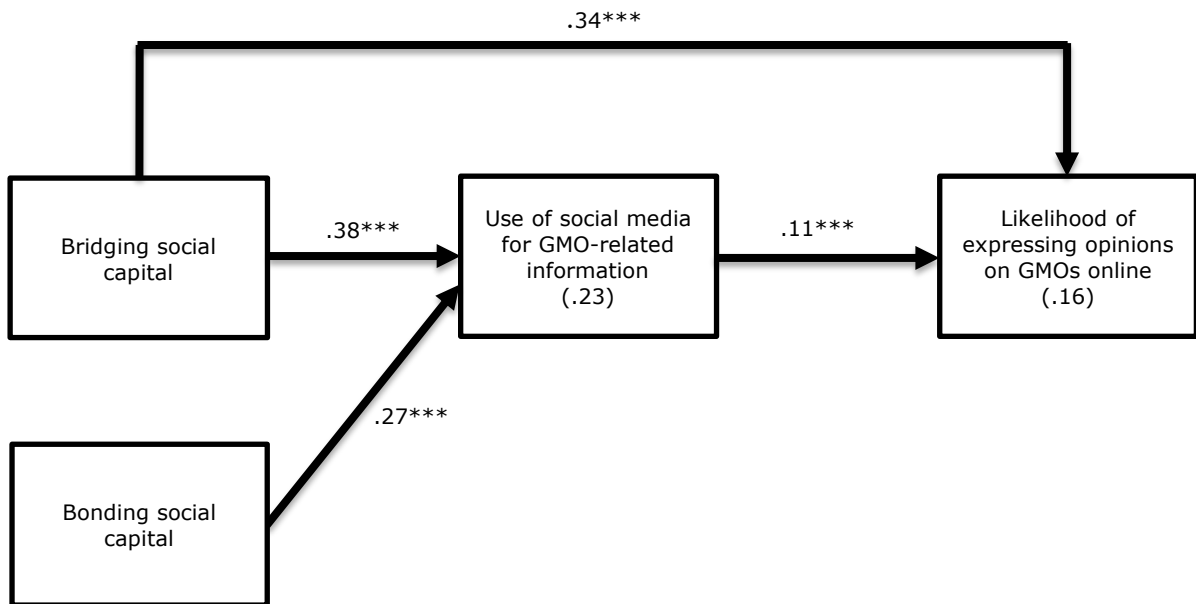


Figure 2. Path analysis of bridging and bonding social capital, use of social media for GMO-related information, and likelihood of expressing opinions on GMOs online.

From a process perspective, as shown in Figure 2, the path analysis showed that bridging and bonding social capital had a direct effect on use of social media for GMO-related information (bridging: $\beta = .38$, $p < .001$; bonding: $\beta = .27$, $p < .001$). Bridging social capital also had a direct effect on the likelihood of expressing opinions on GMOs online ($\beta = .34$, $p < .001$). In addition, use of social media for GMO-related information had a direct effect on the likelihood of expressing opinions on GMOs online ($\beta = .11$, $p < .001$). These findings provided additional support for Hypotheses 1–3.

In addition, we compared the indirect and direct effects of bridging social capital on the likelihood of expressing opinions on GMOs online via use of social media for GMO-related information (Preacher & Hayes, 2008). The results supported use of social media for GMO-related information as a mediator between bridging social capital and the likelihood of expressing opinions on GMOs online, because the

value of its indirect effect ($\beta = .38, p < .001$) was larger than its direct effect on the likelihood of expressing opinions on GMOs online ($\beta = .34, p < .001$). These additional findings validated the positive link between bridging social capital on social media platforms and online expression of opinions on GMOs, which was further mediated by use of social media for GMO-related information.

Discussion

This study aimed to examine the role of various social media platforms as a public sphere for civic engagement about GMOs in China, an issue that arouses passionate debate among those who follow it. Previous research on the relationship between new media and citizen engagement has been conducted primarily in Western societies and advanced democracies. Less is known about the role of social media in fostering citizen engagement in non-Western societies. Therefore, as one of the first empirical studies to assess the effects of social media platforms on citizen engagement in China, this study aimed to bridge the gap.

First, results of this study showed the significant role of social media, albeit heavily censored in China, in fostering civic culture and in rallying citizens' engagement with controversial socioscientific issues, such as GMOs. Specifically, informational use of the less regulated social media platforms in China increased the likelihood of expressing opinions on GMOs online. Consistent with the deliberative model of democracy, this finding shows that easy and expanded access to diverse public-oriented information through social media reinvigorate engagement on important issues (Boulianne, 2015). This particular finding has implications for a media-rich but information-poor country like China, suggesting that social media can fill the void in maintaining what Baym and boyd (2012) called "socially mediated publicness" (p. 320).

In addition, this study found that informational use of social media predicted likelihood of expressing opinions about GMOs online, providing evidence consistent with the spillover hypothesis of political participation (Cantijoch et al., 2016). Compared with expressing opinions and ideas such as asking questions, posting comments, forwarding articles, and interacting with others, which are time-consuming and require higher levels of skills, informational use of social media is a softer form of participation and can be conducted more easily (Cantijoch et al., 2016). However, individuals may take a gradual step up the ladder of participation (Cantijoch et al., 2016), moving from low-intensity activities (e.g., use of social media to seek information) to more active and purposive activities (e.g., articulating and discussing). As such, a more mobilized citizenry is likely in China where formal political participation is rare, while the process may take place hierarchically and incrementally, from softer forms of participation to harder and more resource-intensive versions.

Findings of this study also contribute to a deeper understanding of social capital and its influence on civic engagement concerning GMOs. Although social media have the capacity to expand the breadth and depth of one's relationships with other users, the two types of social capital, bridging and bonding, may exert their influence on engagement via different paths. Particularly, this study showed a direct and indirect effect of bridging social capital on civic engagement with GMOs. Consistent with previous studies

arguing that bridging relationships have the potential to encourage people to be more open-minded and curious about new ideas and perspectives (Williams, 2006), this study showed that bridging social capital directly predicted informational use of social media for GMO-related information. This suggests that bridging ties are particularly useful for diffusion of new information and ideas, such as the relatively new GM biotechnology, and motivating people to take actions. Further, the direct effect of bridging social capital on likelihood of expressing opinions on GMOs was mediated by the informational use of social media. This finding supports the reinforcement effect of informational use of social media on citizen engagement in relation to bridging social capital. In other words, individuals who acquire useful information from their networks on social media platforms—even if their networks consist of only weak-tie strangers, acquaintances, or friends—have a tendency to speak their minds on GMO issues.

Nonetheless, this study did not find the direct relationship between bonding social capital and the likelihood of expressing opinions on GMOs online as significant. This finding is consistent with Hampton (2011), who showed that the whole network diversity (similar to bridging) was significantly associated with all civic engagement variables, whereas the core network properties (similar to bonding), such as size and nonkin proportion, were not. An explanation of the nonsignificant association between bonding capital and civic engagement may lie in the conceptualization of bonding social capital. Unintentional outcomes of building strong in-group identities might be segregation from other social groups, stereotypes, misunderstandings, and distrust between groups, which may not be conducive to political and civic engagement (Chong & Ng, 2011; Williams, 2006). This drawback was termed by Putnam (2000) as “negative” social capital. Another possibility is that in addition to an increasingly diversified network of new people (weak ties) and new ideas, which may benefit political participation (Hampton, 2011), social media use also facilitates persistent contact with and “pervasive awareness” of existing (core) social ties, resulting in higher awareness of political and socioeconomic diversity of core ties (Hampton, Lee, & Her, 2011; Hampton et al., 2017). Core ties are believed to have more similar attitudes and opinions than do strangers (Goel, Mason, & Watts, 2010), although this perception may be inaccurate. Awareness of dissonant opinions and diversified interests and backgrounds of core ties may increase people’s uncertainty and cognitive dissonance toward a particular public issue and public issues in general, which may inhibit further engagement. In addition, GM foods and related technology may not be popular topics of discussion among the general public; the direct relationship between bonding social capital and citizen engagement shown by previous studies may be moderated or confounded by the nature of this topic.

Although the role of bonding capital in predicting engagement with GMOs was found to be relatively unsubstantial in this study (as shown by the smaller effect of bonding on use of social media for GMO-related information and the nonsignificant effect of bonding on likelihood of expressing opinions on GMOs online), does this mean that bonding capital has little influence on civic engagement? Not really. Results of this study showed that bonding social capital predicted informational use of social media regarding GMO issues, which in turn predicted likelihood of expressing opinions on GMOs online. These findings suggested that people who can learn useful information related to GMOs from their strong ties are more likely to speak their minds on the issue, compared with those who only solicit psychological resources from the relationship. Contradictory with the current study, Liu (2017) suggested, using qualitative evidence, a facilitating role of bonding ties (i.e., *guanxi*) in mobilizing Chinese citizens’ collective actions. The inconsistent findings may stem from different conceptualizations of bonding social

capital in the two studies. Distinctive from our conceptualization of social capital in an online context of public discussion facilitated by social media, Liu focused on strong, reliable, and reciprocal relationships connected through text messaging via mobile phones. The sample used in Liu's (2017) study was obtained from events in 2007–10, when mobile phones were more commonly used than social media in China. Nonetheless, in the age of social media, forming strong, bonding relationships is less contingent on existing social ties (e.g., family, friends in real life, others recommended by friends) than before, and the scope of online social ties has been expanded to include even those whom people will never get to know in off-line life. As Gil de Zúñiga, Barnidge, and Scherman (2017) pleaded, future research can examine how social capital in social media settings (the present study) versus in nonsocial media settings (Liu, 2017) affects online participatory behaviors.

This study has some limitations. Although the sample statistics, particularly in terms of gender, are by and large comparable with the population parameters of Jiangsu Province, the quota sampling technique we employed was a nonprobability sampling method, limiting the generalizability of these findings to the population. In addition, the low response rate may be a limitation of the study. Several meta-analyses and reviews of literature (e.g., Cook, Heath, & Thompson, 2000; Fan & Yan, 2010) show that salience of a topic is one of the most important factors that influence response rates in online surveys. The relatively low response rate of this study may suggest that GM technology, compared with other social issues, may be deemed a less important issue and of less interest to general Chinese consumers. Also, the survey data employed in this study is cross-sectional by nature, which is not sufficient to determine causal relationships. Findings described above do not necessarily indicate that social capital on social media causally influenced engagement on GMOs. Alternatively, the latter may shape the former. Therefore, future studies need to use longitudinal data or other approaches to untangle the causality of the relationships found in this study.

Despite its limitations, this study makes an important contribution to the understanding of social media's potential in mobilizing civic engagement with controversial social issues and enhancing democratic vitality in a non-Western context. Given the growing popularity and penetration of social media, these relatively new sources for information and platforms for networking merit further study. As findings of this study suggest, social media could make real contributions to participatory behaviors concerning public issues. Learning and connecting through social media, no matter how loosely or tightly, enabled users to engage in discussion of important public issues, which is a prerequisite of participative democracy. Findings of this study also offer practical implications for practitioners of science communication. For a controversial issue like GMOs, practitioners of science communication should consider incorporating social media as essential platforms to solicit public discussion and support of scientific and technological innovations and applications.

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Appendix. List of Survey Question Items

Bridging social capital

1. Interacting with people on these GMO-related social media platforms makes me interested in things that happen outside of my town.
2. Interacting with people on these GMO-related social media platforms makes me want to try new things.
3. Interacting with people on these GMO-related social media platforms makes me interested in what people unlike me are thinking.
4. Talking with people on these GMO-related social media platforms makes me curious about other places in the world.
5. Interacting with people on these GMO-related social media platforms makes me feel like part of a larger community.
6. Interacting with people on these GMO-related social media platforms makes me feel connected to the bigger picture.
7. Interacting with people on these GMO-related social media platforms reminds me that everyone in the world is connected.
8. I am willing to spend time to support general online community activities on these GMO-related social media platforms.
9. Interacting with people on these GMO-related social media platforms gives me new people to talk to.
10. On these GMO-related social media platforms, I come in contact with new people all the time.

Bonding social capital

1. If I need an emergency loan of 1,000 yuan, I know someone I can turn to on these GMO-related social media platforms.
2. The people I interact with on these GMO-related social media platforms would put their reputation on the line for me.
3. The people I interact with on these GMO-related social media platforms would be good job references for me.
4. The people I interact with on these GMO-related social media platforms would share their last dollar with me.
5. The people I interact with on these GMO-related social media platforms would help me fight an injustice.

Use of social media for GMO-related information

1. Contributing original information on these platforms
2. Asking questions on these platforms
3. Answering questions asked by other users on these platforms
4. Connecting with other users on these platforms
5. Updating profiles of personal information or status
6. Browsing other users' personal pages or profiles on these platforms
7. Discussing with other users on these platforms
8. Managing a group or community on these platforms

Likelihood of expressing opinions on GMOs online

1. Browsing GMO-related websites
2. Posting on blogs, Weibo, and/or WeChat about GMO issues
3. Watching GMO-related videos
4. Posting comments or asking questions about GMOs on news websites, blogs, Weibo, and/or WeChat
5. Forwarding news articles, Weibo posts, WeChat articles, and/or videos about GMOs to friends or other members of the online community